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Coloring in the Margins: Understanding the Experiences of Racial/Ethnic and Sexual/Gender Minority Undergraduates in STEM

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by

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ABSTRACT

Extensive research has documented the experiences and outcomes of women and certain underrepresented racial/ethnic minority groups in STEM educational programs. This paper contributes to current conversations by focusing on the experiences of individuals that identify as both a racial/ethnic and sexual/gender minority (SGM). This paper has two major objectives in mind: (1) provide one of the first empirical studies examining the experiences of SGM students in STEM and (2) interrogate the intersection of racial/ethnic identity and sexual/gender identity within the context of these programs. In order to provide a more robust understanding in these areas, this paper is guided by the following research questions: (1) What are the experiences of students who identify as both a racial/ethnic and sexual/gender minority in STEM educational programs, (2) in what ways do these students' sexual/gender and racial/ethnic identity influence these experiences, (3) do racial/ethnic and sexual/gender minorities feel a sense of belonging within their respective programs and why, and (4) how do racial/ethnic and sexual/gender minorities perceive they are treated by peers, faculty, and staff within these programs. This paper takes a mixed-method approach, incorporating both interviews and quantitative survey data to gain insights into these questions. Upon analysis, major findings demonstrated that students experiences an erasure of student diversity in the classroom, while also experiencing higher salience with their sexual/gender identity when compared to their racial/ethnic identity in these spaces.

CHAPTER ONE: INTRODUCTION

There is a long tradition of academic research that has examined the educational and professional outcomes of Science, Technology, Engineering, and Mathematics (STEM) fields. Scholarly interest in these fields have delved into myriad different perspectives and topics ranging from teamwork dynamics (Tonso 2006), to factors determining academic persistence (Wao, Lee, and Borman 2010; Palmer, Maramba, and Dancy 2011), to research examining key learning principles in the field (Hansen and Gonzalez 2014). Further, the disproportionate number of certain racial/ethnic groups and women in STEM fields has also led to the pursuit of academic questions that focus on the inclusion of these groups, as well as what factors influence higher levels of persistence and success.

There has been extensive research documenting the experiences of underrepresented racial/ethnic minority groups in STEM (Daily and Eugene 2013; DeWitt et al. 2011; MacPhee, Farro, and Canetto 2013; Ong et al. 2011; Cech et al. 2011; Palmer, Maramba, and Dancy 2011; Tyson, Smith, and Ndong 2010). This research shows that these underrepresented groups encounter a unique experience once they matriculate into their respective programs. However, this body of literature often fails to address the role sexual/gender identity may play in the experiences of these students. This exclusion is particularly surprising considering the work that has documented the importance of understanding the experiences of multiple minority students in higher education (Wall and Washington 1991; McCready 2004; Diaz and Kosciw 2009; Goode-Cross and Tager 2011).

According to the *2010 State of Higher Education for Lesbian, Gay, Bisexual, and Transgender Persons,* sexual and gender minority (SGM) students are more likely to indicate harmful experiences and negative academic outcomes (Rankin et al. 2010). In particular, SGM students experience less welcoming campus climates based on their identity and are at the highest risk of being subjected to experiences that undermine their ability to live and learn on campus (Rankin 2005; Rankin et al. 2010). Little is known, however, about the specific experiences of SGM students in Science, Technology, Engineering, and Mathematics (STEM) fields.

Considering this scarcity of empirical research on the experiences of SGM students in STEM fields, this project has two major objectives in mind: (1) provide one of the first empirical studies examining the experiences of SGM students in STEM and (2) interrogate the intersection of racial/ethnic identity and sexual/gender identity within the context of these programs. In order to provide a more robust understanding in these areas this project is guided by the following research questions: (1) What are the experiences of students who identify as both a racial/ethnic and sexual/gender minority in STEM educational programs? (2) In what ways do these students' sexual/gender and racial/ethnic identity influence these experiences? (3) How do racial/ethnic and sexual/gender minorities understand a sense of belonging within their respective programs? (4) How are racial/ethnic and sexual/gender minorities treated by peers, faculty, and staff within these programs?

CHAPTER TWO: LITERATURE REVIEW

Underrepresented Populations in STEM

There has been a plethora of research published that discusses underrepresented populations in STEM fields (Cole 2008; Wao, Lee, and Borman 2010; Dewitt et al. 2010; Cech, Rubineau, Silbey, and Seron 2011; Palmer Maramba, and Dancy 2011; McGee and Martin 2011; MacPhee, Farro, and Canetto 2013). For example, Ong, Wright, Espinosa, and Orfield (2011) review and synthesize over 100 pieces of literature that have been published during a 4-decade period that addresses the unique experience of being a woman of color in STEM fields. Their review finds that members of this subgroup experience issues related to isolation, identity, invisibility, negotiating/navigation, microaggression, sense of belonging, and tokenism. Ong et al. (2011) also find that research on women of color is often seen as low priority, which may contribute to a vicious cycle maintaining the invisibility of existing injustices and inequalities. The issue of isolation and tokenism have also been documented in several other pieces on underrepresented groups (Kanter 1993; Tyson, Smith, and Ndong 2010; McGee and Martin 2011).

Racial Stereotypes. A reoccurring theme in the literature on racial/ethnic minority student experiences in STEM discusses the role of stereotypes and microaggressions within the everyday interactions of these students (DeWitt et al. 2010; Goode-Cross and Tager 2011; McGee and Martin 2011; Brawner et al. 2012; MacPhee 2013). McGee and Martin (2011) found that

stereotype threat, a form of confirmation bias where the threat of being viewed through the lens of a negative stereotype is linked with the aversion to doing something to affirm said stereotypes, suppresses academic performance among racial/ethnic minority students. In addition, stereotype lift, the performance boost of one group when comparisons are made at the expense of another group, is often associated with stereotype threat. The authors also provide the concept of stereotype management as a way for racial/ethnic minority students to persevere despite the negative influences of stereotypes.

Similarly, Brawner et al. (2012) interrogated prevailing assumptions and stereotypes regarding industrial engineering to explore why undergraduate women are drawn to this subfield of engineering over others. Their findings show that women gravitate toward this subfield of engineering due to its perceived femininity, warmth and flexibility (Brawner et al. 2012). While the authors examined assumptions and stereotypes related to being a woman in STEM, there was no discussion of other sexual/gender identities.

Factors of Success. There also has been a considerable amount of research that has attempted to better understand what factors are instrumental to the success of students of color in STEM (Palmer, Maramba, and Dancy 2011; Wao, Lee, and Borman 2010; Cole 2008). For example, Palmer, Maramba, and Dancy (2011) considered factors critical to the success of students of color in STEM fields at predominantly white institutions. They found that peer support, involvement in STEM related activities, and proper preparation in elementary and secondary education are factors that contribute to student success. The authors also argue that recruitment of racial/ethnic minorities into STEM is not enough to ensure success, but that universities and colleges also need to ensure that these students receive the support and resources necessary to succeed. Specifically, they stress the need to deconstruct the climate of intimidation

that is often experienced by people of color in STEM (Palmer et al. 2011). Further discussions regarding factors of success in STEM fields can be found in research by DeWitt et al. (2010), Wao, Lee, and Borman (2010), and Cole (2008).

Discipline Culture. It has been asserted that engineering and mathematics are fields that are culture free spaces (McGee and Martin 2011). However, this claim has been critiqued and proven to be false (Bishop1990; Kantner 2008; McGee and Martin 2011). DeWitt et al. (2011) conducted research that analyzed minority students' interest in studying science and their aspirations in pursuing science related careers. Their research finds what they called the "Asian effect:" Asian students display a highly positive package of attitudes, expectations and behaviors that foster a deep interest in science (DeWitt et al. 2011). They also found that racial/ethnic minorities and lower socio-economic status students do not have access to the same resources that promote success and achievement in the natural sciences and that racial/ethnic minorities are faced with racist attitudes and other inequalities in these fields (DeWitt at al. 2011). This body of research suggests that there is a dominant culture within STEM education programs that privileges male, white/Asian, heterosexual, and gender normative students at the expense of others.

