FACTORS INFLUENCING LGB STEM MAJOR UNDERREPRESENTATION IN STEM FILEDS

by

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ABSTRACT

While literature on sexual minority issues is limited, there is evidence supporting poor retention rate among lesbian, gay, and bisexual students (LGB) studying science, technology, engineering, and mathematics (STEM). STEM fields often have heterosexist environments that present unique barriers to LGB individuals, though, more must be done to understand factors that deter sexual minorities from entering and remaining in the field. I aim to contribute to the scarce LGB scholarship by examining the STEM climate and exploring factors related to persistence.

This dissertation is composed of two independent articles that each investigate the issue of underrepresentation of LGB individuals in STEM fields. The first article analyzes existing literature and calls on counseling psychologists to address the problem through using queer theory. I identify various factors that make sexual minorities a difficult population to research, note the additional challenges heterosexism creates for LGB individuals, and recommend counseling psychologists use queer theory to research the systems within STEM. I conclude with recommendations for clinicians and universities.

The second article includes an empirical study examining factors related to poor persistence in STEM among LGB undergraduates. Using a mediation model, I hypothesized burnout and the imposter phenomenon would mediate the relationships between stereotype threat and STEM identity, as well as the relationship between STEM identity and persistence. Results indicated stereotype threat was a significant positive predictor of burnout and imposter phenomenon, while STEM identity was a significant predictor of persistence. Results also suggested the effect of stereotype threat on STEM identity is explained better using burnout and imposter phenomenon as mediators rather than stereotype threat's direct effect on STEM identity.

INTRODUCTION

Sexual minorities have been historically and systematically discriminated against. While laws and official policy has progressed to protect this vulnerable population, the heteronormative bias remains alive and permeates all aspects of life in the U.S. (Filax, 2006). STEM fields, which are stereotypically male-dominated and heterosexist, are particularly challenging environments for LGB individuals to thrive. Heterosexist climates often require LGB folks to hide their sexuality and compartmentalize their personal and academic life in order to avoid being perceived as incompetent (Cech & Waidzunas, 2011). LGB undergraduates in STEM domains also endure overt discrimination based on sexual orientation (Habarth, 2014). Ultimately, this environment presents numerous challenges that put LGB individuals in STEM at a disadvantage compared to heterosexual peers. This dissertation begins with an article critically reviewing the existing scholarship related to LGB underrepresentation in STEM fields. While there is ample literature related to women's underrepresentation or lack of racial diversity in STEM fields, research pertaining to LGB individual's experiences in these fields is scarce. For example, while some studies include both sexual and gender minorities, the current study focuses specifically on non-heterosexual individuals who identify as lesbian, bisexual, or gay. Researchers consistently suggest the heterosexist climate in STEM fields contributes to LGB students' poor retention in them, however, there is no existing literature investigating the systematic challenges within these fields using a queer theory approach. I review why counseling psychologists are ideal working with this population.

The second portion of the dissertation is an empirical study examining the relationships among stereotype threat, burnout, imposter phenomenon, and STEM identity, among other variables, for LGB undergraduate students majoring in a STEM field. Due to the heterosexist

climate in these domains, LGB students are frequently exposed to discrimination, making them vulnerable to stereotype type threat, burnout, and imposter phenomenon (Steele et al., 2002; Stroebe & Missler, 2015). Stereotype threat can lead to disengagement with the field, in fact Hall et al. (2015) found a positive relationship between social identity threat and burnout for women in STEM, while other research supports racial discrimination as being associated with increased levels of imposter phenomenon (Bernard et al., 2017). However, these findings have not been extended to any sexual minority population despite the unique challenges they face and their underrepresentation in the fields. Additionally burnout and imposter phenomenon have not been investigated as mediators in the relationship between stereotype threat and STEM identity or STEM identity and persistence. I gathered data using an online survey to test these various mediation relationships, report the findings, and make clinical and research recommendations.

CHAPTER 1. DISMANTLING A HETEROSEXIST SYSTEM: HOW COUNSELING PSYCHOLOGY RESEARCH CAN ADDRESS THE UNDERREPRESENTATION OF LGB UNDERGRADUATES IN STEM FIELDS

Scientific inquiry is vital for societal problems to be investigated, understood, and remedied. Consistent with counseling psychology's emphasis on social justice, the field's professionals often advocate for marginalized populations using research to inform future progress. However, systemic barriers in the United States continue to create disadvantages for individuals with marginalized identities. Minorities are underrepresented in a variety of domains, particularly in science, technology, engineering, and mathematics (STEM) fields (Moran, 2017). While counseling psychologists have conducted considerable research focusing on gender and racial minorities in STEM, lesbian, gay, and bisexual (LGB) representation in STEM is largely overlooked scholarly literature (Cech, 2015; Patridge et al., 2014; Robnett et al., 2015). While underrepresentation of LGB individuals is not exclusive to STEM fields, research suggests LGB individual's underrepresentation is even more significant in STEM – related careers compared to non-STEM careers (Cech, 2015). Researchers describe a hostile context LGB individuals experience in STEM environments that extends to higher education. STEM environments tend to have norms and values that create unique challenges to LGB students, and is likely a contributing factor to the population's underrepresentation in STEM (Cech, 2015; Hughes, 2018). While identifying the general pattern of underrepresentation in the literature is certainly useful, numerous gaps must be explored in order to advocate for the LGB community as counseling psychologists are called to do (Cech, 2015; Hughes, 2018).

The purpose of this chapter is to call counseling psychologists to contribute to LGB research using queer theory, particularly through studies involving higher education and other

Western, individualistic systems. This chapter begins with a general overview of critical theoretical and empirical issues in research with sexual minorities. This is followed by a review of the issues surrounding inequity and marginalization of sexual minorities in STEM careers specifically using a queer theory perspective. I conclude the chapter by highlighting the relevance of these issues to research, practice, and social justice initiatives in counseling psychology, and call on counseling psychologists to dedicate more theoretical and empirical attention to the issue.

1.1 Critical Issues in Sexual Minority Research

One reason the sexual minority population has been the focus of limited research relates to the challenges involved in recruiting a stigmatized population such as the sexual minority community. While explicit and implicit anti-gay attitudes in the U.S. have generally decreased, there remain various issues within the sexual minority population (Boroughs et al.,, 2015; Charlesworth & Banaji, 2019). Researchers of sexual minorities issues commonly struggle to gather a sufficient number of individuals for their studies (Phillips et al., 2003). Some individuals may be "closeted" or have doubts about participant confidentiality, and therefore will not participate due to fear of being "outted" by participating, thereby increasing their vulnerability to homophobic discrimination (Cech, 2015).

Despite the challenges associated with sampling sufficient individuals with a stigmatized identity, researchers must have specific inclusion/exclusion criteria for the population of interest in order to obtain generalizable conclusions. For example, data collected from a sample of LGBT participants (including sexual orientation and gender identity) has limited applicability when being used to compare a sample of LGB participants (sexual orientation only). While sexual orientation and gender identity issues are both considered to be LGBT issues, narrowing the population of interest to fewer subgroups can help increase the representativeness of one's findings. Knowing

some of the barriers sexual minorities can face by participating in related studies, researchers must be purposeful in considering the inclusivity of their population of interest as it relates to their research questions and goals. Due to limited sample size, previous research often grouped the LGB experience with the transgender experience, which makes results more difficult to generalize since the challenges sexual and gender minorities face can be vastly different (Moradi et al., 2010). Due to the difficulty recruiting a sufficient number of individuals within one subgroup of the LGBT community, researchers' populations of interest often include individuals with diverse sexual orientations and gender identities, despite the uniqueness of the groups within the LGBT community (Boroughs et al., 2015). For example, the challenges of a gay man likely differ from the challenges faced by a transgender gay man, and studies that group these. Sexual minority research that does not account for variation across subgroups within the community has limited generalizability.

Another critical issue in sexual minority research relates to methodology. Surveys can now be administered online and help give participants privacy and increase their ability to participate safely, thus improving sample size. However, online administration also limits methodological research designs, and in turn limits the type of research that can be done. Previous studies also highlight the lack of variability in research designs and methodology pertaining to LGB issues (Moradi et al., 2010). Over 80% of designs use a cross-sectional surveys or other correlational models, while experimental designs only represent about 15% of the studies related to LGB counseling issues (Moradi et al., 2010). Cross-sectional designs certainly have advantages of being fast and convenient, but there are limitations to this type of design, including gathering exposure (e.g., STEM environment) and outcome data (persistence, heterosexism) at the same measurement occasion (Setia, 2016). Of the LGB-related literature between 2000-2009, over 70% of the research

designs comprised survey and correlational constructs, and there was no indication that longitudinal designs were used (Phillips et al., 2003). Renn (2010) highlighted the important contributions graduate students have made in LGB research and asserted that longitudinal studies and qualitative designs generally require more time and resources compared to quantitative designs, thus making them less appealing to students. Despite this, Moradi et al. (2010) encouraged researchers to take on the challenge of conducting longitudinal studies to help address one of the major gaps in the literature.

Another obstacle sexual minority researchers face is the lack of consensus on how to define critical terms that are closely tied to relevant issues/research. A primary example of this is the lack of a measurement tools for sexual orientation. Phillips et al. (2003) described five strategies researchers have used to assess sexual orientation, which range from self-identification among sexualities listed in surveys, to responses on the Kinsey scale, to inquiring about sexual behaviors. Additionally, sexuality is fluid and exists on a spectrum; therefore participants may have difficulty identifying with the provided, often limited, options in surveys. Furthermore, researchers have not settled on how to define major terms critical to sexual minority issues (Moradi et al., 2009; Renn, 2010). For example, researchers have not reached an agreement on how to define and measure internalized heterosexism, making it particularly difficult to compare different research studies. This lack of foundation hinders researchers from building off of each other's findings and moving research forward.

For the purpose of this chapter, the terms "sexual minority" and "queer" will be defined as any individual who does not identify as "cis-gender" and/or "heterosexual." While this chapter seeks to focus on sexual orientation specifically, related literature often includes gender minorities (e.g., transgender) by using "LGBT" to include the transgender experience as well. This

inconsistency makes sense as researchers have only relatively recently started to show interest in the sexual minority population and have not yet reached an agreement regarding the best language to define the population of interest (Phillips et al., 2003). Using inclusive language (e.g., "LGBT" and "sexual minorities") enables increased participation of individuals within a disadvantaged population, however, it disregards distinctions between smaller subgroups within the population (Moradi et al., 2010). Methodological obstacles create language and definition barriers that limit the ability to compare existing data. Phillips et al. (2003) recommended that researchers explicitly note the generalizability of their conclusions due to the obstacles associated with gathering a representative sample. Thus, while the current population of interest in this chapter consists of LGB individuals majoring in STEM fields, this chapter references previous research that has used more inclusive definitions (e.g. "LGBT" or "LGBTQ") of the population of interest as they relate to problems in the STEM education and workforce.

1.1.1 Examining Systems of Higher Education in Sexual Minority Research

While the limited research related to the LGB experience in higher education has primarily focused on visibility, perceptions of campus climate, and identity, few studies utilize theoretical frameworks that would explain systemic aspects contributing to common problems the sexual minority population face (Buhrke, et al., 1992; Renn, 2010). Previous literature on LGB issues in higher education examines more of the individual-related issues (e.g., sexual identity development, relationships, and coming out) that also often fail to address the intersectionality of identities through categorical lens (Phillips et al., 2003; Renn, 2010). Phillip et al.'s (2003) literature review on LGB related articles between 1990 and 1999 suggest that authors examined such topics, but lacked theoretical underpinnings that inform them. Some of the earliest research discussed same-sex attraction as pathological, using Freud's theory of psychoanalysis. As society progressed and

LGBT issues were understood as a societal issue, theory-driven research shifted to examining special topics, such as counseling issues, coming out, and HIV/AIDS (Phillips et al., 2003). Research using a queer theory framework, which will be fully described in the next section, "enables a more contextual, less categorical examination of development" and can provide a theoretical foundation to understand systems and cultural norms, which traditional research in LGBT literature often fail to mention or analyze (Renn, 2010, p. 134). Queer theory is described in more detail later in the chapter, but can be understood as a set of theories that are useful in identifying and analyzing systematic injustices, particularly as they relate to gender, sex, and sexual orientation (Spargo, 2000). Moradi et al. 2010 highlighted the need for sexual minority researchers to look beyond the individuals and adopt multilevel research designs because researchers tend to focus on person-level experiences instead of looking at systemic factors that are creating and maintaining unwelcoming environments. This type of research design is well suited for research questions such as the underrepresentation of sexual minorities in some domains because it helps account for the important influence of contextual variables on individuals' attitudes. Systemic factors are especially relevant in systems with cultures that hinder individuals' abilities to safely express who they are. STEM fields are notoriously male-dominated and heteronormative, resulting in LGB individuals feeling unwelcomed (Abes & Kasch, 2007; Hughes, 2018; Patridge et al., 2014; Yoder & Mattheis, 2015). This culture reinforces a system benefitting individuals who are already privileged (i.e., heterosexual), and further marginalizes LGB individuals.

In order to comprehensively address the problem of underrepresentation of minorities in STEM, there is a need for conscious, purposeful action. Counseling psychologists are in an ideal position to expand LGB research using queer theory due to their professional values. In the

following section I argue that counseling psychologists can use queer theory to examine the root of problems sexual minorities face in a variety of systems, such as issues of underrepresentation of LGB individuals in STEM fields.

1.2 Relevance to Counseling Psychology

The field of counseling psychology is unique in its values, roles, settings, and professional activities (Gelso et al., 2014). Counseling psychologists have three primary roles, including remedial, preventative, and educative-developmental (Gelso et al., 2014; Packard, 2009). The remedial role involves working with clients to assist them in remedying their problems, the preventative role involves forestalling future difficulties that may arise, and the educative-developmental role focuses on enhancement and helps individuals plan, obtain, and derive maximum benefit from the experiences that will enable them to discover their potentials (Gelso et al., 2014). Counseling psychologists participate in each of these roles in many different ways through their various professional activities. Counseling psychology's values emerged from the themes established at the Northwestern Conference of 1951, including the focus on peoples assets and strengths, regardless of presenting concern, emphases on person-environment interaction in addition to education and career development of individuals (Gelso et al., 2014; Packard, 2009). The issue facing LGB individuals in STEM fields pertains to several of these themes. First of all, the attending to the person-environment interaction is imperative to fully understand LGB individuals' experiences in fields that are unwelcoming and even hostile. Secondly, counseling psychologists also emphasize education and career development, which directly pertains to LGB STEM professionals. In fact, a large portion of the LGB research tends to focus on career identity (Gelso & Fretz, 2001). The population of interest, LGB undergraduates in STEM fields, inherently has an intact personality allowing entrance to begin studying in a STEM program.

Another unique aspect of the counseling psychology field is its value on diversity and multicultural issues. Counseling psychologists support and promote multiculturalism through conducting research with marginalized populations, understanding individual's personal concerns in the context of environment forces, and advocating and respecting person's agency (Packard, 2009). Social justice is also a critical aspect of multiculturalism. Social justice is a means through which counseling psychologists can use their power to address the institutional problems that oppress marginalized populations (Constantine et al., 2007; Vera & Speight, 2003). Counseling psychologists can get involved in social justice at a variety of levels (e.g., individual, community, institutional, organizational, societal, systemic, etc.) through psychoeducational workshops, outreach, or advocating for changes in public policy to name just a few (Motulsky et al., 2014; Vera & Speight, 2003). The LGB community is an example of a marginalized population counseling psychologists are interested in advocating for. The power and privilege of counseling psychologists can be used to create and implement effective interventions for unjust systems. Counseling psychologists can use queer theory in particular to research the oppressive systems maintaining heteronormativity in STEM fields. In addition to conducting research, counseling psychologists can promote social justice through serving as consultants for organizations regarding how to create inclusive environments and optimize group dynamics. Below I provide a theoretical lens and describe contributing factors to the underrepresentation of LGB individuals in STEM fields, followed by practical and research implications relevant for counseling psychologists to explore.

1.3 Queer Theory

While previous literature suggests various strategies for LGB individuals and universities to improve the culture, none have suggested directly focusing on the system using a top-down

approach to address underrepresentation of LGB individuals in STEM fields. Although sexual minority research has established the problem of underrepresentation of LGB individuals in STEM domains, a clear solution to the problem has not yet been discovered or adopted. Because STEM's heteronormative culture is closely related to the unwelcoming environment, described in detail in the next section, research examining specific STEM systems themselves is essential to understand the factors that create unique challenges for LGB individuals in the workplace and higher education.

