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Underrepresented Racial/Ethnic Minority Graduate Students in Science, Technology, Engineering, and Math (STEM) Disciplines: A Cross Institutional Analysis of their Experiences

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Education

by

Tanya Figueroa

ABSTRACT OF THE DISSERTATION

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Considering the importance of a diverse science, technology, engineering, and math (STEM) research workforce for our country's future, it is troubling that many underrepresented racial minority (URM) students start graduate STEM programs, but do not finish. However, some institutional contexts better position students for degree completion than others. The purpose of this study was to uncover the academic and social experiences, power dynamics, and programmatic/institutional structures URM students face within their graduate STEM programs that hinder or support degree progression. Using a critical socialization framework applied in a cross-comparative qualitative study, I focused on how issues of race, ethnicity, and underrepresentation within the educational contexts shape students' experiences. Data was collected from focus group interviews involving 53 URM graduate students pursuing STEM disciplines across three institution types – a Predominately White Institution, a Hispanic-Serving Institution, and a Historically Black University.

Results demonstrate that when students' relationships with faculty advisors were characterized by benign neglect, students felt lost, wasted time and energy making avoidable mistakes, had less positive views of their experiences, and had more difficulty progressing through classes or research, which could cause them to delay time to degree completion or to leave with a master's degree. Conversely, faculty empowered students when they helped them navigate difficult processes/milestones with regular check-ins, but also allowed students room to make decisions and solve problems independently. Further, faculty set the tone for the overall interactional culture and helping behavior in the classroom and lab contexts; where faculty modeled collaboration and concern for students, peers were likely to do the same.

International peers sometimes excluded domestic students both socially and academically, which had a negative affect on intergroup dynamics and limited the opportunities for learning among URM students. Interestingly, students describe peer dynamics that occasionally suggest racial undertones in interactions; however, many students were unaware of implications on their training experiences or were simply uncomfortable naming racism. Prevailing racial stereotypes even impacted students trained in welcoming and culturally respectful programs. The study expands studies on URM graduate students, socialization theory, and formal and informal structures in programs that can assure success in graduate school.

The dissertation of Tanya Figueroa is approved.

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DEDICATION

This dissertation is dedicated to my parents – Raul and Awilda Figueroa. From one generation to the next we went from a family of high school graduates to a family of college graduates, including a doctorate. Your love and support make your children nothing less than extraordinary. Together we go far.

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CHAPTER 1 INTRODUCTION

Considering the importance of a highly educated and diverse pool of STEM researchers for our country's future, it is troubling that on average, more than half of students who start science, technology, engineering, or math (STEM) doctoral programs do not persist to degree completion (Council of Graduate School [CGS], 2008). Completion rates in STEM masters programs are not much better, with 23% of students leaving and a mere 41% attaining degrees after the second year (Kent, 2013). Making matters worse, Black, Latino, and American Indian students – recognized as underrepresented racial/ethnic minorities (URM) by the federal government – are the least likely to complete their graduate degrees (CGS, 2008).

Precise completion rates vary widely by both discipline and student race/ethnicity with completion rates for STEM doctoral students ten years after initial enrollment averaging from a low of 41% for Black students in the physical sciences to a modest high of 67.5% for Latino students in engineering (CGS, 2008). The extent to which institutions are successful at facilitating the progression of URM graduate students through their programs and ushering them to degree completion in STEM also varies across institutional type with historically Black colleges and universities (HBCU) and Hispanic serving institutions (HSI), compared to predominately White Institutions (PWI), producing a disproportionate number of advanced degree holders in STEM who are also from Black or Latino backgrounds (Nelms, 2011; Santiago & Soliz, 2012).

Wide racial differences in graduate degree completion within institutions of the same type are indicative of systematic barriers that affect students and are suggestive of possible "hierarchies of power, communication, and opportunity" (Charmaz, 2006, pgs. 130-131) within STEM education. Uncovering the facilitators and barriers to success in graduate school is a necessary line of scholarly inquiry, especially since barriers often affect students from racially marginalized groups "first and most severely" (George & Malcolm, 2011, p. 10). As such, URM students play a role equivalent to a canary in the mines; they alert others of the first signs of a

poisonous atmosphere within STEM graduate education and of problems that threaten the persistence of all students, not just racial minorities (Guiner & Torres, 2003). A firm commitment to improving approaches to STEM persistence will therefore be beneficial for all graduate students irrespective of racial background (Mitchell, Dancy II, Hart, & Morton, 2013). Furthermore, significant racial differences in graduate degree completion rates across institution of various types indicate that certain institutional contexts better position URM graduate students for degree completion in STEM, and that context is an important consideration when looking at the graduate experiences of URM students.

Students' graduate experiences affect their progression through their programs and contribute to the ultimate outcome of completion of the graduate degree (Nettles & Millet, 2006). Thus, this study will investigate the experiences of URM students in STEM graduate programs across three institutional contexts (HBCU, HSI, and PWI) to gain insight as to how graduate departments can increase the retention and ultimate persistence of its URM students and promote degree attainment. Specifically, the purpose of this study was to uncover the academic and social experiences, power dynamics, and programmatic/institutional structures URM students face within their graduate STEM programs that hinder or support degree progression. Particular attention will be given to how issues of race, ethnicity, and underrepresentation within the educational context have shaped students' graduate experiences. An additional layer of analysis will be to examine how students' experiences converge or diverge by institutional context. This type of research is necessary for identifying, evaluating, and sharing practices that have the potential of making lasting and transformative change in STEM graduate programs.