Regarding teamwork and engineering culture, Tonso (2006) looked at the differing roles students may play within engineering educational programs using ethnographic research and participant observations. They found there is a specific culture within these programs that privileges men at the expense of women. Further, the author suggests that women in engineering faced barriers associated with not only their gender, but also other components of their identity and emphasize the need for intersectional research on this topic (Tonso 2006) This need for an intersectional approach is a major objective of the currently proposed project.

Leaving the Major. Another major topic of study within the literature on underrepresented populations in STEM, analyzes what factors determine if a student will switch out of a STEM major to a non-STEM one (Tyson, Smith, and Ndong 2011; Seymour and Hewitt 1997). Work by Tyson, Smith, and Ndong (2011) examines factors that influence why students leave engineering as a major. They found that women and racial/ethnic minority switchers, those students that switch out of the engineering major, point to inadequate preparation in high school as the primary reason for leaving engineering for alternative majors outside of STEM (Tyson et al. 2011). They also found that administrators believed that switchers were merely students who did not have the drive or commitment to succeed, ignoring the influence of the students' social position within these environments. In addition, Black students who switched described a lack of social fit in the program as well as having to deal with their group's underrepresentation in engineering (Tyson et al. 2011). Overall, Black students who switched had a more difficult time making the adaptions necessary to persist in engineering when compared to other racial/ethnic minorities (Tyson et al. 2011).

Sexual/Gender Minorities in Higher Education

While there has been extensive research emphasis on women and students of color in STEM fields, there has been very limited research completed on the experiences of sexual/gender minorities (SGM). One of the few pieces considering this topic is an exploratory study by Cech et al. (2011). In their work, using multinomial logistic regression and ordinal logistic regression, the authors found that pervasive, negative perceptions of competence can severely limit students' opportunities to succeed. However, even this research does not address the role sexual/gender minority status plays on student interactions with faculty, peers, and staff

within these STEM educational programs. Further, Bilimoria and Stewart (2009) investigated the experiences of SGM faculty within STEM, however there was no discussion included on SGM student experiences within these same programs. While this piece did not address SGM students directly, their findings suggest that SGM individuals contend with both internal and external consequences due to their SGM status stemming from invisibility of their social identity (Bilimoria and Stewart 2009). This gap within the STEM literature on the experiences of SGM students is surprising considering the long tradition of research examining LGBT+ issues within higher education (Wall and Washington 1991; McCready 2004; Rankin 2005; Beemyn et al. 2005; Diaz and Kosciw 2009; Rankin et al. 2010; Renn 2010; Goode-Cross and Yurman 2011).

History. Renn (2010) provides an overview on the history of literature discussing LGBT and queer issues in higher education. From their work, the author found that higher education scholars divide their research into categories covering students, faculty, administrative officials, organizations, governance and finance, policy, or teaching (Renn 2010). The author further divides the literature into two waves. The first wave, which encompassed all research before the mid-1970s, generally pathologized homosexuality and deemed it as something deviant and requiring treatment. The second wave, which covered all literature since the 1970s, was structured around providing evidence of normalcy, visibility and civil rights for sexual/gender minorities in higher education (Renn 2010). From this second wave, there have been three dominant paradigms within higher education research on SGM issues: (1) visibility of LGBT people, (2) campus climate for LGBT people, and (3) LGBT student identities and experiences (Renn 2010). Renn (2010) then concludes by emphasizing a need for more empirical research addressing transgender students and LGBT students of color. My proposed research attempts to extend the current dialog into the latter group within the context of STEM educational programs.

Deleterious Experiences of LGBT Students. A common point of discussion in the literature on SGM student experiences in higher education relates to their negative interactions within these environments (Wall and Washington 1991, McCready 2004; Rankin 2005; Beemyn et al. 2005; Diaz and Kosciw 2009; Rankin et al. 2010; Renn 2010; Dugan and Yurman 2011; Goode-Cross and Tager 2011). The work by Rankin and Rankin et al. (2005; 2010) has found that LGBT students are often marginalized on campus as a result of their sexual/gender identity. The most common form of harassment was derogatory comments, and, despite efforts taken by many colleges and universities, many LGBT students still fear for their safety, confront frequent harassment, and feel their institution is unsupportive of LGBT people (Rankin 2005; Rankin et al. 2010; Renn 2010). However, even with LGBT students facing pervasive and frequent homophobia, there is a body of research that has illuminated how these students respond and persist within these negative environments (Goode-Cross and Tager 2011; Rankin 2005; Diaz and Kosciw 2009).

Invisibility and Tokenism. Paradoxically, multiple minority individuals in higher education settings experience both invisibility and hypervisibility (Goode-Cross and Tager 2011; Bilimoria and Stewart 2009; McCready 2004). This occurs due to these students regularly being the only LGBT person of color in these environments, forcing them to serve in a representative role for both underrepresented groups. Further, with this simultaneous visibility and invisibility comes tokenism. Tokenism occurs when individuals from a certain social group are numerically rare in certain contexts and environments (Kanter 1993).

Unique Experience of Multiple Minority Students. Within the literature on sexual/gender minorities in higher education, there is a subfield dedicated to exploring the unique experiences of individuals who are both a racial/ethnic and sexual/gender minority in these educational

contexts (Wall and Washington 1991; McCready 2004; Diaz and Kosciw 2009; Goode-Cross and Tager 2011). Goode-Cross and Tager (2011) were interested in exploring the factors that contributed to the persistence of gay and bisexual African-American men at predominantly white institutions. From their research, the authors assert that having a dual minority status presents those individuals with unique challenges for persistence in these educational settings. Further, they found that their participants would minimize one aspect of their social identity in order to gain acceptance and affirmation (Goode-Cross and Tager 2011). Similarly, McCready (2004) found that facing multiple oppressions stemming from social identity can marginalize students in the very communities that are thought to provide them safety and support. Moreover, gay and gender nonconforming people of color contend with a variation of marginalization different than that of their heterosexual and gender normative counterparts (McCready 2004). McCready (2004) concludes their piece by asserting that attempting to understand multiple minority students' experiences by looking at sexual identity or racial identity alone is simultaneously reductive and overly simplistic, future research needs to consider how these multiple social hierarchies intersect. My aim is to emulate these studies and bring a more intersectional perspective into this body of research on multiple minority students with a specific focus on their experiences in STEM programs.

Racism and Homophobia. Within the literature on racial/ethnic and sexual/gender minorities in higher education, there is a body of work discussing how these individuals must contend with prejudice and discrimination within their respective communities (Wall and Washington 1991; McCready 2004; Diaz and Kosciw 2009; Goode-Cross and Tager 2011). This research shows that often queer people of color face both racism and homophobia. Within communities of color, those that also identify as sexual/gender minorities often confront

hostility, prejudice, harassment, and discrimination instead of social and emotional support that is often needed from these communities (Wall and Washington 1991; Goode-Cross and Tager 2011). A similar pattern is observed with LGBT communities and organizations, but instead of homophobia, queer people of color are presented with racism and ethnic prejudice (McCready 2004; Goode-Cross and Tager 2011). Often, LGBT oriented organizations undermine their supposed inclusivity and are white spaces that promote a homonormative ideology (McCready 2004).

Intersectionality

The scope of this projected is interested in examining how differing social hierarchies operate and mediate experiences in the context of STEM educational programs. With this in mind, it is important to mention the theoretical orientation of intersectionality. Coined by Kimberlé Crenshaw, intersectionality "highlights the need to account for multiple grounds of identity when considering how the social world is constructed" (Crenshaw 1991:1245). Crenshaw was interested in examining race and gender within the law, indeed intersectionality emerged due to the experiences of women of color being insufficiently represented by both feminist and racial discourses, and was a way for scholars and activists to counter this invisibility (Crenshaw 1991; Collins 2000). Intersectionality allows for multiple social hierarchies to be examined and for the unique positioning of those subjected to multiple oppressions to be illuminated. An intersectional approach is taken because it is important to acknowledge that students' social identities do not exist within a vacuum, they are interconnected and operate together within the classroom.