Queer theory represents a useful framework from which to consider issues of STEM inequity for LGB individuals. This theory can be understood as a school of thought that "critically analyzes the meaning of identity, focusing on intersections of identities and resisting oppressive social constructions of sexual orientation and gender" (Abes & Kasch, 2009, p. 620). Researchers using this framework are particularly interested in undoing the normalization that perpetuates socially constructed binaries, and emphasize the "politics of representation" (Renn, 2010; Spargo, 2000, p. 41). Queer theory challenges problematic socialization processes and serves as a useful precursor to political action research (Filax, 2006). Queer theory assumes "there is no fixed, unified, biological essential or prediscursive self" (Filax, 2006, p. 141). Examining sexuality in this way does away with the strict categorical ideology of the straight-gay dichotomy, and instead expands what is and can be considered normal. The term "queer" has historically been used as an adjective to describe qualities deemed non-heterosexual, and as a noun to describe a person who is not straight (Dilley, 2013). However, using queer as a verb in queer theory suggests investigating "the relationship between sexuality, power, gender, and conceptions of normal and deviant, insider and outsider" (Dilley, 2013, p. 39).

There are a variety of benefits to using queer theory in research. First, this perspective can be helpful in illuminating problematic assumptions that contribute to an oppressive system, and can help researchers identify and understand which identities are valued in specific settings (McCann, 2016). A queer theory framework acknowledges the role that sexuality plays in how society is organized and in dictating who has access to power. This perspective aims to examine the status quo and notice how categorical sexual identities influence access to power. Questioning the norms could create a deeper understanding of the heteronormative dualistic ideology and can allow for implementation of the most suitable policies and interventions (Yoder & Mattheis, 2016). As noted above, existing LGB research tends to lack a theoretical framework for understanding the underrepresentation of LGB individuals in STEM fields. Examining this underrepresentation problem through the lens of queer theory can fill a major gap in literature.

Second, queer theory frameworks can be applicable to broader research unrelated to gender and/or sexuality (Filax, 2006; Renn, 2010). Systematic disadvantages negatively impact a variety of identities that are oversimplified when understood categorically, such as race and class. Therefore, queer theory can help illuminate how the social pressures have influenced other identities that also permeate through all aspects of life. Queer theory offers a framework to question the systemic status quo through its refusal to normalize categorical, dichotomous identities that are typically unchallenged (Dilley, 2013; Jagose, 2009).

The queer theory perspective can also empower research participants by calling attention to unjust systems, which can help them externalize the root of their pain (Filax, 2006). For example, Bain et al. (2016) contributed to the body of knowledge through queering music therapy with LGBTQ adolescents by providing important interventions that acknowledge the systematic contributions music in the media can have on mental wellness. Establishing a personal musical

preference often plays a role in identity formation and coping for adolescents, who are simultaneously vulnerable to external influences. Clinical recommendations for music therapy with LGBTQ adolescents range from critically examining lyrics to groups collaboratively writing anthems (Bain et al., 2016). Queer research can also spark participants to become introspective about other social identities and increase self-awareness. After identifying the issue, researchers can move forward to determine best ways to improve the conditions and interrupt the problematic societal pressures.

Although there are critiques of queer theory, they do not undermine the potential impacts the framework could have in uncovering systematic oppression. First, identity categories of gender and sexuality are key components to having power (McCann, 2016). One critique claims using queer theory to address heterosexism in research may make political change difficult to achieve due to the pressures of working against heteronormative academic systems (Filax, 2006). However, Filax (2006) cautions to not "underestimate the political effects of presenting and publishing scholarship about otherwise taboo subjects" (p. 140). The heteronormativity present in culture will not change without being challenged, and queer theory provides a framework to do so through academia. Other researchers argue that queer theorists may be overemphasizing the power of sexuality in society (McCann, 2016) while other scholars understand that the dichotomization of sexual orientation lies at the core of how power is organized in Westernized cultures (Semp, 2011). While sexual orientation is only one identity that plays a role in how power is organized, it remains a source of discrimination and inequity, thus requires further investigation to effectively address the specific challenges in specific marginalized communities. Additionally, heterosexism is more pervasive in some contexts compared to others. As previously identified above, heteronormativity

and heterosexism are especially pervasive in STEM fields and pose numerous disadvantages to non-heterosexual people in the field.

A vast majority of existing literature addressing LGB issues is quantitative and cross sectional; the use of queer theory is extraordinarily rare and has not been given a chance to see if it can lead to systematic changes in this context of STEM fields. Renn (2010) noted that qualitative research on LGB issues is especially sparse. Dilley (2013) asserted one way to fill in the gaps in the literature is through using the queer theory perspective and qualitative methodology. The framework and methodology complement each other through their flexibility, and ability to analyze challenging societal categorical labels that constrain sexual minority literature. The queer theory perspective resists categorization and focuses on the role of discourse on the system, while qualitative designs can capture rich information surveys are unable to examine. At this point in the development of queer scholarship, research questions must critically analyze the system that defines who is queer and questions sexuality's role in accessing power (Dilley, 2013).

Because of the LGB community's history of institutionalized oppression, it is imperative that LGB research attends to systems and their roles in creating and maintaining problems. Examining the system can help researchers understand the culture, thus generate solutions to create a more inclusive system. Using queer theory to analyze LGB experiences in higher education, STEM specifically, is crucial to fully understand the culture and normalized problematic assumptions. In order to change a problematic system, researchers must learn as much as possible about the problem in order to be informed on interventions that are relevant, effective, and practical. Furthermore, considering the cultural acceptance of the sexual minority community over the past few decades, understanding the system is necessary in order to measure future progress and monitor effects of systematic changes (Renn, 2010).

Semp (2011) examines ways in which heteronormativity creates barriers in a therapeutic relationship and considers queer theory to be an approach to advocate for same-sex social justice issues. Semp's (2011) research exemplifies how queer theory can analyze systemic factors to "inform research and clinical practice in ways that affirm queerness by questioning heteronormativity" (p. 69). Interviews with staff and LGB-identified clients in a public mental health service revealed how heterosexist assumptions can play a role in LGB clients' experiences in counseling. Analyzing "public mental health services for same-sex attracted people" uncovered the various reasons LGB individuals may not offer information regarding their sexual orientation as well as the fact that mental health staff rarely addressing sexuality directly with clients (Semp, 2011, p. 69). Existing research guided by queer theory exposes the importance of questioning the heteronormative aspects of a system. Semp (2011) noted that it is now policy for staff in public mental health services to assess a client's sexual orientation. Just as queer theory helped researchers understand the practical implications of heteronormativity in therapy (Semp, 2011), it maybe useful to use to study STEM fields as well, especially in relation to the sexual minority population. Identifying and understanding the STEM system and the factors that create challenges for sexual minorities will shed light for future research and how to best intervene.

Generally, LGB research pays little attention to the intersectionality of sexual identity and specific contexts (Renn, 2010). Counseling psychologists, who acknowledge the importance of the person-environment interaction (Vera & Speight, 2003), can build on LGB literature by using the queer theory framework to address issues in higher education and career development from a culturally informed perspective. Scholarship impacts what policies are needed and which policies are implemented; therefore, change in any system is dependent on being properly represented in literature (Freeman, 2020). Increased visibility of LGB experiences in research can fuel the efforts

to promote equity and inclusivity in policy, while providing practitioners with a better understanding of STEM systems the clients may be navigating (Mattheis et al., 2019; Renn, 2010). Previous literature about STEM fields suggests the environment and culture pose unique challenges to women and racial minorities, but research regarding how the field's climate impacts sexual minorities and their representation in STEM is still scarce (Yoder & Mattheis, 2016).

1.4 The STEM Climate

Understanding the basic approach of a queer theory lens is useful in trying to understand the multitude of challenges commonly faced by LGB individuals in STEM workplaces and educational environments. The stereotypical STEM professional is a White, heterosexual, cis-gender male who adheres to the masculine gender script (Shin et al., 2016; Yoder & Mattheis, 2016). Therefore, the majority of people in STEM hold values that benefit them and are likely unmotivated and/or unaware of the obstacles minorities in STEM must overcome, which may blind them from the obstacles that STEM minorities face. Furthermore, due to the value placed on technical competence and objectivity in STEM, personal lives are perceived as having little value and relevance to the work (Bilimoria & Stewart, 2009).

Researchers have identified significant contextual factors contributing to LGB underrepresentation in STEM, including a competitive environment and heteronormative and heterosexist cultures within STEM fields. First of all, cultures within STEM fields tend to value masculine, competitive, individualistic mentalities that can influence how individuals behave in scenarios in which competence is tested; in efforts to establish superiority to others, competitive students and employees often behave cold and aggressive toward others resulting in impersonal, distant relationships (Morganson et al., 2010; Pedersen & Minnotte, 2017). Cech and Pham (2017) noted that "hostility toward non-heterosexual and non-binary gender expression often

accompanies social contexts dominated by hegemonically masculine gender performances", which allows heterosexist and heteronormative attitudes and beliefs to take root (p. 10). Indeed, STEM environments often emphasize the attainment of agentic goals, or goals that prioritize self-interests, as opposed to communal goals, which support "the interests of others" (Diekman et al., 2017, p. 143). Previous research noted the tendency for women to gravitate towards and persist in careers requiring human connection generally and within STEM, suggesting that women perceive fields that promote communal goals as more appealing (Diekman et al., 2017). The underrepresentation of women in STEM is likely a reflection of the gender role stereotypes (i.e., that women should be caretakers and men should serve as providers) that imbue these environments and leave women feeling as if they do not belong in the STEM community. The same is likely to be true for LGB individuals, but the reasons for low STEM participation and persistence rates among LGB individuals have not been thoroughly examined.

While the literature suggests that aspects of STEM environments make it challenging for women based on gender roles, such environments also pose unique challenges for individuals with an LGB identity. One aspect is the unique influence the STEM climate can have on sexual minorities. Heteronormativity refers to the assumption of heterosexuality in others as normal and natural, which in effect erases and silences the non-heterosexual experience (Yoder & Mattheis, 2016). Heteronormativity is a powerful force giving privilege to straight people while creating disadvantages for sexual minorities. Heteronormativity also underpins dualistic thinking commonly seen in STEM fields and can manifest through narrow, rigid, close-minded expectations regarding how "gay" and "straight" people behave, or the activities men and women "should" perform (Yoder & Matthies, 2016). For example, in engineering, technical and social skills are treated as binary traits, with masculinity associated with technical skills, which are valued over

femininity associated with social skills (Cech & Waidzunas, 2011). This dualism expands into sexual orientation as well. In fact, bisexual individuals face a unique challenge as identifying "between" gay and straight, and can get "pushed into" a categorical identity that misrepresents them (Cech & Waidzunas, 2011). Heteronormative ideology consequently leads to depreciating deviations from a cis-gender, heterosexual lifestyle.

Another major influence on STEM culture, heterosexism, takes heteronormativity a step further. Heterosexism, as defined by Herek (1992), is "an ideological system that denies, denigrates, and stigmatizes any non-heterosexual form of behavior, identity, relationship, or community" (p. 89). The field's climate leads to exclusivity, resulting in a homogeneous, male-dominated group of people who emphasize traditional socialized gender roles and share similar experiences/backgrounds (Cech, 2015; Maranto & Griffin, 2011). Heteronormativity and heterosexism encourage adherence to gender role expectations and discourage individuals from outwardly presenting as not conforming to the heterosexual norm (Hughes, 2018). It is important to acknowledge that this problematic culture permeates STEM through both the workplace and college context, which could help explain the underrepresentation of LGB faculty in higher education.

The heteronormative environment in higher education is often adopted by students and replicated in the workforce, which fuels the unwelcoming environment maintaining underrepresentation of LGB individuals in STEM fields. Heteronormative STEM cultures also negatively impact LGB students' experiences of belongingness, which is one factor that predicts student persistence (Smith et al., 2013). Because LGB faculty are also underrepresented in STEM, LGB students have limited access to the benefits of having role models who share their marginalized identities. Role models who experienced similar challenges can provide evidence to

undergraduate students that it is indeed possible to overcome the challenges and work as a STEM professional (Crocker, 2011; Shin et al., 2016). However, climates in STEM departments are not conducive for faculty members to be open about their sexual orientation. About 70% of LGBTQ faculty members in STEM who are out describe feeling uncomfortable in their department (Patridge et al., 2014). Researchers have found that exposure to in-group role models improves academic interest, self-efficacy, and professional belongingness for women and racial minorities in STEM, however, similar studies do not exist for LGB-identified STEM students (Crocker, 2011; Drury, 2011; Shin et al., 2016).

The homogeneous makeup of STEM professionals (i.e., underrepresentation of LGB, women, and racial minorities) allows heterosexist/heteronormative attitudes to fester without being challenged, which perhaps is the most dangerous aspect of STEM cultures, as these harmful attitudes are likely to become an insidious part of the system with ideologies that can be carried over into the workforce. Overt harassment and hostility are not likely to be stopped, which could be due to unawareness of problematic behavior and/or a lack of interest. Individuals within these climates often narrowly view success as reflecting achievement of technical competence, which limits receptiveness to discussions about structural inequalities in STEM fields (Allen-Ramdial & Campbell, 2014; Hughes, 2018). It is crucial to acknowledge that the challenges LGB individuals face in STEM domains is due to the context, not the individual. While it is important to know how the STEM culture impacts LGB individuals, which is described below, intervention at the systemic level, using queer theory, is needed to address these issues.

1.4.1 Impacts on LGB STEM Majors

Experiences in the STEM environment have a variety of negative impacts on LGB students that accumulate to negatively affect well-being through experiences within a hostile environment and difficulty aligning career and personal identities. LGB majors describe worrying about "outing"

themselves or acting gay in STEM spaces and may try to hide their sexuality by omitting pronouns of a significant other or lie about sexuality due to fear that if their sexual minority status were known, they would not be seen as a credible STEM professional (Cech & Waidzunas, 2011). Living a closeted life in STEM may also require LGB individuals to compartmentalize their personal and professional lives. Not only does a strict separation limit what is acceptable to discuss with other STEM professionals, but it also requires LGB folks to suppress parts of their authentic selves in their professional domains (Cech & Waidzunas, 2011). After realizing the magnitude of heteronormativity and heterosexism in their academic environments, many LGB majors may worry about the future of their career, or if there will even be a future, which is exacerbated by lack of role models in the field who could help enhance undergraduate's sense of belongingness in STEM (Cech & Waidzunas, 2011; Crocker, 2011; Shin et al., 2016). The unique obstacles LGB individuals face in STEM takes a negative toll on emotional, physical, and interpersonal health (Cech & Waidzunas, 2011; Kashubeck-West & Szymanski, 2008).

Another barrier LGB STEM majors must navigate relates to identity. The development of career identity is one factor associated with persistence (Robinson et al., 2018). For example, the heterosexist environment also negatively impacts LGB STEM majors due to the difficulty LGB students experience with aligning personal and professional identities within the unwelcoming setting (Cech & Waidzunas, 2011; Freeman, 2020). Due to this dissonance experienced in the STEM, LGB individuals may distance themselves from their professional field and/or LGB identity, creating social and academic isolation. Furthermore, the underrepresentation of LGB in STEM limits the possibility of connecting with others who are also fighting the same battle and the heterosexism pressures LGB people to hide their sexuality, resulting in additional isolation (Cech & Waidzunas, 2011; Freeman, 2020). LGB individuals in STEM who are out of the closet

describe feeling the need to compensate for their academic work to prove their technical competence in order to avoid their sexuality discrediting their ability (Cech & Pham, 2017). For example the dualistic, heteronormative ideology "often conflates homosexuality with technical competence," and leads to LGBT students feeling as if they need to work harder than straight counterparts (Cech & Pham 2017; Cech & Waidzunas, 2011, p. 1). The overall dissonance that LGB individuals face within STEM fields contributes to the poor retention of LGB STEM majors and helps explain the underrepresentation of LGB individuals in the STEM workplace as well (Cech & Waidzunas, 2011; Fassinger, 2008).