Why Current STEM Graduate Degree Completion Rates are Problematic

The ability of higher education institutions to help STEM graduate students persist to degree completion and to ultimately produce more advance degree holders in STEM disciplines – especially among URM individuals – is vital to the health of the nation (Bair & Haworth, 2004), considering several pressing factors. These factors include the changing composition of the

country's citizenry, the current economic state of scarce resources, the strength of STEM as a discipline, movements toward social justice, and the personal well-being of students.

Indeed, the cultural and racial landscape of the country has been changing whereby individuals from minority backgrounds comprise an increasingly larger portion of the national population (Esri, 2012) and are projected to outnumber the White population by 2053 (U.S. Census Bureau, 2004). Since all sectors of American life (i.e. employment, housing, and schooling) will likely be affected by current shifts in the racial composition of the citizenry, equivalent changes in the composition of students graduating from STEM graduate programs would be expected – which in ideal conditions would reflect the racial and cultural diversity of the larger society. However although there has been a rise in the number of URM students enrolling in graduate school (Gonzales, Allum, & Sowell, 2013), enrollment rates have not translated to significantly higher numbers of URMs among STEM graduate degree holders. Indeed Black, Latina/o and American Indian students comprised only 4.52%, 5.5%, and .3% respectively of STEM doctorate degree earners in 2011 (NSF, 2011), despite representing 12.6%, 16.3%, and .9% of the national population in 2010 (Humes, Jones and Ramirez, 2011).

It is worrisome that the segments of the country's population that are growing the fastest (i.e. minority ethnic/racial groups) are also the groups that are the least represented among those with doctorate degrees in STEM (Nettles & Millett, 2006). Further, although URMs comprised 30% of the national population in 2000, they consisted of only 4.6% of those working in STEM who held advanced degrees (Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development, 2000). A shortage of STEM degree holders from URM backgrounds has contributed to the dearth of URMs in the STEM workforce, which hovers around 9% (NSF, 2012). The representation of minority faculty in STEM disciplines is equally as dire with URMs comprising only 8% of the professoriate (Mwenda, 2010). This underrepresentation runs in the face of decades of government

sponsored diversity initiatives and has led to claims that individuals from URM backgrounds are "missing" persons among STEM professionals (Sullivan Commission, 2004).

Low persistence rates in STEM graduate programs is a contributing factor to the lack of real progress in the number of URMs reaching the highest levels of educational attainment in STEM disciplines (CGS, 2008). Low persistence rates among domestic students also has contributed to a phenomena whereby an increasing proportion of science and engineering doctoral degrees are being conferred to individuals who are *not* US citizens, which in 2005 stood at 36% (National Science Foundation, 2007). Minimal progress in increasing the production of domestic advanced STEM degree holders puts the United States at risk of not meeting national demand for new scientific talent and jeopardizes the country's position as a global leader in technology and innovation (Olson & Riordan, 2012). Considering the impressive academic profiles of students who are admitted to graduate programs, each student who does not finish their degree represents a great loss of talent for the country as these individuals could have used their expertise to contribute to critical areas such as such as energy, health, and environmental protection (Olson & Riordan, 2012) and could have become great role models for the next generation of STEM aspirants (Joseph, 2007).

Recognizing the precarious position of the United States in relation to other countries, an advisory group to the President comprised of the nation's leading scientists and engineers has called for an improvement in the STEM educational pipeline at all levels (Olson & Riordan, 2012). In trying to meet this goal, a considerable amount of institutional resources and both state and federal funds continue to be directed to the recruitment, instruction, and financial support of STEM graduate students despite an economic state of limited fiscal resources (Bair & Haworth, 2004; Smallwood, 2004). Thus, a significant investment is lost when graduate students do not finish their degrees in terms of financial and human resources (Gardner, 2008). Likewise, degree non-completion is an inefficient use of finite faculty time and effort spent in advising, training, and socializing students into the discipline (Lunneborg & Lunneborg, 1973).

The economy is not the only entity that incurs a loss from student dropout at the graduate level; severe underrepresentation of URM students specifically among STEM graduate degree holders (NSF, 2011) contributes to the perpetuation of a largely homogeneous population of scientists and engineers and restricts the field's ability to draw from a diverse range of ideas and perspectives that are needed to flexibly meet 21st century challenges (Herzig, 2004a). Because the ability of a group to identify creative and effective solutions increases and achievement rises when more people from different backgrounds get together to solve a problem (Crosby, Iyer, Clayton, & Downing, 2003), a diversity of minds is a necessary component of attacking current societal, environmental, and health problems (George & Malcolm, 2011). Racial and gender diversity in the STEM workforce also broadens the types of questions that are asked and adds variety to the interpretation of findings, thereby enriching scientific inquiry as a whole (Blickenstaff, 2005). Diverse workforces additionally provide important and novel insights to the needs of traditionally underserved communities (Reskin, 1998).