Gaps in the Literature

When considering the body of work that examines the experiences of underrepresented minority groups in STEM, there are two primary areas that I am interested in developing further, (1) the lack of empirical research on sexual/gender minorities in STEM, and (2) the lack of research taking an intersectional perspective on the experiences of sexual/gender and racial/ethnic minorities within STEM fields. In addition to this, the extant literature on sexual/gender minorities in higher education also fails to address two topics that I have an interest in. First, while there has been some research conducted on the experiences of queer people of color in higher education, this research is in its infancy and requires further development. Second, this area of research has not considered the experiences of queer people of color within STEM educational programs. The goal of this research is to provide elaboration on these topics and illuminate these areas that have yet to be pursued academically.

CHAPTER THREE: METHODS AND DATA

This study is guided by the following research questions:

1. What are the experiences of students who identify as a racial/ethnic and sexual/gender minority in STEM educational programs?
2. In what ways do these students' sexual/gender and racial/ethnic identity influence these experiences?
3. Do racial/ethnic and sexual/gender minorities feel a sense of belonging within their respective programs? Why?
4. How do racial/ethnic and sexual/gender minorities perceive they are treated by peers, faculty, and staff within these programs?

To thoroughly interrogate these questions, I utilized a mixed method research design composed of in-depth interviews and quantitative survey data. Interview questions are included in Appendix A and survey questions, which have been segmented into Set I and Set II, are included in Table 2. This project's first research question, *what are the experiences of students who identify as a racial/ethnic and sexual/gender minority in STEM educational programs*, will be answered with data collected from interview responses and survey questions from Set I. The second and third research questions, *in what ways do these students' sexual/gender and racial/ethnic identity influence these experiences* and *do racial/ethnic and sexual/gender minorities feel a sense of belonging within their respective programs,* will both be answered with qualitative interview data. The fourth research question, *how are racial/ethnic and sexual/gender*

minorities treated by peers, faculty, and staff within these programs, will be answered with interview data and responses from survey questions in Set II.

Data Set

Survey data analyzed for this project originated from the study *The Effects of Social Capital and Cultural Models on the Retention and Degree Attainment of Engineering Undergraduates*. The purpose of this longitudinal study was to broaden understanding about how social capital and cultural models of engineering success contribute to the retention and degree attainment of women and racial/ethnic minority engineering undergraduates who are traditionally underrepresented in STEM. Quantitative data originated from Survey 2 which asked undergraduate students who were in engineering programs questions regarding their experiences while in their first year of their respective program. Specifically, Survey 2 asked questions about students' participation in STEM related activities and programs, their experiences in STEM related courses, their interaction with peers, faculty, and staff, individuals who influenced their decision to pursue their engineering major, and their beliefs about how to be successful academically in their major. These engineering students were in cohorts from 11 different universities with varying demographics. These universities represented a mix of either Predominantly White Institutions, Hispanic Serving Institutions, or Historically Black Colleges and Universities. The purpose of including these survey responses is to help provide context to patterns and themes that emerge from the qualitative interview data. Further, this survey data can help in providing an intersectional approach to the experiences of underrepresented groups in STEM.

Interview data was also collected for the present study. The interviews included, supplemented the lack of information on SGM students in the quantitative survey data. They attempt to illuminate the experiences of those students that are both a sexual/gender and racial/ethnic minority within the context of STEM educational programs at a university in the Southern United States. The interview protocol utilized was designed based on the suggestions by Quinn (2005), Hill (2005) and Charmaz (2012). As such, they were semi-structured, in-depth interviews that were conversational in nature. While an interview protocol was used, it was not strictly adhered to, with each interview tailored to the responses of the participant. Charmaz's (2012) method of thematic analysis was also used with the qualitative interview data, however, grounded theory was not. Additionally, all interview participants were given a pseudonym to protect their identity. The interview guide is included in Appendix A.

Survey and Interview Demographics

Survey Demographics. There were 1,755 respondents for Survey 2. Along gender, 66.72% (n=1,171) of respondents were male and 33.28% (n=584) were female. In total, there were 17 category options possible for respondents to answer regarding race/ethnicity, this was collapsed into five categories to provide more useful statistical analysis. Broken down along race/ethnicity, 48.49% (n=851) of respondents were White, 24.73% (n=434) identified as Hispanic, 16.30% (n=286) as Asian, 5.75% (n=101) identified as Black, and 4.73% as other racial/ethnic group (n=83), respectively.

Table 1. Race/Ethnicity and Gender of Survey Respondents, Frequencies

Race/Ethnicity	Female		Male		Total	
	n	%	n	%	N	%
White	286	16.30	565	32.19	851	48.49
Black	42	2.39	59	3.36	101	5.75
Hispanic	130	7.41	304	17.32	434	24.73
Cuban	7	0.40	25	1.42	32	1.82
Mexican	10	0.57	16	0.91	26	1.48
Puerto Rican	79	4.50	200	11.40	279	15.90
Other Hispanic	34	1.94	63	3.59	97	5.53
Asian	97	5.53	189	10.77	286	16.30
Asian Indian	27	1.54	59	3.36	86	4.90
Chinese	38	2.17	69	3.93	107	6.10
Filipino	9	0.51	9	0.51	18	1.03
Japanese	0	0.00	8	0.46	8	0.46
Korean	5	0.28	10	0.57	15	0.85
Vietnamese	7	0.40	7	0.40	14	0.80
Other Asian	11	0.63	27	1.54	38	2.17
Other	29	1.65	54	3.08	83	4.73
AIAN	2	0.11	7	0.40	9	0.51
Hawaiian/Other	0	0.00	0	0.00	0	0.00
Mid-East/Arab	7	0.40	22	1.25	29	1.65
Other	20	1.14	25	1.42	45	2.56
Total	584	33.28	1,171	66.72	1,755	100.00

Interview Demographics. A mixture of snowball and convenience sampling was used to recruit participants. In addition, recruitment presentations were given in several Introduction to Sociology courses on campus. In total, 7 interviews were collected, however, two were dropped from analysis due to the interviewee not meeting the demographic qualifications for participation. Each of the remaining five participants self-identified as both a member of an underrepresented racial/ethnic and sexual/gender group in STEM. Two participants identified as gay or lesbian, a further two as pansexual, and one identified as heterosexual; one participants identified as male, while four identified as female. Racially, two identified as Black, one as

mixed race, one as white-Hispanic, and one as Asian Indian. All participants were from different ethnic groups and academic majors. Appendix B summarizes participants' demographics.

Table 2. Interview Participants' Demographics

	Sexual Orientation	Race	Ethnicity	Gender Identity	Major
Jay	Gay	Black	American	Male	Electrical Engineering
Ruth	Heterosexual	Black	Sierra Leonean /Liberian	Female	Health Sciences
Sappho	Pansexual	White	Hispanic	Female	Public Health /Sociology
Syrena	Pansexual	Asian	Indian	Female	Animal Biology
Zara	Lesbian	White/ Asian	Korean	Female	Environmental Biology

Variables of Interest

For the purposes of statistical analysis, a subset of variables included in Survey 2 were focused on that covered participant experiences within their major, beliefs about their engineering program, and interactions with peers, faculty, and staff. Specifically, analyses were run on respondents' gender, race/ethnicity, negative and positive experiences as an engineering student, opinions on the environment of these programs, whether they observed/experience gender discrimination from peers, faculty, and staff, and whether they observed/experiences racial/ethnic discrimination from peers, faculty, and staff. These variables are summarized in Table 3.

