"IT'S LIKE HAVING TO GO BACK INTO THE CLOSET EVERY DAY":

A NARRATIVE INQUIRY EXAMINING THE IMPACTS HETERONORMATIVITY

AND HETEROSEXISM HAVE ON THE EXPERIENCES OF GAY MEN IN STEM

MAJORS

by

DAVID PAUL STEELE

(Under the Direction of Deborah Tippins and David Jackson)

ABSTRACT

Gay men continue to experience discriminatory and oppressive practices, even as societal attitudes towards them have improved. These experiences include both implicit and explicit issues of heterosexism and heteronormativity that is present at all levels of society. Using a narrative inquiry approach, this qualitative study examined how students who self-identified as gay men experienced heterosexism and heteronormativity in their STEM majors. Drawing upon the work of Costa (1995) and Aikenhead (2001), the goal of this study was to determine how gay men navigated, or were not able to navigate, cultural borders between their lived-world and the world of canonical science. Data collected through the utilization of interviews, photo-elicitation, and photo-feedback were used to reconceptualize cultural border crossing as a continuum of navigational responses gay men exhibit to the genderized conditions of their STEM environments. Using thematic analysis, three distinct themes emerged from the data: a) how heterosexism acts as a barrier to STEM access: it pays to be straight; b) having multiple social identities has

negative implications for my emotional, social, and educational selves; and c) my

behavior in STEM is dictated by heteronormative expectations. These three themes were

illustrated in counter-stories from the point of view of composite characters. The

findings suggested that multiple factors contributed to participants' persistence in STEM

fields. First, the findings highlighted strategies the participants employed to navigate the

often homophobic and heteronormative environments found in STEM classrooms. For

example, these strategies included policing actions through closetedness and gender

enactments. Additionally, the findings suggested having a strong STEM identity is, in

part, a key to gay men persisting in STEM fields.

INDEX WORDS: Heteronormativity, Heterosexism, Gender Performativity, Gay

Males, Cultural Border Crossing, Closetedness, STEM, Qualitative

Study, Narrative Inquiry

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DEDICATION

I would like to first and foremost dedicate this dissertation to my inspiration and my biggest cheerleader; my mom! Without the numerous sacrifices you made for me and our family, I know I would not be where I am today. It has not always been easy, but in the end, it was worth it. I hope that I continue to make you proud. I thank you from the bottom of my heart and am thankful for your undying support. I love you!

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CHAPTER ONE

INTRODUCTION

"We already know how painful it must be to women or students of color to sit in science classrooms and feel excluded from the Club, excluded from mention or consideration. So why haven't we long since recognized the same pain on the part of gay and lesbian students in our classes? Or gender- or sexuality- questioning students? How must they feel when they get no recognition from us or our science, no acknowledgement of their very existence? When they are sitting right in front of us?"

Lemke (2011) offered these questions in hopes of eliciting a thoughtful provocative response and as a wake-up call to social scientists, researchers, and science, technology, engineering, and mathematics (STEM) educators to begin thinking holistically about the current field and its practices and their influence on individuals who are marginalized within sciences due to an invisible identity. The very idea that some students do not feel welcome in STEM classrooms, in part due to their inability to conform to genderized norms, has led me to this study.

While societal attitudes toward, and acceptance of gay men have improved, these individuals continue to find themselves subject to genderized expectations on college campuses and in the workplace. Consequently, gay men face oppression and heteronormativity through societal norms that are expressed both implicitly and explicitly. For instance, gay men encounter feelings of isolation and often report feeling the need to develop coping strategies such as covering their sexuality or making

themselves indispensable to ensure employment (Chung, Chang, & Rose, 2015). The interplay of these, along with potentially other negative experiences may impact the overall enrollment of gay male students across college campuses. This impact might be exacerbated by the heteronormative assumptions and hegemonic masculinities embedded in the genderized roles often found in STEM classrooms, where the public perception of a scientist is still envisioned as White, male, *heterosexual* [italics added], and middle class (Yoder & Mattheis, 2016).

In recent years, as a response to both changing societal attitudes and the developing understanding of the marginalization of gay men, colleges and universities have attempted to create welcoming environments for sexual minority students through the inclusion of sexual orientation and gender identity in non-discriminatory policies and the creation of lesbian, gay, bisexual, and transgendered (LGBT) student support services (Bilimoria & Stewart, 2009; Munn & Hornsby, 2008; Sears, 2002). However, research indicates that the experiences of self-identified LGBT individuals still include issues of heterosexism, homophobia and hostility from peers and other members of the educational academy (Bilimoria & Stewart, 2009; Sears, 2002). One primary example of the barriers in educational academy includes the genderized culture of science, technology, engineering, and mathematics (STEM) related classrooms and fields and the distinct disadvantage gay men frequently encounter as a marginalized group (Cech & Waidzunas, 2011).

Certain STEM fields (i.e. physics, computer science, engineering, and chemistry) have been and continue to be dominated by men; and as such they are presumed to be genderized as masculine due to their objective, unemotional, hands-on work and their

perceived creation of power and dominance (Acker, 1990). Connolly (2000) writes that for gay males, these genderizations may be in direct conflict with the perception of their own gender and sexual orientation, causing them to struggle in their sense of identity while experiencing difficulties with academic success. The often-formulaic heteronormative assumptions and the correspondingly rigid expectations of gender and sexuality in STEM fields has placed increased pressure on gay men to downplay the importance of gender and sexual orientation in their personal lives or to hide their queer identities altogether (Yoder & Mattheis, 2016). These pressures along with the indifference of the field to an individuals' identity, personal life, and experiences may increase the level of discomfort for gay men (Bilimoria & Stewart, 2009) and thus might have a silencing effect on gay-identified male students (Dalley & Campbell, 2006).

Research suggests that STEM cultures in the United States are distinctly heteronormative due to the attempt to maintain a sharp distinction between the two sexes while legitimating only heterosexual attractions and relationships as natural or acceptable even as the norms of these fields silence the concerns of gay students (Cech & Waidzunas, 2011). It follows, then, that a hyper-genderized environment could have negative effects on any student who does not identify strongly with the hegemonic masculine identity pervasive in these fields, while individuals who break gender rules often experience backlash and increased pressure to conform to gendered expectations (Moss-Racusin, Phelan, & Rudman, 2010). Students who do wish to study in fields gendered as masculine but do not exhibit strictly masculine characteristics because they are female, identify as women, or identify as gay are continually sent messages by the dominant group that they do not belong (Nassar-McMillan, Wyer, Oliver-Hoyo, &

Schneider, 2011). In a study of gay and lesbian engineering students, 15 out of 17

respondents reported at least one instance of anti-gay comments over the previous

semester while another reported a mechanical engineer using engineering language and

symbols during class to express a rationale for heterosexuality; "the man is the plug and

the woman is the outlet and if there are two plugs, how's [anything] going to charge?"

(Cech and Waidzunas, 2011, p. 10).

　　　　As noted by Schueler, Hoffman, and Peterson (2009), gay students also face the

following obstacles: a lack of mentors who represent their identity, homophobia, and an

academy that is heavily heteronormative (one that believes heterosexuality is the norm,

preferred, or right way of behaving) and heterosexist (built to systematically privilege the

heterosexual). To understand the concept of heterosexual thinking, Braidotti (2013)

writes that Western science and humanism have created binaries of difference; of

sexualized, racialized, and naturalized 'others'; in essence marginalizing any group that is

not white, straight, wealthy or male. Individuals who do not fit into the category of

White, male, heterosexual, and middle class, are relegated to a marginalized position of

inferiority. Accordingly, research suggests that being a part of a marginalized, or othered

group can hamper career success and productivity (Yoder & Mattheis, 2016).

　　　　These considerations make it of vast importance for the academy to begin to

expand research attempting to understand how heteronormativity impacts gay men in

STEM classrooms and careers. For science to continue in its advancement, equity needs

to be at the forefront of the classroom as a means to ensure that any individual wanting to

pursue a STEM career is given every opportunity to be successful in that endeavor.

Heteronormative attitudes that work to create binaries of otherness and systems of power

and privilege must be addressed and renounced at every opportunity. If these attitudes

are allowed to persist in STEM classrooms then they could lead to potentially devastating

impacts on gay men wishing to pursue careers in these fields.

This dissertation examines the gap in knowledge relating to how

heteronormativity has a marginalizing effect on gay men in STEM fields. One such

avenue is by examining the effects of heteronormativity on creating stereotypes of gay

men. Stereotypes have long been known to have a relationship on an individuals'

occupational choice and "may serve to promote or inhibit creation of a conceptual match

between the individual and a particular career" (Nassar-McMillan, et al, 2011, p. 89). If

for instance the stereotype is that gay men are great make-up artists and hair stylists, then

this may indeed become a self-fulfilling prophecy. Thus, it is imperative to examine the

attitudes and stereotypes created through heteronormativity that prevent gay men from

entering the STEM pipeline as well as the stereotypes gay men have regarding STEM

fields in order to identify practices that can lead to improving retention of these

individuals in STEM classrooms and fields.

As Connolly (2000) writes, gay males often struggle developing their sense of

identity in conjecture with the expected identities created in the genderized and masculine

cultures of certain STEM fields due to heteronormative assumptions and practices. A

large body of research has found that concealing a stigmatized sexual identity is a

substantial source of stress, associated with higher rates of anxiety, depression, and other

negative health outcomes; as well as lower academic success (Meyer, 1995, 2003; Yoder

& Mattheis, 2016). Understanding how students are able, or not able, to manage multiple

identities might shed light onto whether these individuals are able to be successful by

persisting in STEM fields. It might also allow for an understanding of strategies that gay men employ in order to navigate both their identities inside and outside of the classroom. In order to develop a body of knowledge on how to address and alleviate these concerns, we must first work to understand: a) the forms in which heteronormativity exists in classrooms and on college campuses; and b) how the marginalization of gay men due to heteronormative assumptions affects students within the academic arena. In this study, I investigated ways in which students navigated STEM environments that require them to have multiple identities when one identity (being gay) is theoretically incongruent with another one (being a scientist).

Rationale for the Study

Previous research demonstrates that all students experience some level of border crossing dependent upon their unique cultural backgrounds (Aikenhead 1996, 2001). Although these findings are insightful, they often fail to study the impact of sexual orientation and gender expression on a student's ability to successfully navigate identities between their lived-world and the world of canonical science. As such, the ability to smoothly negotiate borders could be hindered by, amongst other things, the heteronormative assumptions and the genderized roles in STEM classrooms, where the public perception of a scientist is still envisioned as White, male, *heterosexual* [italics added], and middle class (Yoder & Mattheis, 2016).

Of key importance is the discussion about the role of STEM professionals in the United States. It is often suggested that STEM professionals are the key to maintaining the country's competitiveness on a global scale (Yoder & Mattheis, 2016). Individuals working in STEM fields are an increasingly integral part to innovation. Innovation, the

improvement of existing or the creation of entirely new products, processes, services, and business or organization modes, drives long-run economic growth, competitiveness, and quality-of-life improvements (Atkinson & Mayo, 2010). Science and technology based innovation is impossible without a workforce educated in science, technology, engineering, and math. As a result, it behooves the United States to support open access and diversity across all STEM fields as competitors recognize the links between STEM, research, and increased innovation (Atkinson & Mayo, 2010). However, in recent years the decrease in the number of students pursuing STEM fields, particularly those from historically underrepresented populations has been widely publicized. With such an emphasis on preparing individuals for careers in these fields, not fully supporting any group of students wishing to pursue a career in STEM should be considered unconscionable.

When the paucity of research detailing the experiences gay men have encountering hegemonic masculinity and heteronormativity in STEM classrooms is considered, this study importantly adds knowledge where it is sorely lacking. By using a narrative inquiry approach to explore the first-hand experiences of gay men in these fields, this study adds knowledge by allowing the participants to describe in their own words the structural barriers they face and the coping mechanisms they employ on their journey to becoming STEM professionals. Talking directly with gay men during this study about their experiences also empowered these individuals, who having been silenced for far too long, to share their stories and to hear their own voices rather than conforming to categories and terms imposed on them by others (Creswell, 2013; Sofaer, 1999). It is this potential of transformation through research that drove this study; the

hope of giving a voice to those who have been silenced and bringing awareness to the effects heteronormativity and heterosexism have on gay men in STEM majors/classrooms.

In my current role as a science educator and researcher it is imperative that I advocate for an environment that is inclusive of all students, not just those who meet the norms as they are currently constructed. This research adds knowledge to the existing literature on the experiences of gay men in STEM classes, while also exploring and challenging the notion of gender and sexual orientation norms and binaries.

Overview of the Literature Reviews

There are several areas of literature reviewed due to their ability to add knowledge to and shape this study. This section is composed of brief reviews of the following areas of literature: gender, masculinization of science, and heteronormativity and heterosexism. These two research topics are interrelated as the historical masculinization of science creates environments within STEM fields that is on the one hand heteronormative, and on the other heterosexist. A thorough review of the literature in these areas allows me to present a study that makes implicit biases and privileges explicit. The empirical studies surrounding these foci will be discussed in depth in Chapter Two.

Masculinization of Science

It can be argued that science and several of its sub-disciplines continue to share a male dominant culture because of its institutional history. This can be evidenced in the close connection between the sciences and science education, where scientists have a strong influence, or even a controlling hand, as to what science education should look

like as well as what should be included (Hussénius, 2014). Exploring the literature allows for an unimpeded review of the masculinization of STEM.

Gender roles impact STEM fields in both historical and socio-cultural ways. The profoundness of male bias is evident in men determining the content of science disciplines as well as determining the intentions of those fields, how subject matter is defined, the methods available for use, the canons of impartiality and detachment, and their ruling metaphors (Forde, 2012). However, some scientists have argued that the objective nature of science implies gender has no influence on either who becomes a scientist or the science produced by those scientists; that science is indeed a "manless" or "womanless" endeavor (Rosser, 1985). By doing so, these scientists fail to recognize the influence male dominance has had on the field of science. Taking into consideration that the researcher historically has been a male, it is not outside of reason to imagine science as masculinized and lacking female attributes (Sinnes & Loken, 2014). Sinnes and Loken (2014) also wrote that these female attributes could possibly widen the approaches to and effects of science. Additionally, the lack of women from the decision-making levels of science produces a science that views the world only from a male perspective and is therefore inherently genderized (Keller, 1982; Fee, 1981).

Furthermore, Keller (1982) wrote that perspectives associated with science such as rationality, hardness, objectivity, and elitism are also characteristics synonymous with a masculine world view. Gonsalves (2014) added to this in arguing that characteristics of natural sciences are abstract, logical, and mathematical and connects these characteristics to rationality and by default rationality to masculinity. This characterization of a

scientific mind as male poses an issue for any person who is not a man and does not conform to the default (male) or gender-neutral ideal of masculinity present in science.

Heteronormativity and Heterosexism

While gay students combat the masculinization and genderization of STEM classrooms, they must also deal with a culture that is undoubtedly heteronormative and heterosexist. This represents yet another border that students must negotiate in order to be successful in STEM classrooms. Below is a detailed description of what a heteronormative society looks like and how it negatively impacts gay individuals.

Cech and Waidzunas (2011) highlight the notion that gay men encounter broad structural and societal biases daily, which serve to disadvantage and marginalize them in comparison to their heterosexual counterparts. Heterosexism, therefore leads to prejudice, discrimination, harassment, increased substance use, poorer mental health outcomes, and violence as a consequence of societal beliefs in the heteronormative views on sex and sexuality and negating all others (Lorde, 1988; Meyer, 1995).

Heteronormativity refers to the myriad ways in which heterosexuality is continuously produced and reproduced through systemic discourses as a natural, unproblematic, taken-for-granted, ordinary phenomenon and it is embodied in what people do rather than in their beliefs, values, ideologies, or faiths (Kitzinger, 2005). This definition implies that it is not simply prejudiced attitudes or beliefs or a deliberate intent to discriminate against gay men, but is instead embodied and displayed implicitly. On the individual level, heterosexism and heteronormativity can take the form of sexual prejudice, prejudicial attitudes and behaviors expressed by individuals against people on the basis of their sexual orientation (Cech & Waidzunas, 2011).

Ultimately heterosexism and heteronormativity have produced documented cases of harassment and violence towards sexual minority students at a far higher rate than other populations, perhaps as much as four times more often than the general population (Comstock, 1991; Evans & D'Augelli, 1996). These ideologies and heteronormative discourses allow "heterosexual men to maintain control by reinforcing binary structures that value heterosexual over homosexual and masculine over feminine, linking them together inextricably" (Grace, Hill, Johnson, & Lewis, 2004, p. 318-319).

The complete literature review in Chapter Two describes, in much more detail, each of those areas and how the interplay of the two contributes to the marginalization of gay men and the conceptualization of this study. Chapter Two will also provide critiques of my literature foci while creating an argument as to why they are relevant to this study.

Research Purpose and Questions

The purpose of this study is to identify and examine the perceptions gay men have of boundaries between their life world and canonical science world, and how these perceptions impact their ability to navigate said boundaries. To examine this aim, the following research questions guide this study:

1. To what extent do gay men perceive the culture of STEM classrooms to be heteronormative?

2. How do gay men perceive the relationship between any heteronormative culture of STEM classrooms and their experiences within these classes/majors?

3. From the perspective of the gay man, what is the relationship between a gay male's "outness" and his experiences with any discrimination he has experienced and might experience in STEM related classes/majors?

Overview of Theoretical Framework

This study exposes how sexual minority students face marginalization due to genderized norms within STEM communities. This type of work aligns cohesively with emancipatory gay and lesbian studies. Researchers working in an emancipatory, or critical, framework task themselves with identifying those who are oppressed and giving them a voice (Lather & St. Pierre, 2013). Conversely, the bind with using such frameworks is the continued perpetuation of a hetero/homo binary. While this tension is worth highlighting, I argue that the lack of research in this particular area, along with the continued silencing of marginalized groups in STEM and society at large, is defense for the use of the emancipatory gay and lesbian framework.

Additionally, to understand gay men's experience in science classrooms, the epistemological utilization of cultural border crossing as a conceptual framework allows researchers to view learning science as an "anthropological perspective that contextualizes learning in a cultural milieu" (Cobern & Aikenhead, 1998, p. 1). In developing his conceptual theorizations regarding cultural border crossing, Aikenhead (1996, 2001, and 2001) drew on the writings of Costa (1995) and Phelan, Davidson, and Cao (1991) to inform much of his research.

Every day, individuals move across a variety of borders as they move from one context to the next, or from one subculture to another. Typically, these borders are negotiated with ease as the majority of people are adept at moving from one from context to the next. However, the disparity between school science and the students' worldviews has been attributed to the mismatch between the subcultures of science and the life-worlds of students and this is often a source of cognitive dissonance (Aikenhead, 1996).

Dependent upon the congruency of the two worlds, movement between them is categorized into patterns of: a) smooth, b) manageable, c) hazardous, and d) impossible (Aikenhead, 1996, 2001, 2001; Aikenhead & Jegede, 1999; Phelan, et al, 1991).   This study applied the conceptual framework of cultural border crossing to the experiences of gay students in STEM in hopes of understanding how gay male students navigate the borders between their lived worlds and the world of canonical science. A more thorough description of the ways the conceptual framework of cultural border crossing has been used to understand the movement between worlds and how it applies to this study can be found in Chapter Two. This description includes a review of literature in which this framework has been utilized as well as new and more current conceptualizations of boundaries and borders.

Overview of Study Context

Maxwell (2013) argued that "the decision about where to conduct a research study and whom to include in it are an essential part of the research method" (p. 96). In this study, the context will refer to the setting, site, and population. Although the decision to focus on a specific setting can be constraining due to the study being defined by and intimately linked to that place, this study sought to develop an understanding of heteronormative climates of specific STEM majors; therefore, having a concrete setting is imperative. I inquired into the experiences of gay men in specific STEM majors (physics, chemistry, computer science, and engineering) due to the lack of diversity of other marginalized groups such as women and African Americans in these specific majors (Nassar-McMillan, et al, 2011). This lack of diversity has been proposed as a source of hegemonic reproduction of genderized norms within these majors and as a

societal structure that continues to marginalize minority groups (Yoder & Mattheis, 2016). To have a suitable sample size, four participants, I recruited individuals from colleges and universities within the southeastern United States as necessary. While the argument could be made that each college and university has their own distinct culture, my argument is that the majority of universities within the geographic space of the southeastern United States will be bound by similar cultures due to several influencing factors including, but not limited to religious and political ideologies. A detailed description of participants and the recruitment strategies employed for this study are included in Chapter Three.

Overview of Methodological Framework

In wanting to understand the lived experiences of gay students, I chose to use narrative inquiry as my methodology in hopes of answering the research questions posed for this dissertation study. Narrative inquiry as described by Clandinin and Connelly (2000) serves the researcher who wishes to understand a phenomenon or an experience rather than the one who wants to formulate a logical or scientific experience. Narrative inquiry, therefore allows the storyteller to organize the story told by linking events, perceptions, and experiences in order to give meaning to experiences.

Participants met the following criteria to participate in the study: identified as a gay or bisexual male; were majoring in physics, chemistry, computer science, or engineering at a four-year college in the southeastern part of the United States; were a graduate student or an undergraduate student with a junior or senior standing; and were available and willing to contribute to the study at the time of data collection.

Data was analyzed using thematic analysis techniques described by Clarke and Braun (2014). The methodology for data collection and data analysis is detailed in a more thorough fashion in Chapter Three.

Subjectivities Statement

I am inherently connected to this research project as a gay male who received a degree in a STEM related field. As a closeted gay male growing up in the southeast, rural Alabama to be exact, I learned at a very early age that being a homosexual man was not accepted or condoned by my peers or family. Homosexuality was also vilified by those who were in position to shape the molding and development of my mind, my classroom teachers. I developed strategies to mask my sexuality as a means to fit in, to not be picked on or bullied. I even pretended to like girls; I had several girlfriends throughout middle school and high school. I had learned to lie about who I was, and I learned to do this very well.

As I got older and developed more confidence in my identity as a gay man, I began to open up about my sexuality to friends and classmates at the university I attended. With my "effeminate" attributes, my sexuality was always a topic of conversation for other people and at this point in my life was not a secret I cared to keep from others. Although I had not disclosed my sexual preference to everyone, there was little doubt that I was gay. During one class discussion during my junior year a student asked me, "What do you think you need to do to make us who are not gay more comfortable with you and your lifestyle?" Unfortunately, at this age I was more consumed with rage than knowledge and so my response was not as profound as it might be today.

Usually the people who talked to me during class and those who would partner with me for laboratory courses were girls. Heterosexual guys would not be seen talking to me in fear of being presumed to be gay themselves. Unflattering comments were thrown at me from various students while on campus. While no professor openly made harassing or disparaging statements, I feel as though my sexuality hindered some of the opportunities I could have had if I were heterosexual. These perceived slights caused me to choose a different path once I graduated from college and while I am now extremely happy with my life, I want to do this study to advance the literature on the discriminatory practices gay men face in STEM classrooms.

I would also like to address the inherent value I am placing on Western canonical science. By no means would I hold myself to the beliefs of positivism; that there is a single reality and that it can be measured using valid tools or that science is void of researcher influence. However, I do believe that science has the ability to account for and understand various phenomena. I also believe that science and scientific endeavors have the ability to lead to advancements in technology and together these bolster economic possibilities in a world driven by those who have. So, although I value traditional forms of knowledge, I also place value on scientific knowledge and because of this I find it imperative that all individuals have access to science classrooms where they are valued and feel free to express their identity without being harassed, shunned, or marginalized.

Definition of Salient Terms

Border: Borders, as defined by Phelan et al (1991), refer to both real and perceived lines and barriers between worlds.

Cultural border crossing: Cultural border crossing is defined by Aikenhead and Jegede (1999) as the cognitive transition between a student's life world and the world of school science.

Culture: Phelan, et al, (1991) defined culture as "the norms, values, beliefs, expectations and conventional actions of a group.

Equity: Rohn (2013) defined equity as appropriate and reasonable accommodations made to promote access, achievement, and opportunity by gearing instruction toward the differing needs of individual students.

Gay: In this study, the term *gay* is used to describe the identity of being a male who is attracted to other males "in a romantic, erotic, and/or emotional sense" (LGBTQA Resource Center, 2012, p. 4).