Since advanced STEM degrees holders influence how the nation frames and responds to current day challenges, they also play a large role in how much progress is achieved in working towards social change and restoring the natural environment; STEM professionals in particular are well positioned to use their expertise to irradicate inequities faced by marginalized and low-income populations, which include poor health care and living conditions characterized by environmental pollution and industrial waste (Garibay, 2013; Harding, 2006; Serageldin, 2002; Vaz, 2005; Washington, 2005). While scientist and engineers of any background can demonstrate a commitment to addressing societal issues and pondering the ethical and social implications of their work (Beckwith & Huang, 2005), URM individuals are more likely than their majority counterparts to use the specialized training they received while attaining their advanced degrees to study issues affecting minority communities (Nicholas, 1997). It is also well documented that students of color use education as a means to give back to and enhance the

living conditions of the communities they come from (Jennings, 1993). Within STEM disciplines specifically, URM students rate working for social change as more important than their non-URM peers (Garibay, 2011). Retaining a more diverse array of students in STEM graduate programs thus has the potential to create a positive impact on working to address wider societal issues and creating applications to science that are more socially responsible (Eisenhart, Finkel, & Marion, 1996).

Finally, attrition from a graduate program is simply costly to the individual professionally, financially, and personally (Ingram, 2007), since much of the economic and social value of majoring in a field of study is derived from actually attaining the degree (Perna, 2005; Thomas, 2000). Specifically by not finishing their graduate degrees in STEM, non-completers are precluded from prestigious positions in STEM research and education (Bair & Haworth, 2004) and excluded from high level leadership positions entrusted with the authority and power to make decisions that have national impact. Further, in a society where nearly every social indicator (i.e. educational attainment, socioeconomic status, health conditions) reveals a disparity between the lives of underrepresented racial minorities and White Americans (Bishaw & Semega, 2008), advanced degrees in STEM represent powerful vehicles by which individuals from marginalized racial groups can gain access to lucrative careers that will improve their social and economic circumstances (Carnevale, Smith, & Melton, 2011; Gurin et al., 2002; Kuh & Love, 2000; Yosso et al., 2004).

At a personal level attrition is simply a profoundly painful, frustrating, and demoralizing experience (Lovitts, 2001) especially considering the dedication and determination students possess upon entering their programs (Herzing, 2004a; MacLachlan, 2006) and the great deal of time and money they invest into their degrees before quitting (Bair & Haworth, 2004). Many graduate degree non-completers have never experienced an academic failure of such magnitude before (Smallwood, 2004) and do not easily make the decision to withdraw from graduate school (Golde, 2005). As Lovitts (2001) remarked, “The most important reason to be

concerned about graduate student attrition is that it can ruin individuals' lives" (p. 6). While not everyone needs an advanced degree for a job in science, it can be painful to redefine aspirations for career goals and defer dreams after significant personal investment.

In short, increasing the number of minority persons who persist and attain advanced degrees in STEM is needed for technological and innovative advancement in industry and business, for the efficient use of scarce resources, the diversification of the STEM workforce and faculty ranks in academia, for more aggressive research on issues affecting the living conditions of minority communities, and because individual lives are devastated from non-completion. For these compelling reasons, universities ought to make changes that will better support graduate students as they try to persist in their STEM programs (George & Malcolm, 2011).

The Gap in the Student Persistence Literature

In the last three decades, many scholars have attempted to demystify student persistence in graduate education. Much of this work placed a heavy emphasis on background characteristics of the individual to explain for differential experiences and outcomes among students (Flynn, Sanchez, & Harper, 2011; George & Malcolm, 2011). Similarly, the limited amount of research specifically on URMs in masters or doctoral graduate programs commonly framed attrition as a logical consequence resulting from students' shortcomings, especially in comparison to their White peers (Orellana & Bowman, 2003). Although student background characteristics certainly have played a role in students' decisions to persist within their graduate program, a major limitation with research that attributed incidences of drop out largely to student background factors is that it provided an incomplete picture of students' graduate educational experiences. Such research also diminished the important role institutions and departments played in student departure during graduate school and absolved institutions of responsibility for finding solutions (Noguera, 2001).

To account for this limitation, a growing body of more recent research on graduate education has placed more prominence on the importance of the context in which students experience their graduate education. Although there is a growing body of research on graduate education in general (Golde, 2005; Lovitts, 2001; Millet & Nettles, 2006), few empirical studies have sought to understand the particular experiences of URM graduate students in STEM disciplines (Gardner, 2010). Further, not much is known about the particulars of students' experiences (i.e. their social support, relationships with peers, how information is shared, stressors, and mentoring relationships) or the environmental factors that contribute to these experiences (Flynn, Sanchez, & Harper, 2011).

Studies that compare the experiences of graduate students across institutions are also virtually non-existent. Of the few studies on graduate student persistence and retention that sample multiple institutions, most use quantitative methodologies leaving more nuanced questions about persistence and the experiences that influence students' decision to stay in their programs unanswered (Bair & Haworth, 2004; Nettles & Millet, 2006). Equally as important, there is currently no qualitative research that investigates how URM students' experiences in graduate education differ by institutional context. Armed with insufficient empirical research, STEM graduate departments and programs lack a firm understanding of the experiences of URM students as they journey towards a graduate degree in STEM and have little concrete information they can use to inform reform efforts that can better support diverse graduate students to degree completion. This study contributes to this understudied area in the literature.

Purpose of this Study

As institutions enroll an increasingly diverse population of students, they also have a responsibility to meet the needs of those students (Guillory, 2001). Essential to meeting these needs is an understanding that although persistence in a graduate program is challenging for anyone, students from URM groups find it especially challenging to persist (George & Malcolm, 2011; Herzig, 2004a) partly because of inequities that raise systematic barriers (Flowers &

Banda, 2013). To close opportunity gaps, ameliorate achievement disparities, and create STEM learning environments that are truly welcoming of graduate students from all racial backgrounds, there is a need for research that provides a better understanding of how the social and academic environments in graduate education encourage or inhibit URM student persistence (Rogers & Molina, 2006). In this study, persistence will be conceptualized as "the ability and desire of students to move forward in their academic programs" (Kowalik, 1989, p. 163), as all of the students in the study were in graduate school at the time of the focus group interviews and had not yet reached degree completion.