Table 3. Variables Used in Statistical Analyses

Class	Variables
Set I	
I.A: In my first year as an engineering major I… Yes No	1. Experienced a hostile environment 2. Believed that I fit in well academically 3. Believed that I fit in well socially 4. Often took the lead in group projects/study groups 5. Was invited to participate in study groups 6. Would have been easily identified as an engineering student by members of the engineering community 7. Was isolated 8. Was uncomfortable asking questions in class
I.B: In my first year as an engineering major, I believed that in my engineering major… Yes No Unsure	1. Racial/Ethnic minority students were treated differently from other students 2. Female students were treated differently from other students 3. Students of higher socioeconomic status were more successful in obtaining internships, job offers, etc. 4. Students were too competitive
Set II	
II.A: In my first year as an engineering major, I observed language (e.g. sexual/gender/ethnic stereotypes, comments or jokes) being used by… Yes No	1. Engineering faculty 2. Engineering peers 3. Engineering teaching assistants/graduate assistant/lab instructor 4. Engineering staff
II.B: In my first year as an engineering major, I was stereotyped because of my gender by… Yes No	1. Engineering faculty 2. Engineering peers 3. Engineering teaching assistants/graduate assistant/lab instructor 4. Engineering staff
II.C: In my first year as an engineering major, I was stereotyped because of my race/ethnicity by… Yes No	1. Engineering faculty 2. Engineering peers 3. Engineering teaching assistants/graduate assistant/lab instructor 4. Engineering staff

Research Techniques

For the qualitative component of this study, data were coded then analyzed into dominant themes. For the quantitative component, a triangulation approach was used with frequency distributions, chi-squared tests for independence, and a series of analyses of variance (ANOVA) tests.

Qualitative Coding and Analysis. Once the qualitative interview data were collected, thematic analysis was used in tandem with open and focused coding. This coding approach and form of analysis is elaborated on in the work by Emerson, Fretz, and Shaw (2011) and Glesne (2016). Thematic analysis was utilized to explore the patterns and variation in participants' responses regarding their experiences as a double minority student within their STEM major. Moreover, thematic analysis provides substantive comparisons between those reoccurring patterns, and is conducive in gaining more nuanced understandings of said patterns (Glesne 2016). With this coding process, the first step involved open coding. In the open coding process, one identifies all themes and ideas that emerge from the data (Emerson et al. 2011). After this, focused coding began where one goes line by line and line through the interview transcripts with the themes identified in the open coding process in mind (Emerson et al. 2011).

Quantitative Analysis. For the quantitative analysis, survey questions were segmented into two sets. Set I included those questions that probed at respondents' experiences and beliefs within their academic major, while Set II covered questions related to interactions with classmates, faculty, and staff within their program. First, frequency distributions are presented with regard to gender differences with the variables in Set I and Set II, then comparisons are made using chi-squared and ANOVA tests with race/ethnicity and gender. These analyses are

done to gauge the level of influence respondents' racial/ethnic and gender identity have on variables of interest within the survey data.

CHAPTER FOUR: FINDINGS AND DISCUSSION

First, survey results and statistical analyses will be presented, with the variables in Set I discussed first followed by the variables in Set II. Second, the major findings from the qualitative interview data will be presented and analyzed. Finally, comparisons and discussion on the survey and interview findings will follow.

Survey Results

Survey responses were analyzed in order to help answer research questions one and four. The survey data presents responses from students of varying racial/ethnic backgrounds and along gender. This data is included due to its ability to determine if there are clear differences experienced by students along race/ethnicity and gender, thus setting the stage for the qualitative data to be presented that incorporates the perspective of SGM students who also identify as a member of an underrepresented racial/ethnic group in STEM. The variables presented in Set I are oriented toward question one, while the variables in Set II are oriented toward question four (Table 3). The first subset in Set I asked respondents whether they agreed or disagreed with a series of statements regarding their experiences during their first year in their respective engineering program. The second subset in Set I asked respondents whether they agreed or disagreed with a series of beliefs regarding their respective engineering programs. These questions attempt to tap those aspects related to respondents' experiences and beliefs within their academic major and program. Questions in Set II asked respondents if they observed sexist/racist language from engineering peers, faculty, and staff, and if they were stereotyped based on their

gender or racial/ethnic identity within their program. These questions help explore the ways gender and racial/ethnic identity influence student interactions with peers, faculty, and staff within these engineering programs. For purposes of statistical analysis, gender is coded as male or female while a five-category race/ethnicity variable is used as presented in Table 1 (Asian, Black, Hispanic, Other, White).

Experiences and Beliefs in Engineering Program. Tables 4 and 5 describe how gender influences the experiences and beliefs of respondents within their program. These tables tabulate responses to the variables included in Table 3 that ask about experiences (Set I.A) and beliefs (Set II.B) within their engineering program. To determine whether there were differences among groups, comparisons of data were made across gender. To focus on the most pertinent answers, the response option *unsure* was removed in Table 5. These comparisons use simple χ^2 analysis of counts in addition to ANOVA analyses.

Table 4. Experiences by Gender: Frequency

Experience	Male				Female			
	Yes	%	No	%	Yes	%	No	%
Experienced a hostile environment*	122	10.42	1,049	89.58	105	17.98	479	82.02
Believed that I fit in well academically**	927	79.16	244	20.84	398	68.15	186	31.85
Believed that I fit in well socially**	876	74.81	295	25.19	381	65.24	203	34.76
Often took the lead in group projects/study groups	709	60.55	462	39.45	352	60.27	232	39.73
Was invited to participate in study groups	853	72.84	318	27.16	442	75.68	142	24.32
Would have easily been identified as an engineering student by member of the	739	63.11	432	36.89	289	49.49	295	50.51

Table 4, Continued

engineering community**								
Was isolated	322	27.50	849	72.50	156	26.71	428	73.29
Was uncomfortable asking questions in class*	455	38.86	716	61.14	309	52.91	275	47.09

*A significantly ($p<.05$) larger proportion of females agreed with this statement.
**A significantly ($p<.05$) larger proportion of males agreed with this statement.

Table 5. Beliefs by Gender: Frequency

Belief	Male			Female		
	Yes	No	Unsure	Yes	No	Unsure
Racial/Ethnic minority students were treated differently from other students**	115	923	133	58	406	120
Female students were treated differently from male students*	211	800	160	226	2290	68
Students of higher socioeconomic status were more successful at obtaining internships, job offers, etc.	338	569	264	164	301	119
Students were too competitive*	344	655	172	255	265	64

*A significantly ($p<.05$) larger proportion of females agreed with this statement.
**A significantly ($p<.05$) larger proportion of males agreed with this statement.

From these results, there are clear gender differences in the majority of areas within the experiences and beliefs variables. In five of the eight experience statements, there are significant differences between male and female responses, with females more likely to experience a hostile

atmosphere and discomfort when asking questions in class, while males were more likely to experience fitting in academically, fitting in socially, and being identified as an engineering student by members of the engineering community. Similarly, males and females differed in three of the four areas for beliefs about their program. Males were more likely to agree that racial/ethnic minority students were treated differently from other students in their program, while females were more likely to agree with the statement female students were treated differently from male students and that students were too competitive in their program.

The same process described for gender groups was used to describe how respondents' race/ethnicity influenced the variable in Set I, which discussed experiences and beliefs in their engineering program (Tables 6 and 7). Like gender, race/ethnicity was found to differ significantly in a majority of areas for the beliefs variable, while it played a lesser role with respondents' experiences within their major, with significant differences found in only three of the eight areas. With respect to the experiences variable, Black students were less likely to agree that they fit in well academically when compared to all other groups, while Asian students were less likely to agree that they took the lead in group projects/study groups or were invited to participate in study groups. With respect to the belief variable, White students were less likely to agree with all four possible belief options than their counterparts. When compared to White students, all other racial/ethnic groups were more likely to agree with the belief that racial/ethnic minority students were treated differently from other students in their engineering program. Further, Black students were more likely to agree that female students were treated differently than male students when compared to White and Other racial/ethnic groups. Hispanic students were found to agree more often with the belief that students of higher socioeconomic status were more successful at obtaining internships and job offers when compared to White respondents,

while Black students were more likely to agree with the belief that students were too competitive in their program when compared to Asian, Hispanic, and White groups. From these results, gender and racial/ethnic identity both influence the experiences and beliefs of respondents, however, gender seems to play a more prominent role when compared to race/ethnicity for the experiences variable.