Gender: Gender will be defined as a category "that deals with what is considered as male and female, how femininity and masculinity are constructed, and the resulting consequences for social activity (Harding, 1986). As such the binary construct of gender implies that sex, gender, and sexuality default to align with one another.

Heteronormativity: Defined by Rumens (2014) as the "power relations, knowledge and institutions that sustain normative constructions of heterosexuality as 'natural' and "privileged".

Heterosexism: Defined by Blumenfeld (1992) as "both the belief that heterosexuality is or should be the only acceptable sexual orientation and the fear and hatred of those who love and sexually desire those of the same sex".

Subculture: Some of the most recognized subgroups are identified as race, language, and ethnicity, but other categories include gender, social class, occupation, and religion

(Aikenhead, 1996). This study will include sexual orientation as a recognized cultural subgroup.

World: In this study, the word "world" is defined to "mean the cultural knowledge and behavior found within the boundaries of students' particular families, peer groups, and schools; presuming that each world contains values and beliefs, expectations, actions, and emotional responses to familiar insiders" (Phelan, et al, 1991).

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Overview of the Study

</div>

Chapter One introduced the study by providing a background to the problem as well as a rationale for the study. I decided to also include my subjectivities statement in this chapter as I consider this to be crucial in understanding the lens, and possible biases in this study. This chapter also provided an overview of the relevant literature, theoretical frameworks, and methodological frameworks used in the study. Chapter Two includes a review of the literature on heteronormativity and heterosexism, masculinization of science, and gender. Chapter Three develops in more detail the description of the study context, theoretical framework, and methodology. Chapter Four provides a discussion of the themes and findings collected through interviews, photo-voice, and photo-feedback. Chapter Five concludes the dissertation with an in-depth interpretation of the findings as they relate to the theories used in the study as well as the research questions. Chapter Five also includes implications for theory, research and practice.

The next chapter provides a more detailed and nuanced analysis of the literature reviewed for this study. Chapter Two closes with a summary of the literature review and a preview of Chapter Three.

CHAPTER TWO

REVIEWS OF LITERATURE

Introduction

This chapter presents a review of literature as a means of situating the study

within the larger contexts of current research. Several overarching bodies of research are

important to the issues explored throughout this study, starting with a review of gender

and gender norms as they are played out in STEM environments. Following this review,

I explore the key concepts associated with heteronormativity and heterosexism and how

they influence the marginalization of gay men. This section includes a review of the

intellectual influences that inform heteronormativity; and ends by discussing critiques of

heteronormativity research while providing responses to these critiques. The explicit

description of heteronormativity and heterosexism provides an opening into one example

of the oppressive structures gay men face in their lived worlds.

From there, I review the historical masculinization of STEM. This review creates

a historical perspective of the environments found in some present-day STEM classrooms

and careers while fashioning a foundation for the importance of this study.

Following this, I provide a review of the body of research that has already been

done on gay men in STEM related fields. In this section I provide a thorough description

of the data bases used, the search terms employed, as well as the range of years included

for reviewing the literature. This framing of the literature allows the reader to understand

the lack of research exploring these issues and provides further rationale for completing this study.

While the literature exploring the intersection of sexual orientation and the gender on men and their experiences in the STEM fields is nearly nonexistent, the literature that explores and disrupts the hegemony in other contexts (e.g., women in STEM) allows an important view into the possible negative outcomes of not conforming to the strict gender rules and expectations within these fields. Therefore, I provide a review of the empirical research surrounding the historical experiences of women in STEM fields while also providing a glimpse of the progress that women have made in the field.

At the end of the chapter the conceptual framework, cultural border crossing, and how I used it in this study is described in detail.

What is Gender?

Gender studies offer a starting point for understanding how gender norms work to limit the multiple ways in which individuals are permitted to move, look, talk, behave, and learn (Hussénius, 2014). More than biology, family, friends, and society influence impressions of what it means to be a boy or girl, placing rigid gender expectations on children from an early age. A brief review of the literature indicates that such limitations encourages and supports the continued binaries of difference that impact, influence, and maintain the socially constructed gender norms that are prevalent within and throughout STEM education and workplace (Yoder & Mattheis, 2016). Important in gender studies is the inclusion of women's studies and masculinity studies. (Hussénius, 2014). The annexation of masculinity studies increases the relevance, for my research, of using gender studies to uncover and investigate the ways in which the norms of the hyper-

genderized environments in STEM classrooms continue to marginalize individuals who do not align with those norms and expectations.

'Gender' in an essentialist point-of-view is assigned at birth as both a means of distinguishing between biological sex (male/female binary) and as a structure to convey social aspects of femininity and masculinity (Butler, 1990). Understanding sex/gender as a rigid binary requires a simplistic, artificial categorization process where other possibilities, such as biological ones, are either distorted or ignored (Bazzul & Sykes, 2010). To this end, Butler (1990) argued that gender is a cultural construct developed to create gendered roles with prescribed behaviors seen as appropriate for a person of a specific gender. Danielsson (2014) added to this by writing that gender is not a stable trait of the individual but in actuality is fluid and subjective, created and negotiated in interactions between individuals and social structures. In addition, Gonsalves (2014) wrote that gender is "concurrently a process, something that is done in the social interaction and a discourse, a set of ideas or figures of thought that are commonly shared in a society (p. 462). Using this understanding allows us to ask: In what ways does gender influence what performances (process) are recognizable (discourse) (Gonsalves, 2014).

However, for purposes of this study, gender will be defined as a category "that deals with what is considered as male and female, how femininity and masculinity are constructed, and the resulting consequences for social activity (Harding, 1986). As such, the binary construct of gender implies that sex, gender, and sexuality default to align with one another. In other words, a person assigned as a male at birth should be masculine in appearance, character traits, and behavior, including a heterosexual attraction to people

assigned female at birth (Keating, 2002). Using these definitions allowed for an encompassing view of the structures that have historically masculinized STEM including present day structures that continue to reproduce this genderized environment. With this in mind, it is imperative to understand when using the term gender in research, one should not assume the female position as gender roles and norms adversely affect males who do not conform as well. Boys who act like "sissies" are generally not granted the same social acceptance as girls who act like "tomboys" in part because of the lower power or prestige associated with femininity traits and behaviors. Because of this, boys who do not conform to gender norms are "the victims of physical violence to a much greater extent than girls and are more prone to substance abuse and suicide than that of women. Such differences are socially, not biologically determined" (Mmari, et al, 2017).

Gender Enactments in STEM

To understand how gender structures are created and perpetuated in STEM fields we first must recognize the three forms of gender as described by Harding: gender symbolism, gender structure, and individual gender. According to Harding (1986), alternative meanings of masculinity and femininity that vary from culture to culture do not impede the three forms of gender fashioned in social life. Due (2014) provides the following definitions for each of these forms of gender:

> *Gender symbolism* is about how things and phenomena, that often have no natural connection to sex differences, are thought of as gendered. Different school subjects are also symbolically gendered; natural science is often associated with masculinity while domestic science is recognized as belonging to a feminine sphere. *Gender structure* describes how people organize their interactions and

activities in domestic life, on the labour market or in small group discussions at

school. This aspect of gender deals with division into different occupations but

also about who is doing what within organisations or whenever people interact.

Individual gender deals with feminine and masculine identity and behavior. An

example is how boys and girls position themselves in school and what it means to

perform masculinity and femininity in that context (p. 443).

Heterosexism and Heteronormativity

To fully understand the experiences of gay men in STEM classrooms, we must

first understand how heterosexism and heteronormativity pervade our society. Since the

1970's, the gay community has worked to change the narrative from the "problem of

homosexuality" into the "problem of heterosexism" by shifting the focus from the

perceived deficits of LGBT individuals to the multiple oppressions to which they have

been subjected (Kitzinger, 2005). Some of these issues range from state-sanctioned

execution, torture, and enforced psychiatric treatment; to institutional discrimination and

hate crimes; to mundane oppressions of everyday life, such as anti-gay jokes and the

social gaffes made by well-meaning heterosexuals in talking to, or about, LGBT people

(Kitzinger, 2005).

Blumenfeld (1992) defines heterosexism as "both the belief that heterosexuality is

or should be the only acceptable sexual orientation and the fear and hatred of those who

love and sexually desire those of the same sex" (p. 15). This belief has led to the

accumulation of negative outcomes and disadvantages for gay men in our society.

Consequently, gay men are often disadvantaged as a result of lower employment

opportunities, getting fired, being passed over for promotion, or given less desirable

assignments or compensations because of their sexual orientation; and lastly, being

informally disadvantaged through social isolation by coworkers, family members, and

friends, heterosexist remarks or jokes, and/or assault (Chung, Chang & Rose, 2015).

These disadvantages happen as a result of the combined "prejudice against gays with the

institutional power to impose that prejudice as a hegemonic tool, encouraging

heterosexuals to assume that everyone is, or should be, heterosexual and that

homosexuals can choose to change their sexual orientation" (deWelde & Hubbard, 2003,

p. 75); while continuing to associate normality with heterosexuality (Warner, 1993,

Dreyer, 2007).

Heterosexism is reproduced in schools through two silencing processes: a)

systematic exclusion, defined as "ignoring or denying the presence of lesbian, gay, and

bisexual people" and b) systematic inclusion occurring "when discussions regarding

homosexuality happens, they are consistently placed in a negative context" (Dalley &

Campbell, 2006, p. 12). As indicated, systematic exclusion can include the lack of

information on gay authors, actors, bibliography or contributions to society by gay

individuals. Similarly, systematic inclusion is the justification of violent crimes against

gay men as the appropriate punishment for their sexual orientation (Park &

Mykhyalyshyn, 2016). Lastly, the biases of heterosexism are also reproduced through

heteronormativity; "the interpersonal and institutional enforcement of norms that create a

strict male/female sex binary and designate heterosexuality as the only acceptable

relationship form" (Kitzinger, 2005, p. 477).

To combat these various inequities toward gay men and to disrupt the hegemonic

discourse Warner (1993, p, xxi) first coined the term "heteronormativity", to refer to the

complex ways in which "heterosexual culture thinks of itself as the elemental form of human association, as the very model of intergender relations, as the indivisible basis of all community, and as the means of reproduction without which the society wouldn't exist". Since then, others have added to the understanding of the term. Rumens (2014) describes heteronormativity as:

> …the power relations, knowledge and institutions that sustain normative constructions of heterosexuality as 'natural' and privileged. Positioned as a cornerstone of the sex-gender system, one that insists on the duality of man/woman and masculine/feminine, and one in which particular heterosexual identities, norms, intimacies, and relationships to mention   but a few are established as a normative standard (p. 181).

Heteronormativity has now become a widely used contemporary political, social, and critical theory used to describe the socio-legal (Phelan, 2001), cultural (Lancaster, 2003) organizational (Grace, 1999) and interpersonal (Blasius, 2000) practices that derive from and reinforce a set of taken-for-granted presumptions relating to the organization of sex and gender (Kitzinger, 2005). Consequently, heteronormativity legitimizes the standard social expectations on sexual relations between individuals (Ingraham, 1999). Similarly, heteronormativity is culturally supported by the consistent pairing of women and men (Dreyer, 2007). Lastly it includes the presumption that there are only two sexes (male and female) who are attracted to each other (Kitzinger, 2005). Thus, heteronormativity as a framework, contextualizes unconscious and automatic assumptions about heterosexuality as the norm and all other types of sexual experience as abnormal,

continuing the creation of binaries in which the first of these is deemed superior to the latter. This construction of a dualistic system of sexuality – those who are heterosexual and those who are homosexual – is a culturally reproduced device used to subordinate the homosexual (Hubbard, 2008).

Taken together heteronormativity perpetuates the privileging of heterosexism that contains "socially conferred benefits or advantages that result from mere membership in a particular social group that confers both blindness to others' experience as well as to one's own power (Montgomery & Stewart, 2012, p. 162). Similarly, it is comprised of an assemblage of attitudes, responses, and beliefs that in one instance values and supports heterosexual privilege while at the same time stigmatizes sexual minorities as well as heterosexuals who violate social norms (Hegarty, Pratto, and Lemieux, 2004; Herek, 1998). An aspect of this privilege is the inherent limiting of who is counted as a citizen and the ways in which a citizen can participate in democratic citizenship (Dreyer, 2007) due to belief that heterosexuals can and should have the right to limit the freedom of expression of gay men (Dalley & Campbell, 2006).

Heteronormativity, in sum, refers to the myriad ways in which heterosexuality is continuously produced and reproduced through systemic discourses as a natural, unproblematic, taken-for-granted, ordinary phenomenon and is embodied in what people do rather than in their beliefs, values, ideologies, or faiths (Kitzinger, 2005). This definition implies that it is not simply prejudiced attitudes or beliefs or a deliberate intent to discriminate against gay men, but is instead embodied and displayed implicitly. On the individual level, heterosexism and heteronormativity can take the form of sexual

prejudice, prejudicial attitudes and behaviors expressed by individuals against people on the basis of their sexual orientation (Cech & Waidzunas, 2011).

Ultimately heterosexism and heteronormativity have produced documented cases of harassment and violence towards sexual minority students at a far higher rate than other populations, perhaps as much as four times more often than the general population (Comstock, 1991; Evans & D'Augelli, 1996). These ideologies and heteronormative discourses allow "heterosexual men to maintain control by reinforcing binary structures that value heterosexual over homosexual and masculine over feminine, linking them together inextricably" (Grace, Hill, Johnson, & Lewis, 2004, p. 318-319).

Intellectual Influences of Heteronormativity

"Until we name the practice, give conceptual definition and form to it, illustrate its life over time and in space, those who are its most obvious victims will also not be able to name it or define their experience" (Rich, 1980, p. 644). Those words could easily describe a variety of oppressions that individuals face due to the societal creation of otherness. They most certainly could be a rallying point for gay men who work to abolish heteronormative practices in society. The fact of the matter is, they were written from the feminist perspective of Adrienne Rich. According to Butler (1990) works by Rich and other early feminists, namely Gayle Rubin, related heterosexuality to the perpetuation of gendered divisions of labor and male dominance over women's productive and reproductive capacities. Their work laid the groundwork for the rise of the concept of heteronormativity. Of these two, Rich's well laid out argument against the societal forces of "compulsory heterosexuality" is seen as the forerunner to the concept of heteronormativity. She defined compulsory heterosexuality as, "a man-made institution,

as if, despite profound emotional impulses and complementarities drawing women to women, there is a mystical/biological heterosexual inclination, a "preference" or "choice" which draws women toward men" (Rich, 1980, p. 637). In her arguments, Rich (1980) criticized the work of other feminists for treating lesbianism as marginal or less natural and rails against the ideal that heterosexuality is normal. The notion that heterosexuality is 'normal' then relegates others who do not conform to this form of sexuality as abnormal, deviant, pathological or emotionally deprived. These ideologies have been manifested in our society as a form of institutional control that is maintained by a variety of heterosexist forces (Rich, 1980).

While Rich wrote about the many forces enacted to ensure women complied with their "natural" calling to be heterosexual, she also wrote about the politics and modes of oppression revolving around an individual's sexuality. Rubin (1984) argued that the institutional forms of oppression regarding sexuality began in this country in the late 19th century as morality crusaders began a quest to eliminate amoral sexual acts such as homosexuality and prostitution, leading to the many laws that made participating in any of these acts illegal. These conservative morality crusaders continued their witch hunt for homosexuals through the 1950's and 1960's by portraying gay men as deviant, sex offenders and creating the campaign "Save Our Children" from homosexual recruitment (Rich, 1984). Rich (1984) writes that:

> Modern Western societies appraise sex acts according to a hierarchical system of sexual value. Marital, reproductive heterosexuals are alone at the top of the erotic pyramid. Clamouring below are unmarried monogamous heterosexuals in couples, followed by most other heterosexuals. Solitary sex floats

ambiguously…Stable, long-term lesbian and gay male couples are hovering just

above the groups at the very bottom of the pyramid. Individuals whose behavior

stands high in the hierarchy are rewarded with certified mental health,

respectability, legality, social and physical mobility, institutional support, and

material benefits (p. 151).

Obviously, this does not leave room at the table for gay men to be privy to these types of

rewards and privileges offered to straight people. It does however, create a system that

has continued to exert economic and social forces denying gay men equal status as

citizens of this country. Because of the works of these two feminist researchers, and

countless others, the concept of heteronormativity was birthed.

Critiques of Heteronormativity Research

One critical criticism of heteronormativity research is founded in its sole focus on

the affects it has on gay individuals and in so called 'gay spaces'. For instance, Hubbard

(2008) wrote that this generalized binary notion that spaces are either heterosexual or

homosexual fails to acknowledge the diverse sexualities that may exist along the

continuum of these two categories. Continuing to identify spaces as nominally straight or

gay actually contributes to the divisive construction of the binary sexuality that

heteronormativity research and queer theory research is trying to disrupt. Studies of

heteronormative assumptions must also broaden their scope and recognize that there are a

multiplicity of heterosexualities, that heterosexuality is not a monolithic or unbending

structure (Hubbard, 2008). Likewise, Hearty, Pratto, and Lemieux (2004) argued that

heteronormativity indeed affects "all individuals regardless of sexual orientation,

proscribing and requiring different kinds of actions and experiences based on gender, and

creating categories of acceptable groups of people" (p. 124). As researchers, we must

recognize that heteronormativity affects straight men as well as gay men due to the

normalizations of certain forms and expressions of masculinity. Those who live outside

of these norms may also find themselves marginalized by the practices of

"institutionalized, normative heterosexuality and its associated practices (Jackson, 2011,

p. 13). Accordingly, the notion of male masculinity is a highly contingent and unstable

reproduction that is specific to cultural and geographical locales (Berg & Longhurst,

2010).

Even though heteronormativity research focuses attention on 'gay spaces' and gay

individuals, and neglects to address the fact that there are a multiplicity of masculinities

and heterosexualities, studies of heteronormativity can produce meaningful and useful

results. Responding to the criticism, it is important to recognize that there is "not one gay

community, or even one queer movement, but many" (Hubbard, 2008, p. 644) and this

indeed makes it difficult to produce far reaching claims. Ultimately, studies must

specifically address the cultural masculinity norms in particular locales in order to

capture the true nature of power and control and how these aspects assert dominance

through the construction of heteronormality (Hubbard, 2008). By gradually building a

body of knowledge in this area, research into heteronormativity can still help to increase

and improve upon our understanding of heteronormativity and its contribution as a

structure of oppression.

Another criticism of heteronormativity research is the emerging concept of

homonormativity. Homonormativity is the process of creating a perceived hierarchy

within the LGBT community where individuals are privileged based on how closely they

fit into heteronormative ideals and constructs (Browne, 2011). Proponents of homonormativity believe that heteronormativity research pushes for members of the LGBT(Q) community to assimilate into heterosexist normative assumptions about sexuality, such as monogamous relationships, which serve to continue to (re)produce as 'others' those who do not fit into these categories, including transgender individuals (Richardson, 2005). A response to this criticism, would be to challenge heteronormativity researchers to continue with a focus on breaking hegemonic discourses of sexuality and gender binaries. Similarly, it is vital that researchers ensure that the narratives used to examine, describe, and explore the lived experience of gay men is not done in a generalized manner which collapses all sexual minority individuals' experiences as a monolithic occurrence. We can best produce valid research when we make it distinctly clear that our findings represent the experiences of the individuals (gay men or otherwise) who are our subjects.

While the aforementioned criticisms cover heteronormativity research in general, one additional criticism relates specifically to STEM education and careers. Science is argued by some to be a completely objective field, meaning that if you can follow procedures and gather good evidence, then any extenuating issues do not interfere. Harding (1996) inferred that good science, good philosophy, and good methods allow for scientific inquiry that is not tainted by social, or ethical values. These processes have allowed science to remain value free and objective while positioning the creator of knowledge as invisible and disembodied. When researchers enact the prescribed methods, he/she remains objective, while increasing the likelihood that the knowledge produced is considered valid.

By contrast, the idea that science is objective and value free is archaic and heavily criticized. Longino (1990) argued that science is always affected by external factors which include social, political, and moral values. These values shape the interests of those conducting and funding the research and mold scientific enterprise while excluding any conception of value freedom. Kuhn (1998) added to this argument as he suggested that there can be no separation between researcher and the context of the experiment because the paradigms in which science operates are explicitly chosen by the scientist. On the idea of objectivity, Haraway (1988) proposed "an invisible conspiracy of masculinist scientists and philosophers" (p. 575) which suggested that "ideologies about objectivity and the scientific methods are bad guides to how scientific knowledge is actually made …what scientists believe or say they do and what they really do have a very loose fit" (p. 576). Taken together these three theorists propose a circular and cultural understanding of theory at all phases of scientific inquiry by arguing that knowledge is never impartial, that production of knowledge is never completely objective, and that the producers of knowledge always bring with them their own set of beliefs and values that undoubtedly influence the interpretation and construction of knowledge.

Historical Masculinization of STEM

From a historical perspective, it was once widely accepted that knowledge could only be generated through the church and via vesicles (*men*) of God who were morally worthy (St. Pierre, 2012). However, with the creation of the Cartesian man and his ability to think rationally, Descartes set *man*kind on a path of knowledge production through verification using "scientific practices in order to know truth" (St. Pierre, 2012,

p. 486). His belief in the rational self and the ability of *man* to produce objective

knowledge spread throughout Europe in the teachings of Comte and became the

cornerstone in the creation of modern day Western science. St. Pierre (2012) wrote that

Comte's philosophy on knowledge production included the removal of human values

from influence in scientific experiments and provided society with objective, neutral

science. This production of objective results and knowledge free from the bias of values

and beliefs of the scientist is the cornerstone of the scientific community. The objectivity

of science would continue as unabashed and unquestioned basis for good science for

many decades in the future.

On the other hand, Gilbert (2001) argued that since science comes out of the

enlightenment period, rationality is by its nature masculine. As she sees it, binary

opposites such as rational/emotional, objective/subjective, science/nature, and

male/female where the first in the ordered pair is associated with men and science

supports her position of the masculinity of science. Keller (1982) added that perspectives

associated with science such as rationality, hardness, objectivity, and elitism are also

characteristics associated with masculinity. While Gonsalves (2014) contributed to this

by arguing that characteristics of natural sciences are abstract, logical, and mathematical;

and that these characteristics are connected to rationality, and rationality to masculinity.

Others have argued that the objective nature of science implies gender has no

influence on either who becomes a scientist or the science produced by those scientists;

that science is indeed a "manless" or "womanless" endeavor. By doing so, these

scientists fail to recognize the influence male dominance has had on the field of science

and how the lack of women from the decision-making levels of science has produced a

science that views the world only from a male perspective and is therefore inherently genderized (Keller, 1982; Fee, 1981).

In their article on gendered STEM education, Sinnes and Loken (2014) argued that scientific knowledge and its processes are directly influenced by the researcher. Since the researcher historically has been a male it is bound to be masculinized and lacking female attributes that could possibly widen the approaches to and effects of science (Sinnes & Loken, 2014).

An additional example of a masculinized practice within STEM fields is the notion of technical/social dualism; a concept primarily found in engineering and other natural sciences. Cech and Waidzunas (2011) conceptualize technical/social dualism as the "ideological separation between 'technical' activities and skills (such as design, science, and math-related activities) and 'social' tasks and skills (such as management, communication with others) (p. 4). The technical/social dualism helps to define the field as well as creates a regulatory culture within the field that relegates issues of justice, politics, social consciousness, and identity to the 'social' realm. Therefore, issues related to gender and sexual orientation are categorized as 'social" and thus considered extraneous. As such, they become inappropriate topics for discussions within the profession and the classroom and they help to create an environment that is both unwelcoming and silencing.