Using a critical socialization framework applied within a constructivist paradigm, this study aims to better understand the academic and social experiences of URM students within graduate school as they navigate their educational programs in STEM. Specifically, the purpose of this dissertation is to identify the supports and challenges to persistence URM students face in their graduate programs, understand how power, race, and underrepresentation shape those experiences, and to determine the extent to which experiences compare by institutional type, since previous research shows that context matters, and matters greatly when it comes to student outcomes (Crisp et al., 2009; Museus, 2011).

The guiding research questions are as follows:

1. What are URM students' social and academic, both formal and informal, experiences at the graduate level in STEM disciplines?
2. What power dynamics are at play in URM students' graduate programs in STEM and how does race and ethnicity influence students' training and educational experiences?
3. What institutional structures, contexts, and/or processes can explain the difference and/or similarities in experiences of URM students?

Scope of the Study

Qualitative is used to explore the topic of persistence at the graduate level among URM STEM students because it allows for greater differentiation and detail in the description of students' experiences and how students feel about those experiences (Kidd et al., 1996). This study also takes a constructivist approach in which it assumes that people understand and perceive the world differently; there is no "one way" to view reality. Therefore the findings emerging from this study offer an interpretive portrayal of students' graduate school experiences (Charmaz, 2006).

The scope of the study involves three institutions, each representing a different institutional context: a Hispanic-serving institution (HSI), a historically Black college/university (HBCU), and a predominantly White institution (PWI). These institutions were selected because they are classified as high research universities by the Carnegie Foundation, represent a diversity of geographic locations, and are known for having a relatively large number of URM students who pursue graduate work in STEM.

The data for this study was collected from focus groups interviews of URM STEM graduate students from three institutions collected as part of a larger STEM retention project conducted by the Higher Education Research Institute located at the University of California, Los Angeles. Students' stories helped unfold the meaning of their experiences while pursing STEM degrees, their perceptions of the educational environment, and to what students attributed their ability to persist year after year in graduate school. Focus groups were useful because they created a social context where participants could listen to the responses and viewpoints of others and provide confirmatory or contradictory insight (Krueger & Casey, 2009; Marshall & Rossman, 1994; Patton, 2002). Multiple focus groups per institution also allowed for cross-validation of findings within institutions.

The purposeful sampling of URM graduate students in STEM programs provided rich information about the phenomenon of interest. A semi-structured focus group interview protocol was utilized with the goal of covering a wide range of graduate student issues so as to better

understand how students made meaning of their graduate school experiences and ability to persist. The flexibility that a semi-structured interview guide provided provoked a conversation between the interviewer and interviewees; allowed participants to describe what is important and meaningful to them; and yielded exploratory, descriptive, and explanatory data (Patton, 2002).

A critical application of socialization theoretical framework was employed as a lens to center race in the analysis of the experiences of URM STEM students while in graduate school. As such, three overarching theoretical perspectives were used to develop this study including one focused on the role of race and power in shaping experiences and relationships, one on inequities and their relationship to outcomes, and one on the socialization of novices typically used in the study of graduate education.

Critical perspectives on race and power note how existing structures within American institutions work to normalize and reinforce racial inequity and social hierarchy (Bonilla-Silva, 2001; Omi & Winant, 1994) and illuminate how racial minorities are often marginalized and possess an "outsider status" within White-dominated environments (Howard-Hamilton, 2003). Examining educational experiences and outcomes via discourse about race (and racism) is therefore necessary to change "structures and systems of oppression and marginalization as experienced by those whose realities and possibilities may be determined by the color of their skin" (Sheared et al., 2010, p. 10). In the present study, race was conceptualized as being a force that could produce different experiences for those of differing racial backgrounds precisely because inequities in power can exist.

Theoretical frameworks on inequities demonstrate that seemingly trivial institutional practices and unconscious individual behaviors can collectively result in great opportunities and benefits for some people and great disadvantages for others (Brennan, 2013; Rowe, 2008; Sandler, 1986; Wylie et al., 2007.) Those who are deemed "different" or the "other" regularly encounter unjust practices that single-out, overlook, discount, exclude, or ignore them (Sandler,

1986). When considered in combination, small acts of disrespect or devaluation – referred to as micro-inequalities – can help explain larger scale inequalities in academia (Brennan, 2013). In examining students' narratives, I paid close attention to these dimensions in order to gain a better understanding of the way small inequities played a role in different graduate school experiences.

Finally, socialization frameworks provide insight as to how a student develops in ways that align with their fields of practice, how development is linked to graduate student outcomes, and the importance of a supportive graduate community to students' development. As a social and cultural activity, socialization is a process by which novice individuals gain increased knowledge and competence in their field, learn the normative ways of participation including accepted customs, traditions, and values, and ascertain how to be positively evaluated (Antony, 2002; Weidman et al., 2001). Accordingly, interactions with more advanced members (also referred to as socialization agents) are key to socialization and the subsequent development and success of novice individuals within any professional domain (Antony, 2002; Weidman et al., 2001). Within the context of graduate school, faculty and more advanced peers serve as the socialization agents because they facilitate the acquisition of necessary skills and dispositions needed to become a researcher and scholar (George & Malcolm, 2011). Positive or negative experiences with the socialization process have great implications for students' performance, satisfaction, and success (Millett & Nettles, 2006). This theory can be used to understand how relationships with others in the academic context shape students' experiences.