Table 6. Experiences by Race/Ethnicity: Summary

Experience	χ^2 Result	Findings
Experienced a hostile environment	9.2, ns	
Believed that I fit in well academically	23.6 p<.001	Black students less likely than all other groups to agree
Believed that I fit in well socially	9.3, ns	
Often took the lead in group projects/study groups	16.4 p<.01	Asian students less likely than White students to agree
Was invited to participate in study groups	27.3 p<.001	Asian students less likely than Hispanic and White students to agree
Would have easily been identified as an engineering student by member of the engineering community	4.3, ns	
Was isolated	9.2, ns	
Was uncomfortable asking questions in class	6.5, ns	

Table 7. Beliefs by Race/Ethnicity: Summary

Belief	χ^2 Result	Findings
Racial/Ethnic minority students were treated differently from other students	74.7 p<.001	Students from all racial/ethnic groups more likely to agree than White students
Female students were treated differently from male students	45.7 p<.001	Black students more likely to agree than White and Other students
Students of higher socioeconomic status were more successful at obtaining internships, job offers, etc.	31.2 p<.001	Hispanic students more likely to agree than White students
Students were too competitive	59.7 p<.001	Black students more likely to agree than Asian, Hispanic, and White students

Oppressive Language and Stereotyping in Engineering Programs. The variables included in Set II were used to help answer the fourth research question, *how are racial/ethnic and sexual/gender minorities treated by peers, faculty, and staff within these programs*. In total, there were three subsets within Set II. The first (II.A) asked respondents if they observed language with sexist or racist content from engineering peers, faculty and staff, while the second and third (II.B and II.C) asked respondents if they personally experienced being stereotyped with regards to their gender and racial/ethnic identity by engineering peers, faculty, and staff.

Tables 8 and 9 present the distribution of responses for males and females with regard to observed language and being stereotyped by gender. These comparisons use simple χ^2 analysis of counts in addition to ANOVA analyses. With respect to observed language, peers were found to use sexist language more often than any other group. Further, a larger proportion of females were found to identify peers as using sexist language when compared to males. With respect to being stereotyped by gender, females were more likely to identify all groups as stereotyping them in some way more often when compared to their male counterparts.

Table 8. Observed Language by Gender: Frequency

Observed Language From:	Male		Female	
	Yes	No	Yes	No
Engineering Faculty	116	1,055	68	516
Engineering Peer*	520	651	312	272
Engineering Teaching Assistant/Graduate Assistant/Lab Instructor	115	1,056	63	521
Engineering Staff	98	1,073	43	541

*A significantly ($p<.05$) larger proportion of females agreed with this statement.

Table 9. Stereotyped by Gender: Frequency

Stereotyped by:	Male		Female	
	Yes	No	Yes	No
Engineering Faculty*	44	1,127	58	526
Engineering Peer*	67	1,104	243	341
Engineering Teaching Assistant/Graduate Assistant/Lab Instructor*	41	1,130	65	519
Engineering Staff*	41	1,130	42	542

*A significantly ($p<.05$) larger proportion of females agreed with this statement.

Tables 10 and 11 summarize the comparisons made by race/ethnicity with regard to the variables on racist/sexist language observed and stereotyping by race/ethnicity by peers, faculty, and staff. Unlike with the results found with the variables in Set I, race/ethnicity played just as influential a role in student responses as gender. With regards to language observed, Hispanic students were more likely to identify racist language by engineering faculty, teaching assistants/graduate assistants/lab instructors, and staff when compared to White students, as well as when compared to Asian students for teaching assistants/graduate assistants/lab instructors. Other racial/ethnic group students were also more likely to identify racist language from teaching assistants/graduate assistants/lab instructors when compared to White students.

For the variable being stereotyped by engineering peers, faculty, and staff, there were significant differences found within all group interactions. With engineering faculty, Black students were more likely to experience being stereotyped when compared to Asian and Hispanic students, while Other racial/ethnic group students were more likely to experience being stereotyped when compared to Hispanic and White students. With respect to engineering peers, Asian and Black students were stereotyped more often when compared to their Hispanic and Asian counterparts, while Other racial/ethnic group students were more likely to experience being stereotyped when compared to White students. With respect to engineering teaching

assistant/graduate assistant/lab instructor, Asian, Black, and Other racial/ethnic group students were more likely to experience being stereotyped by this group than White students. Further, Black students were also found to be stereotyped more often than Asian and Hispanic students. Finally, with engineering staff, Asian and Other racial/ethnic group students were more likely to identify being stereotyped by this group than White students, while Black students were more likely to identify being stereotyped when compared to Hispanic and Asian students. From these results, White and Hispanic students are significantly less likely to be stereotyped when compared to other groups, while Black and Other racial/ethnic group students are most frequently stereotyped by engineering peers, faculty, and staff.

Table 10. Observed Language by Race/Ethnicity: Summary

Observed Language From:	χ^2 Result	Findings
Engineering Faculty	21.2 p<.001	Hispanic students more likely to observe than White students
Engineering Peer	8.6, ns	
Engineering Teaching Assistant/Graduate Assistant/Lab Instructor	33.4 p<.001	Hispanic students more likely to observe than Asian and White students; Other category students more likely to observe than White students
Engineering Staff	23.7 p<.001	Hispanic students more likely to observe than White students

Table 11. Stereotyped by Race/Ethnicity: Summary

Stereotyped by:	χ^2 Result	Findings
Engineering Faculty	38.9 p<.001	Black students more likely to agree than Asian and Hispanic students; Other category students more likely to agree than Hispanic and White students
Engineering Peer	130.61 p<.001	Asian students more likely to agree than Hispanic and White students; Black students more likely to agree than Hispanic and White students; Other category students more likely to agree than White students

Table 11, Continued

Engineering Teaching Assistant/Graduate Assistant/Lab Instructor	45.6 p<.001	Asian students are more likely to agree than White students; Black students more likely to agree than Asian, Hispanic, and White students; Other category students more likely to agree than White students
Engineering Staff	33.5 p<.001	Asian students more likely to agree than White students; Black students more likely to agree than Hispanic and Asian students; Other category students more likely to agree than White students

Summary of Survey Results. It is clear from the analyses presented, there are pronounced differences in the experiences and interactions of students in engineering programs when considering gender and racial/ethnic identity. With respect to experiences and beliefs, gender and racial/ethnic identity both play influential roles, though gender seems to have a slightly more significant impact. With respect to interactions with engineering peers, faculty, and staff, gender and racial/ethnic identity both play a significant role in influencing the types of interactions students are exposed to. Female respondents are more likely to observe sexist/racist language and experience being stereotyped when compared to their male counterparts. Hispanic students are most likely to observe sexist/racist language. However, both Hispanic and White students are significantly less likely to experience being stereotyped, while Asian, Black, and Other racial/ethnic group students are more likely.

Results presented from this survey data demonstrate clear differences in the experiences of students based on their racial/ethnic and gender identity. However, these results do not speak to the unique experience of sexual/gender minorities, nor do they attempt to take an intersectional approach to how students' personal identities mediate their experiences within

their academic major. With this in mind, the qualitative interview data will be presented next to fill in this gap and elucidate those experiences not covered in the survey data.

Interview Results

The interview protocol utilized in this study was designed to probe participants about their experiences within their STEM major. Questions were designed to be as open ended as possible and were guided by an interest to compliment and expand on those questions included in the survey data (See Appendix A and Table 2, respectively). All participants were given a pseudonym to ensure confidentiality. Data gathered from interviewees can help in answering all the questions that are guiding this project. Major themes that emerged from interview responses will be presented first, then each research question will be addressed and discussed.

Major Themes.

From the interview responses, six broad themes emerged. These include: (1) masculine space, (2) heteronormative space, (3) individualism and meritocracy, (4) erasure of difference, (5) sexual/gender salience, and (6) relationship dynamics. The first four themes are characteristics more associated with the culture within STEM educational programs, while the latter two are descriptive of interactions within STEM educational programs.

Masculine Space. The first major theme, masculine space, was referenced to or discussed directly by all interview participants. Interviewees often characterized the culture within STEM educational programs as hyper competitive, arrogant, exclusive, and aggressive. These were consolidated into the category of masculine space. A subtheme under the masculine umbrella

was hyper competitiveness. Jay (Pseudonym), a gay Black man studying engineering, encapsulates this when saying:

> That air of hyper competition all the time…I find it draining personally…Just, like, I feel like I'm always competing with someone else. Like, they're always asking 'how did you do on the test?' Things like that and, like, people always getting together to study and they always, like, try to one up each other, or trying to get, you know, the best opportunities.