In summary, STEM cultures pose numerous challenges for LGB individuals that impact their access to participating in these fields. The competitive ideology that allows for homophobic hostility to occur without being challenged, the pressure to remain closeted and live compartmentalized lives, and overall lack of support from peers and faculty are all factors that put LGB individuals at a disadvantage compared to their heterosexual peers. This unwelcoming culture dissuades potential students from entering STEM in the first place, and as a result, LGB students are underrepresented in STEM fields, and restricted from enjoying the benefits of being a STEM professional, including financial and social power. While there are certainly individual differences within specific STEM careers, according to the U.S. Bureau of Labor Statistics, the average wage for STEM occupations is twice as much as the non-STEM wage national average (Fassinger, 2008; Fayer et al., 2017; Robnett et al., 2015). Data gathered from surveys indicate that LGBT people in the U.S. have over ten percent higher rates of food insecurity than non-LGBT folks, in fact, up to 25% of LGBT individuals make less than $24,000 a year (LGBT Demographic Data Interactive, 2019). It is also important for sexual minorities to have access to the benefits of the STEM profession to move toward a more equitable environment. Many efforts to increase

diversity often fail to include the sexual minority community, and instead prioritize racial and gender diversity (Allen-Ramdial & Campbell, 2014; Patridge et al., 2014). The climate in STEM forces sexual minorities to manage what appear to be conflicting identities, and many leave the field to find solace in a major that is more accepting of sexual orientation diversity. Thus, diverse representation in these lucrative fields is imperative to avoid a single, homogenous group reaping the benefits (Robnett et al., 2015).

1.5 The Need for Research of LGB STEM Majors

Overall, the underrepresentation of LGB individuals within STEM fields parallels the poor representation of LGB individuals in scholarly literature overall. There is an abundance of literature on women and racial minorities in STEM; however, research on the sexual minority population is quite limited (Hughes, 2018). One reason for the limited available research on LGB issues is due to the fact that universities have historically refused to include questions about sexual orientation in surveys gathering demographic data, which has limited opportunities to complete longitudinal research. Hughes (2018) used an early data set from 2011 and 2015 to conduct a rare longitudinal study focusing on sexual minority issues. First year students majoring in STEM were surveyed in 2011 and again in 2015 to compare persistence in heterosexual and non-heterosexual students from 78 different universities. Results revealed that heterosexual STEM majors persisted at a rate above average, and about 7% more sexual minority participants left the field altogether. These longitudinal findings support previous research that claims sexual minorities have lower persistence rates than heterosexual peers in higher education (Cech & Waidzunas, 2011; Fassinger, 2008; Hughes, 2017). Using a variety of research methods helps corroborate previous findings and can also shed light on issues using a different research perspective.

LGB issues, such as experiencing heterosexism, would likely be better resolved if given proper visibility in scholarship. Without the benefit of adequate representation in research it is difficult for institutions to detect problems, such as a particular population's poor persistence, let alone create and implement effective interventions. For example, researchers have investigated the challenges that masculine cultures create for women who pursue STEM in order to understand underrepresentation and poor retention in these fields (Morganson et al., 2010). Studying gender in the STEM culture has revealed that, despite no true difference in intellectual performance, women in STEM perceive themselves as having to try harder than male counterparts due to an "innate talent" that only men possess. However, this effect is minimized by "normalizing effort" that all STEM students must exert to succeed (Smith et al., 2013, p.132). The research regarding women's challenges in STEM has helped inform effective interventions while the same attention has not been given to LGB students in STEM and the disadvantages to sexual minorities.

Garvey and Rankin's (2015) recent research focused on sexual minorities and revealed important implications for students and faculty in relation to their university climate. The study used previous data to help capture the experience of over 5,000 self-reported queer participants' responses regarding gender identity, the coming out process, and perceptions of campus climate (Garvey & Rankin, 2015). Results indicated that (a) queer cis-gender women expressed more outness compared to queer cis-gender men and transgender participants, (b) queer, cis-gender women perceive the classroom climate more favorably than queer, cis-gender men and transgender participants, and (c) transgender participants perception of the overall campus climate was significantly lower than queer, cis-gender men and women. The study suggests practical implications that universities and instructors can easily implement, such as including queer authors in classroom readings and regularly reminding students of resources that can benefit queer students

(e.g., LGBT centers, support groups, counseling, and relevant policies; Garvey & Rankin, 2015). While this study helped illuminate perceptions of campus climate, future research is needed focusing specifically on STEM fields through a systemic lens.

Existing literature does not fully attend to the systematic make up of STEM that is permitting the heterosexist climate. The system itself maintaining the heteronormative biases and unquestioned systematic norms need to be examined using a queer theory approach to improve the context and culture of STEM fields for LGB individuals in those majors. Some LGB literature examines personal experiences, however, there is particularly limited scholarly work using queer theory to address STEM field's systemic force that enables heterosexism and heteronormativity.

Additional research about LGB issues in STEM fields can also highlight that welcoming marginalized groups to enjoy benefits associated with being in STEM would also advance the STEM fields themselves. Diversity improves the functioning of the group through improvements in decision-making and problem solving. Diverse groups benefit from exposure to a wide range of various perspectives that minimizes groupthink and encourages individual creativity, while homogenous groups are restricted in analyzing problems through a narrow lens (Galinsky et al., 2015). STEM fields have contributed significantly to the growth and development of the nation's economy over many decades despite homogenous makeup of its professionals (Patridge et al., 2014). Although underrepresented minorities in STEM have a lower retention rate than White, heterosexual males, increased diversity could help rectify this issue due to its positive association with improved retention (Fassinger, 2008). Additional research may help STEM fields acknowledge the lack of attention given to sexual minorities in addition to other minority groups, and lead to efforts that may have the capacity to increased diversity STEM fields and bolster the economic growth to closer to its full potential.

Diversity can be directly related to how successful a team performs on a project, as it is positively associated with creativity and innovation (Hughes, 2018). In other words, a team made up of straight, cis-gender White men may lack the ideas a diverse team would offer. STEM fields directly benefit from having professionals who offer novel ideas; having a variety of identities represented allows individuals from completely different perspectives to exchange thoughts and built upon each other's contribution in a creative, collaborative way. Although STEM professionals tend to disregard the importance of personal background, each person's life experiences spill over into their work life and affect their worldview (Pedersen & Jodin, 2016). Therefore, regardless of whether or not personal identities are acknowledged in STEM, they still impact the way people think and perform. Furthermore, the stereotypical STEM professional has privileged identities that may consequently hide obstacles minorities must overcome, especially due to the STEM's impersonal nature (Freeman, 2020). This lack of diversity hinders teams from learning about lesser-known problems and using their talents to serve marginalized populations. A diverse team composed of various backgrounds can illuminate issues in which team members with more privilege are unaware of, consequently increasing the ability to use skills to aid populations with less obvious obstacles to overcome.

While research on LGBT issues continues to increase, there is a need for researchers to focus specifically on sexual minority's experiences in STEM fields. In order to identify appropriate interventions, LGBT underrepresentation in STEM fields needs to be explored further. It is clear that increased diversity of STEM will benefit the field's work, in addition to providing advantages to a historically marginalized group. A better understanding of LGBT STEM majors is needed to inform how to best intervene, particularly at the systematic level. I call on counseling psychologists,

as outlined in the next section, to fill this gap in the literature due to the congruence in their various roles and values as they relate to the issue of focus.

1.6 Implications and Future Directions for Counseling Psychologists

Understanding the system of STEM and how it impacts LGB communities has a variety of implications for counseling psychologists, one including clinical practice. Researchers have identified the variety of negative consequences heterosexism can have on well-being, particularly in the LGB population. As previously mentioned, heterosexism permeates throughout numerous aspects of life, therefore, it is especially imperative for practitioners to acknowledge their own personal biases and its power on the client (Filax, 2006; Kashubeck-West et al., 2008). It is important for clinicians to be aware of the STEM climate in order to fully understand LGB STEM majors and the unique challenges it poses for them. McGeorge and Carlson (2011) provide a variety of suggestions for LGB affirmative therapy, such as using non-heteronormative terms to "communicate openness that clients may be LGB" (p. 22), and deconstructing heterosexist experiences with clients. Providing accessible mental health services for LGB STEM majors may help struggling LGB students navigate the STEM environment. Therapists may also use systems-informed therapy to help clients recognize and externalize injustices and work towards empowerment. Counseling psychologists can also lead group therapy to help clients to process heterosexism and its impacts for LGB STEM majors (Smith & Ingram, 2004). Group therapy also allows clients to realize there are others struggling with similar issues (Lenihan, 1985). Due to the pressure to separate personal lives from professional life, LGB students in STEM often compartmentalize their personal and academic life often feel alone and isolated, thus group therapy would benefit these individuals and create the opportunity to connect with other people who are

struggling with similar concerns. LGB support groups also allow more opportunity to process subtle discrimination that heterosexual therapists may be blind to (Lenihan, 1985).

Counseling psychologists can also provide outreach to the LGB community to demonstrate their commitment to social justice (Vera & Speight, 2003). Outreach and prevention are often provided to meet the client demand university counseling centers (UCC) cannot address in individual or group therapy. Golightly et al. (2017) suggest the benefits of using a social justice framework to guide outreach activities. Outreach emphasizing social justice aims to systematically address imbalances of power and access to goods, while focusing on marginalized communities that may benefit from programs (Golightly et al., 2017). Targeting STEM departments in universities would be one way for counseling psychologists to advocate for LGB STEM majors. Outreach programs can educate the community about a variety of mental health and multicultural topics, such as providing information about the counseling center's services offered or multicultural issues. Counseling psychologists can create outreach programing for STEM fields to increase awareness regarding STEM's lack of diversity and promote inclusivity through displaying signs in department buildings or hosting tabling events on campus.

While the implications listed above are likely to benefit LGB STEM majors at the individual and group level, there are also crucial implications for future research, as counseling psychologist are also integral in representing LGB issues in STEM fields in literature to best intervene at a systemic level. It is crucial for future researchers to examine sexual minority disparities at a systematic level. Through applying queer theory, counseling psychologists can conduct such research by uncovering unconscious assumptions within STEM departments. This research could help highlight specific aspects about the system that are excluding sexual minorities and ultimately, shed light on LGB individual's underrepresentation in STEM fields in academic

literature. Research can illuminate the problem and inform policy changes aimed to combat LGB underrepresentation in STEM majors, however, they currently do not suffice. Queer theory can help unpack how heterosexism is manifesting and also can help researchers take a broader look at other systemic factors. If properly funded, counseling psychologists could provide LGB STEM majors support groups, diversity initiatives, and mentor programs (Freeman, 2020). Counseling psychologists could also create programing for STEM fields to help shift the field's norms by providing bias training or other psychoeducation to all members in the field. With proper funding, counseling psychology researchers could test initiatives that have been helpful for improving gender and racial representation in STEM fields to examine if they are similarly helpful at preserving STEM identity for LGB majors (Chang et al., 2014).

1.7 Conclusion

Scholarship on LGB issues has certainly progressed significantly since its initial publications. Before the American Psychological Association (APA) denounced homosexuality as a mental health concern, the vast majority of literature on LGB issues was overtly heterosexist in its focus on diagnosing and finding a cause for homosexuality (Morin, 1977). Follow-up literature reviews showed dramatic progression in the content of LGB studies: between 1978 and 1989, Buhrke et al. (1992) identified no articles relating to assessment or evaluation of homosexuality. Although literature that pathologizes homosexuality has diminished, other subtle forms of heterosexism bias persist, such as the underrepresentation of bisexuality in sexual minority research (Phillips et al., 2003).

Counseling psychology's values are reflected through published literature. The field successfully shifted its understanding of homosexuality as a sinful mental illness to reframing research to focus on more useful topics such as clinical implications with LGB clients or identity

development. The progress made in literature enables sexual minority issues to be examined with "heterosexist environments" increasingly in the 1990s (Phillips et al., 2003, p. 47). While STEM fields have been identified as a particularly heterosexist environment, there are remaining gaps in the literature about the system that could help inform social action. Counseling psychologists should continue to examine STEM environments, however, they should shift their focus to the system itself to uncover problematic norms maintaining heteronormativity through a queer theory lens.

While existing literature on sexual minority issues are difficult to compare and have mixed results on various methodological challenges, researchers consistently report that LGB individuals are underrepresented in STEM fields, and that the STEM environment creates challenges for sexual minorities that heterosexual STEM professionals do not have to face. Counseling psychologists are well equipped to use their professional skills to promote diversity in STEM fields. Using queer theory, researchers can examine the aspects of the STEM system that promote heterosexist biases through disrupting assumptions that make up the system. Considering the alignment between the current issue and counseling psychology's values and skills, counseling psychologists have a responsibility to continue their contribution to literature through promoting diversity in STEM. Diversifying STEM fields will improve its inclusivity, enhance performance and innovation, and increase access for marginalized populations to enter and enjoy the field's financial and social power.

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CHAPTER 2. STEREOTYPE THREAT, VOCATIONAL IDENTITY, AND PERSISTENCE AMONG LGB STEM MAJORS: EXPLORING THE MEDIATING ROLES OF BUNROUT AND IMPOSTER PHENOMENON

This chapter documents an empirical study of the relations among threats to identity and self-esteem, academic burnout, and persistence intentions, or "the degree to which an individual chooses to continue in a chosen area of study" among LGB-identified individuals in science, technology, engineering, and mathematics (STEM) (Wilkens-Yel, et al., 2018, p. 68). First, I provide a brief review of the literature. Next, I describe and review literature on the theoretical frameworks that guide the study – stereotype threat theory and imposter phenomenon theory. Then, I discuss the variables used in the current study, how they relate to the guiding theories, and provide operational definitions used for the current study. The chapter concludes with a presentation and interpretation of the results, followed by implications for future research and intervention with the LGB population in STEM.

Systemic barriers in the United States continue to create disadvantages for individuals with marginalized identities. Individuals with one or more minority identities are underrepresented in a variety of domains, particularly in science, technology, engineering, and mathematics (STEM) fields (Moran, 2017). While many researchers are studying women and racial minorities in STEM, lesbian, gay, and bisexual (LGB) underrepresentation in STEM is largely overlooked and ignored (Cech, 2015; Patridge et al., 2014; Robnett et al., 2015). Data relating to LGB individuals' experiences is sparse in part due to the failure of organizations to include information regarding sexual orientation when collecting demographic information (Hughes, 2018). It is also important to acknowledge that LGB STEM majors are not only underrepresented, but also have a higher attrition rate compared to heterosexual STEM majors (Hughes, 2018). Underrepresented

minorities persist at lower rates than White men in STEM fields, perhaps due to unique obstacles faced throughout their education and career (Ong et al., 2018). Due to the underrepresentation LGB individuals encounter in STEM fields, it is critical to understand more about their experiences to inform potential solutions.

Previous research suggests a variety of reasons that may contribute to the underrepresentation and low persistence of LGB majors STEM fields. One factor that may play a role in this process is the degree to which LGB individuals identify with the STEM career domain. Individuals who share a common set of interests, values, and beliefs with others in a social group tend to feel a greater sense of belonging to that group (Turner, 1982). LGB STEM majors who feel a sense of solidarity with other STEM majors should therefore be less likely to lose interest in STEM and switch majors. STEM identity is strongly correlated with persistence and may therefore add to the understanding of minority groups' poor retention in STEM domains (Robinson et al., 2018). However, there still remains a question as to which factors are associated with a strengthening or weakening of STEM identity.

The heterosexism that is common in STEM environments also creates a hostile atmosphere for LGB individuals (Hughes, 2018). It is possible this environment contributes to the underrepresentation of LGB majors, which alone creates a multitude of challenges for individuals with marginalized identities, such as increased vulnerability to encounter stereotype threat (Tine & Gotlieb, 2013). Stereotype threat**,** or the fear of confirming a stereotype about one's group, not only has negative effects on performance, but can also trigger physiological and psychological distress (Ben-Zeev et al., 2005; Croizet et al., 2004; Martens et al., 2006; Steele et al., 2002). Stigma consciousness, or the extent an individual expects to be stereotyped by others, is another factor important to include when attempting to understand LGB underrepresentation in STEM

(Pinel, 1999). Furthermore, individuals who are high in stigma consciousness are not only prone to perceiving discrimination as stemming from their marginalized identity, but also seek to avoid situations that may highlight their stereotyped group membership (Pinel, 1999). Underrepresentation is also linked to burnout, which represents the weakening of emotional energy consisting of feelings of emotional exhaustion, cynicism, and reduced personal accomplishment (Maslach et al., 2001). Burnout has a variety of negative outcomes, including decreased productivity and satisfaction, rifts in interpersonal relationships, and is even considered an antecedent of negative mental health consequences (Maslach et al., 2001).