Although not an exhaustive review, the works of Harding (1996), Haraway (1996), Keller, (1992), Fee (1981), and Martin (1991) provided critiques of the positivist paradigm of knowledge production that has unfortunately remained immune to criticism and change for decades. As the literature in the next section revealed, there continues to

be ongoing research that challenges this perspective while highlighting the ways in which gendered norms continue to oppress any student, whether female or member of a sexual minority, who does not conform to these norms. It is imperative to highlight the connection between the experiences of women with the experiences of gay men due to the masculinized gendered norms of STEM. The connection lies in the heteronormative ideology that an expression of homosexuality goes against the norm, causing the homosexual to be marginalized, while the act of labeling an individual, points out behaviors that deviate from masculine normality; thus, acting as a doorkeeper to STEM access (Lundin, 2014). As there is a paucity of research regarding the effects of a masculinized culture on the experiences of gay men in STEM, the oppressive forces women have faced as being "othered" in these environments lends itself to a potential starting point.

Women in STEM

Although individuals from all groups of underrepresented minorities are continually missing from the STEM pipeline, my focus for this review is solely on women due to their interactions with genderized norms in these fields.

The current data on STEM workforce and degree attainment continues to highlight the issues of underrepresentation of women in certain fields. According to a report by the National Girls Collaborative Project (2013) women constitute about half of the overall workforce, but only about a quarter of the STEM workforce, with the greatest disparities occurring in engineering, computer sciences, and physical sciences. However, it is imperative to note that these disparities do not start in the workplace, but are a carryover from inequitable educational experiences and access. For instance, while

women earn a majority of STEM bachelor's degrees awarded in fields such as psychology, biological sciences, and social sciences, the percentage of women earning bachelor's degrees in engineering (19.8%), computer science (18.1%), and physics (18.9%) is staggeringly low (NGCP, 2013).

The figures shown below highlight the numbers and percentages of women earning bachelor's, master's, and doctoral degrees in each of these three fields covering a 20-year span from 1995 - 2014 (National Science Foundation, 2017). In Figure 2.1, the data shows that the number of women earning a bachelor's degree in engineering has increased almost 75%. However, when examining the percentage of women earning a bachelor's degree over that same span, the numbers are almost stagnant (17.3% in 1995, 19.8% in 2014). While Figure 2.3 highlights a similar uptick in the number of women earning a degree in physics, the percentage of women was also stagnant across that period (17.6% in 1995, 18.9 % in 2014).   While those two figures highlight the gains made by women in physics and engineering from a numbers standpoint, Figure 2.2 shows that while there was an increase in the number of women earning a bachelor's degree in computer science between 1995 and 2004, the number of women receiving a bachelor's degree in computer science in 2014 decreased (7,063 in 1995, 15,066 in 2004, 10,144 in 2014).
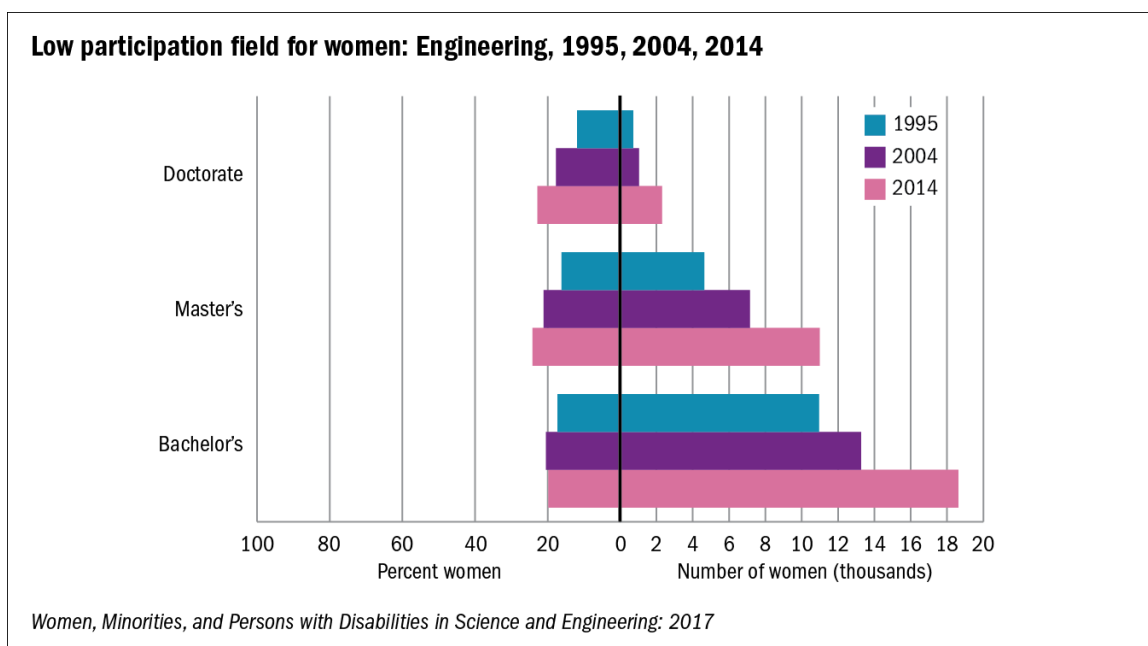
Figure 2.1. Degrees awarded to women in engineering in 1995, 2004, 2014.
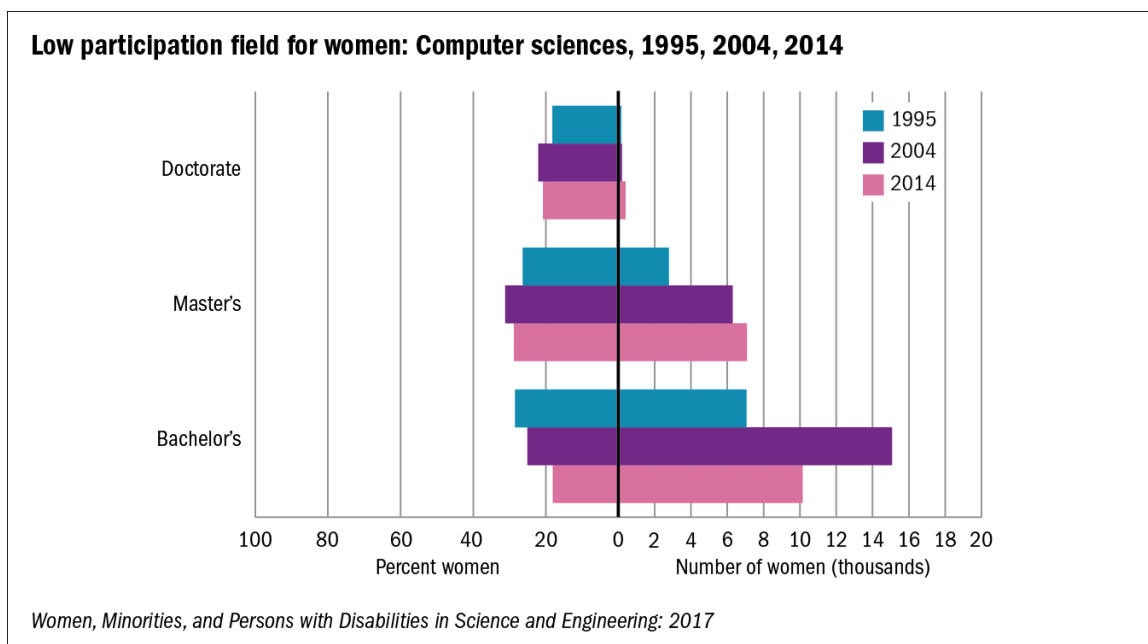
Figure 2.2. Degrees awarded to women in computer science in 1995, 2004, 2014.
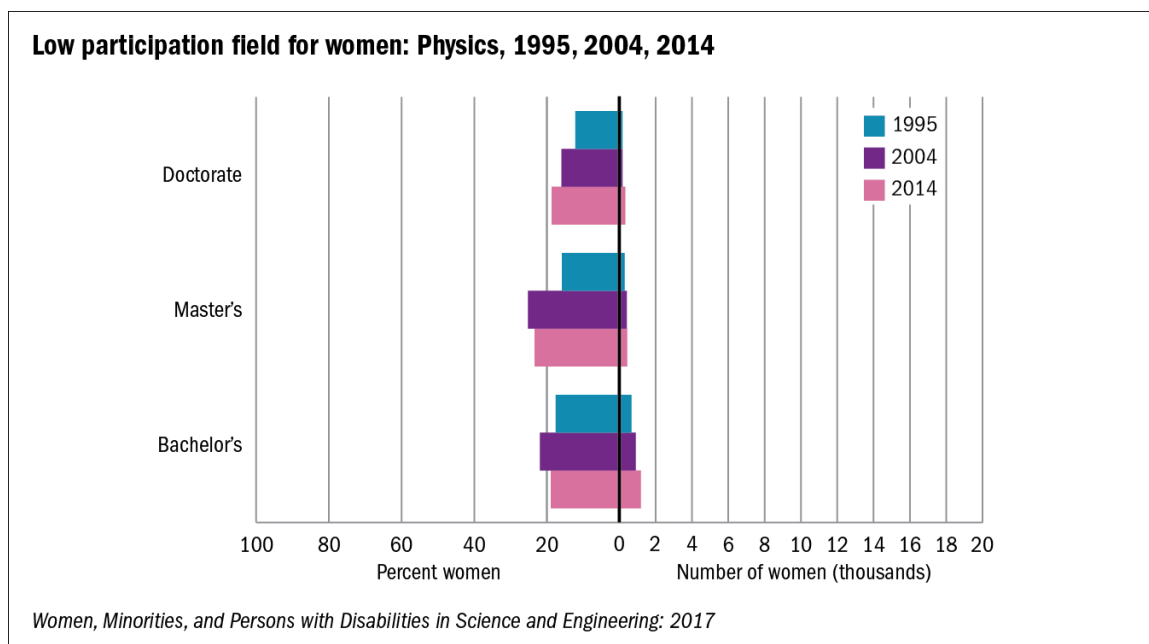
Figure 2.3. Degrees awarded to women in physics in 1995, 2004, 2014.

While this data represents a stark discrepancy between the number of men attaining degrees versus the number of women, there is an additional issue when it comes to persisting in STEM. The U. S. Department of Commerce (2011) estimates that only 26% of women who attain STEM college degrees actually enter STEM fields as an employee. In their report, "Women in STEM: A Gender Gap to Innovation", the authors write that the most common factors contributing to this discrepancy include: a) a lack of female role models, b) gender stereotyping, and c) less family-friendly flexibility in the STEM fields (Beede, Langdon, McKittrick, Khan, & Doms, 2011).

An important precursor to entering a field is anticipating a certain level of success (Bandura, 1997). Women entering STEM fields tend to underestimate their abilities for various reasons and face various perceived negative gender stereotypes that potentially cast doubt on their abilities to perform well (Spencer, Steele, & Quinn, 1999). Similarly, feeling insecure about one's ability to perform a job well because you differ from

stereotypical descriptions of people in a specific field of study can additionally hinder achievement in the field due to stereotype threat.

Researchers examining stereotype threat have put forth the notion that students tend to harbor subconscious fears of confirming negative stereotypes about their groups (Steele, 1997; Steele & Aronson, 1995). For example, when exploring the experiences of women, students of color, and first-generation students, there is a level of fear about confirming the group stereotypes of not being able to excel in the sciences due to the perception that scientists are white men from privileged, highly educated backgrounds (Schinske, Perkins, Snyder, & Wyer, 2016). This perception is regularly conveyed through media images of who does science; more often than not showcasing a relatively narrow view of science and scientists (Tanner, 2009; Martin, 2015).

An additional dimension of male-dominated fields that is unwelcoming to women is the extent to which the field is assumed to embody stereotypes that are incongruent with the female gender role (Diekman, Brown, Johnston, & Clark, 2010). In STEM, these stereotypes include a tendency toward social isolation and a singular focus on technology. In contrast, the female gender role prescribes characteristics such as helping and working with others, being socially skilled, and attending to physical appearance (Cejka & Eagly, 1999; Diekman, et al., 2010). Gender roles shape the way people see themselves and women report feeling dissimilar from people who fit STEM stereotypes (Cejka & Eagly, 1999). As a result, women may underestimate their likelihood of succeeding in STEM.

Ultimately, research exploring the struggles that plague women in STEM fields serve as the backdrop for this dissertation as research findings have helped to highlight

the continued pervasive and oppressive forms of hegemonic masculinity frequently

reproduced within, and throughout this field (Connolly, 2000; Yoder & Mattheis, 2016).

Using these conceptualizations, it is easy to visualize the oppressive nature of genderized

and heteronormative environments on individuals who do not ascribe to these norms as

they are constructed. This review provides an important parallel to frame the negative

experiences gay men have in STEM fields also. The following section provides a review

of the current data exploring these experiences.

Exploring the Research on Gay Men in STEM Fields

This review draws attention to the need for research that examines the experiences

of gay men within STEM related classes and majors. As a marginalized group, gay men

experience heteronormativity in various settings, especially when combining their status

as a sexual minority with the hyper-masculinized climate of STEM majors or fields. I

evaluated empirical studies detailing the experiences of gay men within the confinement

of STEM majors or fields. In my quest to find relevant research, I chose to only review

articles published after 1999 as this year coincides with the monumental decision by then

President Clinton to sign into law legislation making it illegal to discriminate against

members of the gay and lesbian community in the hiring practices of the federal

government. The following key terms were used in Google Scholar to locate the articles;

"STEM science" and "LGBT". This search resulted in 92 articles that were then scoured

to find relevant studies. Most of these articles did not focus on gay men in STEM and

were eventually discarded. Articles were discarded for the following reasons: a) they

were not empirical studies (this included several reviews of literatures unrelated to my

topic or were about policy updates), b) were about women in STEM (these articles came

up in the search when there was a small sentence including members of the LGBT

community as an additional marginalized group), c) were about lesbians, or d) they were

related to the health and healthcare of LGBT individuals. This process resulted in a net

of five relevant articles, of which only one looked at the experiences of students in a

STEM related field while the other four reviewed the experiences of professionals in

STEM related fields and careers. Table 2.1 lists these articles, provides the name of the

authors, the title of the article, the year of publication, and a brief overview of each study.

I summarize the articles below.

In a study of science and engineering faculty who identified as lesbian or gay,

Bilimoria and Stewart (2009) examined the workplace climate for LGBT faculty to

determine the effects of the climate on their work performance and careers. These

researchers found instances of invisibility, interpersonal discomfort, and pressure to

"cover" their sexuality to be prevalent. Less prevalent were instances of overt hostility.

In the only study to specifically research students, Cech and Waidzuna (2011) explored

the experiences of LGB students majoring in engineering. These researchers found that

the students in their study faced prejudicial cultural norms and perceptions of competence

that have a limiting effect on the students' opportunities to be successful. Additionally,

Cech and Waidzunas (2011) found that LGB students used coping strategies such as

"passing" as heterosexual and downplaying cultural characteristics associated with LGB

identities in order to navigate the heteronormative engineering climate. Cech and

Waidzunas (2011) concluded that engineering is often a hostile place for LGB identifying

students because of their experiences.

Eliason, et al (2011) explored the workplace experiences of LGBT nurses using

Table 2.1

Empirical Studies of Relevant Literature Exploring Gay Men in STEM

Author	Title	Year	Study Review
Bilimoria, D., & Stewart, A. J.	Don't ask, don't tell: The academic climate for lesbian, gay, bisexual, and transgender faculty in science and engineering.	2009	These authors researched the experience of gay and lesbian engineering faculty at two universities in the Midwest.
Cech, E. A., & Waidzunas, T. J.	Navigating the heteronormativity of engineering: The experiences of lesbian, gay and bisexual students	2011	The only study involving students in a STEM field, these authors researched the experiences of gay and lesbian students in Engineering at a Midwestern university.
Eliason, M. J., et al	Lesbian, gay, bisexual, transgender, and queer/questioning nurses' experiences in the workplace.	2011	Data collected from members of an online LGBT advocacy organization for nurses. Authors researched the experiences of gay and lesbian nurses.
Eliason, M. J., Dibble, S. L., & Robertson, P. A.	Lesbian, gay, bisexual, and transgender (LGBT) physicians' experiences in the workplace.	2011	Data collected from members of an online LGBT advocacy organization for doctors. Authors researched the experiences of gay and lesbian doctors.
Yoder, J. B., & Mattheis, A.	Queer in STEM: Workplace experiences reported in a national survey of LGBTQA individuals in science, technology, engineering, and mathematics careers.	2016	This is the first paper of a planned three paper research project. The authors collected online survey data of working gay STEM professionals on their level of "outness".

an online survey and found that many workplaces lacked policies and procedures that would make LGBT nurses feel safer and more included. The survey also revealed that nurses are often exposed to increased discriminatory behavior or verbal harassment from coworkers, supervisors, and patients. In a similar study, Eliason, Dibble, & Robertson (2011) collected survey data on the experiences of LGBT physicians in the workplace. The survey revealed that LGBT physicians also experience a wide range of discrimination. This study provided amazing statistical information about the discriminatory actions the physicians had encountered. The study reported that 10% of physicians had heterosexual colleagues deny them referrals; 15% had been harassed by a colleague; 65% had heard derogatory comments about LGBT individuals; and 34% had witnessed discriminatory care of an LGBT patient. In a more recent study, Yoder and Mattheis (2016) recruited LGBTQA-identified persons working in STEM careers to complete an online survey to describe how open they were about their identities in personal, professional and classroom settings. Their findings suggested participants were more likely to be open about their identities in STEM fields with better representation of women. Additionally, those who reported a higher degree of openness in the workplace wore more likely to describe their workplace as safe and welcoming.

Theoretical Framework: Cultural Border Crossing

To understand gay men's experience in science classrooms, the epistemological utilization of cultural border crossing allows researchers to view learning science as an "anthropological perspective that contextualizes learning in a cultural milieu" (Cobern & Aikenhead, 1998, p. 1). In developing his conceptual theorizations regarding cultural border crossing, Aikenhead (1996, 2001, and 2001) drew on the writings of Costa (1995)

and Phelan, Davidson, and Cao (1991) to inform his research. Below is a description of the key concepts of cultural border crossing, followed by a review of the extant literature that has used cultural border crossing as a (conceptual) framework. Ultimately, I end with a brief discussion as to how cultural border crossing was employed in, and throughout this study.

Borders, as defined by Phelan et al (1991), refer to both real and perceived lines and barriers between worlds. Cultural border crossing then, is defined by Aikenhead and Jegede (1999) as the cognitive transition between a student's life world and the world of school science. This process of crossing cultural borders and transitioning between different worlds is an involved, complex cognitive process that often requires forms of collateral learning (Aikenhead & Jegede, 1999) or an ability to play by Fatima's rules (Cobern & Aikenhead, 1997) when individuals are forced to operate in foreign frameworks (Medina-Jerez, 2008).

In this context, the word "world" is defined to "mean the cultural knowledge and behavior found within the boundaries of students' particular families, peer groups, and schools; presuming that each world contains values and beliefs, expectations, actions, and emotional responses to familiar insiders" (Phelan, et al, 1991). Therefore, a student's life world includes knowledge created through socio-cultural interactions with family, friends, peers, and mass media (Brand & Glasson, 2004; Phelan, et al 1991). In contrast to this, the world of school science is inclusive of the culture of school as well as the subculture of Western science (Aikenhead, 1996, 2001, 2001; Aikenhead & Jegede, 1999; Cobern & Aikenhead, 1997; and Costa, 1995).

Even though heavily debated in academia, culture as a term maintains a variety of functional attributes, some of which includes: communication, social structures, skills, customs, norms, attitudes, values, beliefs, expectations, cognition, conventional actions, material artifacts, technological know-how, and worldview" (Cobern & Aikenhead, 1997). In this paper, the definition employed will be "the norms, values, beliefs, expectations and conventional actions of a group (Phelan, et al, 1991). Important for understanding is the idea that there are a multitude of subgroups within every culture. Some of the most recognized subgroups are identified as race, language, and ethnicity, but other categories include gender, social class, occupation, and religion (Aikenhead, 1996). This dissertation will include sexual orientation as a recognized cultural subgroup.

The argument used in the cultural border crossing framework is for science to be considered a cultural enterprise itself due to shared norms, values, beliefs, expectations, and conventional actions of the community of scientists (Aikenhead, 1996). Aikenhead (1996) listed several shared norms, values, etc. of Western science that includes the following cultural features: "mechanistic, materialistic, masculine, reductionistic, mathematically idealized, pragmatic, empirical, exploitive, elitist, ideological, inquisitive, objective, impersonal, rational, universal, decontextualized, communal, violent, value-free, and embracing disinterestedness, suspension of belief, and parsimony".

Every day, individuals move across a variety of borders as they move from one context to the next, or from one culture to another. Typically, these border crossings are often done with ease as the majority of people are adept at moving from family to work and back to family again. However, the disparity between school science and the

students' worldviews has been attributed to the mismatch between the subcultures of science and the life-worlds of students (Aikenhead, 1996). This is often a source of cognitive dissonance (Aikenhead, 1996). Depending upon the congruency of the two worlds, movement between them is categorized into patterns of: a) smooth, b) manageable, c) hazardous, and d) impossible (Phelan, et al, 1991, Aikenhead, 1996, 2001, 2001; Aikenhead & Jegede, 1999).

Extant Research

Various studies have assisted in providing the contextual and theoretical background associated with border crossings as a conceptual framework (Brand & Glasson, 2004; Gurgel, Pietrocola, & Watanabe, 2016; Kang, Bianchini, & Kelly, 2012; Medina-Jerez, 2008; Nielsen & Nashon, 2007; and Piliouras & Evangelou, 2010). The goal of this section is to provide an overview of several of these while highlighting what they add to the research base. The papers are grouped according to whether the researchers used the cultural border crossing framework to: a) understand various borders participants must cross to access Western science, b) uncover strategies that teachers use to help students navigate successfully between borders, or c) develop new categories when the borders involve something other than life-worlds and the world of science. Table 2.2 provides an organized list of publications of empirical research reviewed for this section in order in which they are presented.

Crossing Borders

Medina-Jerez (2008) studied the diversity of student reactions when life-words were paired with the subculture of school science in classrooms in eastern Colombia. In general, it has been recognized that students must bridge their everyday life-worlds and

Table 2.2
Selected Cultural Border Crossing Literature

Author	Title	Year	Study Review
Medina-Jerez, W.	Between local culture and school science: The case of provincial and urban students from eastern Colombia.	2008	The purpose of this study was to examine whether any differences exist in students' abilities to navigate culture borders successfully due to socio-cultural factors.
Nielsen, W. S., & Nashon, S. M.	Accessing science courses in rural BC: A cultural border-crossing metaphor.	2007	In this study, the authors examined whether the training of preservice teachers impacted the ability of students to navigate cultural borders and learn science.
Gurgel, I., Pietrocola, M., & Watanabe, G.	The role of cultural identity as a learning factor in physics: A discussion through the role of science in Brazil.	2016	The authors of this study explored how students dealt with cultural expectations and stereotypes in relation to them learning science. In this study, the authors explicitly made students aware of the contributions made to science by Brazil and Brazilian peoples.
Piliouras, P., & Evangelou, O.	Teachers' inclusive strategies to accommodate 5th grade pupils' crossing of cultural borders in two Greek multicultural science classrooms.	2010	The authors explored pedagogical strategies that teachers employed to assist their students in accessing Western science. These strategies included using socio-cultural principles such as collaborative communities and inquiry based activities.
Kang, E. J. S., Bianchini, J. A., & Kelly, G. J.	Crossing the border from science student to science teacher: Pre-service teachers' views and experiences learning to teach inquiry.	2012	This research study explored the abilities of pre-service teachers in their attempt to cross the cultural border between that of being a student and that of being a science teacher.

those of Western science through a cultural border crossing approach. However, not all

students are able to do this and there is "ample evidence of a disjunction between the

Westernized worldview addressed in the science classroom and the multiple events that

students encounter in their everyday experiences" (Medina-Jerez, 2008, p. 190). Medina-

Jerez compared schools in urban and rural/provincial areas to determine any differences

between the socio-cultural factors affecting students' abilities to navigate borders

successfully. The findings suggest that socio-economic factors assist in creating borders

that are more difficult to cross due to the following issues: a) students in rural areas are

often advised to plan and start a career before completing their secondary education and

b) an inability to update books or buy laboratory materials. More importantly there are

additional socio-cultural factors that influence students' abilities to move fluently

between their life world and the world of science. In rural settings, practices and norms

"are created within specific fields in which they are produced" (p. 206) leading to school

settings adopting the practices, norms, and values professed in the local religious beliefs,

while teachers take on the image of a dictator in which students are told what to learn and

how to learn it. This research adds an important set of data to existing research by

showcasing that there are varying student reactions to crossing cultural borders due to

socio-economic and socio-cultural factors even within the same country.