For Jay, the hypercompetitive demeanor of his classmates is draining, something he wishes he did not have to deal with. This environment of hyper competitiveness is also referred to by Sappho, a pansexual Hispanic woman studying public health and sociology, when discussing the difference between her STEM and sociology classes, saying "It's definitely more competitive [in STEM] because a lot of times someone goes in and there's a huge notion of so many spots [professionally] and that kind of situation, so it does have a competitive edge to it." Sappho also made note of this theme in reference to her classmates in her STEM courses. Ruth, a heterosexual Black woman studying health sciences, referred to competitiveness when asked about the culture of her major, elaborating: "you just see them [classmates] as competition they're not really, like, your friends. So, they're…yeah, they're more like numbers in a classroom." According to Ruth, this competitiveness is also linked with an impersonal aspect, something that was reiterated in other participant responses. Sappho also described STEM spaces as being overtly masculine when asked to explain how she felt about the competitive edge in her classrooms:

> I wish it was different, but I feel like it kind of stems from how the culture is in medicine and STEM in general. I feel like our generation is going to change that but how it is right now is doctors are separate from nurses and feel that sense of superiority when it really shouldn't.

Sappho feels that the competitive culture within STEM is also characterized by a hierarchy that stratifies students studying the more masculine pre-medicine track and the more feminine pre-nursing track.

Heteronormative Space. Heavily intertwined with the theme of masculine space, was the theme heteronormative space. Almost all interview participates made mention of heteronormativity, either directly or indirectly. These two themes were often mentioned together. For example, when Jay was asked why he sometimes feels like he is being treated condescendingly by peers he said:

> Cuz, like, I just, I generally come off as like a shy or timid person and I feel like if you don't project, like, an air of confidence and strength and, you know, (laughing) then you're not seen as, like, masculine enough. If you're not masculine, then that means you're gay… I would say that it's pervasive just as a natural by-product of, you know, having most of the students and the faculty being male so…but it's in everything that…that you'll do, because everything is, you know, with other people in groups so there is always going to be this competition, and…and heteronormativity. I'm sure if you're becoming friends with whoever you're working with, that I'm sure you might have more difficulties along the way if you are a sexual minority because I don't know how receptive a lot of people are. I mean, I generally think you'd be okay but, I mean, you're always going to encounter something, some kind of trouble.

For Jay, his STEM classrooms and interactions are clearly enveloped by masculinity. Jay then links the phenomenon of masculinity with heteronormativity and discusses how the two often work together in creating an environment that he believes negatively influences SGM students and leads to ambiguity surrounding SGM identity. Zara, a mixed-race woman studying environmental biology, brought up heteronormativity when discussing the diversity in her classroom environments saying "I mean there's…there's all different kinds of people but for the majority of it, I feel like that I've come into contact with just a lot of straight people, you know? A lot of heterosexuality pretty much dominates a lot of it." For Zara, one of the areas where her classes are not diverse is with regard to sexual orientation. In fact, these spaces are dominated by heterosexuality from her perspective. Syrena, a pansexual Asian Indian woman studying animal biology, also described the assumed heterosexuality in her major when asked about the language instructors' use in the classroom:

> Sometimes I look around and other people don't seem to be uncomfortable so then I think maybe I'm making it up in my head, you know? Sometimes, I feel like I'm just judging them too harshly but then again, I think to myself that, especially as a college professor, you don't have a right to be that ignorant.

> And when you're looking at a classroom and you can see you're not talking to cis-gendered, heterosexual, males you shouldn't be saying things like that.

Syrena finds these situations make her uncomfortable, however, she feels as if none of her peers feel the same way. Further, her instructors continue to perpetuate an overtly heteronormative ideology even when engaging with the student body, despite not all students being cis-gendered, heterosexual, males.

Individualism and Meritocracy. The third theme, which I call individualism and meritocracy, included those responses that referenced working hard, academic excellence, and STEM students being described as driven, intelligent, and overworked. Ruth, when asked how she fits in with the culture of her major, said:

> I feel like we have the drive to get where we want to be, so yeah. We have that in common we're very driven…[v]ery dedicated, they don't wait until the last minute to start things. I mean like, even if you're like struggling in a class I feel like actually taking the initiative to talk to your professor about how things are, going to tutoring instead of just being like "Oh I'm lost what can I do" and then not taking those steps to make things better.

Ruth believes that she and those students within her major are both driven and proactive with regard to their coursework inside and outside the classroom. Jay conveys a similar message when asked what was emphasized in his major, saying:

> You need to take action and get things done for yourself, yeah. You need to take the initiative and do what you need to do to make sure you're staying on top of everything. Like if you're not going to office hours are introducing yourself and asking questions, they're not going to know you or talk to you or anything.

Finally, Syrena references this theme when asked to describe what she believes to be the typical student within her major:

> Driven. I would say people who have wanted to do this for a very long time. There are a couple who I think maybe didn't understand the expectations so they're finding it difficult, but most of the people who are here tend to have been prepared for this their whole lives so they know what they want to do. They know where they're going, they're all very put together (laughing) A lot of them are very smart, very smart people. I would just assume that they're smart because of what they're doing academically. There's competence, intelligence.

Similar to the responses by Ruth and Jay, Syrena described the expected student within her major to be driven, intelligent, and prepared to do what is necessary to be successful. There is power linked with this emphasis on individualism and meritocracy, the onus of academic success is put upon the student and internal factors, removing any responsibility on the part of the educational program and external influencers that are found within these spaces.

Erasure of Difference. The next theme, erasure of difference, includes those responses that discussed the minimization of student differences within STEM classrooms. With this category, STEM programs are constructed as genderless, raceless spaces that are devoid of any reference to difference among students. Syrena discusses this at length in reference to how her professors conduct their classes:

> I think a lot of the professors see through the lens of their students being male, cis-gendered people so they kind of treat you the same, but in a way that's not a good thing, you know? In a way they're like those people that say I don't see race, you know? Even though there is racial difference and I think that shouldn't be ignored. Obviously, I don't want to be like the black sheep so to speak but also, I do think that my identity is a part of who I am, and it shouldn't be ignored at the same time. In certain classes they make these generalized statements and you kind of think I can't connect to that, personally, and that feels bad. I think within my STEM major, because we're focused on hard science, it tends to be avoided in a way, like no one really talks about their students in terms of their demographics, cuz, you know, we're talking about physics or something like that and that they can't really relate it back to those kind of differences within their student population. So, I think the professors don't treat anyone differently in my opinion, which I think that sometimes I can be sensitive to those kinds of things, but I think it ignores differences.

For Syrena, she finds major problems with instructors in STEM overlooking the vast diversity within their student population, contributing to issues with meaningful connection and belonging. She further elaborates on this point, saying "[e]qual and the same is not kind of…it's not an equivalency when, you know, treating us equally fair is not the same as treating us as the same generic STEM student." She feels that there is a conflation of treating students equaling with treating them the same in regard to difference. This theme was also shown in Sappho's response to why people are hesitant to discuss identity difference in STEM classrooms:

> It never ends up being a topic of discussion because everything is so technical…we all have DNA and we all, like, I don't know, we're all the same on the inside so there isn't…there's no kind of discussion about it. So, there is no way to know. There's no way to kind of get people's reflection in the classroom because it's never talked about.

From Sappho's understanding, her STEM classes are not spaces where student difference is a topic for discussion, instead "technical" content is prioritized. Ruth internalizes this sentiment of difference not mattering when asked what it was like being a Black woman in STEM, stating "[a]s long as you're trying to do your best it shouldn't really matter, yeah…I feel like for me, personally, I would try to go above and beyond because that's not a big factor for me." According to Ruth, her abilities as a student are more important than the difference between herself and other students.