Another factor that may contribute to weakening of STEM identity among LGB majors is referred to as the imposter phenomenon (IP). IP represents an "internal experience of intellectual phoniness" (Clance & Imes, 1978, p. 1) that is marked by the belief that one has fooled others regarding their competence in a given domain. Given these concerns about authenticity and social perceptions of competence, IP is also accompanied by a fear of being exposed as an imposter (Sakulku & Alexander, 2011). Individuals who feel like an imposter disguise their anxiety and are generally unable to enjoy their achievements, which negatively impacts mental health (Joshi & Mangette, 2018; Sakulku & Alexander, 2011). Predictors of IP include little familial support, perfectionistic tendencies to set impossibly high expectations for themselves, and neuroticism (Sakulku & Alexander, 2011). Researchers revealed that high achieving ethnic minorities experiencing IP withdraw from the field in an effort to reduce IP, however, the implications of these behaviors will further limit the chances of continuing in the field (Joshi & Mangette, 2018).

Low persistence is a problem among STEM students in general, however, LGB undergraduates are likely to be even more prone given that they leave the field at a higher rate than their heterosexual peers (Hughes, 2017). High levels of stereotype threat, burnout, and imposter

phenomenon are associated with low persistence however; these findings have not been extended to sexual minority populations in STEM (Maslach & Jackson, 1981; Parkman & Beard, 2008; Steele et al., 2002). Similarly, though research suggests that diminished identity in a career domain predicts attrition, research has not examined this relationship for LGB undergraduates in STEM. The present study uniquely uses each of the variables described in one model, and is interested specifically in LGB participants majoring in a STEM field to help explain the population's underrepresentation and poor persistence.

2.1 Primary Guiding Theoretical Framework: Stereotype Threat Theory

Steele and Aronson (1995) define stereotype threat as the fear of confirming a stereotype about one's identity group. Experiencing stereotype threat on a regular basis can be a significant obstacle that can negatively impact performance in relevant stereotyped tasks. In many cases, negative stereotypes that are made salient and align with one's identity increase the plausibility for that person to confirm the stereotype, which can impede performance (Cadinu et al., 2005). This effect tends to occur whether or not a person believes in the stereotype and has impacts even if one denies the stereotype will impact performance (Steele et al., 2002). Stereotype threat can be triggered by task demand, people, and context (i.e., situational). For example, women are more vulnerable to experience stereotype threat in mathematics courses, however, this threat would not be relevant in art or history courses (Logel et al., 2009). The meaning of the stereotype is another relevant factor in its impact. In other words, stereotypes that target a group's intellectual abilities are considered more threatening than stereotypes that target a group's comedic preferences (Steele et al., 2002). A physiological consequence of stereotype threat is increased arousal, which hinders performance on difficult tasks (Ben-Zeev et al., 2005). Finally, exposure to sustained arousal over time can result in emotional exhaustion, a core component of burnout, which is also associated

with lower performance (Bedyńska & Żołnierczyk-Zreda, 2015; Ben-Zeev et al., 2005). This effect is particularly relevant due to the challenging nature of many STEM fields.

The extent to which an individual identifies with the threatening domain is an important aspect when considering the intensity of stereotype threat. A person who identifies with a domain is deeply interested in it and has a desire to continue involvement in the future. In these situations, a person would detest being the target of a negative stereotype within that domain. Additionally, a strong identification with a threatened identity is associated with experiencing increased stereotype threat in the relevant situations in which it applies (Steele et al., 2002). For example, if gender identity is an integral part of one's self-concept, a woman would experience increased levels of stereotype threat completing a math task compared to a woman whose gender identity as a woman is not important to her. Strong identification in the threatened domain increases the negative stereotype's relevance for the target individual

2.2 STEM Identity

STEM identity will be defined as the extent to which individuals endorse the idea that being a STEM professional is a critical aspect of their self-concept (Robnett et al., 2015). Several researchers have acknowledged the importance of STEM identity in persistence and its positive impact on graduate's career outcomes (Carlone & Johnson, 2007; Meyers et al., 2012; Robnett et al., 2015; Williams & George-Jackson, 2014).

Identity development changes over time and is affected by context (Carlone & Johnson, 2007), suggesting that strength of STEM identity is dependent on one's experiences in STEM fields. Due to the climate in STEM, underrepresented populations report feeling unwelcome in the field, which may negatively impact their formation of STEM identity (Cech, 2015; Williams & George-Jackson, 2014). Williams and George-Jackson (2014) underscore the gender difference in

men feeling more comfortable than women identifying as a scientist. Because higher levels of domain identification is linked to motivation and has positive impacts on performance, STEM identity could play an important role in mediating effects on persistence (Osborne & Walker, 2006). Disidentifying with one's career domain was seen to be a significant predictor of attrition in some racial minority populations; however, this research has not been extended to sexual minorities (Woodcock et al., 2012). Considering how common heterosexism is in STEM domains, and that STEM identity is partially dependent on individual's experiences within STEM fields, it is plausible that the STEM culture negatively impacts how LGB individuals develop their STEM identity.

2.3 Disidentification and Persistence

There are a variety of responses to facing stereotype threat including domain avoidance, self-handicapping, disproving the stereotype, and disidentification (Steele et al., 2002). Disidentification is of particular relevance in the current study due to the interest in students' intentions to persist in STEM. When individuals continuously face stereotype threat, they tend to disidentify from the domain (i.e., STEM fields) or threatened identity (i.e. STEM identity or sexual minority status) (Steele et al., 2002). Individuals who face chronic stereotype threat who are highly identified with the threatening domain are less likely to persist than low-identifying individuals. This is because highly identified individuals experience effects of stereotype threat as more abhorrent than low-identifying individuals, creating a stronger demand to withdraw from the domain (Osborne & Walker, 2006).

Those who choose to disidentify with the threatening domain initially psychologically disengage, avoid the setting, and decrease participation. LGB STEM majors experiencing stereotype threat may initially psychologically disidentify and create distance between their self-

esteem and performance in the threatening domain (Major et al., 1998). Psychological disidentification can also include devaluing the domain and perceiving it and relevant performance feedback as unimportant (Schmader et al., 2001). Disidentification could manifest behaviorally through enrolling in minimum required STEM classes or refraining to ask STEM faculty for help due to fear of confirming negative stereotypes about their group. One long-term effect of stereotype threat is disidentification from the threatening domain altogether. In order words, when LGB STEM majors continuously experience situations that threaten their identity for years on end, disidentification with that identity can reduce the stereotype's negative effects. For example, LGB STEM majors may solve the problem through eliminating their identity as STEM professional (e.g., 'engineer,' mathematician,' 'scientist'), or changing their major to a more accepting and less heteronormative field. Disidentification also protects self-esteem through avoiding negative feedback that is perceived to confirm the negative stereotype (Major et al., 1998). Those who disidentify are also able to protect their self-esteem by building it in other domains that are free from stereotype threat.

While disidentifying with the identity of a STEM professional can help reduce the cognitive dissonance sexual minorities experience between their career identity and sexual orientation identity, individuals can also disengage from the personal identity that is being threatened (Schmader et al., 2008). If LGB STEM majors face stereotype threat and do not disengage from the domain in some way, they are left in a state of incongruence in which their professional identity conflicts with their sexual orientation identity. According to stereotype threat theory, if individuals do not disidentify with the stereotyped domain (i.e., STEM), they may disidentify with the stereotyped identity (i.e., sexual orientation identity) in order to reduce conflict within the domain and protect self-esteem (Schmader et al., 2008; Steele et al., 2002). This means

that if an LGB STEM major strongly identifies with his/her STEM identity, in order reduce anxiety in STEM, he/she may distance him/herself from their sexual orientation identity. Disidentification may include suppressing behaviors that may be considered stereotypically gay within the threatening setting and conforming to gendered social norms (Bilimoria & Stewart, 2009). Despite the identity an individual chooses to disengage from, stereotype threat can lead to an individual restricting his/her expression of his/her true self.

Previous literature focusing on women and racial minorities has demonstrated disidentification as a result of stereotype threat. In Major et al.'s (1998) study, African American students who experienced negative racial stereotypes about intelligence were more likely than European American students to detach their self-esteem from their performance in the academic settings. Woodcock et al. (2012) investigated stereotype threat and disidentification with African American and Hispanic science students. While the results showed both racial minority groups face stereotype threat in science, other contextual variables such as numerical representativeness, impact experience such that African Americans experienced significantly higher levels of threat. Women's underrepresentation in STEM fields has also been a focus in stereotype threat literature. For example, researchers report women vulnerable to stereotype threat demonstrated elevated heart rates and diminished belongingness to the domain (Murphy et al., 2007), while other studies have shown improved performance on math tasks when steps are taken to minimize stereotype threat (Spencer et al., 1999).

Other researchers have extended traditional stereotype threat principles beyond racial minority groups and women in male-dominated fields; these studies have been pivotal in informing efforts to minimize the negative impacts of stereotype threat that can ultimately trigger disidentification. However, these findings have not been extended to the LGB population despite

their underrepresentation and discrimination in these academic STEM-related fields. Given that sexual orientation is an invisible marginalized identity, more information is needed to understand how LGB STEM students navigate disidentification with these threatening domains and identities. Furthermore, it is unclear as to what factors might mediate the relationship between stereotype threat and STEM identity. The direct relationship between stereotype threat and STEM identity seems to vary across groups and is inconsistent. Some individuals disengage with the threatening domain to align with their personal identities, while others may attempt to increase their engagement and identification of the domain to compensate for the cognitive dissonance. Steel et al., (2002) describes the latter response as counterstereotypic behavior, in which individuals with marginalized identities who highly identify with the threatened domain increase engagement in efforts to "disprove" the stereotype and convey it does not apply to all group members. In the following sections, I discuss two potential mediators in this process: impostor phenomenon and burnout.

2.4 Secondary Guiding Theoretical Framework: Imposter Phenomenon

The Imposter Phenomenon (IP) (also referred to as "Imposter Syndrome" in some literature) was originally defined as "an internal experience of intellectual phoniness" (Clance, 1985, p.71). This feeling is rampant in higher education, yet is also relevant in undergraduate education (Joshi & Mangette, 2018). IP elicits workaholic tendencies to compensate for the "phoniness" sufferers internalize (Joshi & Mangette, 2018, p. 1). However, one key characteristic of IP is the inability to attribute success to internal factors (e.g., intelligence, skill, ability; Parkman, 2016). Although people experiencing IP are often perceived by others to be high-achievers, they struggle to internalize achievements and tend to attribute success to external factors. IP is characterized by high levels of self-doubt, which has a negative impact on self-esteem (Hermann et al., 2002;

Sakulku & Alexander, 2011). Individuals who experience IP disregard positive recognition from others and internalize each failure as proof of their fraudulence and low self-worth. Consequently, these individuals experience pressure to maintain their disguise to avoid being discovered (Clance & Imes, 1978).

IP is linked to a variety of negative consequences. In order to hide their perceived fraudulence, individuals experiencing IP downplay their ability, thus hindering their own ability to internalize success and forego the opportunity to recognize the abilities that allow them to belong in the domain (Parkman, 2016). Turning these opportunities down due to fear of public failure helps protect against being "found out," however, it also leads to reduced involvement. Parkman and Beard (2008) claim "the most significant impact of imposter behavior is the tendency to burn out, check out, and leave the organization" (p. 29). IP can be construed by people as a threat to their self-esteem, and disidentifying with the field can help protect it. Other researchers, however, note that some people respond to IP by increasing their dedication to the field and increasing engagement to overcompensate for their internal self-doubts, which can increase identification in the field at the cost of dissatisfaction for the domain itself (Parkman, 2016). Other consequences of IP include an increase in anxiety and depression, decreased self-confidence and self-efficacy, and minority student status stress (Hutchins et al., 2018; Parkman, 2016; Want & Kleitman, 2006).

Experiences of IP are common in university contexts, and some academic domains trigger IP more than others. Klinkhammer and Saul-Soprun's (2009) work on IP in faculty members identified several factors associated with IP that are also relevant to students as well. First, the emphasis on performance evaluation can trigger self-doubt and create the illusion that evaluation is the sole criteria to be successful in the field. Second, highly competitive fields can lead to

catastrophizing minor academic struggles and internalizing feelings of incompetence. Jöstl, Bergsmann, Lüftenegger, Schober, and Spiel (2012) describe the third factor as the "myth of the ingenious scholar" (p. 111), which creates the fallacy among students that academics should be working without leisure time. Finally, transitioning into new roles with differing expectations and level of difficulty can also trigger self-doubt and anxiety that contribute to IP. Each of these factors is particularly relevant to STEM fields, as they are highly competitive and performance-based. The misconceptions about being successful in STEM can lead students to withdraw to conceal personal struggles and forego self-care techniques that could alleviate anxiety.

Lindemann, Britton, and Zundl (2016) acknowledged the influence that the STEM culture can have on IP. IP may be particularly relevant for individuals whose personal identities conflict with the culture. The heteronormativity in STEM fields may be an additional component related to IP. Clance and Imes (1978) initially described IP in reference to women who had internalized the common societal stereotype (at the time) of being less intelligent than men. Similarly, sexual orientation is stereotyped in STEM fields, which suggests LGB individuals could internalize a lack of belonging in STEM due to the heteronormative culture (Joshi & Mangette, 2018). Furthermore, despite the lack of research on LGB individuals' experience of IP, there is literature regarding the unique obstacle of "coming out" in STEM fields which often triggers feelings associated with IP such as anxiety and shame (Joshi & Mangette, 2018, p. 3).

While connection with others is a protective factor against IP, the culture in STEM fields may impede sexual minorities from developing these significant relationships (Lindemann et al., 2016). The competitive, individualistic climate that traditionally characterizes STEM fields does not welcome the type of friendly collaboration, which can intensify feelings of inadequacy and trigger isolation behaviors. The challenging classes required for STEM degrees may also reinforce

and be perceived as evidence of incompetence as well. Similarly, the heterosexist culture may compound feelings of IP for non-heterosexual individuals; being discovered as LGB would likely exacerbate feelings of IP due to the field's traditionally homogenous, male-dominated composition.

2.5 Burnout

Burnout, which is defined and described in more detail below, is an important factor in considering what mediates the relationship between stereotype threat and STEM identity. Pedersen & Minnotte (2017) highlight that burnout often "begins with a mismatch between expectations, ideals, and workplace realities" (p. 47). The heterosexist environment in STEM fields are plausibly putting LGB students at odds with their sexual identities and workplace expectations, which is a misalignment that can result in emotional distress, and disengagement in the domain (Jensen & Deemer, 2019; Pederson & Minnotte, 2017). Due to burnout's relationship to identity misalignment and disengagement, it was included in the current study to gain information regarding the mediating effect burnout has on the relationship between stereotype threat and STEM identity.

Frequent exposure to threatening stereotypes can be emotionally tiring, which is one aspect of burnout (Bedyńska & Żołnierczyk-Zreda, 2015). Burnout refers to the weakening of emotional energy consisting of feelings of exhaustion, cynicism, and reduced personal accomplishment (Schaufeli et al., 2001). Exhaustion is the core characteristic of burnout and refers to the stress associated with the state. The experience of exhaustion triggers cognitive distancing from the domain contributing to burnout, and it is this distancing that ultimately leads to cynicism (Maslach et al., 2001). Cynicism, the second major component of burnout, refers to the mental distance placed between oneself and work and/or colleagues (Spence et al., 2009). The third aspect of

burnout, reduced personal accomplishment, is less understood than exhaustion and cynicism, however, is reported as the outcome of cynicism in several models (Maslach et al., 2001).

Previous literature identifies situational and individual factors associated with burnout. Maslach et al. (2001) identify strong predictors of burnout include a heavy workload under time constraints, lack of positive connections with peers in the group, and perceived unfairness in the domain. Due to the difficulty of STEM majors, classes likely involve completing a large amount of work before predetermined due dates. Secondly, due to the individualistic, competitive nature of STEM fields, the environment is not ideal for facilitating positive connections with other students. STEM climates privilege some groups (e.g., men, heterosexuals) and place other groups (e.g., women, non-heterosexual) at a disadvantage, which could impact the degree to which LGB individuals perceive the STEM field as fair (Pedersen & Minnotte, 2017).