Nielsen and Nashon (2007) also conducted research to determine the differences

in cultural border crossing experiences of students in rural and urban areas in British

Columbia. While their research suggested that socio-economic factors also played a role

in students' border crossing abilities being limited in rural areas, it also added a

significant hypothesis to the literature of cultural border crossing. Nielsen and Nashon

(2007) suggested that the ability of teachers to help students recognize borders and recognize what is necessary to navigate said borders is impeded due to the following two factors: a) teachers in rural settings typically do not stay for more than a year, and b) teachers are from and are trained in urban settings. The second of these seems most appropriate for expanding upon as it leads to implications for how teachers are trained at teacher preparation institutions. To help students move from one subculture to another with ease, teachers must be aware of the norms within each subculture. Teachers who are not familiar with the norms of rural areas may not be able to do this. Aikenhead (1996) argued that teachers must also cross borders to understand new subcultures as they strive to relate to students from different cultural backgrounds.

Teacher Strategies to Assist in Border Crossing

Cobern and Aikenhead (1998) listed the following strategies that teachers should implement in order to move towards cross-cultural science teaching: a) make border crossings explicit for students, b) facilitate these border crossings, c) promote discourse in order to get students to talk in their own cultural interpretive framework as well as the framework of science, and d) substantiate and build on the validity of students' personally and culturally constructed ways of knowing (p. 50). The following studies showed how teachers from different areas of the world (Brazil and Greece) implemented cross-cultural pedagogy in order to assist their students in navigating and crossing potentially hazardous or impossibly borders into the world of science.

Gurgel, Pietrocola, and Watanabe (2016) studied how the cultural identity of a society can affect how students are able to create an identity in education and more importantly, in science. A cultural identity can be steeped with stereotypes as an identity

is often formed by the perceptions of belonging or not belonging to a group (p. 353).

Stereotypes are powerful because they affect not only how we see each other but also

how we see each ourselves. When students create an identity, they are also taking on

those stereotypes belonging to that identity and by doing so begin to believe that "some

element in social life can only be attributed to a pre-determined cultural group, which the

individual does not see himself belonging to" (p. 353). If for instance students believe

that participating in science requires an identity that is not compatible with the identity

already adopted through nationality and culture, then it might lead to an inability to cross

into the subculture of science due to a lack of access. To change students' initial

perceptions of their identities in relation to learning science, an intervention strategy was

implemented in which the contributions of Brazil as a nation and Brazilian individuals

were prominently discussed with students. Although students developed a sense of pride,

the study was not long enough to determine if students actually changed their identity in a

meaningful way in relationship to school science.

Pilouras and Evangelou (2010) were interested in determining the success of

cross-cultural pedagogy in assisting Greek students to navigate cultural borders into the

world of science. The two teachers in this study employed multi-cultural teaching

pedagogy that promoted a collaborative inquiry learning environment for all students.

Pilouras and Evangelou (2010) explained that pedagogy that assists smooth border

crossing included the following socio-cultural principles and strategies: a) inquiry as the

organizing principle of curricular activities, b) establishing a collaborative community, c)

using discursive strategies to scaffold students' learning, and d) designing activities that

bridge colloquial and scientific language (p. 348). This research demonstrated that using

appropriate cross-cultural pedagogy assists students in smoothly crossing cultural borders that might not otherwise be crossed.

An Example of Crossing Borders Outside of Learning Science

To demonstrate how the cultural border crossing framework can be conceptualized outside of science learning, Kang, Bianchini, and Kelly (2012) explored border crossing experience of pre-service teachers as they attempt to negotiate the border that exists as prospective teachers move from the world of veteran students to that of beginning teacher. Specifically, the researchers were interested in exploring their level of ease in "crossing the cultural border from traditional science student to inquiry-oriented science teacher" (p. 436). Based on their findings researchers created their own four categories along a continuum that categorized science teachers based on their willingness to teach inquiry: a) traditional teacher who rejects outright the ideas of teaching and learning science as inquiry, b) teacher of inquiry in theory rather than practice, c) teacher of inquiry but with questions or concerns, and d) inquiry-oriented teacher (p. 436). This study was particularly helpful for this dissertation research as it demonstrated an ability to use the cultural border crossing framework, apply it in a new context, and create a new set of categories for crossing borders outside of the traditional context of learning science.

Use of Cultural Border Crossing for this Study

The essential premise of this study is an attempt to understand gay men's perceptions of boundaries between various worlds, to identify what adaptation strategies, if any, they use as they move from one subculture to another, and to examine the ways gay STEM students perceive and experience heteronormativity within STEM classrooms

and environments. In line with previous research, the underlying assumptions of the cultural border crossing framework allowed me to conceptualize the idea that gay men might also encounter the same four types of border transitions (smooth, manageable, hazardous, and impossible) as they move from their life-worlds to the world of science. In this study, I examined the relevance of these four categories and whether they held true for the experiences described by my research participants. In the end, these categories did hold true and were able to be adapted to the current research. The adaptation of the categories to fit this research and to describe how gay men navigate these borders is described in more detail in Chapter Five.

Although previous research has demonstrated that all students experience some form of border crossing dependent upon their unique cultural backgrounds, I argue that sexual orientation is of itself a subculture that has very different norms than those found in science classrooms. Because of this, the ability to smoothly cross borders could be hindered by, amongst other things, the heteronormative assumptions of genderized roles in STEM classrooms, where the public perception of a scientist is still envisioned as White, male, *heterosexual* [italics added], and middle class (Yoder & Mattheis, 2016).

The culture of science includes various gendered norms, which include: being objective and unemotional (Acker, 1990). This view of science might lead to a direct conflict between the science world and the life-world of those who identify as gay and male. Theoretically, this could cause these individuals to struggle in their sense of identity on top of experiencing difficulties with academic success. Heteronormative assumptions and the correspondingly rigid expectations of gender and sexuality in STEM fields' places increased pressure on gay men to downplay the importance of gender and

sexual orientation in their personal lives or to hide their queer identities altogether (Yoder & Mattheis, 2016). These pressures along with the indifference of the field toward an individuals' identity, personal life, and experiences may increase the level of discomfort for gay men (Bilimoria & Stewart, 2009), ultimately have a silencing effect on gay-identified male students (Dalley & Campbell, 2006).

Due to these factors, gay men may face borders that are hazardous or even impossible to cross. For example, in STEM classrooms across college campuses, instruction is dominated by teacher centered strategies where interaction among students is discouraged and students are relegated to being passive learners that sometimes creates a border that is hazardous to cross (Phelan, Davidson & Cao, 1991). Borders may also be impossible for gay men to cross if teachers fail to speak about the successes and contributions of gay culture and gay individuals; or communicate negative images about gay identity (Phelan, Davidson & Cao, 1991). These borders may also seem to be difficult to cross if the students are struggling to develop a secure sexual identity; in this instance science takes a back seat as far as relevance to their lives is concerned.

Drawing on the works of Costa (1995) and Aikenhead (1999), my goal was to propose new categories that describe how gay men perceive and navigate borders between their life worlds and the world of science and back to their life worlds.

Conclusion of Chapter

In Chapter Two I provided a review of the literature that has guided and informed me when doing this dissertation. This has included a literature review of the following topics: a) gender, b) heteronormativity and heterosexism, c) historical masculinization of

STEM, d) current data on women in STEM, e) research on the experiences of gay men in STEM fields, and f) cultural border crossing.

In Chapter Three, I provide a thorough description of the research design and methods for enacting the study. Included in Chapter Three is an explanation of the following aspects: a) study purpose, b) research questions, c) research design, d) participant selection criteria, recruitment techniques, and participant descriptions, e) data collection techniques, f) data analysis techniques, g) method for representing collected data, h) quality of study and trustworthiness, and i) ethical considerations.

CHAPTER 3

RESEARCH DESIGN AND METHODS

Introduction

The previously reviewed literature made it explicit that gay men encounter greater instances of social marginalization due to a heteronormative and heterosexist society. However, current research also highlighted the lack of research detailing the experiences of gay men majoring in STEM fields. To address this gap in literature, this chapter outlines a detailed description of the qualitative techniques used in this study as a way to provide a more robust understanding regarding the experiences of gay male students enrolled in STEM specific majors and classes. Accordingly, this chapter is organized into various sub-sections: a) study purpose, b) research questions, c) research design, d) participant selection criteria, recruitment techniques, and participant descriptions, e) data collection techniques, f) data analysis techniques, g) method for representing collected data, h) quality of study and trustworthiness, and i) ethical considerations.

Study Purpose

A grand challenge facing STEM education is understanding equity and broadening participation in the STEM education pipeline, especially for women and students from under represented backgrounds and populations (i.e., U.S. Blacks, LGBT individuals, Native Americans, and Hispanic individuals). Therefore, the purpose of this dissertation was to:

- identify and examine the lived experiences of gay men in STEM courses on a southern college campus;

- explore multiple ways that gay men navigate the boundaries between their lived world and canonical science world; and

- explore how these perceptions and experiences impact their abilities to navigate these boundaries and the impact on their participation in STEM.

Research Questions

To examine the previously identified purposes, the following research questions were used to guide this study:

1. To what extent do gay men perceive the culture of STEM classrooms to be heteronormative?

2. What perception do gay males hold regarding the relationship between any heteronormative culture of STEM classrooms and their experiences within these classes/majors?

3. What is the relationship between a gay male's level of "outness" and his experiences with any discrimination he has experienced and might experience in STEM related classes/majors?

Research Design

Qualitative Research

The nature of this study lent itself to using a qualitative research design due to its exploratory examination of the physical events, and/or behaviors occurring with participants, and exploration of how their understandings influence their behavior (Maxwell, 2013). As noted by Marshall and Rossman (2006) qualitative research constitutes "a broad approach to the study of social phenomena that is naturalistic, interpretive, and increasingly critical; one that draws on multiple methods of inquiry" (p.

2). Denzin and Lincoln (2002) described qualitative research as a situated activity where the observer, located as an observer in the world, participates in exploratory activities meant to transform the world by trying to make sense of, or interpret, phenomena in terms of the meaning people bring to them. Accordingly, using a qualitative research design helps researchers, stakeholders, and participants approach understanding through "process theory" in which "the world is seen in terms of people, situations, events, and the processes that connect these; with explanations based on an analysis on how some situations and events influence others" (Maxwell, 2013, p. 29). Therefore, a qualitative approach was needed to provide thick, detailed, and comprehensive descriptions of the participants' lived experiences (Merriam, 2009; Palinkas, 2014; Patton, 2003).

To obtain detailed descriptions and understandings of the participants lived experiences, qualitative methods helped me to understand an event or process through the explanations and interpretations of those with the experience without requiring my presence in the field (Denzin & Lincoln, 2002; Merriam, 2009). With this understanding, a qualitative research approach authorizes opportunities to explore and understand the meaning individuals or groups ascribe to a social or human problem; in this case the social problem was the oppressive and silencing forces of heteronormativity (Cech & Waidzunas, 2011; Creswell, 2014; Yoder & Mattheis, 2016). While qualitative approaches allow for researchers to make sense of the participants' interpretations of certain societal structures, it also addresses concerns of social injustices and inequities with a goal of reforming and restructuring these in order to improve the lives of the participants and others who come from their community (Creswell, 2014).

Qualitative research can also be used to explore "immature" concepts affecting specific populations due to the paucity of research (Creswell, 2013; Creswell, 2014). For example, research exploring the experiences of gay men in STEM classrooms resulted in: a) one article published since 1999 that explored the experiences of gay men in STEM classrooms (Cech & Waidzunas, 2011); b) two related articles exploring the experiences of LGB professors in an engineering department (Bilimoria & Stewart, 2009; Partridge, Barthelemey, & Rankin, 2014); and c) three articles reviewing work experiences of LGBT(+) individuals in STEM workplaces (Eliason, et al 2011; Eliason, Dibble, & Robertson, 2011; Yoder & Mattheis, 2016). This lack of empirical research further espoused the notion that gay men and their experiences in STEM related classes and careers have been inadequately studied. Considering the lack of literature, the impact of negative experiences gay men face related to heteronormativity and heterosexism has not fully been understood. Finally, a qualitative approach was used because this study was not an attempt at predicting the future, but rather an attempt to provide a comprehensive analysis and understanding of individuals and events during a specific time period.

Narrative Inquiry: A Methodology and Phenomenon

"Once a story is told, it cannot be called back. Once told, it is loose in the world. So you have to be careful with the stories you tell. And you have to watch out for the stories that you are told". (King, 2003, p. 10).

Methodology is considered a theory which outlines and specifies the steps researchers navigate when examining an interest or phenomenon (deMarrais & Lapan, 2004). As such the methodology of a study is inherently and cohesively tied to the proposed research questions and the goals of the study (Hesse-Biber & Leavy, 2004).

Therefore, the value placed upon various methods of data collection, data analysis, and data representation by individual methodologies drives the methods that researchers employ in their pursuit of knowledge and understanding (Creswell, 2013, Hesse-Biber & Leavy, 2004). One method, often associated with qualitative research methodology is narrative inquiry, which often provides complementary knowledge: in-depth description, understanding and clarification of lived experience, with attention to specifics and complexity (Polkinghorne, 2005).

> Narrative inquiry as defined by Clandinin and Connelly (2000) is:
>
> …a way of understanding experience. It is collaboration between researcher and participants, over time, in a place or series of places, and in social interaction with milieus. An inquirer enters this matrix in the midst and progresses in the same spirit, concluding the inquiry still in the midst of living and telling, reliving and retelling, the stories of the experiences that made up people's lives, both individual and social. (p. 20)

Narratives provide opportunities to analyze and understand stories as they are lived and as they are told (Clandinin, 2006; Clandinin & Connelly, 2006; Connelly & Clandinin, 1990) and is excellent for capturing details of a participant's life as it assumes that people construct their realities through narrating their own stories (Marshall & Rossman, 2006). Additionally, narrative research is a lens into how humans understand their own lives within particular cultures and times; the process of telling, recording, and interpreting personal life stories can be a poignant vehicle in understanding how we create meaning of our existence (Patsiopoulos & Buchanan, 2011).

Connelly and Clandinin (1990) provided the following argument for using narrative. They wrote:

> …humans are storytelling organisms who, individually and socially, lead storied lives. Thus, the study of narrative is the study of the ways humans experience the world. This general concept is refined into the view that education and educational research is the construction and reconstruction of personal and social stories; learners, teachers, and researchers are storytellers and characters in their own and other's stories. (p. 2)

These stories are passageways and tools through which people enter the world, interpret their experiences, and then make these experiences personally meaningful (Clandinin, 2006). Additionally, Polkinghorne (1995) added that stories are particularly suited as a linguistic form that serves two functions: a) "it allows human experience as lived to be expressed"; and b) "it preserves the complexity of human action with its interrelationship of temporal sequence, human motivation, chance happenings, and changing interpersonal and environmental contexts" (p. 7). In essence, narrative inquiry is the study of the ways humans experience the world and assign meaning to their experiences.

Polkinghorne (1988) viewed narratives as the way through which we render meaning to our existence and suggests that stories are not gathered to determine if events really happened, but more so, stories are about, the meaning people ascribe to these events. Therefore, narrative inquiry is based on the premise that humans come to understand their own lives and the world around them through story (Squire, Andrews, & Tambokou, 2008). In other words, it is by narrating their story that individuals are able to place meaning and to develop understanding of their experiences. Josselson (2006)

wrote that narrative inquiry involves the gathering of these stories and focuses on the meanings people assign to their experiences. Consequently, narrative inquiry assumes an ontological assumption of relativism which suggests that there are multiple realities while epistemologically acknowledging that knowledge is constructed relationally in respect to time and place and can only be understood through interpretation (Polkinghorne, 2005).

In order to provide in-depth information regarding gay students' perceptions of their experiences on college campuses and in particular STEM classrooms, my participants' narratives provide relevant information useful to gaining understanding of the impacts of heteronormativity and heterosexism have on their performance and persistence in STEM.

Key procedural aspects for completing a narrative inquiry include: a) the selection of an appropriate individual who has a story to tell and artifacts to share, b) data collection via observation, collection of artifacts and open-ended interview questions, c) data analysis and theme identification from transcriptions and field notes, and d) restorying … "the process of organizing the stories into some general type of framework" (Clandinin, 2006; Clandinin & Connelly; 2000). Each of these key aspects is described in the following sections.

Recruitment and Sample Selection

Maxwell (2013) argued that "the decision about where to conduct a research study and whom to include in it are an essential part of the research method" (p. 96). Therefore, for this study, I chose to explore the experiences of gay men in specific STEM majors (physics, engineering, chemistry, and computer science) because research shows these majors continually lack diversity, especially of marginalized groups (Nassar-

McMillan, et al, 2011). Yoder & Mattheis (2016) point out that this lack of diversity is a primary source of hegemonic reproduction of genderized norms within these majors. It is within these genderized norms that societal structures continue to marginalize minority groups, especially those individuals who are sexual minorities or those who are gender non-conforming.

To conduct this study, I recruited participants from three land grant research universities within the southeastern United States, based on proximity to Atlanta, GA. To participate, participants:

- identified as a gay male;

- were currently majoring in physics, chemistry, engineering, or computer science at a four-year college in the southeastern part of the United States;

- were a graduate student or an undergraduate student with a junior or senior standing; and

- were available and willing to contribute to the study at the time of data collection.

Before the study began, IRB approval at the University of Georgia was sought and granted. After approval was granted, participants were recruited using both purposive and convenience sampling. For the purposes of this project, purposive sampling was defined as the selection of research participants who could provide insight (Teddlie & Yu, 2007; Tongco, 2007) regarding their experiences in the specific STEM classrooms/majors highlighted earlier. The study examined a hard to reach population, therefore, I also used participant nomination or snowball sampling techniques to recruit

gay men in the above referenced STEM majors. This approach relied on an initial pool of contacts to nominate other participants who meet the criteria for the study (Morgan, 2008). Browne (2005) wrote that this sampling strategy can successfully reach specific target groups that may not be easily reached due to the following issues: a) self-identification often comes with tremendous risk, both real and perceived; b) fear of being "outed" may prevent many from participating; and c) some choose not to categorize themselves according to existing labels (Remafedi, 1987).

Additionally, flyers describing the study were placed in common areas on each of the campuses (Southeastern State University, Southern State University, and University of the Southeast), emailed to a contact person at the LGBT Resource Centers on those college campuses for dissemination to their listserv, and advertised on my personal Facebook page (Hamilton & Bowers, 2006). Each flyer provided a brief description of the study, the contact person for the study, a contact telephone number, and a contact email address for interested individuals (Appendix A) (Hamilton & Bowers, 2006).

Data Collection

Before initiating any interviews, I met with each eligible participant. During this meeting, I reviewed all the previous information and provided potential participants with a hard copy of the IRB approved informed consent form (Appendix B). For this study, I also asked participants to consent to sharing their personally written reflections (described below) with other participants in the study. It was explicitly stated that these reflections would be shared anonymously.

Participants were informed of the study's purpose; however, they were not provided with any of the research questions (Bailey, 2007). Likewise, they were

informed of the option to protect their personal identity by using a pseudonym [of their choice], obtain an assigned pseudonym [provided by the researcher], or use their designated name (Kaiser, 2009). All participants in this study chose to have the researcher assign them a pseudonym. Participants were informed that at any point during the study, if they felt uncomfortable, they could stop the interview or leave the study, without any risks, consequences, or prejudices (Orb, Eisenhauer, & Wynaden, 2001).

All participants were informed that the interviews would be digitally recorded, and transcribed verbatim to ensure the integrity and quality of the conversations (Crist & Tanner, 2003). Participants also were informed that after the face-to-face interviews were transcribed, they had the opportunity to review the transcripts to make any necessary clarifications, ask questions, and/or make amendments to their own interviews in a process known as member checking (Krefting, 1991; Lincoln & Guba, 1985; Orb, Eisenhauer, & Wynaden, 2001). All participants were reassured about the anonymity of the study and in order to protect their confidentiality I was the only person who had access to their oral interviews and once the interviews were transcribed verbatim and checked for accuracy, I deleted them from the recorder. The transcribed interviews were stored on my personal, password protected laptop. These transcripts were saved on the laptop using the assigned pseudonyms (Arskey & Knight, 1999; Kvale, 1996; Street, 1998).

Participant Descriptions

Employing purposive and snowball sampling resulted in seven potential participants reaching out and inquiring about the study. Of these seven potential participants, four eventually agreed to participate in the study. However, after the first

interview one participant chose to not continue with the study but agreed to let me use the data from his initial interview. The three remaining participants each completed the photo-feedback journaling as well as the second interview. The following gives a brief description of each of the four participants, including age, race, major, school, and academic standing. After the participant descriptions, I provide a table summarizing the length of each of their interviews.

Roger: Roger is a 21-year-old, fourth year senior majoring in computer science. Roger is African American and attends Southeastern State University. Roger was my first interviewee but decided that his semester was too demanding to continue participating in the study. However, he did grant me the privilege to continue using his data in my dissertation.

Bradley: Bradley is a 28-year-old, first year PhD student in chemical engineering. His interviews occurred during the second semester of his first year. Bradley is African American and attends Southeastern State University. His narrative consists of his time as a doctoral student as well as his experiences while an undergraduate student at a local historically black college and university (HBCU).

Neal: Neal is a 26-year-old, first year PhD student in computation sciences and engineering at the University of the Southeast. His interviews occurred during the second semester of his first year. Neal is Caucasian and is doing his PhD at the same school where he obtained his undergraduate degree.

Michael: Michael is a 23-year-old, first year PhD student in industrial engineering at Southern State University. His interviews occurred during the second semester of his first year. Michael is Caucasian and did his undergraduate

degree at a different school, which also happened to be located in the southeastern

region of the United States. His story consists of both his undergraduate and

graduate experiences.

Table 3.1
Interview Length for Each Participant

Participant Name	Interview 1 (Minutes)	Interview 2 (Minutes)
Roger	62	Did not do
Bradley	57	18
Neal	51	32
Michael	56	24

Maxwell (2013) wrote that "collecting information using multiple methods is

common in qualitative research in order to gain information about different aspects of the

phenomena under study, or about different phenomena" (p. 102). Creswell (2013)

grouped data into four basic types: observations, interviews, documents, and audiovisual

materials. In this context, qualitative data collection can be managed through a variety of

these data collection tools and techniques or simply employing any one of the four

techniques (Merriam, 2009).

Although data collection could have proceeded using either of the above

mentioned four techniques, narrative inquiry as a methodology focuses on representing

the lived experiences of an individual and therefore emphasizes the use of in-depth and

unstructured interviewing (Connelly & Clandinin, 1990; Marshall & Rossman, 2006).

Murray (2003) wrote that the primary source of material for the narrative researcher is the

interview. However, he pointed out that the narrative interviews should be designed "to

provide an opportunity for the participant to give a detailed narrative account of a

particular experience" (Murray, 2003, p. 7). In-depth, conversational interviews work

well with narrative research projects because, "at the root of in-depth interviewing is an

interest in understanding the experience of other people and the meaning they make of

that experience" (Seidman, 1998, p. 3).

For this study three methods of data collection were utilized: two one-on-one

interviews, photo-feedback, and photo-elicitation. A description of the usefulness of such

techniques is provided. The data collected from all three methods was incorporated into

the final counter-stories created for Chapter Four.