Sexual/Gender Salience. The fifth theme that emerged from interview responses was sexual/gender salience. With this theme, interview participants often discussed how they felt marginalized and tokenized due to their sexual/gender identity, while at the same time acknowledging the racial/ethnic diversity of classroom environments in STEM. For Sappho, being Hispanic rarely came up in the interview process. However, she elaborates on how she believed sexuality was invisible in her STEM classes:

> I'm trying to think of any examples of them talking about homosexuality in any of my science courses, like I don't even know if they have even brought it up in biology. So, that's why I wouldn't say it's [STEM classes] welcoming because they're not…it doesn't seem like they go out of their way to include topics that are in their lectures catered to us, but they also aren't like "gay is bad."

From her perspective, there appear to be no overt displays of homophobia, however, she feels sexuality and gender expression are not inclusive topics in these spaces. Zara, like Sappho, seldom discusses being Asian and Korean, she does, however, frequently mention her sexual/gender identity. One instance was when she discussed how her classmates respond to finding out her sexual orientation:

> *Zara:* A lot of times, people are just like "oh, okay" you know? I have a friend who only talks to me about my being gay, which is annoying. It's not…it's because he's interested for his own benefit, you know what I'm saying?
>
> *Interviewer:* Can you elaborate?
>
> *Zara:* His own interest in just seeing two women together. You know what I'm saying? So, I'll get very intimate questions and kind of uncomfortable ones and it's just rude and I'm just like "you need to back off." It's like to him I'm a lesbian, I'm not Zara. I'm not a student, I'm not everything else that I am. I'm just gay.

With this exchange, Zara discusses how one of her classmates commodifies and fetishizes her sexual orientation, providing an uncomfortable and unwanted interaction.

Finally, Jay succinctly describes what he believes the typical STEM student to be, they are "[p]robably male…cuz you walk into a classroom and you'll see maybe three of four women in a classroom of 25 or 30. It could be any race because the university is pretty [racially] diverse…probably straight." Jay describes the typified STEM student as male and straight but contends they could be any race due to the racial diversity he observes in his classes. This is consistent with interview responses from most participants.

Relationship Dynamics. The final theme, relationship dynamics, incorporates responses that relate to the connections interviewees have with peers, faculty, and staff within their respective major. Syrena mentions being disconnected when she interacts with fellow STEM students, stating:

> I feel like sometimes it's just sort of…I relate to them on a college student level but that's about it. Like, I don't have a lot of personal connections and I don't know if it's just because of me or if it's my experiences feeling disconnected from the rest of them.

Syrena locates the source of her disconnect internally, elaborating elsewhere in the interview that it partially stems from being an international student. The use of "them" in her response shows a clear distancing between herself and her peers. This disconnect from peers was also brought up

by Jay when he discusses how he feels he struggles to fit into the environment in his STEM classes:

> *Jay:* I also don't feel like I fit in just because, I don't know, it's kind of hard to say but I just feel like there's a disconnect for me and everyone else but that's, that's not necessarily because of anything from the department or who I have class with.
>
> *Interviewer*: In what ways do you feel disconnected if you could kind of talk about that?
>
> *Jay:* I just, I've always felt like there was something almost like a veil between me and everyone else and I wouldn't necessarily say that the Department is contributing to that or anything like that, but that's just my own thing.

In line with what Syrena mentions, Jay feels this disconnect is an internal issue, and is not directly caused by the interactions with peers and faculty. In addition to a disconnect with peers, several interview responses covered the underdeveloped relationship participants had with their instructors. When asked to describe interactions with her professors, Zara elaborates that they are "few and far between. They're okay but, you know, they seldom happen." Limited interactions with professor and instructors was also mentioned by Jay, Sappho, and Ruth. In addition to discussing the difficulty in fostering a meaningful connection with professors, Syrena mentions the importance of these relationships for future academic and professional interactions:

> A lot of it is also trying to connect with your professors in the long run and when you're in a class of 300 that can be pretty difficult. You know? You know, so you have to be able to make those connections for reference letters later on so that they know who you are, and you have to make sure your name keeps popping up so that they're able to recognize you later on, which is obviously not an easy thing to do.

Syrena discusses how being in such large class sections can make it difficult to instigate and maintain those relationships necessary to succeed in STEM. Similar answers were provided by Jay, Zara, and Sappho.

Interview Data and Research Questions.

The first research question, *what are the experiences of students who identify as a racial/ethnic and sexual/gender minority in STEM educational programs,* can be partially

answered with several of the themes that emerged from the qualitative data. Interview participants experienced environments that prioritized masculinity and heterosexuality, as well as emphasizing the importance of the individual and personal success while minimizing the diversity of students within these spaces. Further, interviewees experienced greater sexual/gender salience in their academic major when compared to their racial/ethnic salience.

Based on the results from the interview data, the second research question, *in what ways do these students' sexual/gender and racial/ethnic identity influence these experiences*, can be answered by looking at the thematic categories masculine space, heteronormative space, and sexual/gender salience. The interview participants found that their experiences and interactions within their STEM educational program were mediated by their sexual/gender and racial/ethnic identity. However, respondents' sexual/gender identity was more salient in these spaces. Furthermore, while a few participants faced subtle racism characterized by microaggression from peers and faculty, several of them also had to contend with hidden and overt forms of sexism and/or homophobia. In addition, the experiences of interviewees were delivered in spaces that overtly privileged and emphasized heterosexuality and masculinity.

The third research question, *do racial/ethnic and sexual/gender minorities feel a sense of belonging within their respective programs and why*, can be answered using interview data from all thematic categories. Generally, interviewees identified with their academic major and would self-identify as a STEM student. However, several participants acknowledged being disconnected from both STEM peers and faculty. In addition, two participants found external LGBT+ organizations and clubs to be conducive in supplementing the lack of queer representation and interactions they experienced in their academic major.

The final research question, *how are racial/ethnic and sexual/gender minorities treated by peers, faculty, and staff within these programs*, can best be answered using the data that was consolidated into the thematic category relationship dynamics. From this, most participants discussed having underdeveloped relationships with STEM peers and faculty. Often, faculty would use language that was dismissive of SGM students and promoted a heteronormative ideology. With peer interactions, two interviewees discussed instances where their sexuality was fetishized from male classmates. In addition, several interview participants discussed how both STEM peers and faculty would often assume that they were heterosexual or in a heterosexual relationship. It is important to note, however, that there were several positive instances of interactions with STEM faculty, most of which were related to course content and assessments. In one instance, a faculty member who identified as LGBT+, served as both a role model for that student and provided emotional support.

CHAPTER 5: CONCLUSION

There has been extensive research that has examined the influence racial/ethnic and female group membership have on student experiences and outcomes within STEM educational programs (Cole 2008; Wao, Lee, and Borman 2010; Dewitt et al. 2010; Cech, Rubineau, Silbey, and Seron 2011; Palmer Maramba, and Dancy 2011; McGee and Martin 2011; MacPhee, Farro, and Canetto 2013). In addition, there is a growing body of literature that examines the experiences of sexual/gender minorities in higher education (Wall and Washington 1991; McCready 2004; Diaz and Kosciw 2009; Goode-Cross and Tager 2011). However, there is a paucity of empirical research located at the intersection of these two areas. The research presented here has attempted to expand sociological understanding and bridge the gap between these two academic conversations by (1) providing one of the first examples of an empirical project on underrepresented sexual/gender groups in STEM, and (2) taking an intersectional approach to those experiences by examining how sexual/gender and racial/ethnic identity of respondents interact in these spaces.

It is important to note that the reason a mixed methods design was utilized for this study was due to a lack of inclusion on SGM student experiences in the survey data used in the quantitative analysis. In addition, the interviews were conducted to extend and supplement the findings of this survey data. The quantitative and qualitative data both reinforce and contradict one another in several instances. The survey and interview data found that racial/ethnic and gender identity were key factors in influencing the experiences and beliefs of students in STEM

educational programs. Interview findings also suggest that gender and sexuality play a central role in constructing the culture and environment of STEM educational programs. As a result, this necessitates the inclusion of SGM related questions in research that is focused on underrepresented groups in STEM.