Combining the three theoretical perspectives, I looked at URM students' persistence experiences in their STEM graduate programs through a lens I call a critical application of socialization theory. A critical application of socialization theoretical frameworks rejects the notion that it is up to students to assimilate into the dominant academic culture to be successful in their field. Instead, this novel theoretical lens asserts that student success largely rests on the willingness and ability of more advanced members within the graduate community (such as

faculty, veteran students, and administrators) to develop novice members in ways that a) better equip them to navigate discipline-specific expectations and overcome challenges within the educational environment and b) does so while not using power to invalidate students' racial/ethnic backgrounds. Thus, my analysis acknowledged that asymmetric power relations likely influenced the interactions students had with others within their program and this, in turn, likely affected the opportunities students had for professional socialization and success. As such, a critical application of socialization theoretical frameworks helped reframe challenges students encountered in the graduate educational process as social, structural, and pragmatic problems rather than problems primarily stemming from a lack of individual student responsibility and/or the talent deficiencies of the student.

Significance of the Study

With few studies using qualitative methodology to examine the experiences of URM students pursuing STEM graduate degrees, the graduate program's role in persistence, and how students' experiences vary by institutional context, the present study makes a unique contribution to the field of higher education with respect to both practice and theoretical scholarship. With respect to practice, an anti-deficit approach to research on graduate student persistence yields findings that inspire new ways of understanding the experiences of a talented and growing student population, raises consciousness of racism, and empowers STEM graduate departments to critically examine the practices, behaviors, and attitudes that undermine the persistence of students from minority and/or disadvantaged backgrounds. Thus at a practical level, this dissertation provides STEM departments and programs with concrete information on what they can do to enhance positive experiences in graduate education and minimize negative ones to ensure that everyone feels secure, supported and valued and so that persistence is a reality.

The findings can also be used to inform efforts to meaningfully transform graduate education in ways that are inclusive of students from diverse backgrounds, maximize students'

academic potential, and enhance equitable outcomes for all students. In this way, this research assists STEM departments in re-imagining a new reality wherein the social justice concerns of graduate education for URM students are addressed and 21st century problems are solved swiftly due to the availability and creativity of a talented team of STEM professionals who are representative of the diversity found in the United States. Finally, this study is crucial for federal and state policy makers, as it will offer suggestions for better ways to hold institutions (and STEM departments) accountable for supporting their graduate students to degree completion.

This research is additionally one of the first to consider the effects of multiple institutional contexts (i.e. a PWI, a HSI, and a HBCU), specifically the role of minority serving institutions using qualitative methodology, which is necessary to disentangle the complex relationship between students' experiences and their environments. Since minority serving institutions (i.e. HBCUs and HSIs) are especially successful in facilitating minority achievement in STEM majors at the undergraduate level (Contreras et al., 2008; Harmon, 2012; Perna et al., 2009), a great deal is learned from students' experiences attending these types of institutions at the graduate level. Further multi-site research pared with cross-case comparative analysis reveals context-rich explanations regarding how different educational practices – both individually and in combination with others – meet students' educational, social, and cultural needs, define their experiences, and ultimately promote minority student persistence and contribute to degree completion in STEM. In short, there is great potential for learning across institutions from a comparative analysis about innovative practices that help diverse students persist. Further institutional leadership can draw meaningful lessons about how institutional structures, processes, values, or norms account for differences in students' experiences. Such lessons can be used to inform institutional policy improvements and potentially strengthen the ability of all institutions and programs to produce more STEM graduates.

At a theoretical level, this study contributes to the development of socialization frameworks with a specific focus on how present day inequities and asymmetrical power

relationships play a role in students' socialization experiences and subsequent success in graduate school. Future research can use the findings from this study to generate theories that better explain URM success at the graduate level and to create studies that empirically test those theories.

CHAPTER 2 FRAMING THE STUDY

Theoretical Perspectives

This study uses the term "underrepresented racial minorities" to reference a category of people who, because of historical and current educational and societal inequities, are underrepresented in higher education and includes individuals who identify as being Black, Latino, and/or Native American. The chapter begins with a presentation of the theoretical frameworks that inform this study. Using a combination of various frameworks, I employ what I call a critical application of socialization theoretical frameworks as a lens to center race in the analysis of the experiences of underrepresented racial/ethnic minority (URM) STEM students while in graduate school. Examining educational experiences and outcomes via discourse about race is necessary to counteract the tendency to attribute student failure to deficits and to identify how existing structures and practices can be biased or oppressive in ways that result in differential realities and possibilities for URM students.

After a discussion of the theoretical frames, is a review and synthesis of the existing persistence literature on graduate students, which revealed various thematic areas of importance that affect URM students' educational experiences in their graduate programs.