2.6 The Present Study

This study seeks to fill in gaps in the literature through examining the relationships between stereotype threat, burnout, IP, identity and STEM persistence intentions among LGB undergraduate students. More specifically, this study will investigate the indirect relationships that burnout and imposter phenomenon have on the relationship between stereotype threat and intentions to persist. Previous research supports relationships among these variables, however, studies have not investigated these factors specifically with LGB individuals in the STEM domain. While existing literature suggests potential systemic barriers that may be contributing to the problem of underrepresentation of LGB STEM majors, the status of research related to sexual minority issues has not progressed to allow for this approach. Instead, I aim to explore some foundational concepts related to individuals' experiences that will be beneficial for future systemic

research. This study will help inform LGB experiences in STEM and can help explain how the heterosexist environment manifests and contributes to poor persistence.

The relationship between stereotype threat and domain identification varies across research. Some groups, such as African American students, exposed to chronic stereotype threat disidentify to escape the aversive environment (Osborne & Walker, 2006), while other minority populations, such as Latinos or Latinas, do not demonstrate the same reaction (Woodcock et al., 2012). Just as different ethnic minority groups respond in varying ways to stereotype threat, it is important to examine sexual minority groups' responses to situations likely to trigger stereotype threat. This study examines burnout and IP as mediators to better understand the relationship between stereotype threat and STEM identity in LGB students (Parkman, 2016). Because burnout and stereotype threat can both trigger individuals to create distance from the challenging environment, I propose the following hypothesis:

Hypothesis 1: Stereotype threat will exert a significant negative indirect effect on STEM identity through the mediating mechanism of burnout.

Hypothesis 1a: Stereotype threat will be a significant positive predictor of burnout.

Hypothesis 1b: Burnout will be a significant negative predictor of STEM identity.

Similarly, some research suggests students experiencing IP may increase commitment or reduce participation within the field. However, because IP is common in higher education and STEM's heterosexist environment presents barriers to LGB individuals, it stands to reason that this variable would carry the negative effects of stereotype threat to detrimentally influence one's self-concept. Therefore:

Hypothesis 2: Stereotype threat will exert a significant negative indirect effect on STEM identity through the mediating mechanism of IP.

Hypothesis 2a: Stereotype threat will be a significant positive predictor of imposter phenomenon.

Hypothesis 2b: Imposter phenomenon will be a significant negative predictor of STEM identity.

As previously mentioned, both burnout and IP can lead to individuals psychologically disengaging or reducing participation, both consequences that inform intentions to persist. To investigate stereotype threat's effect on burnout and IP's relationship to persistence, I hypothesize:

Hypothesis 3: Burnout will exert a significant negative indirect effect on persistence through the mediating mechanism of STEM identity.

Hypothesis 3a: Burnout will be a significant negative predictor of STEM identity.

Hypothesis 3b: STEM identity will be a significant positive predictor of persistence.

Hypothesis 4: IP will exert a significant negative indirect effect on persistence through the mediating mechanism of STEM identity.

Research is mixed regarding the correlation between stereotype threat and STEM identity, however, the current study hypothesizes the relationship is better explained through IP and burnout. As such, I hypothesize:

Hypothesis 5: The hypothesized model will fit the data significantly better than an alternative model in which stereotype threat is posited to be directly related to STEM identity.

While it is outside the scope of the current study, I also tested an exploratory model in which identity centrality moderates the relationship between stigma consciousness and stereotype threat (see Figure 3). Previous research has suggested that the impacts of stereotype threat are partially

dependent on an individual's awareness of the stereotype and the centrality of their stereotyped identity (Brown & Pinel, 2003).

2.6.1 Operational Definitions

The definitions below are the interpretations of words/phrases that are used in the current study. Definitions are guided by previous literature and are provided to clarify specifically how these terms will be used.

1. Stereotype threat: the fear of confirming a stereotype about one's group (Steele et al., 2002).
2. STEM Identity: the extent to which individuals endorse the idea that being a STEM professional is a critical aspect of their self-concept (Robnett et al., 2015). Imposter Phenomenon: The "internal experience of intellectual phoniness" that is marked by the belief that one has fooled others regarding their competence in a given domain (Clance & Imes, 1978, p. 1).
3. Burnout: The weakening of emotional energy consisting of feelings of emotional exhaustion, cynicism, and personal accomplishment (Bedyńska & Żołnierczyk-Zreda, 2015).
4. Persistence: Intentions to continue participation in within a particular specific realm (e.g., major or career field).
5. Stigma Consciousness: "the extent an individual expects to be stereotyped" by others (Pinel, 1999, p.115).
6. Identity Centrality: The extent to which an individual defines him/her/themselves in relation to a specific identity (Sellers et al., 1997).

7. Sexual minority: Any individual who does not identify as "cis-gender" and/or "heterosexual." In order to analyze sexual orientation specifically, this term only applies to individuals who consider their sexual orientation as lesbian, gay, or bisexual.
8. Field/domain: Used interchangeably to refer to a general sphere of knowledge, or discipline (e.g., career field, career domain). These terms include a realm's culture, norms, activities etc.

2.7 Method

2.7.1 Participants

The target population in the current study is undergraduate students who identify as lesbian, gay, or bisexual, who are also majoring in a STEM field. Participants are eligible for this study if they are currently pursuing an undergraduate degree with a major in science, technology, engineering, or mathematics. Participants were recruited through an online survey sent via email through the university's registrar's office. Because this population is marginalized both broadly and in STEM domains specifically, I am striving to make data collection user-friendly and not demanding of time. Furthermore, considering individuals may not feel comfortable disclosing their sexual identity, responses will not be connected to identifying information and individuals may participate on their own time and in a preferred setting. Exclusion criteria include individuals younger than 18 years of age, individuals who do not identify as LGB, and/or are not currently enrolled in a STEM major.

The final sample consists of 327 undergraduate students (N=327) made up of 104 gay/lesbian individuals (n = 104, 31.8%) and 223 participants identified as bisexual (n = 223, 68.2%). About two-thirds of the participants identified as women (n = 205, 62.7%) and about one-

third identified as men (*n* = 120, 36.7%). Undergraduates' year in school was evenly distributed, with ninety first-year students (27.5%), 87 sophomores (26.6%), 69 juniors (21.1%), and 81 seniors (24.8%). Participant's ages ranged from 18 to 29 (M_{age} = 20.00, *SD* = 1.52). The majority of the sample reported their racial identity as White (*n* = 246, 75.2%), while other participants identified as African American (*n* = 13, 4%), American Indian/Alaska Native (*n* = 1, .3%), Asian American (*n* = 27, 8.3%), Hispanic and/or Latinx (*n* = 17, 5.2%), Native Hawaiian or Other Pacific Islander (*n* = 1, .3%), Middle Eastern American (*n* = 9, 2.8%), biracial/multiracial (*n* = 7, 2.1%), and international students (*n* =23, 7.0%). All participants were currently majoring in a STEM field including engineering (*n* =120, 36.7%), life sciences (*n* = 115, 35.2%), Technology (*n* = 69, 21.1%), physical sciences (*n* = 8, 2.4%), and mathematics (*n* =`15, 4.6%)

2.7.2 Research Design and Data Analysis

The current study explores a number of indirect relationships using a cross-sectional mediation modeling design. Because of the scarcity of existing literature on the current issue, I am using a cross-sectional design to provide more foundational findings in which future researchers can build upon. All participants were surveyed at one particular time using an online survey. Previous literature supports relationships between many of the variables of interest, however, no studies examine the relationships between all variables in one model. Consequently, this study aims to replicate and extend previous findings to an underresearched population and to help explain the relationships between stereotype threat, burnout, imposter phenomenon, and STEM identity. A conceptual diagram of the hypothesized model is presented in Figure 1.

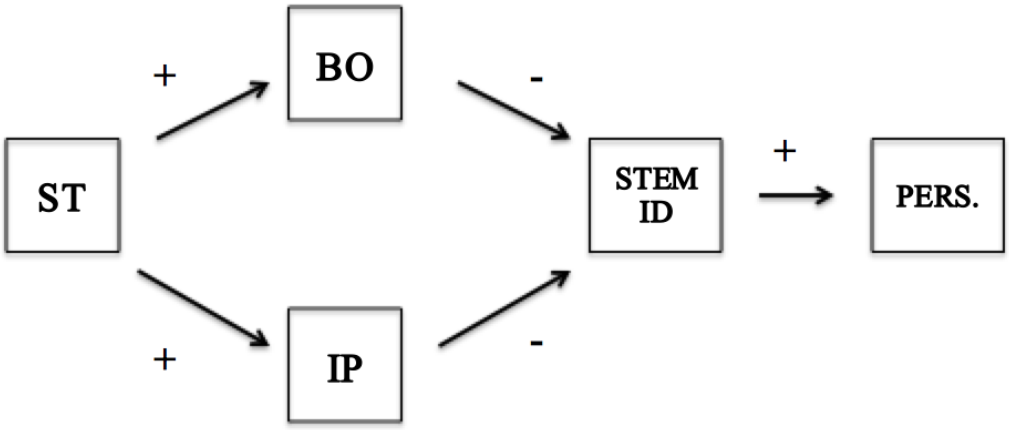

Figure 1.. Conceptual model of current study's hypothesized model. Hypothesized valences of main effects are denoted by +/- signs. SC = stigma consciousness; ST = stereotype threat; BO = burnout; IP = imposter phenomenon; STEM ID = STEM identity; PERS. = intentions to persist.

An alternative model, presented in Figure 2, was tested to determine if the data fits better to a partially mediated model. Here, both the direct and indirect influence of stereotype threat on STEM identity was examined. This model is useful to determine if the indirect effects of stereotype threat on STEM identity fit the data better than the hypothesized model in which the effect of stereotype threat on STEM identity operates entirely through the burnout and IP.

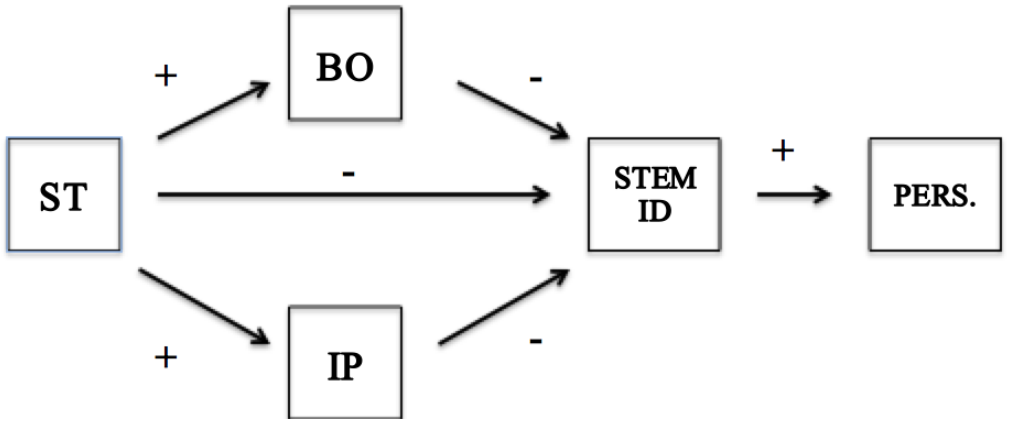

Figure 2. Conceptual model of current study's alternative model. Hypothesized valences of main effects are denoted by +/- signs. SC = stigma consciousness; ST = stereotype threat; BO = burnout; IP = imposter phenomenon; STEM ID = STEM identity; Pers. = intentions to persist.

A path analysis model with parallel mediators was estimated using observed variables. While the present study is primarily focused on stereotype threat's direct and indirect effect on the variables, for exploratory purposes, I included stigma consciousness and identity centrality as exploratory variables to examine how they impact the level of stereotype threat individual's experience, shown in Figure 3. While outside the scope of the current study, I included these variables due to research indicating stigma consciousness as a predictor of stereotype threat (Brown & Pinel, 2003); furthermore, stigma consciousness and identity centrality have not been studied with LGB participants. I am also interested in the moderating effect that identity centrality has on the relationship between stigma consciousness and stereotype threat (Settles, 2016). A conceptual model of the exploratory model is depicted in Figure 3.

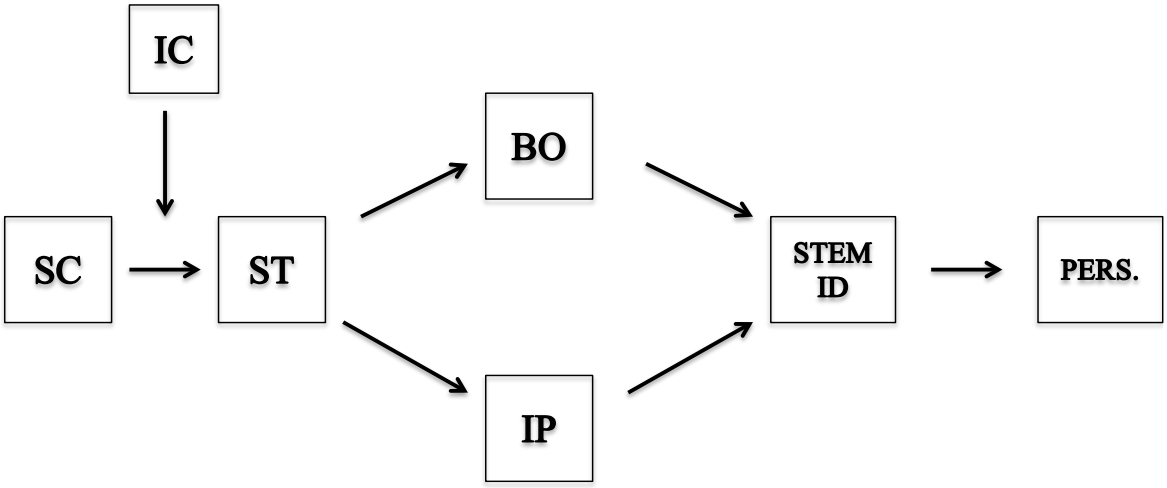

Figure 3. Conceptual model of current study's exploratory model. SC = stigma consciousness; IC = identity centrality; ST = stereotype threat; BO = burnout; IP = imposter phenomenon; STEM ID = STEM identity; PERS. = intentions to persist.

Path analysis allows researchers to test the interrelationships among constructs by simultaneously fitting several regression equations to the data (Kline, 2011). Persistence was regressed on STEM identity, STEM identity was regressed on the parallel mediators of burnout

and IP, burnout and IP was regressed on stereotype threat, and stereotype threat was regressed on stigma consciousness. The fit of both models were evaluated using several fit indices: (a) chi-square test of model fit, (b) comparative fit index (CFI), (c) root mean square error of approximation (RMSEA), (c) standardized root mean square residual (SRSMR), and (d) Akaike information criterion (AIC). Indirect effects were computed using the product of coefficients method (MacKinnon et al., 2002). Because indirect effects are typically not normally distributed, I tested the significance of the indirect effects using a bootstrapping technique. Bootstrapping is a nonparametric resampling procedure used to test mediation that does not assume normality of the sampling distribution (Preacher & Hayes, 2008). Following Preacher and Hayes' (2008) recommendation, I generated 500 randomly generated samples from the original data set and compute 95% confidence intervals to estimate the indirect effects. The indirect effect is statistically significant if zero is not included in the 95% confidence interval (Preacher & Hayes, 2008).

Preliminary analysis was executed through SPSS statistical software. I screened the data to confirm participants meet inclusion criteria and excluded data from participants that did not complete one or more questionnaires. Next, I computed means and standard deviations for each variable, in addition to correlations between them. Then, I tested the psychometric properties of each instrument to confirm reliability previous researchers have cited. I then proceeded to primary analyses.

2.7.3 Delimitations

This study has a few delimitations, including the diversity within STEM. All majors within College of Science, College of Engineering, the university's Polytechnic Institute, and College of Agriculture are considered "STEM" in the current study. The heterogeneity of colleges and specific majors may have varying cultures and attitudes about LGB issues. Finally, because

participants belong to only one university in the Midwest, the results have limited generalizability. One single university was used due to limitations such as time-constraints and limited funding, and was considered adequate for the present study due to its strong emphasis in STEM.