In addition, the present study was limited in a number of ways. First, the survey data included responses from students who were enrolled in engineering disciplines, and not STEM broadly. As a result, it is difficult to generalize these responses beyond engineering. Further, due to difficulties in recruiting participants, only five interviews were included in the qualitative analysis. While these responses provided meaningful accounts, incorporating more interviews would have strengthened the present study. Finally, within the interviews that were included, women were over represented in the sample.

The survey data was used to help answer research questions one, *what are the experiences of students who identify as a racial/ethnic and sexual/gender minority in STEM educational programs*, and four, *how are racial/ethnic and sexual/gender minorities treated by peers, faculty, and staff within these programs*. Survey results show that there are pronounced differences in the experiences, interactions, and beliefs of students based on their racial/ethnic and gender identities.

Statistically significant differences between male and female responses were found in a majority of areas for both the experiences and beliefs variables, with females more likely to experience a hostile atmosphere and discomfort when asking questions in class, while males were more likely to experience fitting in academically, fitting in socially, and being identified as an engineering student by members of the engineering community. Similarly, males were more likely to think that racial/ethnic minority students were treated differently from other students in

their program, while females were more likely to think female students were treated differently from male students and that students were too competitive in their program. With respect to observed language, peers were found to use sexist language more often than any other group. Further, a larger proportion of females were found to identify peers as using sexist language when compared to males. With respect to being stereotyped by gender, females were more likely to identify all groups as stereotyping them in some way more often when compared to their male counterparts.

Race/ethnicity of survey respondents was found to differ significantly in a majority of areas for the beliefs variable, while it played a lesser role with respondents' experiences within their major, with significant differences found in only three of the eight possible areas. With respect to the experiences variable, Black students were less likely to agree that they fit in well academically when compared to all other groups, while Asian students were less likely to agree that they took the lead in group projects/study groups or were invited to participate in study groups. With respect to the belief variable, White students were less likely to agree with all four possible belief options than their counterparts. When compared to White students, all other racial/ethnic groups were more likely to think that racial/ethnic minority students were treated differently from other students in their engineering program. Further, Black students were more likely to think that female students were treated differently than male students when compared to White and Other racial/ethnic groups. Hispanic students were found to agree more often with the belief that students of higher socioeconomic status were more successful at obtaining internships and job offers when compared to White respondents, while Black students were more likely to think that students were too competitive in their program when compared to Asian, Hispanic, and White groups.

With regards to language observed, Hispanic students were more likely to identify racist language by engineering faculty, teaching assistants/graduate assistants/lab instructors, and staff when compared to White students, as well as when compared to Asian students for teaching assistants/graduate assistants/lab instructors. Other racial/ethnic group students were also more likely to identify racist language from teaching assistants/graduate assistants/lab instructors when compared to White students.

For the variable being stereotyped by engineering peers, faculty, and staff, there were significant differences found within all group interactions. With engineering faculty, Black students were more likely to experience being stereotyped when compared to Asian and Hispanic students, while Other racial/ethnic group students were more likely to experience being stereotyped when compared to Hispanic and White students. With respect to engineering peers, Asian and Black students were stereotyped more often when compared to their Hispanic and Asian counterparts, while Other racial/ethnic group students were more likely to experience being stereotyped when compared to White students. With respect to engineering teaching assistant/graduate assistant/lab instructor, Asian, Black, and Other racial/ethnic group students were more likely to experience being stereotyped by this group than White students. Further, Black students were also found to be stereotyped more often than Asian and Hispanic students. Finally, with engineering staff, Asian and Other racial/ethnic group students were more likely to identify being stereotyped by this group than White students, while Black students were more likely to identify being stereotyped when compared to Hispanic and Asian students. From these results, White and Hispanic students are significantly less likely to be stereotyped when compared to other groups, while Black and Other racial/ethnic group students are most frequently stereotyped by engineering peers, faculty, and staff.

The interview data presented was used to help answer all four research questions guiding this project. From the interview responses, six major themes emerged. These include: masculine space, heteronormative space, individualism and meritocracy, erasure of difference, sexual/gender salience, and relationship dynamics. Interview participants characterized their STEM classes as spaces that were overtly masculine and heteronormative. In addition, interactions and experiences were enveloped and influenced by a culture that promoted individualism and meritocracy and an erasure of difference of any kind among the student body. When taken together, this translates into spaces that remove responsibility of achievement and success from the educational programs and the curricula, and places all the work on the individual student. This is dangerous because these same spaces implicitly and explicitly favor a specific type of student. This student is assumed to be White/Asian, male, heterosexual, and proactive. This leads students who do not fit into the typified STEM role to feel disconnected from their peers and faculty. Further, these same students often disengage from the material and may feel pressured to leave their major. The qualitative and quantitative results reported here are consistent with much of the research presented on underrepresented groups in STEM (DeWitt et al. 2010; Seymour and Hewitt 1997; Ong et al. 2011; Tyson, Smith, and Ndong 2010; Wao, Lee and Borman 2010) and on multiple minority students in higher education (Goode-Cross and Tager 2011; McCready 2004; Wall and Washington 1991).

With the results presented in this study, it is clear that future research on the outcomes and experiences of students within STEM educational programs needs to not only incorporate the perspective of sexual/gender minorities, research also needs to take into account how students' multiple identities interact and mediate their experiences, interactions, and outcomes. Future research, both qualitative and quantitative, can take what was found in this project to

inform their research design and analysis. Possible avenues for future research include conducting a longitudinal study on identity salience in STEM for multiple minority students as they progress through their respective program, an ethnographic study exploring resource availability and belonging within informal groups and channels in STEM, or work further exploring the masculine space and heteronormative space themes discussed in this paper that looks at masculine performance and policing in STEM.

STEM educational programs need to take a more active role in deconstructing the culture of intimidation present in many of their classrooms that privileges certain students at the expense of others. A great starting point would be to engage in meaningful conversations with students, faculty, and staff on how best to address the needs of *all* students in these spaces. Changes that are implemented need to be more than superficial attempts at saving face; programs need to incorporate institutional, instructional, and belief reforms that are conducive toward outstanding educational opportunities for all students in these heterogeneous classrooms. Importantly, the onus of success should not be placed solely on the students' shoulders, it is also partly the responsibility of their peers, faculty, and staff.

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APPENDIX A:

INTERVIEW PROTOCOL

1. Demographic Questions (Age, gender, race, ethnicity, orientation, academic status, class background, etc.)
2. What is your major?
3. How did you become interested in your major?
4. What was your high school experience like? Did it prepare you for your major?
5. What are your classes like? What are the classrooms like? Do you have groups assignments? What are those like?
6. Have you ever felt uncomfortable in the classroom? Why?
7. Do you meet with faculty outside of the classroom? How often? What are these meetings like?
8. Do you like your faculty/professors/TAs/Peers?
9. Have you ever felt uncomfortable around faculty? Peers?
10. Do you hang out with non-STEM students?
11. Do you feel any pressure from faculty/staff/peers? What kind of pressure? Why do you think that is?
12. Are you taking labs? What are your labs like?
13. What are some things you like about your program? Dislike?
14. What are your future plans?

15. Do you have any questions for me?

APPENDIX B:

INSTITUTIONAL REVIEW BOARD APPROVAL

USF
UNIVERSITY OF
SOUTH FLORIDA

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
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August 14, 2017

Jonathan Ware
Sociology
Tampa, FL 33612

RE: **Expedited Approval for Initial Review**
IRB#: Pro00031542
Title: Coloring in the Margins: Understanding the Experiences of Racial/Ethnic and Sexual/Gender Minorities in STEM

Study Approval Period: 8/12/2017 to 8/12/2018

Dear Mr. Ware:

On 8/12/2017, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved
Item(s): Protocol
Document(s):
Coloring in the Margins Protocol Version 1 August 9 2017.docx

Consent/Assent Document(s)*:

Coloring in the Margins Consent Form Adult, Version #1.docx.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent documents are valid until the consent document is amended and approved.

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110. The research proposed in this study is categorized under the following expedited review category:

(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have
any questions regarding this matter, please call 813-974-

5638. Sincerely,

Kristen Salomon, Ph.D., Vice Chairperson
USF Institutional Review Board