Critical Perspectives

Critical perspectives acknowledge the historical exclusion, oppression, and marginalization of ethnic and racial communities in American society (López, 2003; Peña, 2012) and recognize that the present social order is characterized by inequitable distribution of resources whereby political, social, and economic rewards are allocated along racial and class lines (Bonilla-Silva, 2001; Omi & Winant, 1994). These perspectives advance the notion that racism is part of everyday American culture (Davis, 1989). The pervasive nature of racism means that racism is not only perpetuated by individuals, but also institutions, society, and civilization (Scheurich & Young, 1997). Indeed, many structures and practices within American

institutions work to normalize and reinforce racial inequity, social hierarchy, and White privilege (Bonilla-Silva, 2001; Omi & Winant, 1994). Further critical perspectives recognize that racism "is not necessarily the product of biased actions, but can be the artifact of seemingly liberal, neutral or normed, rules and actions" (Johnson-Bailey et al., 2009, p.183) that may be void of explicit racial terminology, but still disproportionately harmful to members of specific racial groups and result in differential outcomes by race (Bonilla-Silva, 2001).

A strength of critical perspectives is that they aim to expose a) hidden assumptions and b) inconsistencies and contradictions between what people believe to be true and the results of actual practice (Schwandt, 1997). Individual people need not be racist to enjoy the multiple privileges that are based on a legacy of racism and Whiteness (Tatum, 1997). Several scholars have already theorized educational settings as spaces in which students of color confront oppression (Gay, 2004) and as contexts that discriminate, reproduce racial inequities, racially segregate, and ultimately push out students of color due to hegemonic structures and practices that seem race neutral but are not (Bryan, Lewis, Willis, & Wilson, 2012; Hurtado, Milem, Clayton-Pederson & Allen, 1998; Ladson-Billings & Tate, 1995; Yosso, 2002).

Manifestations of power and power relationships play an important role in critical perspectives. Abrams (1993), a critical feminist scholar, advances two important notions regarding dominant groups in society and the power they hold in shaping perceptions and the treatment of people from subordinate groups. First, she asserts that people who hold positions of dominance have the power to make their perspective normative; that is, their perspectives are accepted as objective and accurate portrayals of life (Abrams, 1993). Similarly, those in the dominant group have the power to characterize those in subordinate groups in ways that are marginalizing and disempowering. Dominant perspectives and definitions of people are perpetuated precisely because they are treated not as a point of view, but as fact. Translated to the context of STEM graduate programs, faculty (and to a lesser but still significant extent

student peers) hold varying positions of power. With respect to race, White individuals represent the dominant group both in academia generally and in STEM more specifically.

Second, Abrams (1993) argues that individuals in dominant positions talk about people as being either similar or dissimilar to themselves. Those considered to be dissimilar are subsequently "othered" or perceived as an outsider. Those considered to be an "other" are regularly characterized as being non-normative and having less value (even if this isn't explicitly stated), and as such are held at a distance. Such characterizations also have the potential to become shared truths (Abrams, 1993). Exclusionary practices that set the "others" apart from everyone else, send a message that the "others" are not only different, but do not belong. Such practices along with other seemingly inconsequential habits and customs serve to stigmatize those that are deemed to be the "other" and create a larger pattern of oppression for excluded groups (Abrams, 1993). In STEM graduate programs, students with identities that are dissimilar from the dominant group – by race, gender, and intersections of identities – are likely to be characterized as the "other" and to subsequently encounter challenges that those belonging to the dominant group do not. Specifically as non-White individuals, URMs will likely be marginalized and possess an "other" or outsider status within the White-dominated STEM environments into which they are invited; indeed people of color are often not acknowledged nor heard in these environments but rather ignored (Howard-Hamilton, 2003) As such, racial/ethnic minority students will have very different lived experiences in education (Espino, 2012; Harper, 2012; McQuillan, 1998).

Literature on workplace climate provides more insight into the consequences that seemingly trivial practices and behaviors can collectively exert on the outcomes of people (Brennan, 2013; Rowe, 2008; Sandler, 1986; Wylie et al., 2007). Indeed, institutional practices and interactions between people can be informed by either intentional discrimination or implicit biases that occur below the threshold of conscious decision-making. Nonetheless, such practices and interactions can result in great opportunities and benefits for some people and

great disadvantages for others. Those who are deemed “different” or the “other” regularly encounter unjust practices that single-out, overlook, discount, exclude, or ignore them (Sandler, 1986). When considered in combination, small acts of disrespect or devaluation – referred to as micro-inequalities – can help explain larger scale inequalities in academia (Brennan, 2013).

Microinequities are very similar to microagressions, which are difficult-to-detect expressions of racism that come in the form of insulting comments, behaviors, or indignities within the environmental context (Sue et al., 2007, p. 271) that signal to people of color that they are inferior (Donovan, Galban, Grace, Bennett, & Felicie, 2012) and help reinforce the belief that the they do not belong (Guzman, Trevino, Lubugin, & Aryan, 2010). The eight most common forms through which microaggressions manifest include 1) assumptions about the intelligence of someone based on race; 2) treatment as lesser or a second class citizen; 3) pathologizing cultural values and communication styles of people of color; 4) assuming that someone is deviant or criminal based on race; 5) the assumption that the person of color is a foreigner; 6) assertions that one is color blind or does not see race; 7) the assumption that race has no role in the success people achieve and the myth of meritocracy; and 8) denying the role that the individual personally plays in perpetuating racism (Sue et al., 2007). Perpetuators of microaggressions may not realize they are committing one or be conscious of the effect of their actions. Since racial microaggressions are layered in nature, they manifest at intersections of race and other social constructions such as sex, class, or gender (Yosso, 2000).