In narrative inquiries, interviews are often conducted in an informal

conversational manner to encourage the participants to reveal their individual stories. As

highlighted by Kvale (1996),

> …the researcher listens to what people themselves tell about their lived world,
>
> hears them express their views and opinions in their own worlds, learns about
>
> their views and their work situation and family life, their dreams and hopes. The
>
> qualitative research interview attempts to understand the world from the subject's
>
> point of view, to unfold the meaning of people's experiences, and to uncover their
>
> lived world prior to scientific explanations. The qualitative research interview is a
>
> construction site of knowledge. An interview is literally an *inter view*, an inter
>
> change of views between two persons conversing about a theme of mutual
>
> interest. (p. 1)

The use of the one-on-one interviews takes assumptions of the phenomenon and reduces

them into more specific and concrete terms using the direct words of the participants

(DiCicco-Bloom & Crabtree, 2006; Padgett, 1998). Similarly, these interviews have been useful in co-creating meaning of events and experiences of gay men in STEM majors/classrooms (DiCicco-Bloom & Crabtree, 2006). The interviews provided an understanding of the participants' experiences as they shared their uniquely individual stories (Ollerenshaw & Creswell, 2002). According to Clandinin and Connelly (2000), these stories, called field texts, constituted the raw data for the research and report both personal experiences as well as social experiences. It is from these interviews that narrative inquiry research draws its meanings and rich, emotion-laden stories.

Interview One

The first interview for this narrative inquiry introduced the purpose of the study and began the conversation between myself and each participant by exploring their experiences within their specific STEM fields. While a narrative approach traditionally begins with participants and inquirers engaging in telling and listening to stories (Clandinin, 2006), I also developed and used a semi-structured interview protocol (Appendix C) to prompt participants and to focus participants to questions that would help further clarify responses, if, and when needed. Questions included, but were not limited to: a) "To what extent are you 'out' to the faculty in your department?"; b) "What sort of consequences would you expect if you had your sexuality revealed to faculty in your department?"; c) "How would you describe your interactions with other students in your STEM classes?"; and d) "Do students in your STEM classes ever talk or joke about sex or sexuality?". While the interview protocol was handy, most of the questions were answered without being asked, through continuous dialogue between myself and the participants as they told the story of their experiences.

Photo-feedback: Written counter-stories

For the second stage of data collection I chose to incorporate the use of photographs. Photographs are an effective trigger to help participants better articulate their lived experiences and allows participants to better explain their thoughts, feelings, and experiences (Harper, 2002; Hatten, Forin, & Adams, 2013; Wang & Burris, 1997). Due to a photo's ability to jog participants' memories, photographs provide an entry point for participants who might have trouble verbalizing their experiences (Hatten, Forin, & Adams, 2013). Harper (2002) added that photos "evoke deeper elements of human consciousness than do words because exchanges based on words alone utilize less of the brain's capacity than do exchanges in which the brain is processing images as well as words" (p. 13). For these reasons, images do not simply elicit more information, but a different kind of information. Using photographs and playing with the content (what is in the photo) and process (how photos were presented), allows researchers to probe participants to discuss social relationships (Epstein, et al, 2006).

The use of photographs as a methodological tool for research purposes has been given many different names including: photo-voice, photo-elicitation and photo-feedback. Wang and Burris (1997) made the distinction that photo-voice "entrusts cameras to the hands of people to enable them to act as recorders, and potential catalysts for change in their own communities" (p. 369). In comparison, photo-elicitation is based simply on the idea of inserting a photograph into a research interview (Harper, 2002). Tippins, Bilbao, and Morano (2018) writes that photo-feedback can "reduce the feelings of vulnerability and anxiousness that might be caused by talking directly to individuals in positions of power" (p. 6), while the narratives produced allow for the images to be

situated in context. Using these definitions, my processes of data collection included both photo-feedback and photo-elicitation as described below.

Within 24 hours of completing the first interview, I provided each participant with the same five photographs taken from the internet (Appendix D). The selected photographs represented salient concerns and experiences I had both experienced and observed during my time as a gay student in various STEM classrooms. Once participants received these, they were asked to reflect upon and write critically about 3-4 of photographs they felt were particularly relevant to their experiences. All photographs used were captured from Google Images using the terms "gay" "science" or "classroom" and to make sure I would not be infringing on copyright laws, I used the tool to ensure that each photo was "labeled for reuse". To elicit participant responses, each photograph had the following writing prompts: a) what do you see in the photographs, and b) how does this photograph represent your own experience in your respective STEM major? I also provided a personally written reflection to one of the photographs as an example for the participants. The photograph and narrative provided was an example for the participants and follows below (Figure 1). Participants were asked to provide the written narrative within a two-week time frame as they were needed prior to scheduling the second interview.

Figure 3.1: Stamford Advocate: Cloonan Middle School Science Teacher

When I see this picture, I think about myself as a classroom teacher and what I feel like the expectations are for who I present myself to be. For me I felt the pressure to be straight and used "passing" strategies such as lowering my voice, controlling my mannerisms, and making sure that I did not say any phrase that might be misconstrued as something a "gay" person would say. I told myself that this was necessary to stop students from thinking badly of me and for parents not to have negative thoughts about me as a teacher and to continue to trust me with their children. It's as if being gay means that you are a pervert and untrustworthy. I can even remember a former co-worker making a statement about me being close to my students and that it was not appropriate due to my sexual orientation. I was flabbergasted and highly offended and it made me continue to live my "teacher life" in the closet. I often think about how exhausting and silly it is for me to keep up this charade, but I continuously find myself lying to my students and lying to my student's parents about who my authentic self is. Why should I silence myself? What would be the repercussions if I lived out loud? How would my students react? Would they treat me differently? Would they act out, or start being disrespectful? These are all questions that I ask myself and for whatever reason I find that I'm too scared to discover the answers.

Note: Cummo, M. (2016). Cloonan science teacher earns White House honor. [Photograph]. Retrieved from http://www.stamfordadvocate.com/local/article/Cloonan-science-teacher-honored at-White-House-6847469.php

The decision for me to provide the participants with the photographs instead of allowing them to collect or take their own was a combination of two salient issues: a) participants describing a low comfort level with taking their own photographs; and b) having several potential participants decline to participate in the study due to being asked to take pictures. Epstein, et al (2006) made the argument that researchers are at liberty to provide the photographs if they are guided by a particular conceptual framework. While providing the photographs might be construed as introducing bias, I believed that my status as a former member of the STEM classroom as well as my membership in the gay community provided a unique insight and gave me the flexibility in doing so. This limitation is discussed in greater detail in Chapter Five.

Interview two: Photo-elicitation

Once the remaining three participants completed and submitted the photo-feedback elicitations, the second one-on-one interview was scheduled. These interviews were scheduled within a month of the first interview and within two weeks of the participants completing their written reflections with respect to the photographs. During each interview, I provided participants with the photographs and written narratives they previously submitted and asked them to describe the photo and to discuss their written reflection to serve as a tool to elicit further conversation from the participants. Next, I gave each participant the written narratives from the other participants. The goal was to provide participants with different perspectives or experiences that might assist in jogging a memory to an experience they also had but failed to think of during their reflective writing. To assist with this interview, I created the mnemonic **PERSIST.** The following prompts are associated with this mnemonic:

1. describe what you see in this *P*hoto

2. what does this photo tell you about the *E*xperience of the person who took it?

3. how does this photo *R*elate to your own personal experiences in STEM?

4. in reading the other narratives, are there any *S*hared experiences between yourself and the person who wrote it? If so what are they?

5. what existing *I*ssues with heteronormativity in STEM environments do the narratives highlight that you were previously unaware of

6. what *S*trategies are highlighted by the narratives that you currently use to assist you in being successful in STEM environments

7. how has this research project made you think about your potential career *T*rajectory within STEM careers?

In this section, data collection was discussed including the participant selection and methods employed. Four participants were included in the first one-on-one interviews while three participants provided the photo-feedback and continued to the second one-on-one interviews that included photo-elicitation.

Data Analysis

Polkinghorne (1995) categorized narrative inquiries into two types dependent upon varying types of cognition used for analysis – paradigmatic or narrative. In the case of this dissertation study, I employed paradigmatic reasoning in my analysis of the collected stories. By using this type of reasoning, Polkinghorne (1995) labeled this as an analysis of narratives. An analysis of narratives occurs when the researcher "collects stories as data and analyzes them with paradigmatic processes that result in descriptions

of themes that hold across the stories, characters, and settings" (Polkinghorne, 1995, p. 12). During this paradigmatic analysis of narratives, the goal was to locate "common themes or conceptual manifestations among the stories collected as data" by using several stories rather than a single one (1995, p. 13).

In order to locate common themes across all stories, I used thematic analysis as outlined by Clarke and Braun (2014). According to these authors, "a good thematic analysis involves more than simply reporting what is in the data; it involves telling an interpretive story about the data in relation to a research question" (Clarke & Braun, 2014, p. 6626). Their approach to thematic analysis follows an iterative six-phase process: a) familiarizing yourself with the data and identifying items of potential interest, b) generating initial codes, c) searching for themes, d) reviewing potential themes, e) defining and naming themes, and f) producing the report.

Familiarizing myself with the data

For this study, data analysis occurred concurrently with data collection and during the write-up of findings (Creswell, 2013; Creswell, 2014; Merriam, 2009). For example, interviews were transcribed verbatim and then reviewed within 24 hours of the interview. During the initial reading of each interview, my preliminary analytical approach was to mark particular passages or comments provided by each participant that warranted further clarification. As such, I wrote clarifying questions that I asked the participant during the second interview. I also provided each participant with their own interview transcripts as well as the final written counter-stories as a means of member validation (Seale, 1999). The participants were asked to record changes (e.g. additions, elaborations, and contradictions) using the Word tool to track changes. All participants stated that the

transcripts were accurate and there were no significant changes to the content. One participant recognized that in the transcript his real name was listed and I immediately changed this to his pseudonym. All participants were given a copy of the final narratives and all were thrilled with the outcome and the representation of their stories.

Generating initial codes

During my third reading of the transcripts and narratives, I began "pre-coding" my data, a process that Saldaña (2015) describes as "circling, highlighting, bolding, underlining, or coloring rich or significant participant quotes or passages" (p.19). These subsequent readings provided opportunities to pay closer attention to the transcripts, and to begin identifying potential concept words, that were later used to create code words which then led to the eventual creation of themes (LaRossa, 2005). My initial coding followed Charmaz' tradition of line-by-line coding, using gerunds to capture the action represented in the data (Charmaz, 2008). These emergent in-vivo codes were documented in the margins of, and throughout the transcript texts (Elo & Kyngas, 2008; Graneheim & Lundman, 2004). This line-by-line coding constituted the first phase of coding, known as open coding (Charmaz, 2008).

Generating themes

With each subsequent reading, my notes and codes began moving away from specifics and toward a wider focus of meaning patterned across a dataset (Braun & Clarke, 2014). Once the data was coded, I set it aside for a few days so that I would be reading it with a fresh set of eyes the next time. I then read through the data as well as the codes and started to link common codes together, even if the wording was not exactly alike. I began to think of categories that would tie these codes together and to think of

themes that the categories would fit into. Eventually, I came up with the following categories from my coded data: strategies for STEM success; gender expectations; past experiences affecting future behaviors; negative impacts due to sexuality; identity; heteronormativity and homophobia; heterosexism; representation; and strategies used to "pass" or "cover" as being straight.

To visually see these categories and the subsequent supporting data, I created a large square push board and sectioned it into 9 equal squares. The squares were labeled with each of the 9 categories mentioned above. Once I sectioned these squares, I printed additional copies of the interviews and written narratives and cut out segments of the data that fit into each category. In several instances, there were data extracts that required being placed in more than one category. To streamline this, I focused more intently on defining the categories and eventually collapsed several of these categories to create singular themes that were much broader and more clearly defined.

Reviewing potential themes

At this juncture in the data analysis Braun and Clarke (2014) suggest checking the themes to assess whether they work in relation to the coded data as well as the complete dataset. I did this with the dataset from each participant individually and then across all participants.

Defining and naming themes

During this phase of thematic analysis, I was tasked with producing detailed definitions of each theme that captured not only their essence but also described how these themes were interrelated. The three major themes that were identified during this study included: a) multiple social identities, b) pervading heteronormativity in society,

and c) issues of heterosexism. Braun and Clarke (2014) also suggest naming each theme with informative, yet engaging tag lines that capture the crux of the theme. Using the data and the literature, as well as my own thoughts, I developed the following named themes:

- Having Multiple Social Identities Has Negative Implications for My Emotional, Social, and Educational Selves

- My Behavior in STEM is Dictated by Heteronormative Expectations

- How Heterosexism Acts as a Barrier to STEM Access: It Pays to Be Straight

In instances where there were difficulties pertaining to coding clarity, inconsistent codes, or other coding difficulties, I had discussions with my major professors to help elucidate and guide the nuanced process. In addition to this analytical method, additional memos and journal notes were written to further document the process and aide me in better understanding, connecting, and tracing the analytical process (Saldana, 2015).

Representation of Data

Investigators collect many stories and inductively create conceptual groupings from the data. Connelly and Clandinin (2006) wrote that narrative inquirers in their writing need to "reflect the temporal unfolding of people, places, and things within the inquiry, the personal and social aspects of inquirer's and participants' lives, and the places in the inquiry" (p. 485). Borrowing from the work of Pushor (2001), the hope is that this form of representing the text will "connect the personal of each moment to the larger social and research context" that illuminates the experiences of gay men in STEM classrooms.

To achieve this, I exemplified and elaborated each of the major themes by combining verbatim text from each individual participant's story to create cohesive counter-stories. The counter-stories allowed me to reveal my participants' experiences with and responses to heterosexism and heteronormativity in their respective STEM environments. (Solorzano & Yosso, 2002). According to Solorzano and Yosso (2002). The use of counter-stories is a method of telling stories of people whose experiences are not often told; of documenting the stories of those individuals on the margins of society. Considering the paucity of research discussed in Chapter Two, gay men, specifically those in STEM fields, have not had their stories and experiences told.

Creating counter-stories was the best way to represent my data because mainstream, or majoritarian stories generate from a legacy of privilege and often downplay the impact of heteronormativity and heterosexism on sexual minority students. These majoritarian stories, or grand narratives, create stories about meritocracy and equal opportunity (Yosso, 2005) while ignoring the significance of sexuality and gender norms prevalent in STEM. Solorzano and Yosso (2002) explained that a majoritarian story distorts and silences the experiences of people of color. I find that this silencing can also be applied to the experiences of gay men and it is the reason I chose to represent my data in this format.

This turn to a more artistic and creative form of data representation is a response to the: a) "perceived crisis of representation in qualitative research and the inadequacies of the traditional scientific research report to faithfully and fairly represent the lives of research participants; b) growing rapprochement between the methods and imperatives of the social sciences and humanities; c) desire to evoke more feeling (as opposed to purely

cognitive) understandings; and d) desire to provoke action for social change rather than simply to report results" (Sandelowski, Trimble, Woodard, & Barroso, 2006, p. 1354). Therefore, rather than representing my findings via a linear report, I chose to use counter-stories in hopes of "delivering facts in ways that move the reader toward a deeper understanding of a topic" while "capturing or describing a subject so that the most resistant reader will be interested in learning more about it" (Caulley, 2008, p. 427).

To assist in writing these counter-stories, I created composite characters that are grounded in real-life experiences solicited from the empirical data and are contextualized in social situations that are also grounded in real-life (Solorzano & Yosso, 2002). These composite characters were fashioned using the analyzed findings from the interviews, photo-feedback, and photo-elicitation techniques used in this dissertation research. Each composite character is a compilation of the data collected across all participants for each individual theme. This resulted in the creation of counter-stories written using the dramatic method; described as scenes of showing instead of telling (Caulley, 2008). In each counter-story, I used the analyzed data to create a scene starring a composite character and a second individual (me as the researcher) from my perspective.

An important notation to make is that while I am using the literary strategies suggested by Caulley (2008) to create the counter-stories as described above, I am not using creative non-fiction as my data representation because all elements in this form of writing need to be accurate. My use of composite characters to tell counter-stories creates an element of fiction that Banks and Banks (1998) suggested is an appropriate method whenever the aim of the research is to evoke in audiences a feel for the subjective experiences of others.

Quality of Study and Trustworthiness

Connelly and Clandinin (1990) argued that narratives should rely less on criteria for validity, reliability, and generalizability but should be more concerned with concepts of apparency and verisimilitude. Verisimilitude is described by Polkinghorne (2005) as "the appearance or likelihood that something is or could be true or real" (p. 5). Verisimilitude, in Polkinghorne's view, is more important than verification of proof since the goal of narrative studies is to understand rather than to gain facts or information. Connelly and Clandinin (1990) added to this in writing that narrative truth shows in an account in which a reader might say, "I can see that happening" (p. 8). Apparency on the other hand is considered in terms of how the reader makes sense of the details and the degree of recognition of someone's life (France, 2010).

In addition, Polkinghorne (2005) argued that there are aspects of social sciences, including research using a narrative inquiry methodology, that do not fall within the limitations of what has been considered evidence and proof. Narrative inquirers are among the researchers who believe that descriptions of life experiences provide knowledge and understanding of human lives in ways that other research approaches cannot achieve. Claims about understanding human behaviors are possible only through the reflective stories shared in the teller's own language. Narrative research is therefore conducted in order for the researcher to "say something to readers about the human condition" (p. 6). Stories are about personal meanings and not the actual facts of the events. Clandinin and Connelly (2000) supported this in writing that the distinction between fact and fiction is often muddled in narrative inquiry. The final narrative account is but one possible representation of a multitude, storied through a joint

collaborative process between researcher and participant (Patsiopoulos & Buchanan, 2011).

Ethical Considerations

In addition to standard research procedures, researchers using narrative inquiry as a methodology must also consider the relational aspects of this type of study. Narrative inquirers have a responsibility to move beyond the institutional narrative of "do no harm" by learning an attitude of empathic listening, by not being judgmental and by suspending their disbelief (Clandinin & Murphy, 2009, p. 647) as they attend to participants' stories. Narrative researchers are also tasked with using their research to enact social change (Clandinin, Pushor, & Orr, 2007). In this instance, my work will not be completed with the publishing of this dissertation but will continue as I work to create social actions that break away barriers gay men face when attempting to navigate STEM classrooms and careers.

Conclusion of Chapter

In Chapter Three, I provided an account of the rationale for the study. I also conveyed the purpose of the study as well as the research questions that I aimed to answer. In hopes of answering the research questions, I described the intentionality of a qualitative research design and a narrative inquiry methodology for this purpose. Chapter Three also provided a descriptive review of the methods I used for participant recruitment, data collection, data analysis, and data representation. Participant descriptions are included as well. I ended Chapter Three describing my means of data representation, the ethical considerations necessary when doing a narrative inquiry, and ways to ensure the quality of my study.

    In Chapter Four, I participated in the restorying process by using the lived experiences of the participants to explore the three major themes created during analysis of the data corpus.

CHAPTER FOUR

FINDINGS

Introduction

The previous chapters set the stage for presenting this narrative inquiry examining

the impact heteronormativity and heterosexism have on the ability of gay men to

successfully border cross into the world of canonical science, including the detailed

methodology used to examine the lived experiences of four unique STEM students. The

data analysis previously described in Chapter Three resulted in the development of the

following three themes: a) how heterosexism acts as a barrier to STEM access: it pays to

be straight; b) having multiple social identities has negative implications for my

emotional, social and educational selves, and c) my behavior in STEM is dictated by

heteronormative expectations. This chapter utilizes the data from interviews, photo-

feedback- and photo-elicitation to answer the research questions of interest to this study

through counter-stories that are organized and discussed under their respective themes.

To fully represent the experiences of the four participants, I represent their stories

through the creation of counter-stories and composite characters, Michael and Neal, as

described in Chapter 3. Finally, the chapter is summarized and I present a preview of

Chapter Five.

Before telling the counter-stories, it is essential to provide a description of my

own positionality during data collection and writing of the counter-stories. Drawing on

the writings of Preissle and deMarrais (2011), I positioned myself as a responsive

researcher, one "who watches and listens to those studied, and changes research questions and topics according to participant interpretations and meanings" (p. 32). I was a responsive researcher at several moments as evidenced in my data collection with participants. Instead of following a strict interview protocol, I asked questions of my participants based on our conversations and the topics the participants described. Additionally, responsiveness refers to an "interaction between researcher and research participant that generates the information or data sought and where knowledge flows both ways between researcher and participant where the researcher is in the midst of the research process" (Preissle & deMarrais, 2011, p. 32). Instead of being a passive observer, I was an active participant in the research as I shared my own experiences as a gay student in STEM and provided participants with relevant literature to read. I found that the combination of being a member of the gay community *and* openly sharing my own experiences gave participants a sense of comfort and allowed them to unequivocally speak their mind without fear of repercussion or judgment. In the counter-stories my attempt is to make sure that the voices, experiences, and struggles of my participants are at the forefront. However, I also provide commentary throughout the counter-stories of my interpretations of what my participants are saying and at times what they are not saying based on their body language, vocal tones, and pauses. At times I also include in the counter-stories instances where the participants response caused me to reflect upon my own experiences.

Composite Characters

Michael is a self-professed "nerd" and "lover of learning". He feels like the most exciting thing about being in the STEM field is the challenge that there is "always

something new to learn, especially with science; things are forever changing". A 23-year-old doctoral student in engineering at Southern State University, Michael shared with me his thoughts on being a gay student in a variety of STEM spaces. These spaces are inclusive of the classroom, laboratory, and internships; and as told in one counter-story, these experiences bleed over into his lived-world. In the following counter-stories where Michael is the main character, we are sitting in Starbucks engaged in a conversation exploring his stories as they relate to intersecting experiences of being both a gay male and a STEM student.

Neal is a 26-year-old, first year PhD student in computation sciences and engineering at the University of the Southeast. He has made it abundantly clear in our conversation that he prefers teaching over research and when he finishes his doctoral degree he wants to be an academic. In the counter-stories where Neal is the main character, we are sitting in my office at his request. As a closeted student, he is very particular that we meet in my office late at night, fearing that being seen with me would "out" him or cause suspicion.

Counter-Stories

Theme 1: How Heterosexism Acts as a Barrier to STEM Access: It Pays to Be Straight

In the following counter-stories the focus is on how heterosexism acts as a barrier for gay students wanting to pursue STEM related majors and careers. Heterosexism as defined in Chapter 2 is the privileging of heterosexuality and both the implicit and explicit accumulation of negative outcomes for gay men. There are two counter-stories, one centering on Michael and the other featuring Neal.

Michael: Where Have All the Gays Gone?

In this counter-story, Michael and I broached the following categorical topics related to the theme: a) lack of representation of people who share your sexual minority status; b) lack of a mentor who shares your sexual minority status; c) having a fear of how others would react to or treat you as a person and as a researcher if sexual minority status were made public; d) being uncomfortable living in your own skin; e) concerns over job security and career trajectories; and e) the need to constantly prove your worth by becoming indispensable in order to be viewed as an equal to heterosexual counterparts.

As we begin our conversation, Michael and I share a few laughs about our love lives and then gossip about television personalities and a few people we find attractive in Starbucks. We both notice the same tall, dark-haired guy and give each other a look.

"Do you think he's gay?" I ask.

"Yeah definitely", Michael replies with a smirk on his face.

"How do you know?" I replied quickly.

Smiling coyly, Michael replied, "He is wearing a rainbow bracelet."

I definitely missed the rainbow bracelet, a symbol of the gay community, when I first looked. I knew that we could continue this conversation and spend hours just talking about people and scoping out guys, but I also knew I needed to get my research questions answered. So I seized the moment.

"But do you think he is in the STEM field?", I quickly asked as a follow up to his response, hoping to get the conversation steered towards my research goals without really having to stick to a prescribed script. Michael stopped, looked back at the guy, then back at me, then back at the guy.

"No, not at all." It was to the point and succinct, no elaboration whatsoever. I waited a second hoping he was going to continue, but he never did.

Curiously, I asked, "Why so certain?"

"How many people do you know in STEM that are gay?" he asked pointedly. It was a valid question. Honestly, I did not know anyone that was gay and in STEM and that bothered me. I quickly lobbed the question back to him.

"None, what about you?"

"I think it's just that, I think it's not that they don't exist, I just don't think they are actively out. They're just hiding their sexual orientation. Actually, I don't know any openly gay men in STEM. In like administrative roles or people who run labs. I don't even know of any professors who are gay. If they are, they don't talk about it and it's not something they advertise. It's not like I've ever had any classes and had a teacher or professor say they're gay and definitely none that took the time to point out the contributions a gay person has ever made to STEM."

That was true. I've been that teacher to point out the contributions that women have made, or African Americans have made to the advancement of our scientific understandings. But I had never gone out of my way to talk about the contributions gay men have made. Do I even know any? Sadly, I don't.