2.7.4 Power Analysis

To determine a sufficient sample size needed to accurately analyze the indirect effects, I performed a Monte Carlo simulation using Mplus 7.4 (Muthén & Muthén, 1998-2013) statistical software. The power analysis used path coefficients from previous literature when possible. I used 500 replicated data sets for the analysis. I analyzed all of the hypothesized relationships in the model to approximate the statistical power needed to detect significant effects. I used a coefficient of .40 for the relationship between stereotype threat and burnout (Bedyńska & Żołnierczyck-Zreda, 2015) and a coefficient of -.25 for the relationship between stereotype threat and STEM identity, with science identity serving as a proxy for STEM identity (Deemer et al., 2015). I used a coefficient of .35 for the relationship between stigma consciousness and stereotype threat, with discrimination serving as a proxy for stereotype threat (Pinel, 1999). A coefficient of .29 was used for the relationship between stereotype threat and IP (Wierzchowski, 2019). For relationships that lacked empirical research, I used a small-to-medium effect size coefficient of ± .25 (Cohen, 1988). Analysis results suggested a sample size of 170 in the current model will produce power to detect significant effects at least 80% of the time for all indirect effects with the exception of the stereotype threat→IP→STEM identity indirect effect. However, the power to detect this effect was .78 which approaches the 80% threshold that is common in power analysis (Murphy & Myors, 2004). The mean χ^2 was 8.17 (df = 8), the mean AIC was 2,429.30, the mean RMSEA was .02, and the mean SRMR was .04. Therefore, a sample size of 170 should be sufficient to detect the hypothesized effects.

2.7.5 Measures

Demographic Questionnaire

The demographic questionnaire was used to gain information about participants' age, gender identity, race/ethnicity, sexual orientation identity, educational status (i.e., year in school), field of study (i.e., major), state of origin, current relationship status, and current living situation. The questionnaire has 15 items, including multiple choice and free response questions (see Appendix A).

Stereotype Threat in Science Scale (STSS; Deemer et al., 2016)

The STSS is a six-item instrument designed to measure participants' perceptions of threatening stereotypes and identification with stereotyped groups. Thus, the instrument consists of two subscales – social identity (3 items) and identity threat (4 items). Identity threat is defined as the "affective consequences of facing threatened social identities" (Deemer et al., 2016, p.149). Three items from the identity threat subscale were used to measure stereotype threat in this study (see Appendix B). Items are answered using a 4-point Likert-type scale ranging from 0 (*never*) to 3 (*frequently*). Measuring stereotype threat is particularly important in the current study to inform the direct and indirect effects it may have on STEM identity and intentions to persist. The STSS was originally developed to gain understanding of gender stereotypes in STEM domains, however the current study modified items to focus on sexual orientation identity. For example the original item, "I am afraid that I will not perform the way I want in this class because of my gender" was modified to "I am afraid that I will not perform the way I want in STEM because of my sexual orientation." The STSS demonstrates construct validity through high factor loadings, which indicates the items were measured with little error. This scale also demonstrates concurrent validity

through the significant positive relationship with identity threat (β = .75, p = .001) (Deemer et al., 2016).

Clance Imposter Phenomenon Scale (CIPS; Clance, 1985)

Clance's Imposter Phenomenon Scale (CIPS) is a 20-item instrument that measures global feelings of fraudulence and inauthenticity (Clance & O'Toole, 1988). The CIPS assesses fear of failure and evaluation, self-doubt, negative feelings associated with success, and faulty logic regarding performance of self and others (see Appendix C). Items are rated on a Likert scale ranging from 1 (*not true at all*) to 5 (*very true*). To contextualize measurement of IP perceptions within STEM, participants were asked to rate the items based on the following anchor statement: "When it comes to STEM…". A sample item is "I can give the impression I'm more competent than I really am." This scale has high internal consistency reliability with a Cronbach's alpha of .96 (Holmes et al., 1993). Holmes et al. (1993) also reported that the CIPS is strongly correlated with Harvey's Imposter Phenomenon Scale (1982), demonstrating concurrent validity, however, the CIPS is more sensitive and is less likely for responses to create a Type 1 error. Chrisman et al., (1995) reported a Cronbach's alpha of .92 for undergraduates and strong concurrent validity with Kolligian and Sternberg's (1991) Perceived Fraudulence Scale (PFS). Furthermore, the convergent validity of the CIPS is evident through its negative correlation with the Self-Esteem Scale (S-ES; Phinney & Gough, 1985) and the Rosenberg Self-Esteem Scale (RS-ES; Rosenberg, 1965) (r = -.54 and r =0.60, respectively).

STEM Identity (Chemers et al., 2011)

Chemers' et al. (2011) Identity as Scientist Scale was used to measure STEM identity. This scale contains 6 items that measure the degree to which being a scientist is a part of one's identity

(see Appendix D). To ensure that STEM identity is measured adequately, the items were adapted by replacing terms that reference science with terms that broadly reference STEM. An example item is "I have come to think of myself as a 'scientist'" and an example of the adapted item is "I have come to think of myself as a 'STEM professional.'" The items are measured on a Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Chemers' et al. (2011) cited a Cronbach's alpha of .89 for undergraduates and .90 for graduates and reported convergent validity due to the scale's significant correlation to commitment to a science career (r =.51).

School Burnout Inventory (SBI; developed by Salmela-Aro et al., 2009)

Burnout was measured using the School Burnout Inventory (SBI; Salmela-Aro et al., 2009). This tool has three subscales– exhaustion, cynicism, and inadequacy. The SBI has a total of nine items, with four items in the exhaustion subscale, three items in the cynicism subscale, and two items on the inadequacy subscale. The exhaustion subscale refers to "feelings of strain, particularly chronic fatigue resulting from overtaxing schoolwork" (Salmela-Aro et al., 2009, p. 48). The cynicism subscale measures a loss of interest in schoolwork and emotional detachment from academics, while the inadequacy subscale measures student's self-perceptions of general diminished competence in academics. SBI items are measured on a 9-item Likert-type scale ranging from 1 (*completely disagree*) to 6 (*completely agree*), with higher scores reflecting more school burnout (see Appendix E). Items will follow an anchor statement "When it comes to STEM…" and an example item is "I feel overwhelmed by my schoolwork." The SBI has sufficient internal consistency for overall school burnout (Cronbach's α = .88) and within the exhaustion (Cronbach's α = .80), cynicism (Cronbach's α = .80), and inadequacy (Cronbach's α = .67) subscales (Salmela-Aro et al., 2009). Additionally, the SBI demonstrated concurrent validity through its significant positive correlation with depressive symptoms in each SBI subscale

(Salmela-Aro et al., 2009). Convergent validity was determined through the finding that school burnout is a significant negative predictor of GPA and schoolwork engagement (Salmela & Upadaya, 2012).

Stigma Consciousness Questionnaire (SCQ; Pinel, 1999)

The current study will include Stigma Consciousness Questionnaire (SCQ) to measure the degree to which stereotyped individuals anticipate others will judge them based off of the targeted attribute (Pinel, 1999). The SCQ has been used for a variety of stigmatized identities, including gender, sexual orientation, and race. This study will use the 10-item SCQ for Gay Men and Lesbians (see Appendix F). The original items use the term "homosexual," which was modified to reflect current language and to avoid perpetuating pathologizing non-heterosexual relationships. For example, the original item "My being homosexual does not influence how people act with me" was modified to "My being lesbian, gay, or bisexual does not influence how people act with me." Participants will respond on a Likert-type scale ranging from 0 (*strongly disagree*) to 6 (*strongly agree*). The SCQ has acceptable internal consistency (Cronbach's $\alpha = .81$). Evidence of concurrent validity of the SCQ for gay and lesbian men has been demonstrated through a significant positive correlation with the Self-Consciousness Scale (Fenigstein et al.,1975), suggesting participants with high stigma consciousness have more concern about how others perceive them (Pinel, 1999). Despite varying responses among different minority groups, stigma consciousness demonstrated a positive relationship with perceived discrimination (Pinel, 1999). Brown and Pinel's (2003) study revealed construct validity through the finding that women who were high in stigma consciousness in the stereotype threat experimental condition performed significantly worse compared to women with low stigma conscious women exposed to the same condition.

Identity Centrality (Sellers et al., 1997)

Identity centrality was measured using Sellers et al., (1997) 8-item Identity Centrality subscale which contains a Likert-type scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) (see appendix H). While the original full Multidimensional Inventory of Racial Identity (MIRI) includes seven subscales to measure three core elements of the racial identity in African American individuals (centrality, ideology, and regard), identity centrality subscale was used in the current study. Identity centrality refers to the extent to which an individual defines him/her/themselves in relation to a specific identity and Seller's et al.'s (1997) subscale is a helpful tool to measure the centrality of other identities since it is a "general cognitive [process] that [is] not confined to any one identity" (Sellers et al., 1997; Sellers et al., 1998, p. 34). Items were adapted from the original scale to reflect sexual orientation identity. For example, the original item "Being Black is an important reflection of who I am" was modified to "Being LGB is an important reflection of who I am." The identity centrality scale also demonstrated internal consistency (Cronbach's $\alpha = .77$) within African American participants and when used with LGBTQ participants (Cronbach's $\alpha = .80$) (Sellers et al., 1997; Sheehan et al., 2020).

Intentions to Persist Scale (Lent et al., 2007)

The Intentions to Persist Scale was used to assess students' plans to continue in their STEM majors (see Appendix G). This scale contains 4 items that are measured on a Likert-type scale ranging from 0 (*strongly disagree)* to 9 (*strongly agree).* One example item is "I plan to remain enrolled in a STEM major over the next year." Wilkins-Yel et al. (2018) reported a Cronbach's alpha coefficient of .70, however, the original study using engineering students reported a Cronbach's alpha to be .95 (Lent et al., 2003) and Lent et al. (2007) also reported strong internal consistency (Cronbach's $\alpha = .95$). Wilkins-Yel et al. (2018) reported intentions to persist was

significantly associated with academic satisfaction and intentions for strong academic performance, supporting the scale's convergent validity.

2.7.6 Procedure

After obtaining Institutional Review Board (IRB) approval, data was collected using a qualtrics survey sent out through the university's registrar. A recruitment email (see Appendix H) was sent to undergraduate students who are currently enrolled in a STEM major from College of Engineering, College of Mathematics, College of Agriculture, and the university's Polytechnic Institute. Clicking the link in the email will bring participants to an online information sheet (see Appendix I) briefly explaining the purpose, participants' rights and incentives, and contact information of the primary investigator. One week after the initial recruitment email is sent, a follow-up reminder email was sent. After completing each measure, participants were debriefed and have the option to enter their email address for a chance to win a $20 Amazon gift card.

2.8 Results

2.8.1 Data Screening

Data screening included examining the variables for normality, outliers, missing data, linear bivariate relationships, homoscedasticity, and collinearity. Inspection of histograms revealed that all variables except persistence were normally distributed. Persistence, however, was negatively skewed with an absolute skewness value of -3.28 as 233 participants obtained the maximum possible score of 36 on the persistence scale. Therefore, I recoded persistence into a binary variable whereby scores of 36 were coded as 1 and all other scores were coded as 0.

A total of 419 individuals participated in the study, however, 92 cases were deleted. Sixty-two participants identified as heterosexual, 19 participants identified as other sexual orientations

within the LGBTQ community and not LGB, 2 participants reported majoring in a non-STEM field, and 6 participants only provided demographic information or did not complete three or more scales. These cases were deleted because they did not meet inclusion criteria for this study (identify as lesbian, gay, or bisexual). I also deleted 3 negatively skewed outliers since several variables had *z*-scores of three or more standard deviations from the mean (Tabachnick & Fidell, 2013). STEM identity had one outlier, ID centrality had two outliers, and persistence had ten outliers. The final sample size after data screening was 327. Of the final sample, over 94% participants had no missing data. These missing values were thus assumed to be missing at random and dealt with using full information maximum likelihood.

Next, I created bivariate scatter plots to assess for linearity and homoscedasticity. Visual examination of scatter plots indicated linear relationships and the variances of each variable's scores were evenly distributed across all levels of the other variable in each pair of variables. Thus, the scores were determined to be homoscedastic. Finally, I tested for multicollinearity by regressing each dependent variable in the hypothesized model on the set of predictor variables. All tolerance values were over .10 (range = .64 to .98), therefore multicollinearity was not judged to be a problem.

2.8.2 Preliminary Analyses

Before I focused on my primary analyses, I did a preliminary analysis to examine descriptive statistics for each variable, including scale ranges, means, standard deviations, and Cronbach's alpha coefficients (see Table 1). Internal reliability coefficients ranged from .81 to .92, with one exception.

Table 1. Descriptive Statistics and Reliability Coefficient of Scale Scores

Measure	Scale Range	*M*	*SD*	α
Stigma Consciousness	7-70	37.75	10.95	.823
Stereotype Threat	3-12	5.34	2.45	.846
ID Centrality	8-56	33.19	10.17	.874
Burnout	6-48	33.75	8.98	.868
Imposter Phenomenon	20-100	68.72	14.60	.919
STEM Identity	5-25	19.27	3.40	.807
Persistence	0-36	24.55	3.45	--

Note. $N = 327$

I then conducted an independent samples *t*-test in order to examine group differences between lesbian/gay and bisexual participants. Table 2 shows the mean differences between lesbian/gay individuals and bisexual individuals. Group differences between gay/lesbian and bisexual individuals were significant for stigma consciousness, $t(321) = 3.36$, $p < .001$, $d = .41$) and identity centrality, $t(318) = 3.61$, $p < .001$, $d = .43$).

Table 2. Descriptive Statistics Grouped by Sexual Orientation

	Gay/Lesbian		Bisexual		Mean Difference	
Variable	*M*	*SD*	*M*	*SD*	*t*	*p*
Stigma Consciousness	40.72	10.12	36.38	11.01	4.33	.001
Stereotype Threat	5.75	2.67	5.15	2.33	.60	.051
ID Centrality	33.91	5.20	31.69	8.06	2.22	< .001
Burnout	32.98	8.99	34.10	8.97	-1.12	.295
Imposter Phenomena	69.3	14.63	68.73	14.61	.57	.745
STEM Identity	19.12	3.53	10.05	3.77	.06	.889
Persistence	34.8	3.01	34.64	3.64	.66	.386

I conducted a one-way multivariate analysis of variance (MANOVA) to examine if there were differences in the study variables based on major type (e.g., engineering). Many researchers report the heteronormative environment in engineering, thus I wanted to examine engineer majors

specifically in comparison to the other domains within STEM. I coded for type of STEM major and categorized them into one of four grouping variables: engineering (n =120), life sciences (n = 110), and technology (n = 64); I did not include physical sciences and mathematics) in the MANOVA due to small sample size within those groups. Results suggested no significant difference in scores depending on major, Pillai's Trace V = .082, $F(14, 556) = 1.705$, $p > .05$, partial $\eta 2$ = .041. Next, I conducted a bivariate correlation analysis, which indicated that many of the variables were significantly and positively correlated (see Table 3).

Table 3. Bivariate Correlations Between Variables

Variables	1	2	3	4	5	6
1. SC	-	-	-	-	-	-
2. ID centrality	0.09	-	-	-	-	-
3. ST	0.52*	0.10	-	-	-	-
4. Burnout	0.09	0.12*	0.25**	-	-	-
5. IP	0.04	0.11*	0.26**	0.54**	-	-
6. STEM ID	-0.08	0.004	-0.07	0.27**	0.11*	-
7. Persistence	0.01	0.03	-0.06	0.15**	-0.11	.042**

Note. N = 327. *p < .05 (2-tailed), **p<.01 (2-tailed).

Analysis of Hypothesized Model

I conducted a path analysis to test the hypotheses. There were various mediators acting on the primary outcome variable, persistence. Analysis of this model indicated it fit the data well, χ^2 (4, N = 327) = 5.56, p = 0.23. Other goodness-of-fit indices include: CFI = .99; TLI = .98; WRMR = .51; RMSEA = .04 (90% CI: .00, .10). Additionally, the predictors explained 32.0% of the variance in persistence.

As can be seen in Table 4 and Figure 4, there were many significant direct effects in the

hypothesized model. Stereotype threat was a significant positive predictor of burnout (β =.25, p = 0.00) and imposter phenomenon (β = .26, p = 0.00). Burnout was a significant negative predictor of STEM identity (β = -0.34, p =0.00), however imposter phenomenon was not a significant predictor of STEM identity (β = 0.04, p =0.55). Finally, STEM identity was a significant positive predictor of persistence (β = .57, p = 0.00). These direct effects are depicted in Figure 4.