Continued exposure to micro-inequalities are harmful in that, as a collective, they represent large deficits of support for victims (Wylie et al., 2007) and can have wide-ranging effects on those victimized including impaired performance, diminished self-esteem, and in some cases voluntary removal from the context in which the micro-inequities are enacted (Sandler, 1986). Compounding the problem, micro-inequalities and their cumulative harms are easily overlooked by both the perpetrator and victim because of their small size (i.e. they are not full-blown inequities) and their ambiguous nature, in which they are not clearly racist or sexist

(Brennan, 2013). Even when micro-inequities are recognized, they are easily given an alternative interpretation or explanation for their occurrence or the significance attached to inequitable events is denied (Brennan, 2013).

When applied to higher education and graduate school experiences, the critical theoretical perspectives described above would posit that students positions' as either belonging to a dominant racial group (i.e. White) or a subordinate one (i.e. underrepresented racial/ethnic minority group) has a powerful effect on how they are viewed and whether they are considered an "other", how they are consequently treated, and what their outcomes will be. Those who are deemed different from the dominant group, such as URM students, will encounter inequities, both large and small, as part of their everyday experiences in academia. Some inequities, especially the smaller ones, will not be clearly biased or discriminatory, but nonetheless when considered in their aggregate form will be effectively harmful to students.

Theoretical Perspectives on Socialization

Socialization perspectives represent a commonly used theoretical lens in understanding the processes that shape graduate student outcomes and persistence. As a social and cultural activity, socialization is a dynamic process by which novice individuals develop increased knowledge and competence in their field, learn the normative ways of participation in the discipline including accepted customs, traditions, and values, and ascertain how to be positively evaluated by others (Antony, 2002; Gutiérrez, 2002; Gutiérrez & Rogoff, 2003; Weidman et al., 2001). Indeed, there are many different dimensions of socialization: not only is a person acquiring skill proficiency and gaining content knowledge, but they are also maneuvering organizational politics and power structures, taking on organizational goals and values, and learning how to engage in the unspoken social and cultural practices of the field, all of which is necessary to move towards professional maturity as a successful independent research/scholar

and a full participant of the discipline (Chao, O'Leary, Wolf, Klein, & Gardner, 1994; Gerholm, 1990; Lave & Wenger, 1991; Lovitts, 2001; Weidman et al., 2001).

Accordingly, relationships and interactions with more advanced members (also referred to as socialization agents) are key to socialization and the subsequent development and success of novice individuals in any professional domain (Antony, 2002; Weidman et al., 2001). Within the context of graduate school, the social and academic interactions students have with program faculty and student peers play a critical role in the socialization processes and developmental experiences of students (Barnes & Austin, 2009; Gardener & Barnes, 2007; Nettles & Millett, 2006; Weidman, Twale, & Stein, 2001; Tinto, 1993). When such relationships are supportive and encouraging, they can buffer students from the potentially harmful effects of negative socialization experiences (Ferrer de Valero, 2001; Weidman & Stein, 2003). When students do not feel supported or feel disconnected from others within their academic context (Ferrer de Valero, 2001), socialization will be more difficult, and can lead to feelings of isolation, frustration, self-doubt, and perceptions of inadequacy (Austin, 2002; Gay, 2004; Golde, 1998), which ultimately reduce the likelihood of persistence and degree completion (Gasman et al., 2004; Golde, 2005). Thus, the experiences students have with respect to the socialization process have great implications for students' performance, satisfaction, and success (Millett & Nettles, 2006) and influence students' assessment of whether they fit within their academic programs (Sweitzer, 2009).

The literature has situated faculty advisors as especially critical socializing agents as they introduce students to the cultural values, norms and behavioral expectations of the department (Weidman et al., 2001) and represent important sources of career and academic advice and guidance (Sweitzer, 2009). Faculty advisors can act more as mentors when they go beyond the official duties of an advisor and expose their students to information-rich professional networks, protect them from unnecessary harm, provide positive feedback, and

offer friendship in addition to other forms of psychosocial support to students, (Johnson et al., 2007; Palmer & Gasman, 2008; Smith, 2007; Sweitzer, 2009), all of which positively contribute to the development of students and their sense of worth (Cole & Griffin, 2013). These functions are especially crucial to the success of students who do not come from families with long histories of educational attainment and may need additional guidance (Carlone & Johnson, 2007). Mentors act as institutional agents in the socialization process when they intentionally use the status and authority associated with their university positions to advocate for historically disenfranchised students by expanding students' educational opportunities and exposing them to much needed resources, networks, and knowledge bases. In this way, faculty play a large role in helping students interpret and navigate the educational environment (Stanton-Salazar, 2010) and empowering them in ways that help them achieve success (Dowd, Sawatzky, Rall, & Bensimon, 2013). Irrespective of background, students' require guidance from faculty at every step of the graduate school process (Gasman, Hirschfled, & Vultaggio, 2008).

While socialization perspectives demonstrate that socialization into academia is important for all graduate students, these perspectives alone are problematic when applied to individuals who are from URM backgrounds for a number of reasons (Taylor & Antony, 2000). First, socialization perspectives fail to take into account how issues of race and power shape the relationships between people of color and others in educational contexts. For example, the commonalities shared between people on a number of social characteristics – such as race, ethnicity, or gender – can impact with whom individuals tend to seek interactions (McPherson, Smith-Lovin, & Cook, 2001). In higher education, the desire to work with people like oneself may influence the interactional decisions of students. In a similar way, this desire may have an impact on the behaviors of faculty and to whom they choose to provide close mentorship or research opportunities (Cole & Griffin, 2013). Interestingly, there is evidence that the nature of the mentoring relationships White professors have with graduate students differs in that those

with White students are more likely to be characterized by a high level of closeness and nurturing, while those with students of color are not as rich (Bowman et al., 1999; Brown et al., 1999); similarly a greater proportion of Black graduate students compared to White students are unable to identify a faculty member who they would consider a mentor in their academic life (Nettles & Millet, 2006) – a reality that decreases the probability of degree completion in one's graduate program and later career success (Brown et al., 1999).