"And maybe they're kind of feeling pressure by the discipline not to talk about it and so they don't talk about it for the same reasons I don't share my sexual orientation with people." Michael continued quickly, as if he had been thinking about this for quite some time.

"Do you think that there are gay men in science that do good scientific work?" The words came rushing out of my mouth.

Michael, paused, looked at me in amazement, "Yes of course, but I can't name a single one. They're just hiding their sexual orientation because STEM is more of a conservative field. But I can't say that I blame them, they're just pressured to remain quiet."

"Who's doing the pressuring", I asked, loving the conversation we were having.

Without hesitation, Michael jumped in to his response, "Well actually just being in STEM. I think the field tells you that when you come to science you leave everything else on the outside. And when you're there you're only a representation of your field and your research. And it's almost in a way, the field is dehumanizing because you're just stripped down to what you know and what you can do and your publications and your research and your program. And if there's this inkling of your personal life popping up, it's a no-no, especially something as taboo as sexual orientation."

"How so?" I asked half-heartedly.

"Because people look at you differently when they find out that you are gay. It's just more of a hush, hush thing, it's just not comfortably or openly talked about. And I mean certain fields just embrace diversity more than others. I think if someone all of a sudden, if someone has done all this cutting-edge research in their field and they're a pioneer. And then it comes out that they're gay, I feel like it almost kind of essentially erases everything they've done as far as research in their field because now all people will focus on is the fact that they're gay. They'll only focus on their sexual orientation and it takes away from their prestige as a scientist and as a researcher and as an academic. And I think that's unfair. And people know that it's a possibility and so I feel like that stops a lot of people from being open about their sexual orientation." Michael was on a roll. I could tell that he had given this a lot of thought because he was in this predicament as a doctoral student.

I countered, "But the argument is that anyone who can do science will be able to find success in the field."

"Well I don't think there is anything about my sexual orientation that impacts whether I can do science or not, but I do think there are structures in play in our society that try and prevent me from doing it well. It might not impact whether I can do science, but my sexuality can impact how people perceive the science that I do," was Michael's hurried response. I felt like I couldn't get a word in edge-wise. He was dominating the conversation, but isn't this what a good research interview looks like? I was going to let him continue getting this off his chest with minimal interruption.

"But even if all the people in STEM who were gay came out, I still feel like there wouldn't be a lot of us. I don't know the reason but I think a lot of, I mean I feel like there's this idea that a gay male shouldn't, I guess it's like they shouldn't be working in a lab or doing science. They should be doing, I don't know, things that are less difficult or less strenuous. So maybe most gay guys have bought into that. And they've decided to do things that are artistic, like be an interior designer or work in the theatre because that's what they always see gay guys doing. Oh, or maybe be a nurse or a teacher, no offense".

"LOL, none taken." I knew he was talking about the stereotype of the roles gay men play in our society and not trying to be offensive. But in the back of my head I started thinking about how gay men are portrayed in society, on television and in the movies. For a brief moment, I was awash in anger. I didn't realize that doing this research would cause this much emotion. I was lost in my own thoughts when I heard Michael continue with his.

"I guess it's just this idea of representation. It's the same as with gender and race. It definitely makes it a little more difficult in terms of navigating, because essentially, I'm left to my own devices when it comes to figuring this all out. You know, just being a gay male in STEM and understanding how I fit in. I've always wished I had a professor or an advisor that was also gay. Don't get me wrong, I've had two female professors in my undergraduate degree who knew I was gay, and they were really supportive, but at the

same time their experiences weren't the same as mine or even similar really. And it would be great just to have that role model that I can look up to because we share this similarity and they're successful in the field and so it's makes me realize that it's at least possible for me to be successful too. Not having someone who looks like you and represents your identity in your field makes it hard to see yourself being successful in that field."

Michael stopped talking. I'm not exactly sure how much time passed before I realized this. He had been talking so rapidly and constantly that I just expected him to keep talking. I definitely knew the struggle he was facing trying to find a mentor that shared his sexuality. And I agreed that not having a mentor made life a little more difficult when trying to navigate straight spaces. You never know who is an ally and what is expected of you; what you can and cannot say or do. I kept hearing him talk about closeted gay men in STEM and how they felt pressured to remain closeted due to an array of fears. It was a lot to take in.

Finally, I composed myself and asked, "Are there any other reasons you can think of as to why gay men in STEM stay closeted?"

"Job security!" he bellowed. The people sitting next to us looked over as if he had made some otherworldly noise. Michael noticed too. Lowering his voice to barely above a whisper he said, "I'm sure they're concerned about keeping their jobs. I know it's something that I think about, especially now as I'm doing internships and thinking about whether or not to go into academia or industry."

I knew where he was going with this. I have often had those same fears in my own career and the fear can be paralyzing. It's partially the main reason I chose to move to a major metropolitan city. Being a gay person out in rural areas is difficult, being gay AND a teacher is damn near impossible to pull off. Having grown up in a rural area, I know how people felt about gay people; their ideology was well known and well established.

"What specific concerns do you have with job security in the future?" I asked him just to see how closely aligned my fears were with his.

Michael looked up, his facial expression more somber. "Everything. I worry about it all. If I become a consultant and I meet a potential client for the first time and they're not comfortable working with a gay person, I don't get the job. Or if I do get a job in industry but maybe the company needed to cut employees or lay some people off or something. Umm, I feel like I could possibly be a little more disposable if I were openly gay. I mean it would depend on the company and the management but I could be a little more disposable even if my work ethic and what I've contributed to the company was better than someone who was heterosexual, I feel like I would be a little more disposable than they would be".

"So, is it just about keeping the job?" I pried.

"Well even getting the job might be more difficult too. I guess I would have to try and pass as straight during the interview. And too, that's part of the reason I decided to do this PhD. My goal is to have such a level of expertise that I'm kind of invaluable. And so that's where I'm trying to position myself, so that the knowledge I bring and the work I do is more important than my sexuality. And then I feel like I would have to put a lot more time in to work in different areas, just work harder and enhance other aspects of myself as an employee so I can keep my job or get that promotion. I think sometimes when people come out, they feel like they have something to prove so I know a lot of gay people in professional settings who go above and beyond. It's like you have to work twice as hard to show that you're just as good as someone who's straight."

"That doesn't seem fair", I said rhetorically.

Michael had a half smirk come across his face for a second, and then seriously said, "Life is not fair, isn't that what people say all of the time? And it's even less fair for gay people. I think that the unequal treatment might be why gay guys in STEM aren't out and probably a big reason why some stay away from the field and end up going in to careers and majors where they won't have as many negative experiences. And for some guys who are out, the actual process of coming out was so monumental that they feel like they've accomplished enough, so they choose not to go into other challenging fields. But I like the challenge and I'm determined to prove that I can succeed regardless of the barriers in front of me."

Neal: Is It Professionalism or Silencing?

In this counter-story with Neal, he described his decision to remain closeted to his classmates and professors as a combination of attempting to remain professional and also an attempt to avoid homophobic treatment from other classmates. By the end of the counter-story Neal began to see major differences in his professional behavior and the professional behavior of his straight classmates. He also described the treatment of an openly gay student from his courses as an undergraduate student pursuing a degree in Computer Science.

"I don't really discuss any personal life in the workplace," Neal responded when I asked him how out he was to his professors or classmates.

I felt like I was asking a rhetorical question, but I wanted to get his response just to confirm what I suspected. "How come?"

"I don't think it's appropriate to discuss your sexuality in a professional setting because your personal life and professional life should not overlap. And I think probably I'm scared a little. You know in my position as a student, I'm competing for resources and the faculty. And I want them to like me and look up to me as much as possible and I don't know what their personal views are about gay people. In the worst case I think they might not want to work with me in the future, but I don't really know, so I just stay closeted."

It was a matter-of-fact response. "So, you just try passing as being straight?" I asked. Again, rhetorical question but I was trying to get Neal to open up and describe his experience on a deeper level and to see inequalities he was facing, even if he wasn't consciously aware of them.

"Yeah of course. I mean I'm pretty masculine and I've become comfortable compartmentalizing different aspects of my life and not letting them overlap. Everyone is not as able to easily conform, but I am, and I choose to conform to other people's views of how I ought to behave. I guess I'm willing to silence part of myself so I could be treated as an equal. If you want to live out loud you have to accept the fact that you are less likely to be treated fairly and less likely to get the same level of access. It's a shitty choice you have to make".

"How are gay guys who don't choose to conform treated?" was my next question.

"Actually, there was a guy in my undergraduate courses that was pretty much out. He was openly gay, pretty, I wouldn't say flamboyant but he was, vibrant. He colored his hair a lot of different bright colors and had different piercings and stuff. So, it was kind of evident that he was gay if you think of typical stereotypes."

I wasn't as "vibrant" as Neal's description of his classmate when I was in school, but I was openly gay and I remember how people treated me as a peer. It wasn't pleasant and it was the biggest reason why I didn't want to pursue a career in STEM. This was especially true because I was extremely insecure about my sexuality due to being raised in a devout southern, Christian home. In dealing with my own insecurities and the way I was treated by my peers and some professors, I had a natural inclination to try and avoid these situations. I can only assume that there are other gay guys who have felt this exact feeling and have chosen to leave the field or not enter it at all because of these perceptions. I needed to move on with understanding how Neal experienced and understood his STEM courses as a gay man. "And how did he fit in, or how was he treated?" was the only response I could think of at this moment.

Neal looked up, "He was pretty isolated. In computer science, you kind of go through the core classes as a cohort and so the majority of us had several courses together and during that time I never once saw anyone try to include him in their groups. I was guilty too. I didn't want to be gay by association so I avoided him at all costs. But he always

would sit by himself and like I said, no one ever made an effort to include him in their groups."

"Do you think he isolated himself or was isolated by the group?" I suspected it was a mixture of both.

"No one ever talked to him. My computer science courses were about 80% guys and so probably none of them wanted to be gay by association either. I wouldn't say that the guys made direct comments to him, but they would say things like, "Oh that's gay, or stop being so gay" if someone did something stupid or one of their friends would do something they felt was feminine. And of course, there were several times someone would say something about fags. They would say it loud enough so that everyone in the class heard it, so he might have purposefully avoided these interactions as much as the straight guys avoided him."

"Did hearing these words and comments from your peers affect you", I asked.

"Yeah it can be extremely distracting. Even though no one knows I'm gay, just the fear or people talking about you can be overwhelming emotionally. Especially in class when you think you're in a safe space. Just knowing that these are people who I have to go to school with, work with, and might someday be my boss, it just can be too much at times. Some days it makes me question is it worth it to even stay in the field," was Neal's somber response.

"Did you ever speak up or speak out against when you heard these comments?"

"I was just trying to make my grades and do what I had to do to be successful. Just wanted to keep my personal life separate from what I was doing at school. I told you I'm still pretty much like that. I don't really give anyone any indication about my sexual orientation. I just don't think it goes over very well, being gay in the south, and majoring in a very conservative field dominated by straight, white men. So just to try and fit in, I pretend to be straight."

"I'm trying to understand what being straight looks like in the classroom or when you're working in the lab," I followed up.

Looking confused, Neal asks, "What do you mean? I'm not sure that I follow."

"Well I assume that you work side by side with the same people on a daily basis. What do you talk about?"

"Oh, well we talk about school and our work assignments mostly. Sometimes we talk about sports or where we are trying to intern and companies that are hiring," Neal responded, still unsure of where I was leading him.

"And there's never a time when the conversation steers towards your personal life, or theirs for that matter?" I asked, keenly aware that this was the question I was hoping would start to provide me with what I really wanted to know.

He smiled, "Yeah of course. I just lie. When you're in a lab with somebody and you're working with them daily, eventually you start to build a relationship or friendship with them. I don't usually do much talking, just listening. I guess there's a certain level of banter that is to be expected between people who work so closely. I just don't feel comfortable sharing to the same degree that the other people do."

Eager to continue, I asked, "So the straight guys in your classes and lab settings share personal information about their lives?"

"Absolutely!" Neal responded. "Straight people do not have a hard time talking about and sharing every detail of their life. They talk about their girlfriends, their dogs, their wives, who they're smashing. For example, about three days ago, I was looking at some pictures of a Formula One race with one of the guys who works in my lab. He was showing me pictures of the festivities on the streets and he's scrolls through the pictures until he sees what he calls a "racer girl". Now this "racer girl" is dressed in tight, provocative clothing and she's walking around serving shots and beers. So, he taps on this picture and zooms in on her breasts, and says, "Now those are the kind of titties you can motorboat for hours". And I didn't say anything. It's like this macho, mano y mano joking with me. It's just that he presumes me to be straight and he was kind of like objectifying women in my presence."

"And what would have happened if you made a similar comment about wanting to do something sexual with a guy in the photo?"

"Oh, wow. Well I'm a pretty muscular guy so I don't think he would have tried to fight me. I'm not sure how he would have responded, probably said something about not being "gay" around him. Case-in-point, a few weeks ago, we had all worked late on a project and decided to go grab some food, so we called an Uber. So, this same guy started talking to the Uber driver and at dinner one of the other people in the lab asked him if he had developed a bromance with the Uber driver. And he responds, "Don't talk about that gay shit around me, you know I don't like fags" and so what do you say to that? I didn't really know what to say and I didn't think it was worth fighting about so I just let it go. But it just reinforced that I shouldn't bring my personal life to class or laboratory".

Feeling another sensation of anger rush over me, I scolded, "So, it seems pretty clear to me that you're the only person in this setting who feels like remaining professional means you shouldn't talk about your personal life. You're the only person who feels this way because the other guys are straight and their heterosexuality allows them to be very comfortable discussing whatever they want. It just pisses me off that we've been put in a

box so if we bring it up we're being unprofessional but if they bring it up, it's just normal guy talk".

Knowing that I was a little angry, Neal looking for a way to calm me says, "I guess I just kind of filed it away mentally as normal, but now I'm realizing that it's not. I had always thought to myself that it would be inappropriate for me to talk about my personal life, but in actuality my straight counterparts are doing it all of the time. In the back of my mind I just always rationalized that as normal behavior, but you're right that people shouldn't have to do this. I guess it's just being a part of the majority, they don't really see how their actions are inappropriate or offensive to others."

Theme 2: Having Multiple Social Identities Has Negative Implications for My Emotional, Social, and Educational Selves

Michael: The Struggle is Real

The dialogue of the conversation that ensues suggests that Michael is having a difficult time navigating the gendered expectations of his field with the social expectations placed on him by his friends. Michael described several of the tensions he is facing and how these tensions are impacting him socially, emotionally, and educationally due to feeling he has to behave differently dependent upon his surroundings. Some of the tensions included in this counter-story include: a) emotional and mental stress of attempting to pass as straight; b) stress of coming out in social and academic environments; c) stress of constantly policing your behaviors, and d) not having a support system of peers to work with on school problems.

"I wish I could be more like you, be out and not worry about it", Michael whispered as he looked out the window into the distance. He sounded almost to the point of exasperation.

"Why can't you? You're a fun-loving person, you're smart, people will like you no matter what. And if they don't then they don't matter", I stated emphatically.

"Yeah that's easy for you to say. Engineering is a different beast. In high school when I came out, it almost caused me to have a nervous breakdown. Most of my friends, especially my guy friends started acting strange. I was on the track team and the guys

didn't want to get undressed with me in there. Just the entire vibe started being very, very different with people I had grown up with. It wasn't a very comfortable feeling. And now I don't want to have to go through that again".

Michael seemed to be on edge. He seems to be obsessing over whether or not to tell his classmates and professors that he is gay. I sipped my caramel macchiato and let him continue talking, watching as he hurried through his thoughts.

"And my friends who I had grown up with my entire life, were like, "Oh my God he's gay and we can't be friends with gay people!" And my mom was the same way, she didn't take it very well at all. She kicked me out of the house for a few weeks. So, I always think that if my best friends and my own mother can treat me so cruelly because of my sexual orientation, what's to say that strangers won't do the same. So here I am, trying to hide who I am; avoiding questions about my social life and lowering my voice to try and pass as straight".

I almost spit out my coffee. Michael as straight? Now that's something I would pay to see. Not because I think it's funny for people to pretend to be something they're not, but because Michael is by all stereotypical accounts obviously gay. I could tell from the look of worry on his face that he was genuinely concerned. "Why are you so concerned about attempting to pass as straight at this point in your schooling?" I asked - not fully understanding why now as a doctoral student this would be consuming his thoughts.

"I got a TA position for next semester", Michael replied with the assumption that I would connect the dots.

"Oh, wow that's awesome. You'll be great!" I was desperately trying to lighten the mood and brighten his outlook.

But the fear in Michael's eyes told another story. "What if they find out?" he hurriedly asked.

"Who, what?" I asked. I wasn't sure where he was going with this conversation.

"My students. What if they can tell I'm gay? I mean I talk with my hands, I'm very excitable, and I'm full of energy when I start talking about science. And I know that being a little too overly animated is looked at as quote unquote gay behavior. I'm constantly worried about whether or not they're going to think that I'm gay if I do this, or if I do that; am I dressed too gay", he explains.

"So what!" I stated emphatically.

"I don't want my sexual preference to take away from my credibility and negatively impact my students." His gaze was intense and captivating when he said, "I'm an engineering student and it's mentally exhausting to put on this charade every day,

constantly having to think about what you're going to do next and how people are going to perceive your actions. Here I am working on being something and someone I'm not, just because of the negative experiences I've had in the past. I'm putting all this energy into something that I shouldn't have to waste energy on, just to please people in the classroom. And they don't even know about this internal struggle that's going on. And it just interferes with other parts of your life. I could dedicate this energy and time to different areas of growing personally, instead of trying to become more heteronormal (sic). I could focus on different smaller details that actually matter to me, I could make changes in my life that are beneficial and I actually want to make."

I was beginning to understand his anxiety more and more. He was on the verge of tears and for a moment, I could feel his pain. It wasn't the pain of heartbreak or the pain of losing a family member, but a pain from deep within. It was the pain of seeking a place to fit in, a place where he could just be himself. It was the pain of a man who wanted people to see him for his merits and not for his sexuality. As a gay man in today's society, I felt his pain. I felt his pain because I too had been in a similar situation and he just made me revisit a painful experience.

"Michael, I understand your situation all too well. When I first started teaching, I taught middle school and I was terrified that a student would find out about my sexuality and there would be issues I wasn't prepared to deal with. So, every day on my way to work, I would practice talking deeper than normal, using a very monotone approach to speaking. I made myself so boring and blah. It was two of the worst years of my life. But that was ten years ago and I was teaching middle school students. Things have changed and you're teaching undergraduate students so you should be okay to be yourself, right?" I was hoping that he could see the logic in my response. Certainly, we had progressed as a society.

We sat in silence for a few minutes, both of us contemplating the significance of what was just said. Michael looked up, took a sip of coffee, blew out his breath, almost as in despair, and almost as if a heavy weight had been lifted from his shoulders by sharing his concerns. Again silence. We sat like this, him twiddling his fingers and playing with his fidget spinner, and me staring at my phone waiting for a response for what seemed like ten minutes. Finally, he stated matter of fact like, "I'll just do what I can to keep my personal life separate from my professional life. I'll butch it up, express a more masculine presentation. I feel like it's becoming a normal practice. I'll deepen my voice a little, make sure I'm not drawing out my vowels or other syllables. Try and watch what I do with my hands and how I'm walking."

Saddened by his response I asked, "Are you serious? You're seriously going to keep this up when you just told me how much stress it adds to your life?"

"Yeah of course. When I'm in straight spaces, I feel like I have to fake the funk. I become very self-aware. And it's become a normal thing for me, it's like code switching. You have to police yourself and your actions. And engineering is definitely a straight

space. I feel like the field is normalized as masculine, you're not supposed to be too emotional, either positive or negative; things like that. Femininity is not allowed, expected, or accepted. So I have to watch how I act and how I talk; even what I do. You have to focus on procedures and equations. You're not supposed to bring your personal life into the classroom or the lab you know," he explains the rules of engineering in short, hastened murmurs. "It's like having to go back into the closet every single day."

I couldn't tell if it was the fact that we were in Starbucks and he was trying to be respectful of the people around us; or if it was the subject matter that was making him talk so quietly. However, this was definitely not the Michael that I had talked to about participating in the study. That Michael was boisterous and self-assured. For the first time during my interviews I felt uncomfortable, I felt like a researcher prying into someone's personal and private life. As if I were eavesdropping on a stranger's conversation.

Michael raised his head, began to speak in this deep, monotone voice as if he's practicing, "At school I've always just played really straight and been really guarded about my personal life. I've always just projected that masculine side more. If my classmates ask me about my weekend or if I have a girlfriend, I just lie or talk about my relationship but pretend my boyfriend is my girlfriend. It's liking having multiple identities. I'm one way at school and I'm another way with my friends. It helps that I keep my two environments completely separate too. My gay friends are the people I socialize with outside of school and on the weekends and my academic colleagues are not my friends, but people I see in class or in the lab. I don't have a blending of like personal and professional circles where the people you go to class with or work with are also your friends. It's not like it's been some in school and some not, my groups have always been mutually exclusive. Sometimes I feel like it would be easier to be successful if I had a group of academic friends that I could study with, you know people to work on problems with, etcetera. Especially in graduate school, you cannot work in a silo, you need different perspectives and feedback from people. But I don't really have that sense of community where I feel confident or comfortable working with them outside of class."

"How has that impacted your success as a STEM student?" was the only response I could think of at the moment.

"Well like I said, most of the time I work by myself because I don't really have that community of students who I relate to and I feel super friendly with so I'm fairly certain it has a negative impact. I see a group of people who get together and they work on problems and I know if I had that, it would make learning more meaningful. So I just know there's a negative impact by not having support and being isolated in your studies", was his reply.

I felt sorry for him. Sorry because of the internal struggle he was experiencing trying to fit in and be accepted, and empathetic because I knew all too well the struggle of trying

to be someone I was not. "Why do you stay in engineering if you feel like you have to have these multiple identities and you don't think you fit in?" I finally asked.

"I just love science and technology and math. Like they've always been my favorite subjects. Plus, STEM is the only thing that I find to be really relevant in today's world. I mean I guess not the only thing, but we're more of a technological world than anything else now, so I just want to contribute to that and kind of build on top of what we're already working towards," he responded excitedly. And for the first time during this conversation I saw this giddy little nerd glow and his eyes sparkle as he talked about his passion. "At the end of the day, I'm really good at it and I think I can make an impact on the world by following my passion".

Theme 3: My Behavior in STEM is Dictated by Heteronormative Expectations

The counter-story below focused on Neal's perception of: a) what aspects of STEM make it gendered, b) assumptions about who is and is not supposed to do STEM, and c) homophobic and stereotypical attitudes of some classmates. Although Neal has stated that he easily passes as straight and that he portrays masculine traits, he is still keenly aware of his place as a gay male in STEM spaces.

Neal: What Does a Scientist Look Like?

"Do you think it would be easier for you to be openly gay, say, if you were majoring in literature or public relations?" I asked him.

"Oh yeah probably. Literature, at least from my experience, you take this piece of text and you describe it through your lens, you add your perspectives. So your experience is kind of part of that discipline whereas in computer science and engineering, you know, no one cares about your experience or your perspective. It's about can you perform the next task. Are you going to be able to get this research published, or can you get this program to work? In STEM fields it just seems much more competitive, because I feel in general, in liberal arts fields three different people can look at the same results and could come interpret them differently and they all get publications out of it. But in STEM, if three people do the same experiment, they'll probably get the same results and only one publication is going to come out of it. It's a dog eat dog world and they don't care about your emotions, your problems, or your concerns. You have to leave all that at home so you can do your work objectively", Neal replied.

"That's interesting, so you think STEM is objective?" I interrupted.

Neal continued, barely noticing my interjection. "Like I said previously, STEM is perceived to be one of those masculine fields, something that men do. And we always talk about results being valid because numbers don't lie. So, it's this imaginary objective stance that we take. We're not supposed to be emotional. But I don't really see it that way. People are emotional about what they believe in and I think people study stuff that they are somehow attached to. I think they claim numbers don't lie, but in reality, I know people accept data that supports their thoughts and theories."

"Who says that STEM is objective and unemotional?" I was curious as to why he would say this.