Table 4. Direct effects of Hypothesized model

Path	β	*SE*	*p*
To Persistence from:			
STEM Identity	0.57	0.06	<.001
To STEM Identity from:			
Burnout	-0.34	0.07	<.001
Imposter Phenomenon	0.04	0.08	0.58
To Burnout from:			
Stereotype Threat	0.25	0.05	<.001
To Imposter Phenomenon from:			
Stereotype Threat	0.26	0.06	<.001

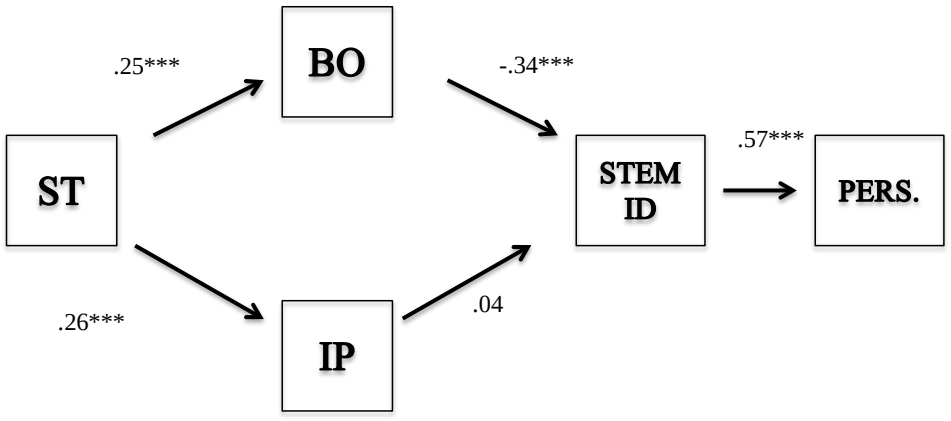

Figure 4. Standardized direct effects of the hypothesized model.

** p< .001

I used the bootstrapping procedure with 500 draws from the data to produce an estimate of the mediation effects, which revealed several significant indirect effects in the hypothesized model (see Table 5). I considered indirect effects significant if the range of the parameter estimate did not include 0. There was a significant indirect effect from stereotype threat → burnout → STEM identity (*estimate* = -0.08, 95% CI [-0.14, -0.04]) and from burnout → STEM identity → persistence (*estimate* = -0.20, 95% CI [-0.29, -0.11]). These results support hypotheses 1 and 3. The two other indirect effects were not considered significant because 0 was included in the confidence interval, thus hypotheses 2 and 4 were not supported. Table 5 presents these results.

Table 5. Indirect Effects of Hypothesized Model

Indirect Effect	*Estimate*	*Lower 2.5%*	*Upper 2.5%*
Burnout → STEM Identity→ Persistence	-0.20*	-0.28	-0.11
Imposter Phenomenon → STEM Identity → Persistence	0.02	-0.06	0.11
Stereotype Threat → Burnout → STEM Identity	-0.08*	-0.14	-0.04
Stereotype Threat → Imposter Phenomenon → STEM Identity	0.01	-0.03	0.05

Note. 95% bias-corrected confidence interval for the parameter estimate does not contain zero.

Analysis of Alternative Model

Burnout and imposter phenomenon were shown to mediate the effect stereotype threat has on STEM identity; however, in the alternative model I examined the direct effect of stereotype threat on STEM identity. Results from the alternative model indicated it fit worse than the hypothesized model, which supports hypothesis 5, χ^2 (3, N =327) = 6.63, p =.08. Other goodness-of-fit indices include: CFI = .98; TLI = .92; WRMR = .51; RMSEA = .06 (90% CI: .00, .13). Similar to the hypothesized model, the predictors explained 32.0% of the variance in persistence

in the alternative model. I also compared model fit for the hypothesized and alternative model by nesting the hypothesized model within the alternative model by fixing the path from stereotype threat to STEM identity to zero. Next, I compared this nested hypothesized model to the alternative model using chi-square difference testing. Results indicate the direct effect of stereotype threat on STEM identity in the alternative model did not improve the model, $\Delta \chi^2$ (1) = .05, p = .84, which offers further support that the hypothesized model fits the data better than the alternative model.

The direct effects of the alternative model are the same as the direct effects in the hypothesized model with one exception. Consistent with hypothesis 5, the relationship between stereotype threat and STEM identity was not significant (β = -0.01, p = .82). All direct effects are presented in Figure 5.

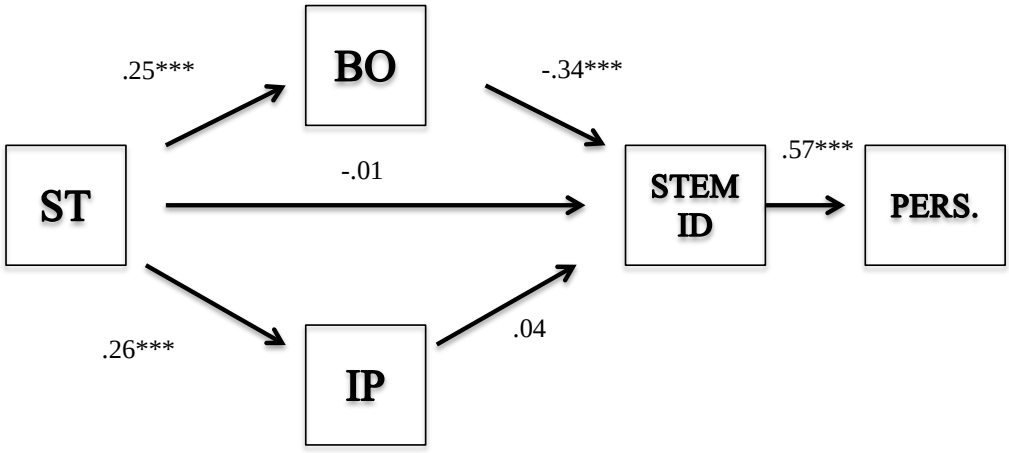

Figure 5. Standardized direct effects of the alternative model.
***p < .001.

2.8.3 Analysis of Exploratory Model

For exploratory purposes, I added stigma consciousness as a predictor of stereotype threat and also included identity centrality as a moderator between stigma consciousness and stereotype threat. Including this interaction effect in the model resulted in the worst fit among the three models

tested, χ^2 (16, N =327) = 59.30, p = .00. Other goodness-of-fit indices include: CFI = .73; TLI = .58; WRMR = 1.19; RMSEA = .09 (90% CI: .07, .12). Computing the product of the stigma consciousness and identity centrality variables created the interaction variable. The interaction effect had a significant p-value (β = -.01 p = .04), but due to zero being contained in the confidence interval, the interaction effect is not significant (*estimate* = -0.01, 95% CI [-.010, .002]), and no further analyses were executed.

2.9 Discussion

The purpose of the current study is to examine the mediating factors associated with stereotype threat and STEM identity among individuals who identify as LGB and are currently enrolled in a STEM major. STEM identity is used as a predictor of student's intentions to persist within their major. The current study uses stereotype threat and imposter phenomenon theories to understand the process by which LGB individuals identify with and persist in STEM. Researchers have studied stereotype threat's impact on gender and racial minority groups however; it has seldom been extended to the LGBTQ population. Existing literature within LGBTQ research has identified the underrepresentation of sexual minorities in STEM fields, however there remains a gap in the literature regarding the direct and indirect effects that stereotype threat has on LGB STEM majors' STEM identity and persistence. I aimed to better understand factors that contribute to LGB's underrepresentation and poor persistence within STEM fields.

Although the hypotheses did not include between group differences, it is important to acknowledge the current study's gender representation, as about two-thirds of the participants identified as women, while the rest as men. Since more research regarding the barriers women (versus LGB individuals) face in STEM fields exists, women may have heightened awareness about their underrepresentation in these fields, and feel a sense of obligation to participate to give

voice to their experiences as marginalized students. Because the present study is focused on sexual orientation identity, not gender identity, no further analyses of gender were completed in an effort to not conflate the two identities. For this reason, there were no transgender participants in the study. It is also notable that over 68% of the participants identified as bisexual, while about 32% identified as lesbian or gay. Lesbian and gay individuals were grouped together because bisexual individuals experience unique stereotypes that do not apply similarly to bisexual individuals. While there is limited research about bisexuality even within LGBTQ literature, there are stereotypes about bisexual individuals that suggest they are confused about his/her/their own sexuality, disloyal to romantic partners, and "sexually promiscuous" (Zivony & Lobel, 2014, p. 1165). Additionally, it is possible that the STEM culture may pose less of a threat to bisexual individual's sexual identity, as he/she/they could be less vulnerable to heterosexism than lesbian and gay counterparts, though future research is needed to support this claim.

Based off of previous research identifying psychological and physiological distress resulting from stereotype threat, I predicted higher levels of stereotype threat would be associated with higher levels of burnout (H1a) and imposter phenomenon (H2a). The rationale behind these hypotheses relates to the various negative consequences of stereotype threat that have been replicated with other minority groups. Furthermore, burnout has been tied to underrepresentation and negative impacts on performance (Maslach et al., 2001). Maslach et al., 2001) describe burnout to include three dimensions: emotional exhaustion, cynicism (depersonalization), and reduced personal accomplishment. Burnout frequently manifests as exhaustion, and also captures the tendency individuals have to distance oneself from the taxing domain (depersonalization); burnout also encompasses individual's relationship with the domain and often leads individuals to feel less effective and a reduced sense of personal accomplishment. Due to the challenges associated with

being LGB in a stereotypical STEM culture, it is expected to be emotionally exhausting for these students, which is one core aspect of burnout. Results confirmed stereotype threat is a significant predictor of burnout within LGB STEM majors. It is important to note that burnout was measured with one overall scale, and future research could pinpoint the effects of stereotype threat on burnout by using the burnout subscales.

Results also indicated stereotype threat had a significant positive effect on IP. Psychological distress associated with experiencing stereotype threat might account for this effect. For example, individuals who face stereotype threat may experience anxiety related to fears of confirming the stereotype, which may result in LGB folks to worry whether they have the academic skills to succeed in STEM. Previous literature has investigated the relationship between stereotype threat and IP among women in STEM fields; however, similar research has not been extended to sexual minorities (Lindemann et al., 2016). Lindemann et al. (2016) identified that systematic and cultural norms were important contributors to women having more experiences of stereotype threat and IP in STEM fields; thus, the cultural values and beliefs are likely relevant factors in the current study. Results align with the notion that LGB STEM majors facing an unwelcoming environment likely increase levels of both stereotype threat and IP. The heteronormative culture in STEM fields and underrepresentation of LGB individuals within these fields was expected to result in a significant relationship between stereotype threat and IP, which was supported by the data (H2a).

Due to previous literature that highlights disengagement as a consequence of both burnout and IP, I hypothesized that burnout (H1b) and IP (H2b) would be negative predictors of STEM identity. Previous research suggests that burnout can be initiated through individuals experiencing incongruence between their "expectations, ideals, and workplace realities" (Pedersen & Minnotte, 2017, p. 47). Given the heteronormative culture existing within many STEM domains, it is likely

that LGB individuals face this mismatch. Because burnout can lead individuals to disengage with the domain, I predicted that burnout would have a negative impact on STEM identity, which was supported by the data. LGB individuals may be experiencing an unwelcome environment in STEM domains and resolve the incongruence by minimizing the level to which they identify with the domain. Exhaustion, the most important dimension of burnout, can also lead to use of cognitive distancing, or "developing an indifference or cynical attitude when [feeling] exhausted" (Maslach et al., 2001, p. 403). Thus, even if LGB STEM majors do not reduce their participation within STEM fields, it appears as though exhaustion may be sufficient to reduce STEM identification.

The data did not support my hypothesis of IP being a negative predictor of STEM identity (H2b). Previous literature suggests that experiencing IP can lead some individuals to decrease their engagement within the field to avoid being discovered as fraudulent, however, other studies research suggests some individuals increase their engagement within the field to compensate for their self-doubt (Parkman, 2016; Parkman & Beard, 2008). It is possible that some participants in the current study coped with IP by both decreasing their involvement, thus decreasing STEM identity, while other participants tried to compensate for their perceived fraudulence by increasing their dedication to the field, which could increase levels of STEM identity. These different reactions to IP likely explain why IP was not a significant negative predictor of STEM identity. Thus, hypothesis 1, which states that stereotype threat will exert a significant negative indirect effect on STEM identity through the mediating mechanism of burnout was supported, while hypothesis 2, or the prediction that stereotype threat will exert a significant negative indirect effect on STEM identity through the mediating mechanism of IP, was not supported by the data.

Results supported hypothesis 5, and the data in the current study fit the hypothesized model better than the alternative model. The impact of stereotype threat on STEM identity was better

explained through burnout and IP, rather than their direct relationship. The direct effect of stereotype threat on STEM identity was likely not significant due to individuals tendency to either (a) disidentify with the domain creating the threat, thus reducing STEM identification, or (b) increasing identification within the threatening domain in order to compensate for self-doubts and to avoid fulfilling the stereotype, thus increasing STEM identification. These two responses to stereotype threat on STEM identity appear to cancel each other out, which is likely why the data fit the hypothesized model better than the alternative model. It is unclear when the relationship between stereotype threat and STEM identity may be significant, therefore additional research on potential moderators of this relationship is needed.

For exploratory purposes, stigma consciousness and identity centrality were added as predictors of stereotype threat. The rationale behind the exploratory analysis stemmed from previous research indicating stereotype threat vulnerability is dependent on how much an individual expects to be stereotyped (stigma consciousness) and how central the threatened identity is to one's self-concept (identity centrality) (Pinel, 1999; Settles, 2016). Results suggested including the interaction of identity centrality and stigma consciousness as a predictor of stereotype threat did not improve model fit. It is possible that participants in the current study did not anticipate to be stereotyped by their sexual orientation, and/or the participant's sexual orientation identity may be less central/important to their concerns about confirming the stereotypes. Future research should focus on identity centrality as a predictor to stereotype threat in order to better understand the role stigma consciousness and identity centrality independently have on stereotype threat.

2.9.1 Practical and Clinical Implications

The current study has many implications for university's STEM fields. Results indicate that there is a need to protect undergraduate LGB STEM majors from burnout due to its negative impact on STEM identity and persistence. Results from the current study indicate it could be beneficial to develop policies within STEM programs to help prevent burnout. Pedersen and Minnotte (2016) discuss that burnout can be triggered by any "mismatch between expectations, ideals, and workplace realities" (p. 47). Therefore, faculty in STEM could create policies aimed at minimizing this type of mismatch. For example, professors could be encouraged to be fully transparent with their students about realistic expectations for their courses, which could help students set realistic expectations and avoid idealistic thinking; transparency from faculty would also model open communication that could also serve to minimize interpersonal conflict that is also associated with burnout (Magnuson et al., 2002; Maslach & Leiter, 2017; Pedersen & Minotte, 2016). Another practical implication is for department heads to require professors include a minimum number of collaborative projects in order to increase student-student interaction and improve chances of students developing supportive relationships (Maslach & Leiter, 2017).

There are also clinical implications from this study. University counseling centers (UCC) can act as an intervention through the use of its resources. For example, counseling staff can provide psychoeducation to faculty, such as Safe Space and Implicit Bias training that can provide leaders in STEM fields the knowledge and awareness about burnout, particularly how to avoid it. Additionally, UCC can offer interpersonal process or support groups for students to share their experiences and increase sense of belonging; a support group for LGBTQ folks in STEM fields would be particularly powerful and potentially decrease feelings of burnout within the major. Receiving such support from peers can be helpful in reducing emotional exhaustion (Maslach & Leiter, 2017). Finally, UCCs can develop outreach strategies to educate STEM students about the

impact of being a numerical minority. This would help the population of interest in the current study but also encompass other minority groups as well, ultimately fostering a more inclusive environment and culture.

2.9.2 Limitations and Future Directions

There are a few limitations of the current study. First of all, the data lack generalizability due to only including one large, Midwest university. It is important to note that this university is public and known for its research and strong engineering program. Results from this study may lack generalizability to small, private institutions in different regions of the United States, for example. Additionally, the undergraduate student body at this university represented primarily White U.S. residents, therefore, my findings likely do not reflect experiences of non-White and/or international students. Gathering data from several different universities would likely increase the generalizability and be more representative of an average LGB STEM major in the United States.