"I mean I don't know everything about the evolution of STEM, science specifically. But ever since I can remember, my teachers have taught the scientific method and made us believe that doing science is as simple as following these prescribed steps. And if you think about the history of science it seems that it's something that men have done. Old white men. And actually that's still how it's perceived today. That science is something stuffy old straight white men do. I mean that's not necessarily true but it's how I perceive it. I mean there are just so many older white men, and they're probably all conservative."

"How do you think the number of older white men in STEM impacts the environment for minorities, especially women or gay guys?" I asked, finally able to sneak in a question as Neal stopped for air.

"In my experience, I have heard and seen men look down on women who are in STEM fields. Many men who have been in the field for a longer period of time seem to have this idea that women aren't nearly as capable of being a scientist as they are. With my classmates, I have noticed them talking over the women until the women don't speak anymore. It's like they expect them to be docile and quiet and submissive. The guys don't value their opinions as much as they value each other's. You gave me a picture of a bunch of scientists standing around looking at a piece of data, and it's all men and one woman. It's like a ten to one ratio. So, I can imagine that the men are sitting there thinking all these negative things about the woman. "Oh, is she qualified, or is she even smart enough to be here". Not that you can read that through their facial expressions, but it's been my experience in STEM. It's very male dominated and when women come into those spaces, I've seen those thoughts and attitudes arise," Neal answered while looking at one of the photographs I provided for photo-elicitation.

"But how does all of this impact gay men?" I followed up.

Neal contemplated his answer before giving it. He looked at the picture several times, finally saying, "Well I think one, gay men are bombarded all of the time with ideas about what they're supposed to be good at, like fashion or design. It's like anything that women are supposed to be good at, then gay men are told by society that they should be good at it too. It just feels like there's this underlying assumption that if you're in STEM,

then you're straight and the thought is that openly gay men can't do science or don't want to do science, which is so weird to me. And two, it's this stereotype that just because you are gay, you are also feminine. And in STEM, the norm is there should be no femininity. Sadly, too many of the people in my classes equate homosexuality with wanting to be a woman or with people who are extremely feminine. And for whatever reason the straight guys I have interacted with in my classes and labs have a lot of issues with anything remotely gay. It's like they either think that associating with gay guys will make others question their own sexuality or they just have some internal hatred for us."

These attitudes seemed entirely too familiar. I knew I decided not to continue to face them when I was a STEM student, but everyone does not react the same way. I wanted to know how these stances affected Neal. "How do these attitudes and behaviors impact you specifically?"

"Well, I told you that I don't talk about my sexuality or personal life in general, with my classmates. So, I guess I'm a little more guarded and probably self-aware, a little more in touch with how I should or shouldn't act, what I should or shouldn't say. I think about who I should be in the classroom," was Neal's solemn response.

"Do you think there would ever be a time to talk about your experiences as a gay male in any of your classes?" I quickly retorted.

Neal looked slightly confused, or maybe even slightly annoyed that I was asking this. "In the actual class? No, because I'm not out, and I mean the classes are a lot of writing codes and I don't see how it becomes part of the discussion. I think it's one thing if you're in a class that remotely dealt with that sort of stuff. You know political science kind of classes, where they are talking about policy. Or maybe even social work or social justice classes."

"But if you are writing code, and I know from a teacher's perspective, that I want my students to do things that are relevant to them and their lives. So, don't you think that you could possibly write codes or algorithms that address some pressing issue in the gay community?" I asked, wanting him to realize that real world issues are essential components of a great STEM education.

Before I could even finish the question, Neal responded, "No I wouldn't do that."

"But could you?" I retorted just as quickly.

"I guess I could if I wanted to out myself", Neal's replied sharply.

I could tell that this was going nowhere fast so I decided to switch gears. "Let's pretend that you were out, what would stop you from bringing this discussion to the classroom, or what would stop you from using computer science or engineering to address issues in the gay community?", I asked hoping that he would role play with me.

"I still probably wouldn't. I've never asked, but I assume everyone in my classes are straight. Even if I wanted to, I don't see where gay issues fit into computer science or engineering. This is mathematical and hands-on work. And I feel even if I were out I wouldn't want them to stereotype me. It's like my sexual orientation would erase other aspects of who I am as a student and a scientist. And if I'm looking at gay issues, they would think that was very typical of gay people. So, I wouldn't want to reinforce those stereotypes and do "gay" stuff.

"Gay stuff?" I asked.

"Yeah, you know, the gay agenda. People think you are pushing your ideas and sexuality on to them. And just people believing that we as gay people always have to talk about being gay, or talk about the gay community and us being oppressed or marginalized. You know people don't want to hear that. It makes them uncomfortable. Especially in STEM, where they pretend to be objective and think that if you're smart enough to do the work then there is nothing keeping you from doing it.

Not wanting to let this go I asked, "How do you think your classmates would respond?"

"Instead of being a respected scientist and being valued for what I bring to the field, the girls in class would probably be like, 'Oh Neal, you're gay, you should come help me pick out an outfit or help me choose some wine for my party. Or they would start asking me more and more questions about my social life and wanting to talk about guys. So instead of being a part of the science community of my peers, I'm the gay guy. It's like all of these microaggressions constantly coming. It would be annoying. I've encountered that in my personal life. The girls become super invested in wanting to ask all these questions about your personal life, and assume you want to be their new gay-best-friend."

"And what about the guys?" I inquired further.

"Well the guys would probably start treating me differently too. We talked earlier about them discussing their personal lives pretty openly, and I feel like they would feel weird doing that and probably stop interacting with me. I might be ostracized."

"That might not be such a bad idea, considering how you stated they over-indulge their personal business", I said half joking.

Neal laughed. It was the first time in a while that he seemed to be less on edge. "Yeah that probably wouldn't be so bad."

Answering the Research Questions

1. To what extent do gay men perceive the culture of STEM classrooms to be heteronormative?

In this study, the participants discussed several aspects of STEM classes they perceived as heteronormative in nature. The most obvious of these was the heteronormative assumption by classmates and professors that each of the participants were straight. None of the participants in this study were out to their classmates and each attempted to "pass" as straight. Participants felt this was necessary in order to maintain a professional identity, feeling that they should not mention their sexuality. In line with this, participants relayed the idea that society assumes all STEM professionals to be straight as well. Michael pointed out that not only did he not personally know any scientist who was gay, but also stated that he had never had any teachers or professors "point out the contributions a gay person has ever made to STEM". Neal stated that part of this assumption lies in the false stereotype that gay men want to do and are good at doing things that women stereotypically have done, such as fashion or design. He stated that this stems from the belief that if "you are gay, you are also feminine."

Each of the participants were also keenly aware that their STEM environments were less than tolerant when it came to expectations of gender expression. Very bluntly, Michael told me that "femininity is not allowed, expected, or accepted" in his STEM classes and that the focus was always on "procedures and equations." Additionally, Neal described how the masculinization of STEM fields was partly due to the field being "competitive" and being something "that men do" that is "objective" and "unemotional."

These descriptions of STEM are part of the binaries synonymous with a masculine world view.

2. How do gay men perceive the relationship between any heteronormative culture of STEM classrooms and their experiences within these classes/majors?

Heteronormative assumptions play a huge role in the experiences of all people, especially members of the LGBT community. In this study, my specific goal was to examine the impact heteronormativity has on gay men in specified STEM majors. Combining the belief that all individuals are straight with the genderized norms of STEM (i.e. objectivity and suspension of individual beliefs and biases), participants felt the need to downplay or hide their queer identity altogether. In the case of the participants in this study, each person used strategies to "pass" as straight. These strategies included lying about having a girlfriend and presenting a more masculine expression. Participants discussed the idea of masculinity in terms of using a deeper voice, avoiding talking excitedly or with their hands, and policing the way they talked and walked. According to Michael, one of the reasons he remained in the closet is because "the field tells you that when you come to science you leave everything else on the outside…and you're only a representation of your field and your research". Neal added that it was not "appropriate to talk about your sexuality in a professional setting because your personal life and professional life should not overlap". This self-policing and maintaining of dual identities required the gay men in my study to devote time and mental energy that they could use in other areas of their lives.

Additionally, heteronormative assumptions play a role in the production and reproduction of heterosexism. As previously described, heterosexism is the accumulation

of privileges assigned to heterosexual members of society. These privileges were manifested in a variety of ways in my participant's experiences in their respective STEM courses. Primarily, each participant repeatedly noted the lack of STEM professionals who represented their identity as a gay male. Although each participant echoed that they knew there had to be gay people in STEM, each of them made it clear that they did not specifically or personally know any gay professors or gay scientists who had contributed to the field. While this lack of representation did not impact my participants' desire to be a STEM professional, in their minds it did confirm to them the idea that staying in the closet was what was best for, and expected of, them. Although the participants were not deterred from wanting to persist in STEM, the lack of representation did play a role in their abilities to navigate the borders between their lived world and the world of canonical science. Participants described the importance of having a mentor or role model that shared their identity and how the lack of having one impacted them negatively. Michael stated that "not having someone who looks like you and represents your identity in your field makes it hard to see yourself being successful in that field" and that it "makes it a little more difficult in terms of navigating because I'm left to my own devices when it comes to figuring out… how to be a gay male in STEM and understanding how I fit in".

In addition to feeling like they were left to their own devices due to a lack of role model or mentor that shared their identity, the participants also discussed feeling a sense of isolation due to their sexual minority status. This isolation expanded beyond just their STEM classes as my participants discussed not having an overlap in the people they associated with outside of class and their classmates. For these participants, social

isolation stemmed from their lack of comfort with sharing their sexual minority status

with classmates. Each participant talked about the uncertainty in how their classmates

would react to them being gay as part of the reason they were timid in sharing their

sexual orientation. According to the participants, this social isolation impacted their

understanding of coursework and could possibly negatively impact their success in the

field. Michael stated, "I see a group of people who get together and they work on

problems and I know if I had that, it would make learning more meaningful. So, I just

know there's a negative impact by not having support and being isolated in your studies".

3. From the perspective of the gay man, what is the relationship between a gay male's "outness" and his experiences with any discrimination he has experienced and might experience in STEM related classes/majors?

Since each of my participants were still in the closet, and each of them used

strategies to "pass" as straight, I relied on their description of how classmates who were

more openly gay were treated to answer this question. There was only one instance of an

"out" gay man and from Neal's account, he was ostracized by his classmates and made to

feel unwelcome. Even though Neal stated that he never heard anyone directly say

homophobic things to the student, he did clearly remember other men in class make

subtle remarks like, "that's gay" and "stop being so gay" when someone in the group did

something remotely feminine. These kinds of behaviors send strong messages to

individuals who do not conform to gender expectations that they do not belong in STEM.

From all accounts, the participants in the study felt like openly gay students would have a

much more difficult time navigating STEM classes. This was especially true if the

student also expressed more feminine qualities or stereotypical gay attributes. This belief

and fear of discriminatory and homophobic behavior was an important determinant in the

participants in this study making sure they self-policed their own behaviors. Not having a participant who was "out" to his peers and professors makes this question more difficult to answer because the participants in the study could only discuss how they perceived the experiences of individuals who were "out". This is an area where the research should be expanded in the future and is discussed more in Chapter Five. The argument can be made, however, that the participants in this study had experiences that suggested that being out would increase the level of difficulty required to navigate STEM courses.

Conclusion of Chapter

In Chapter Four I presented my research findings in the form of counter-stories and through the use of composite characters. By doing so, I was able to elaborate on the three themes found in my research while telling counter-stories of marginalized individuals that are relatable, yet captivating. More importantly, these counter-stories provided a glimpse into the societal barriers that work to prevent gay men from having equal access and equal opportunity in STEM classrooms and careers.

I concluded Chapter Four by providing summary answers to the previously stated research questions. These answers are expanded upon in Chapter Five, where I discuss my findings in light of the literature reviewed for the dissertation. Additionally, these findings illuminate several ideas previously unconsidered in the original literature review, which are explored more fully in Chapter Five. Chapter Five also includes a description of the limitations of this study and provides a thorough review of the implications and recommendations garnered from this research.

CHAPTER FIVE

LIMITATIONS, DISCUSSION, AND IMPLICATIONS AND RECOMMENDATIONS

Introduction

In Chapter Four I presented counter-stories using composite characters that substantiated the three themes evident from my data analysis. I concluded Chapter Four by answering the specific research questions posed in this dissertation.

In Chapter Five I address some of the limitations of this study. These limitations include, but are not limited to: issues with participant sampling, measurement bias, researcher bias, and participant-response bias. Following this section, I provide a more thorough discussion of my findings. Specifically, I use the cultural border crossing framework to develop four categories of border crossing experienced by gay men in this study as they attempted to navigate the borders between their lived-world and the world of canonical science. Next, I provide discussions that link my findings to the previously reviewed literature of heterosexism, heteronormativity, and gender enactments. During this discussion I introduce a new concept, closetedness. The findings from this study also highlight the following ideas: a) the importance of a strong STEM identity, and b) the importance of having and finding your voice as a marginalized member of society. These areas are addressed as well.

Chapter Five concludes with a discussion of the implications and recommendations for education researchers, educators, academic administration, and gay

men. The chapter includes a section that previews future areas of research that would provide a deeper understanding of issues facing the gay community.

Limitations

There are several methodological limitations that must be addressed in light of this study. This research, like many qualitative studies, did not seek or claim generalizability (Holosko, 2006). I qualitatively explored and examined retrospectively, the unique lived experiences of self-identified gay males who were: a) currently majoring in physics, chemistry, engineering, or computer science at three different four-year colleges in the southeastern part of the United States; and were b) graduate students or undergraduate students with a junior or senior standing. Therefore, issues related to participant recall, biases, and researcher bias all collectively impacted the type and quality of information recorded, analyzed, and presented in this study.

This study used a mixture of purposive and convenience sampling techniques to explore the experiences of the participants. The experiences of those who were not currently in school (either because of graduation or other factors), had not reached at least a junior standing, or those who had left STEM or decided not to major in STEM as an incoming freshman were not included. These individuals may have different perspectives and opinions about the impacts of heteronormativity and heterosexism on their ability to navigate STEM courses. Accordingly, the information garnered from these specific sub-groups would yield different information if recruitment and sampling techniques were done differently. Similarly, the experiences of those who are lesbian, transgender, or bisexual were not examined as my focus was solely on the experiences of gay men. It is

important however, to consider future and additional research that examines their experiences as well (Mattis, 2002).

For this study, there were three forms of unintended biases: measurement bias, researcher bias, and participant-response bias. As indicated by Richie et al. (1997), measurement bias is based on how qualitative questions are presented to elicit specific types of response information, which may be a result of question wording, sequencing, and/or structuring. Additionally, there were several researcher biases regarding research questions, data collection and analyses, and interpretation (Chenail, 2011). For example, being a member of the group participating in the study can introduce bias (Mehra, 2002). Given this membership, "insider" researchers may "limit their curiosities so they only discover what they think they do not know, rather than opening up their inquiries to encompass also what they don't know they don't know" (Chenail, 2011, p. 257). This bias can impact researchers as they attempt to write open-ended research questions, especially new researchers with limited experience in performing qualitative research. This bias was minimized through the collaborative efforts between myself and members of the research committee. Furthermore, during data collection I introduced bias in this study by purposefully providing participants with photographs for the photo-feedback assignment. As mentioned previously in Chapter Three, this was done because participants were hesitant to take their own photographs and potential participants declined being involved in the study because of this requirement. One concern participants had was the possibility of being "outed" if they took pictures of students who were not in this study. Doing so would have required obtaining consent forms from those students and the consent forms would have informed these students about the aims of this

study and by doing so inadvertently "outed" participants. After a discussion with committee members, it was decided that I would provide photographs I felt represented gay men's experiences in STEM majors in part due to being an "insider" as a member of the gay community and as a former STEM student. Even though participants provided excellent written feedback to the photographs and this led to rich, descriptive discussions during the second interview, important experiences might have been missed due to participants not taking their own photographs.

Moreover, because of my status as an "insider", I had numerous friendly interactions with participants as well as intimate interactions with the data and themes. These interactions may have inadvertently and indirectly affected how data was analyzed, how information was interpreted, and what was included and omitted in the final result. Therefore, the final results may not be applicable to all, and are subject to modification, as soon as new information becomes available (Fereday & Muir-Cochrane, 2006). Finally, the participants were asked to retrospectively recall incidents that had occurred previously. Perhaps, some information was forgotten, dismissed, and/or omitted. Although this may be true, the rich descriptive dialogue participants shared during this study deserves to be shared and warrants being heard.

Discussion

Application of Cultural Border Crossing

Because gay men face numerous societal and academic barriers in their attempts to navigate between their lived-world and the world of canonical science, border crossing is a useful way to understand their experiences. In this study I used Aikenhead's (1997, 2001) notion of border crossing to describe participants' ability to navigate said borders.

Border crossing is defined as the process of moving between two cultures marked by differences in languages, norms, values, practices or histories. I presented the argument earlier that science has a distinct culture that is vastly different than the culture of the gay community due to heteronormative assumptions and genderized norms. In the findings section I highlighted through counter-stories, instances of the barriers participants faced as they negotiated these borders/boundaries. In this discussion, I adapted Costa's (1995) four types of border crossings to categorize how gay students navigate between their lived-world and the world of canonical science. Below I discuss what I found to be a commonality among the four participants that allowed them to successfully navigate the borders between these two distinct worlds.

Costa (1995) in her research outlined four types of border crossings: smooth, manageable, hazardous, and impossible. Instead of creating new categories, I redefined these existing ones to fit this study and exemplify gay students' abilities to navigate cultural borders. Table 5.1 provides a conceptual and definitional comparison of Costa's original work with my own re-conceptualization.

From this perspective, students who negotiated smooth border crossings are those students who feel as though there are no issues of heterosexism or heteronormativity. These students will persist in STEM through matriculation and into career as there is no incongruence between their lived world and the culture of canonical science. None of the participants in this study exhibited characteristics of smooth border crossers. I redefined manageable border crossers as those who notice and experience the oppressive and marginalizing effects of heterosexism and heteronormativity, but have persisted in their STEM majors and have an intention of a career in STEM. According to my new schema,

Table 5.1
Re-conceptualization of Cultural Border Crossing

Border Crossing Category	Costa's Definition of Categories	Outcome for Student's Using Costa's Definition	My Definition of Categories	Outcome for Students Using My Definition
Smooth	Culture of family is congruent with culture of school and science	Potential Scientists: Leads to an in-depth understanding of science	Students do not notice issues of heterosexism and/or heteronormativity	Persist in STEM through graduation and career
Manageable	Culture of family is congruent with school but inconsistent with science	Other Smart Kids: Academic success; students have no interest in pursuing science	Students notice and experience effects of heterosexism and/or heteronormativity	Persist in STEM through graduation and career
Hazardous	Culture of family is inconsistent with cultures of both school and science	"I Don't Know" Students: Leads to a superficial understanding of science; students have no interest in pursuing science	Students notice and experience effects of heterosexism and/or heteronormativity	Persist in STEM through graduation but choose not to enter the field for career
Impossible	Culture of family is discordant with cultures of both schools and science	Outsiders: Can lead to dropping out, physically or intellectually	Identity as a gay male is incongruent with norms and identities found in STEM	Student drops out of STEM; changes major to avoid negative environment

hazardous border crossers are those who matriculate to completion of a STEM degree, but choose not to continue into a STEM career due to their experiences with heterosexism and heteronormativity. These students find that these experiences create environments that are too toxic to persist through career. Finally, impossible border crossing is exemplified by gay students who find that their identity as a gay man is completely incongruent with the genderized environments sometimes found in STEM majors. Students might experience impossible border crossings at multiple points in their educational experience.

Although all participants in this study described being subjected to the same heteronormative expectations and heterosexist barriers, I did not find any variation in their ability to navigate cultural borders. Even though I had constructed four categories along a continuum, representing students who persist in STEM to those whose identities were incongruent, all participants in this study demonstrated manageable border crossings. This is evidenced as each participant had persisted in STEM and planned on continuing in a STEM career, whether in academia or industry, after graduation. The participants each expressed a love for the content and articulated their appreciation for the relevance of STEM to their lives and to their world. For them, these two things provided enough incentive to overcome being isolated, silenced, and unwelcomed.

There are three possible interpretations of these results. One, because I limited the study to students who had achieved at minimum a junior standing in their STEM majors, I anticipated that all participants would demonstrate either smooth or manageable border crossings. However, further research needs to be done to determine if these four categories are valid and actually represent the border crossing for all gay men. Another

possible interpretation of these results is the idea that border crossing is "messy" at best (Carter, 2010). Carter argued that ''science education needs more sophisticated concepts to better unravel the complexities of the contemporary world where globalization has meant the continual rubbing together of cultures and knowledges, fraying their edges and borders'' (p. 430). Instead of conceptualizing the boundaries between STEM and gay cultures as being a clear demarcation between the two, perhaps, I should have recognized that boundaries shift or form spaces, or ''border zones,'' between cultures (Kang, Bianchini, & Kelly, 2012). This too, can be examined in future research studies. Additionally, the concept of STEM identity was ignored when conceptualizing and implementing this study. However, after completing data analysis and creating the counter-stories, the data revealed that these students had a strong STEM identity, which has been linked to STEM performance. This is addressed in the following section.

STEM Identity

STEM identity is the concept of fitting in with STEM fields, specifically, the way individuals make "meaning of science experiences and how society structures possible meanings" (Carlone & Johnson, 2007, p. 1187). Likewise, researchers have also defined STEM identity as the ability of individuals to see themselves as the kind of individuals who could be legitimate participants in STEM through their interests, abilities, race, gender and culture (Hughes, Nzekwe, & Molyneaux, 2013). STEM identity is impacted by three factors: a) a student's interest in STEM and STEM careers, b) a student's self-concept – one's perception of his/her abilities in the domain of math and science, and c) the influence of role models on student's perceptions of who can and who does science. For underrepresented groups in these fields, the added component of role models is even

more important in that these individuals need to see that there are people like them persisting in STEM (Carlone & Johnson, 2007).

However, not all researchers are sold on the premise of role models. Britzman and Pitt (1996) problematized the notion of role models. Primarily they felt that this traditional view of educational role models' abilities' to ensure the success of marginalized students represented a deficit model of thinking about students whose identities are marked by social difference. Additionally, Britzman and Pitt (1996) suggested that role models are ineffective due to the partial, ambivalent, and shifting ideas of identity. These authors also argued that too often the reliance on positive role models has been used as a substitute for pedagogy.

Conversely, other researchers have written about the importance of having positive role models, especially in the LGBT community. For example, Wohlford, Lochman and Barry (2004) found that participants were more likely to have high self-esteem if they believed they share many character traits with their role models. In short, because having role models with similar characteristics predicts high self-esteem, it seems reasonable that LGBT individuals who have access to LGBT role models may have higher self-esteem than LGBT individuals who lack access to such role models. Additionally, Cheung and Yue (2003) found that modeling after accomplished and distinguished individuals is related to higher sense of self-efficacy among adolescents. It follows then that LGBT adolescents who model after successful or personally known LGBT individuals may have a greater sense of self-efficacy.

An important caveat is that participants in this study were able to develop a strong STEM identity without the influence of a role model who represented their identity as a

sexual minority. Understanding the development of their STEM identity is an area that

could be studied further in the future. While many studies have focused on issues of race,

gender, and ethnicity on STEM identity development (Carlone & Johnson, 2007; Polmer

& Miller, 2010), studies have not explicitly focused on the impact sexual orientation may

have on the development of STEM identity. In this study, sexual orientation did not

seem to have a direct impact on participants' development of a STEM identity. However,

this might be directly related to the criteria used to select participants. Each participant

recognized himself as a "science person", expressing enthusiasm for science's practices,

subject matter, or career possibilities (Carlone & Johnson, 2007). Moreover, the

participants saw science as an exciting way of knowing and expressed the importance of

science not only in their day to day lives but also its importance on a global scale.

However, this might not hold true for all gay students and future research would provide

additional data to aid in our understanding.