Selection bias and response bias are other limitations. It is possible that the current study has a sample of LGB STEM majors who care deeply about the topics of the study, and were more likely to choose to participate than LGB STEM majors who lack an interest in STEM-related issues. Additionally, despite the effort to avoid question order bias, it is possible the survey questions at the beginning primed participants of certain experiences related to their LGB and/or STEM identity. Similarly, all participants consented to participate in the study knowing its purpose was to better understand LGB students' experiences in STEM fields; having this awareness could have led participants to make inferences regarding the researcher's predictions about their experiences, and could have experienced pressure to respond in a way consistent with them. Due to the survey relying on self-report measures, I was unable to determine if participants responded in ways consistent with their lived experiences.

Finally, the current study is correlational in nature, therefore, causal inferences cannot be made. For example, despite results indicating stereotype threat positively, significantly correlated to burnout, it is inaccurate to claim that stereotype threat causes increased levels of burnout. Instead, we can only infer that participants who endorse high levels of stereotype threat also experience higher levels of burnout. It is possible that there is an unknown confounding variable influencing both variables that may better explain the relationship between stereotype threat and burnout.

Future research is needed to determine if the results from the current student extend to other groups that fall under the LGBTQ umbrella. Due to the extreme scarcity in literature focusing exclusively on transgender individual's experience, it would be valuable to know if trans STEM majors respond similarly to LGB STEM majors. Another potential future direction is to explore how LGB individuals in other majors (e.g., liberal arts) respond to the same study. This direction of research could help determine if STEM majors are significantly different in eliciting stereotype threat and other negative experiences in comparison to domains that are not known to be heteronormative. It would also be useful to gather information from heterosexual individuals in STEM majors to determine if the variables in the current study are impacting LGB individuals significantly more than their heterosexual peers.

Future research should also examine specific cultural factors that may contribute to LGB individual's experience of the STEM environment. Jensen and Deemer's (2019) research explored women in STEM's experience of a chilly climate; it would be helpful to extend this finding to LGB individuals to gain a better understanding of how the STEM culture may be influencing the impact of stereotype threat and burnout on STEM identity and persistence. Future studies should incorporate some of the systemic factors into their model. For example, it would be useful to measure heterosexism directly to understand how it relates to experiences within the STEM culture.

There are other variables that are likely related to the underrepresentation of LGB in STEM fields that were not included in the current study. First of all, it would be helpful to gather information about students' previous experiences (prior to college) in STEM to gain an understanding on how that may impact STEM identity and persistence. It is possible that high schools that incorporate special STEM programming for students may increase their STEM identity. Additionally, examining the function of role models could also be useful. Previous findings suggest role models to be associated with increased academic performance and academic belonging (Shin et al., 2016). It would be helpful to study if positive experiences with role models reduce levels of burnout. Furthermore, future research could also investigate if having a role model with a shared marginalized identity (i.e. LGB) changes the impact of the relationship.

2.10 Conclusion

The purpose of the current study was to contribute to LGBTQ literature to inform researcher's understanding of LGB underrepresentation in STEM fields. Researchers have started to study the underrepresentation of LGBTQ folks in STEM domains, however, there remains a gap in the literature regarding the role of stereotype threat, burnout, IP, STEM identity, and persistence for LGB undergraduate students majoring in STEM. The study examined how burnout and IP mediate the relationship between stereotype threat, STEM identity, and ultimately persistence. Results indicated that among LGB individuals in STEM fields, burnout has a significant indirect negative effect on the relationship between stereotype threat and STEM identity; however, IP was not found to be a significant mediator between stereotype threat and STEM identity. Therefore, it may be beneficial for future research to investigate more regarding burnout's influence on STEM identity. For example, research examining the three burnout subscales (i.e, emotional exhaustion, cynicism, and inadequacy) separately may inform

interventions that could buffer the impact of burnout on STEM identity and persistence. Identifying ways to increase inclusivity in STEM spaces is also an important future direction for researchers, and could improve the STEM culture and LGB individual's experiences in STEM overall, therefore encourage other LGBTQ students to pursue STEM domains.

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APPENDIX A. DEMOGRAPHIC QUESTIONS

1. Age: _____ years
2. Current gender identity:
    ___ Man
    ___ Woman
    ___ Transgender
    ___ Do not identify as female, male, or transgender
3. Sex
    ___ Male
    ___ Female
4. Race/Ethnicity (Select one or more):
    ___ African American
    ___ American Indian or Alaskan Native
    ___ Anglo American/White (not of Hispanic origin)
    ___ Asian American
    ___ Hispanic or Latino American
    ___ Native Hawaiian or Other Pacific Islander
    ___ Middle Eastern American
    ___ Biracial/Multiracial (Please specify: _____)
    ___ International Student (National origin: _____)
    ___ Other: (Please specify: _____)

5a. Do you think of yourself as (please check all that apply):
    ___ Heterosexual (i.e., you identify as someone who experiences sexual, romantic, and/or physical attraction to people of your opposite gender)
    ___ Gay or Lesbian (i.e., you identify as someone who experiences sexual, romantic, and/or physical attraction to people of your same gender)
    ___ Bisexual (i.e., you identify as someone who experiences sexual, romantic, and/or physical attraction to people of your own gender and your opposite gender)
    ___ Questioning (i.e., you are exploring your sexual orientation identity)
    ___ Other (i.e., none of the categories above adequately captures your sexual orientation identity) (please specify: _____)

5b. If you selected gay, lesbian, bisexual, questioning, or other, do others know about your sexual orientation identity?
    ___ Yes (Please specify who knows (e.g., family members, friends, teachers, classmates, etc.):_____)
    ___ No

6. Year at school:
    ___ First year undergraduate
    ___ Sophomore
    ___ Junior
    ___ Senior
    ___ Masters (year in program ___)
    ___ Doctoral (year in program ___)

7. Current Student Status:

___ Full-time student
___ Part-time student

8. Major(s) or Field of Study: _____

9. To what extent is the breakdown of sexes equal in your field of study?
___My sex is a very small minority in my field
___The sex breakdown is about equal
___My sex constitutes the vast majority in my field of study

10. Current Employment Status:
___ Unemployed
___ Not in labor force
___ Part-time employed
___ Full-time employed
___ Retired
___ Disabled

11. Current Relationship Status:
Single, please specify:
___ Not in a relationship
___ In a relationship but not cohabitating
___ Cohabitating
___ Married
___ Engaged
___ Partnered
___ Divorced
___ Married and separated
___ Widowed

APPENDIX B. STEREOTYPE THREAT IN STEM SCALE (STSS)

Instructions: Please respond to each item using the scale provided below. Please note that "STEM" refers to science, technology, engineering, and mathematics.

0	1	2	3
Never	Very Rarely	Sometimes	Frequently

2. I am afraid that I will not perform the way I want in STEM because of my gender.
3. I am afraid that if I do poorly in STEM, it will confirm the stereotype that women cannot perform well in these disciplines.
6. I am afraid of confirming the stereotype that women do not have the skills to be STEM professionals.

APPENDIX C. CLANCE IMPOSTER PHENOMENON SCALE (CIPS)

For each question, please circle the number that best indicates how true the statement is of you. It is best to give the first response that enters your mind rather than dwelling on each statement and thinking about it over and over.

1	2	3	4	5
Not At all True	Rarely	Sometimes	Often	Very True

1. I have often succeeded on a test or task even though I was afraid that I would not do well before I undertook the task.

2. I can give the impression that I'm more competent than I really am.

3. I avoid evaluations if possible and have a dread of others evaluating me.

4. When people praise me for something I've accomplished, I'm afraid I won't be able to live up to their expectations of me in the future.

5. I sometimes think I obtained my present position or gained my present success because I happened to be in the right place at the right time or knew the right people.

6. I'm afraid people important to me may find out that I'm not as capable as they think I am.

7. I tend to remember the incidents in which I have not done my best more than those times I have done my best.

8. I rarely do a project or task as well as I'd like to do it.

9. Sometimes I feel or believe that my success in my life or in my job has been the result of some kind of error.

10. It's hard for me to accept compliments or praise about my intelligence or accomplishments.

11. At times, I feel my success has been due to some kind of luck.

12. I'm disappointed at times in my present accomplishments and think I should have accomplished much more.

13. Sometimes I'm afraid others will discover how much knowledge or ability I really lack.

14. I’m often afraid that I may fail at a new assignment or undertaking even though I generally do well at what I attempt.

15. When I’ve succeeded at something and received recognition for my accomplishments, I have doubts that I can keep repeating that success.

16. If I receive a great deal of praise and recognition for something I’ve accomplished, I tend to discount the importance of what I’ve done.

17. I often compare my ability to those around me and think they may be more intelligent than I am.

18. I often worry about not succeeding with a project or examination, even though others around me have considerable confidence that I will do well.

19. If I’m going to receive a promotion or gain recognition of some kind, I hesitate to tell others until it is an accomplished fact.

20. I feel bad and discouraged if I’m not “the best” or at least “very special” in situations that involve achievement.

APPENDIX D. IDENTITY AS STEM PROFESSIONAL ITEMS

The following questions ask how you think about yourself and your personal identity. We want to understand how much you think that being a STEM professional is part of who you are. Please circle the one number that indicates your agreement with the following items.

1	2	3	4	5
Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

1. In general, being a STEM professional is an important part of my self-image.
2. I have a strong sense of belonging to the community of STEM professionals.
3. Being a STEM professional is an important reflection of who I am.
4. I have come to think of myself as a STEM professional.
5. I feel like I belong in the field.
6. I am a STEM professional.

APPENDIX E. SCHOOL-BURNOUT INVENTORY (SBI)

Please choose the alternative that best describes your situation (estimation from previous month)

1	2	3	4	5	6
Completely disagree	Partly disagree	Disagree	Partly agree	Agree	Completely agree

1. I feel overwhelmed by my schoolwork
2. I feel a lack of motivation in my schoolwork and often think of giving up
3. I often have feelings of inadequacy in my schoolwork
4. I often sleep badly because of matters related to my schoolwork
5. I feel that I am losing interest in my schoolwork
6. I'm continually wondering whether my schoolwork has any meaning
7. I brood over matters related to my schoolwork a lot during my free time
8. I used to have higher expectations of my schoolwork than I do now
9. The pressure of my schoolwork causes me problems in my close relationships with others

APPENDIX F. STIGMA CONSCIOUSNESS QUESTIONNAIRE (SCQ)

Instructions: Please respond to each item using the scale provided below to reflect

0	1	2	3	4	5	6
Strongly disagree			Neither agree or disagree			Strongly agree

1. Stereotypes about LGB individuals have not affected me personally.
2. I never worry that my behaviors will be viewed as stereotypical of LGB people.
3. When interacting with heterosexuals who know of my sexual preference, I feel like they interpret all of my behaviors in terms of the fact that I am LGB.
4. Most heterosexuals do not judge LGB individuals on the basis of their sexual preference.
5. My being LGB does not influence how LGB people act with me.
6. I almost never think about that fact that I am LGB when I interact with heterosexuals.
7. My being LGB does not influence how people act with me.
8. Most heterosexuals have a lot more homophobic thoughts than they actually express.
9. I often think that heterosexuals are unfairly accused of being homophobic.
10. Most heterosexuals have a problem viewing LGB individuals as equals.

APPENDIX G. INTENTIONS TO PERSIST SCALE

Please indicate how strongly you agree. <u>Please answer all items</u>.

0	1	2	3	4	5	6	7	8	9
Strongly disagree									Strongly agree

1. I intend to major in a STEM field.
2. I plan to remain enrolled in a STEM major over the next semester.
3. I think that earning a bachelors degree in STEM is a realistic goal for me.
4. I am fully committed to getting my college degree in a STEM field.

APPPENDIX H. IDENTITY CENTRALITY SCALE

Respond regarding the extent to which they endorse the items on a 7-point Likert-type scale ranging from:

1	2	3	4	5	6	7
Strongly disagree						Strongly agree

1. Overall, being Black has very little to do with how I feel about myself.
4. In general, being Black is an important part of my self-image.
5. My destiny is tied to the destiny of other Black: people.
6. Being Black is unimportant to my sense of what kind of person I am.
7. I have a strong sense of belonging to Black people.
8. I have a strong attachment to other Black people.
9. Being Black is an important reflection of who I am.
10. Being Black is not a major factor in my social relationships.

APPENDIX I. EMAIL/LISTERV RECRUITMENT

Dear Purdue Student,

My name is Abby Bastnagel and I am graduate student in the Department of Educational Studies at Purdue University. I am emailing to invite you to participate in a research study that explores lesbian, gay, and bisexual (LGB) college students' experience in STEM-related fields.

We would like to give you a Qualtrics survey, which can be completed online. Upon completing the Qualtrics survey, you will be asked to voluntarily submit your email address for a chance to **win one $25 Amazon gift card** from a random drawing by submitting your email address. It is possible to complete the Qualtrics survey without entering the gift card drawing. The odds of winning an Amazon.com gift card are estimated to be 1 in 200. Your responses will remain anonymous even if you participate in the drawing.

In order to participate in the study, you must (a) be 18 years of age or older, (b) currently enrolled as an undergraduate at Purdue University, and (c) identify as lesbian, gay, or bisexual.
Results will be reported as aggregate data, and your responses cannot be identified as yours. You may skip any questions that make you uncomfortable or that you do not wish to answer. If you do not wish to participate, simply ignore this email and the reminder email that you will receive in about a week.

Thank you in advance for your time and participation! If you have any questions about this study, feel free to contact me at abastna@purdue.edu . This study has been approved by Purdue University Institutional Review Board (IRB Research Project Number: IRB-2019-715)

If you agree to participate in the study, simply click on this link or copy-and-paste it into your web browser.

<https://purdue.ca1.qualtrics.com/jfe/form/SV_0CEru5v5aZo40h7>

Sincerely,

Abigail Bastnagel, M.S. Ed.
abastna@purdue.edu

APPENDIX J. RESEARCH PARTICIPANT INFORMATION SHEET

What is the purpose of this study? The purpose of this study is to gain a clearer understanding of LGB students' experiences in STEM-related fields.

What will I do if I choose to be in this study? If you agree to participate, you will be asked to complete one online survey, which will take approximately 15 minutes to complete.

Will I receive payment or other incentive? If you choose, you may enter into a gift card drawing for the chance to win one $25 dollar Amazon.com gift card. The odds of winning the gift card are approximately 1 in 200.

What are the possible risks or discomforts? Participation in this research involves minimal risk. There is no expectation of discomfort expected from participation in this research. The risks involved in participation are no more than would be encountered in everyday life or during the performance of routine psychological exams or tests.

Are there any potential benefits? By participating in this study, you may contribute to the scientific body of knowledge regarding LGB issues in higher education.

Will information about me and my participation be kept confidential? Purdue University Institutional Review Board or its designees may inspect the project's research records to ensure that participants' rights are being protected. Only the researchers will have access to the data. All the data collected will be kept confidential. All information provided in the survey will remain confidential. Only the researchers will have access to the data, which will be downloaded from a secure Internet server (qualtrics.com) and stored on the researchers' password-protected computers. Data will be deleted from their computers after it has been analyzed. Data gathered from this research may be presented in scientific outlets, but this data will be based on *average* responses, not individual responses.

What are my rights if I take part in this study? Your participation in this study is voluntary. You may choose not to participate or, if you agree to participate, you can withdraw your participation at any time without penalty or loss of benefits to which you are otherwise entitled.

Whom to contact if you have questions about the study: If you currently have questions that may aid in your decision to participate in this research or if you have any general questions or concerns, please contact Abby Bastnagel (abastna@purdue.edu), Department of Educational Studies, Purdue University. If you have concerns about the treatment of research participants, you can contact the Institutional Review Board at Purdue University. Contact information for the Purdue University IRB is 1032 Ernest C. Young Hall, 155 S. Grant Street, West Lafayette, IN 47907-2114. The phone number for the Board is (765) 494-5942. The email address is irb@purdue.edu. We suggest you print this page for your records. Clicking "I agree" in the lower right portion of your screen indicates that you have read and understand the information provided above, that you willingly agree to participate, that you are aware that you may withdraw your consent at any time and discontinue participation without penalty. If you choose not to participate, simply close your web browser and the study will be terminated.