Dealing with Heteronormativity and Heterosexism through Closetedness and Gender

Enactments

I would be remiss to not discuss the current social and political climate that

members of the LGBT community must navigate, as issues related to safety are ever

present, especially for LGBT members to who choose to live in their truth. Here, it is

important to highlight a few key points that, on one hand, indicate a positive trajectory in

individual and group attitudes toward equitable treatment. As the scope of this study is

limited to the United States, the data provided in this section is also limited to the United

States as well. In 2001, data revealed that 57% of Americans opposed same-sex

marriage, while 35% were in favor; however, in 2017 62% of Americans supported

same-sex marriage while only 32% opposed it (Pew Research Center, 2017). The

support toward same-sex marriage and equal rights for LGBT individuals has been

lauded as a breakthrough in American society. However, these numbers do not paint a

complete picture. While there seems to be a fundamental shift, in the positive direction

for support of LGBT rights, there are documented instances of opposition, violence, and

hostility against members of the LGBT community at rates higher than any other

minority group (Park & Mykhyalyshyn, 2016).

In 2015, the U. S. Supreme Court made the landmark ruling that legalized gay

marriage nationwide. Since then, states such as South Dakota, Georgia, Indiana,

Mississippi, Alabama, South Carolina, Texas, and North Carolina have all attempted to

enact, and in some cases enacted, laws to limit the freedoms and rights of the LGBT

community. Some of these laws include giving state adoption agencies the right to refuse

gay parents from adopting and fostering, banning transgender individuals the right to

access bathrooms that align with their gender, and giving businesses the right to refuse

service to individuals who they suspect are gay. More recently, the President of the

United States attempted to ban transgender individuals from serving in the military.

While the majority of these laws have ended up either being vetoed by the governors of

these states or being overturned by the courts, the fact that they passed state legislature is

both appalling and damaging.

While there are a plethora of examples of the increased numbers of hate crimes

and homophobic actions directed towards LGBT community members, I want to

highlight two that have a profound effect on me personally. The first incident occurred

last year when political commentator Ann Coulter tweeted that tropical storm Harvey was

"God's punishment for Houston electing a lesbian mayor". Not only are these words

hurtful and hateful, but they continue to perpetuate the heteronormative idea that

heterosexuality is normal and the only acceptable sexual orientation, while

homosexuality is not normal and should be unacceptable. The next incident occurred on

June 12, 2016 when a single gunman entered Pulse nightclub in Orlando, FL and

slaughtered forty-nine people while injuring an additional fifty-eight. This terrorist attack

on members of the LGBT community, which happened in a building designed to be a

safe space for these individuals to be themselves without worry of discrimination or

judgment, showed the depths some people will go to eliminate LGBT individuals from

society. If we are not safe in spaces created by us for us, then how safe are we in

heterosexual spaces? These types of actions, and the multitude of others that I did not

mention, continue to marginalize, oppress, and silence members of the LGBT

community.

One response to this type of homophobia and discrimination is for gay men to

participate in an idea known as closetedness. The creator of the term, which is different

from simply being in the closet, Sedgwick (1990) says closetedness "is a performance

initiated as such by the speech act of a silence – not a particular silence, but a silence that

accrues particularity by fits and starts, in relation to the discourse that surrounds and

differentially constitutes it" (p. 3). Essentially, closetedness is the performance of

heterosexuality by someone who does not identify as heterosexual. In the same way that

gender performativity is considered to be the performance of traditional gender roles,

closetedness can be considered the performance of the dominant sexual orientation (i.e.

heterosexuality). This performance of heterosexuality is wide-spread in the behavior of

the participants in this study. In addition to their performance of gender expectations, participants also talked about explicitly lying about having a girlfriend when asked about personal details. When a member of his lab began zooming in on pictures of girls scantily clad and making sexual remarks, Neal chose to play along with the lab mate instead of disclosing his true sexual orientation. Neal also disclosed that the same guy had made a comment about "hating fags" previously. Not knowing how this lab mate would express his hatred, Neal chose to perform closetedness.

The concept of gender enactments, or gender performativity, was central to participants' experiences in this study. Due (2014) described gender performativity as individual gender and defines it as how individuals express masculinity or femininity. Participants in this study explicitly described the strategies they used to express masculinity in their attempts to pass as straight. They felt pressured by the genderized expectations present in their STEM courses to hide their queer identity and to adopt a second, more masculine identity once they entered the classroom or lab setting. Participants reported policing their behaviors to make sure they did nothing that could be construed as feminine. These behaviors included deepening their voice, changing their vernacular and word pronunciations, and being conscious of the way they walked, the hand gestures they made, and the facial expressions they used. Participants believed students in their classes associated homosexuality with femininity and femininity was not allowed, expected, or appreciated in their STEM courses. The way in which gay men are portrayed in the media and how people react to that stereotype could have contributed to this perception. According to these stereotypes, gay men, due to this false equivalency to femininity, are expected to want to participate in occupations and hobbies that society has

deemed appropriate for women. In turn, these attitudes and expectations have created the "gender structure" of society, in which occupations are divided by strict gender binaries (Due 2014).

Finding a Voice

While participants described policing their own gender performativity and displaying instances of closetedness, each experienced a sort of revelation due to participating in this study. Each of the participants discussed how this study helped them to understand the importance of living their authentic truth. Participants divulged how their experiences navigating their STEM courses was more difficult because they lacked a role model/mentor who shared their identity as a gay male. Specifically, each discussed the importance of representation and how this lack of gay men in STEM caused them to doubt whether they belonged and could be successful in these STEM environments. Without a mentor, participants felt as if they were navigating between their lived-world and that of canonical science without guidance. Because of this, each participant concluded that he needed to begin the process of coming out so that he could be a role model/mentor to other LGBT individuals who need assistance seeing themselves as a scientist. By highlighting how these gay men experienced heterosexism and heteronormativity in STEM classes, this study has provided the outlet for their collective voice to be heard, and helped each participant realize their desire to find their own voice moving forward. At the end of the study, each participant was asked, "How has this research project made you think differently about your career and your career trajectory within STEM?" These responses were not part of Chapter Four's counter-stories, but make an impactful statement about the emancipatory nature of the research. Instead of

using the composite characters, I find it important to share what each participant stated

individually.

Bradley: "I would say it has reaffirmed for me that I need to be my unapologetic self in these academic spaces in STEM. So often I hide and shrink myself and act differently to kind of fit in so people don't get to see the real me. But I know I need to make an effort to not do that anymore because it's important for my own sanity to be who I am. Especially because there's a new undergrad working in my lab and he's gay, and I wouldn't want him to see me acting completely different when he sees me in the lab versus if he saw me out downtown. It might cause him to think that that's what you have to do to be successful. I don't want him to think that he has to be someone he's not just to fit in and be successful in STEM. And I kind of want to be that role model so he knows that it's one hundred percent okay to be your authentic self at all times and you can still be successful."

Michael: "So it definitely has made me feel like, now I feel like it's more important to be a professor and to be out as a professor which I had never really considered before. But with all of my insecurities, I would have loved to have known or even know now that one of my professors was gay. Or I would love to know that every faculty has at least one if not a few gay professors who were in STEM and were out and comfortable. That would help to alleviate some of my feelings right now of being insecure and feeling like I need to stay so closeted. So, if I could be that person for my futures students that would be ideal I think. I feel like the more I closet myself, the less ability I have to help someone who might be struggling with their identity."

Neal: "I definitely think our discussions have made me more aware of the challenges to accessing higher education in STEM is for LGBT folks. A lot of things that I had just kind of filed away mentally as normal, now I'm realizing that it really shouldn't be normal. Like we discussed earlier, things that I had thought to myself would be inappropriate for me to discuss, but in actuality my straight counterparts are doing it all of the time. In terms of career trajectories, it may be rough for some people to spend their lives working in an environment where they can't really live out loud like a straight person could, and I think that's why a lot of gay people don't choose STEM. But I think moving forward I need to see where I can start being myself and hopefully start coming out of the closet. Although I've had the fortitude to continue in STEM and so far done it by pretending to be someone I'm not, some people don't have that option and they shouldn't have to choose something different because they don't fit in. So I need to try and be more open so I can help those people who can't or choose not to conform to the gender expectations."

Clandinin and Connelly (2000) emphasized the connection narrative researchers

have with their participants and with the restorying process. While my reactions to

participant interviews are littered throughout the counter-stories, the sense of pride I had to hearing the participants talk about their desire to try and be more open about their sexual orientation caused me to reflect more deeply about my own life and my practices as a classroom teacher. I have been in their shoes as a STEM student. However, as I wrote earlier, I was an "out" student and it led to me facing homophobia at a level I was not prepared to deal with. Because of my sexual orientation, classmates and professors frequently demonstrated with their words and actions that I did not belong in STEM. After leaving the field, I chose to hide my queer identity in any and all professional settings moving forward. I became that teacher who tried to "pass" as straight through gender performances. Additionally, I enacted closetedness as I lied about having a wife and a family. I convinced myself that this was what was best for me, my career, and my students. After listening to my participants' stories about needing a mentor and creating the counter-stories from their experiences, I felt a sudden and overwhelming amount of sadness. By hiding my queer identity and not acknowledging contributions made to STEM by LGBT individuals, had I silenced any of my own students? Had these actions contributed to any students rejecting a STEM path because they did not recognize themselves in any of the scientists I talked about during class? I had not anticipated these feelings prior to doing this study. The stories and revelations my participants shared provided me with the courage to declare that I, too, am determined to live "out" loud and to live my authentic truth from this day forward both inside and outside STEM classrooms.

Implications and Recommendations

Increasing diversity in the STEM workforce is critical to fostering creativity and innovation (Hughes, 2018), and the underrepresentation of STEM professionals from historically marginalized groups undermines this goal. Therefore, the findings of this study hold importance for educators, education researchers, and/or administrative personnel at colleges and universities. Based on these study findings, educators working within STEM fields must attempt to evaluate their teaching philosophy and move towards implementation of a critical pedagogy that challenges students to become more thoughtful, reflective, and transformative (Kassam, Avery, & Ruelle, 2017). The term critical pedagogy has been used by educators to refer to a broad range of pedagogies that employ any branch of critical theory. Additionally, students and instructors should reflect on their social positionality, and critically question the world around them. Ultimately students use what they learn in order to become social justice agents and critical pedagogies assert that education can be socially transformative in creating equity for all (Kassam, Avery, & Ruelle, 2017).

Barton (2001) suggested that solutions to issues of inequity reside in documenting, critically analyzing, and acting on discriminatory practices found in science classrooms. To accomplish this, researchers and educators should question gender and sexual minority inequities in science, which ultimately results in implicit notions becoming explicit. Otherwise we risk ignoring power regimes that underpin gender hierarchies, leading to a perpetuation of inequities. Researchers and educators should also be involved in generating science education that values both excellence and equity while also working to expose the structures and processes that have been used to oppress

gay men enrolled in STEM courses (Barton, 2001; Steffy & Grimes, 1986). To do this,

educators can work to introduce queer identities into the curriculum and be mindful of

biases often hidden in the binaries created through the notions of objectivity and

rationality. Moreover, educators can translate research on providing increased equity and

access for women to members of the LGBT community at large. This research provides

three ideas where educators can focus to make a difference: a) curriculum and

pedagogy—curriculum and pedagogy that recognize the "experiences, learning styles,

and interests of LGBT members" or gender inclusive education foci (p. 974); b) nature

and culture of science—advocate a change in how science is perceived and defined in the

larger society as well as in schools; and c) identity—advocate the need for opportunities

and studies that focus on helping LGBT members identify with science (Hughes,

Nzekwe, & Molyneaux, 2013).

On college campuses, administrators must work to create environments that are

accessible to all students. While great strides have been made in the arts, humanities, and

social sciences to bring LGBT voices and lives into the curriculum as a way to improve

the climate, the culture within STEM remains resistant to discussions of inequity

(Hughes, 2018). Practitioners within STEM fields continue to believe that inequities are

irrelevant to technical expertise, leading to hostile experiences being overlooked as

isolated incidents rather than systemic problems (Cech, 2013). In a recent study, Hughes

(2018) found that heterosexual men were 17% more likely to stay in STEM than their gay

male counterparts over a 4-year period. In this study, Hughes (2018) argued that having

LGBT faculty serve as mentors and sources of support, and having gay men working

with a faculty member's research projects either individually or through formal

participation in undergraduate research projects positively increased their retention in STEM disciplines. In summary, the following list demonstrates tangible actions that can be taken in classrooms and across campuses to ensure a more equitable educational experience for LGBT students:

- Have a zero-tolerance policy for homophobic remarks and actions

- Instructors should include examples of contributions made to STEM by LGBT individuals,

- Instructors should connect learning to students' experiences; based on their social and cultural backgrounds,

- Instructors should encourage students to use science and engineering practices to solve a multitude of issues; including concerns present in LGBT communities,

- Instructors, faculty, and college administrators need to talk about issues of sexism, homophobia, and heteronormativity to increase awareness of these issues; highlighting their existence might help to foster a healthy discussion on ways to overcome the oppressive forces,

- Require all employees to participate in LGBT Safe Space Training and encourage employees to consider being an LGBT ally and

- Provide research opportunities that are explicitly for increasing LGBT participation in STEM.

Future Research

This study is an important addition to the scant literature on the experiences gay men have in STEM courses/majors. Studies exploring members of the LGBT community are becoming more and more common, even research in STEM spaces. However, the work is still in its infancy. Even so, researchers have barely scratched the surface of the experiences of LGBT individuals. Continued research on diversity in STEM is needed as a way to heighten our understanding of the barriers members of underrepresented minorities face in their attempt to gain access to, and persist, in STEM fields. One way for this research to be continued and expanded is through increasing the number of participants, and to broaden the recruitment geographical span. Doing so, would potentially create comparison groups which may illuminate whether gay men experience heteronormativity differently depending upon their location. Geographic location might influence the level of heteronormativity and heterosexism gay men have to endure as a STEM major.

Similarly, expanding the research to include all STEM majors would create avenues to comparatively explore the experiences of students in courses that are more diverse, by gender, with those which are less diverse. For instance, previous findings highlighted the notion that gay men report being more open about their sexuality when operating in spaces where women are present in greater numbers (Yoder & Mattheis, 2015). Additionally, it is difficult to ignore the intersectionality of an individuals' identity and future research should also consider and address this. For example, students' experiences are also impacted by social identities such as race, gender, and class. These categories of difference do not parallel but instead intersect and reinforce each other

(Espiritu, 2000). Therefore, it is important that researchers recognize these intersections of identities and structure research to examine their impacts.

Personally, I find myself drawn most passionately to understanding the experiences of young gay men enrolled in STEM courses, either during their first two years in college or as high school students. As indicated in this study, the participants were either classified as doctoral students or had reached junior standing in their coursework. It would be interesting to explore whether gay students who left STEM, either in early college, high school, or middle school, did so because they were not interested or they did not fit within the STEM field because of their sexual orientation and/or the heteronormative pressures of the field. Considering research has shown that students actually begin to lose interest in science and mathematics around middle school (Hughes, Nzekwe, & Molyneaux, 2013), lowering the age of participants for future studies is imperative to understanding their reasons for leaving the STEM pipeline. It will also provide researchers and practitioners with a better idea of what changes need to be made in order to recruit and retain this group of individuals. This further ties in to my desire to determine how important cultural and societal stereotypes are in how gay students see their possible selves.

Concluding Remarks

This research started as an attempt to understand the oppressive aspects of STEM majors and classrooms that gay men face in their attempts to navigate cultural borders between their lived world and the world of canonical science. By examining these aspects, including heteronormativity and heterosexism, my goal was to challenge the traditional claims of STEM to objectivity, meritocracy, and equal opportunity. These

traditional paradigms act as a camouflage to the self-interest, power, and privilege of the dominant group (heterosexuals) in U. S. society (Calmore, 1992). While I found that participants were able to be successful in spite of challenges, I also realized that my study was limited in scope and therefore a commitment to future research is needed in order to further highlight the experiences of students from sexual minority groups. On a personal note, this study awakened an internal passion, while at the same time renewed my commitment to social justice for all students, especially members of the LGBT community as a whole. My hope is that this study begins to provide an emancipatory, liberatory, and transformative response to the oppressive and marginalizing nature of heteronormativity and heterosexism.

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APPENDICES

APPENDIX A

Recruitment Flyer

APPENDIX B

Consent Form

The Interplay of Sexual Orientation and Gender Norms on the Experiences Gay Men

Have with Cultural Border Crossing in Science, Technology, Engineering, and

Mathematics

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Researcher's Statement

We are asking you to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. This from is designed to give you the information about the study so you can decide whether to be in the study or not. Please take the time to read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information. When all your questions have been answered, you can decide whether you want to be in the study. This process is called "informed consent". A copy of this from will be given to you.

Purpose of the Study

The purpose of this dissertation is to identify and examine the perceptions gay men have of boundaries between the life world and canonical science world, and how these perceptions impact their ability to navigate said boundaries.

Study Procedures

If you agree to participate, you will be asked to…

- ❖ Participate in two one-on-one interviews with the first interview lasting approximately 60 minutes and the second interview lasting approximately 30 minutes.

- ❖ Participate in a process known as photo-feedback in which you will write critical narrative describing how provided images do or do not represent your experiences in STEM and the feelings these images do or do not conjure (this process will take approximately 20 minutes per image, for a total of 1 hour).

Risks and discomforts

- ❖ The social risks involved in this study could occur due to a breach of confidentiality in which your status as a sexual orientation minority might be made public.

- ❖ The protection of your identity is of utmost importance to me. To ensure that your participation remains anonymous, interviews will be scheduled at your convenience in a safe location such as Aderhold Hall. At no time during the study will you be referenced by name, instead you will be assigned a pseudonym. Coded identifiers will be kept on Mr. Steele's personal laptop, which is password protected. All identifiers and audio recordings will be removed and/or destroyed as soon as data collection and transcription are completed in efforts to decrease any breach of participant confidentiality.

Benefits

By participating in this study, you will be contributing to the knowledge base regarding the experiences of gay men in physics, chemistry, and engineering classrooms. This knowledge can further assist university faculty and administration in fostering a more inclusive environment for all students.

Audio/Video Recording

During the interviews, we will make audio-recordings. No individually-identifiable information, include the audio-recordings, will be shared with anyone not involved in this research project unless otherwise required by law. Within six months of the interviews,

the audio-recordings will be transcribed for further data analysis and will be erased. We will not use your name on any papers that we write about this project. Instead, we will use a made-up pseudonym.

Privacy/Confidentiality

You will have the option to protect your personal identity by using a pseudonym of your choice or be assigned a pseudonym

The project's research records may be reviewed by departments at the University of Georgia responsible for regulatory and research oversight.

Researchers will not release identifiable results of the study to anyone other than individuals working on the project without your written consent unless required by law.

Taking part is voluntary

Your participation in this study is completely voluntary. You may refuse to participate before the study begins, or discontinue at any time, without penalty or loss of benefits to which you are otherwise entitled.

If you decide to stop or withdraw from the study, the information that can be identified as yours will be kept as part of the study and may continue to be analyzed, unless you make a written request to remove, return, or destroy the information.

If you would like to volunteer in the member checking process, and/or if you would like a final copy of the contextualized research findings, you may give your contact information to the Primary Contact. This is not required for participating in the study. Howerver, if you choose you will be sent a copy of your transcribed interviews to edit and clarify and questions, as well as make addition comments on your answers to the interview questions.

If you have questions

If you have any questions about this study or your participation in it, you can contact one of the researchers at the phone numbers or email addresses above.

If you have any questions or concerns regarding your rights as a research participant in this study, you may contact the Institutional Review Board (IRB) Chairperson at 706-542-3199 or irb@uga.edu*.*

Research Subject's Consent to Participate in Research

To voluntarily agree to take part in this study, you must sign on the line below. Your signature below indicates that you have read or had read to you this entire consent form, and you have had all of your questions answered.

_____ _____
Name of Researcher   Signature   Date

_____ _____
Name of Participant   Signature   Date

Please sign both copies, keep one and return one to the researcher.

APPENDIX C

Interview One Protocol

I.   Introduction and Consent
      a.   Verbal consent for interview
      b.   Verbal consent for voice recording.

II. Ice Breakers
      a.   What is your major?
      b.   What is your academic standing in school?
      c.   The study was advertised for gay men in physics, chemistry, and engineering. Do you identify as a gay man?
      d.   What you like most about being a physics (or engineering student)? Least?
      e.   How has your understanding of physics (or engineering) changed since you entered college as a freshman?

III. Experiences with Faculty
      a.   Think about your interactions with your (Insert Discipline Specific) faculty, describe the dynamics of that relationship.
            i.   Prompts
                  1.   How "out" are you to faculty in your department?
                  2.   How would you describe your interactions with faculty? Is there anything that would improve that relationship?
                  3.   In what ways, if any, are physics (or engineering) faculty especially helpful to you?
                  4.   What sort of consequences would you expect if you had your sexuality revealed to your physics (or engineering) faculty?
                  5.   Do any physics (or engineering) faculty ever talk or joke about sex or sexuality? If so, how do you react?

IV. Experiences with students in STEM classes
      a.   Think about your interactions with your (Insert Discipline Specific) classmate, describe the dynamics of those relationships.
            i.   Prompts
                  1.   How "out" are you to your physics (or engineering) classmates?
                  2.   How would you describe your interactions with other physics (or engineering) students?
                      a.   Other students on group projects?
                      b.   Working with lab partners?

      c. Study groups?

      d. Socialize with physics (or engineering) students outside of school?

3. In what ways, if any, are students especially friendly or helpful to you?

4. In what ways, if any, do students cause trouble for you? How do you deal with this?

5. What sort of consequences would you expect if you had your sexuality revealed to your physics (or engineering) classmates?

6. Do any of your physics (or engineering) classmates ever talk or joke about sex or sexuality? If so, how do you react?

V. Environment

  a. Think about the environment for gay men as a (Insert Discipline Specific) major. Can you talk at length about issues related to climate or accessibility?

    i. Prompts

1. Do you ever feel socially isolated in your science classes? If so, what do you think are the reasons for this? How do you cope with this?

2. Do you ever feel excluded from important information in your department? If so, what do you think are the reasons for this? If so, can you describe a specific time when this has occurred?

3. Are there other gay students in your physics (or engineering) classrooms? Do you ever talk to them about issues relating to experiences as a gay student?

4. Regarding sexual orientation, how do you think the climate in your major compares to the climate in other majors?

5. Sexual harassment has received a lot of attention in the past few years. It is usually defined as unwanted words, gestures, or behaviors of a sexual nature. Do you think that's a problem for gay people in physics (or engineering)?

    a. Examples?

6. Have you personally experienced sexual harassment from students or faculty? If so, can you share in detail?

    a. How do you handle these situations?

7. Do you think being gay will affect your job security in the future, either positively or negatively? Why?

8. Has being gay had an impact on your schoolwork, in internships, etc? If so, how so?

      9. Currently gay men make up a very small minority of physics and engineering. Why do you think this is so?

     10. Is there anything about the climate for gay people in physics (or engineering) that we haven't talked about that you think is important?

     11. What would you do to change the environment to be more welcoming of gay individuals?

VI. Academics
    a. What age did you originally decide on your major?
        i. Did being gay factor in any way into your decision process? Why, or why not?
    b. Once you decided to choose this major, have you ever had any doubts?
        i. What factors have kept you in your major?
        ii. What types of strategies have you attempted in order to be successful in physics (or engineering)?

APPENDIX D

Photographs for Photo-elicitation and Photo-feedback

APPENDIX E

Thank You and Follow-Up Email

Insert Date

Hi **Insert Participant Name**,

Find attached the transcribed interview that we conducted on **Insert Date of Interview**. Take some time to review it, make any necessary edits, and have it back to me by **Insert Deadline Day, Month, Date, Year, & Time EST/CST/MST/PST**. In the event that you decide to clarify, delete or add information, please use track changes options in word, or if it works best for you, make the edits on the document and then scan the document back to me, I will then make the final edits based on what you've written, added, and/or deleted. Upon finalization of the data analysis process, and the amalgamation of information, I will forward you and the other participants a final copy of the findings.

In the event that I don't hear back from you by **Insert Deadline Day, Month, Date, Year, & Time EST/CST/MST/PST**, I will assume that you are okay with the interview as is, and I will proceed without any changes made to your interview.

Thank you again for your participation.

Regards,

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