Second, socialization perspectives assume assimilation into a dominant norm and/or disciplinary culture without question. Although STEM disciplinary culture purports objectivity and neutrality with respect to individual characteristics such as race and gender (Cobb, 2004; Johnson, 2007), the dominant culture in STEM educational spaces is reflective of the value system, interactional behaviors, and cognitive ways of knowing and thinking of those who hold dominant positions in larger American society – White men (Davidson & Foster-Johnson, 2001; Ibarra, 2001; Seymour & Hewitt, 1997). One of the White male norms common in STEM culture is a survival of the fittest mentality, which prioritizes the individual interests above the group, and promotes competition over collaboration (Epstein, 2006; Seymour & Hewitt, 1997). Socialization, therefore, privileges White males and expects students to internalize this value, which can greatly marginalize students from racial/ethnic minority backgrounds (Carlone, 2003; Cobb, 2004). Students who have core values/cultural behaviors that do not align with the dominant academic culture (Johnson, 2007; Tate & Linn, 2005), who reject the socio-cultural practices associated with being socialized in the field (Herzig, 2004a), or who are not willing or able (given their interests, values, and skills) to work with the existing structure and rules will presumably have less positive socialization experiences and outcomes (Stage & Maple, 1996). Underrepresented students of color understandably will be the least likely to accept the narrowly tailored norms and culture of science given their more critical worldviews as a result of having experienced the inequities of racism (Traweek, 1988) and differences in cultural values (Ibarra, 2001). Using socialization theoretical frameworks alone therefore leaves little room for

understanding how URM graduate students can learn the norms of a discipline in STEM and at the same time maintain a critical stance about practices or values that reproduce inequity and uphold a desire to avert further inequalities.

Third, socialization experiences assume that learning goes in one direction between faculty and students. Effective socialization and mentoring at the graduate level however has "reciprocal benefits" (Brown-Wright, Dubick, & Newman, 1997, p. 414) in which students' benefit from faculty guidance and faculty benefit from the fresh intellectual perspectives and ideas students' bring to the interpretation of research and professional practice (Brown et al., 1999). Students also raise important questions, that the faculty may not have contemplated, that serve to enhance the research (Griffin, 2012). Faculty are also dependent on the various skills of graduate students to advance their own research. Engagement with students therefore represents a mutually beneficial exchange in which "codiscovery" can occur (Brown et al., 1999). There is also a positive social exchange that occurs from faculty-student relationships; research on Black faculty shows that they experience gains in satisfaction from their relationships with Black students and attributed some of their research productivity to the relationships they had with students (Griffin, 2012). These studies demonstrate that it is to the faculty members' advantage not to force students to fit into a preexisting mold that standardizes ways of thinking and approaches to scientific problems; instead developing the talent of diverse students via mentorship, training, and positive socialization experiences is advantageous to faculty as students use their unique skill sets to make contributions to the scientific enterprise.

A Critical Socialization Lens

A critical application of socialization theoretical frameworks notes the realities of academia whereby disciplinary cultures and socialization norms confer privileges to students belonging to the dominant social group, while disadvantaging those from minority social group

that likely effect the lived experiences of students of color within their graduate programs in STEM. There are three major components that characterize a critical socialization lens, all of which I will use in the analysis of interview data. First, this lens takes issues of race and inequality and the climate of the graduate program into account when attempting to understand students' experiences. Specifically, as a White male-dominated discipline, it expects that STEM graduate programs will reflect dominant norms that subtly send a message that STEM is a male and White pursuit, while women and URMs are likely to be perceived as deviations from the norm (Seymour & Hewitt, 1997; Young, 1990). There is likely to be numerous inconsequential practices that are disproportionately harmful to URM students.

Second, this lens considers how power and its manifestations in relationships play a role in how students are treated or perceived, their professional developmental opportunities, and their overall experiences in their graduate program. A perception that URM students are deviant coupled with asymmetric power relations that exist within graduate departments likely influences the interactions students have with others in their program, whether they feel empowered or disempowered as STEM emergent scholars, and their subsequent success in and beyond graduate school. Third it recognizes that students have social agency or may enact modes of resistance as they learn how to be successful in graduate and beyond. In this way students are not just repositories of socialization from faculty but enact change in their programs, even if this change is of a small magnitude, via their contributions to the research enterprise and ways of negotiating disciplinary norms.

Using the theoretical lens outlined above to view students' experiences, the challenges URM students face in graduate education in STEM are likely in part symptomatic of a) issues of race and unexamined inequalities, b) differential power dynamics, and c) a rigid socialization process that has a narrow ideal of what is considered acceptable practice and does not recognize the different contributions and needs of diverse students. All of these factors likely

impact the socialization experiences students have with advanced others in their disciplinary environment, their development, and students' subsequent ability (and desire) to navigate discipline-specific expectations and the various challenges that arise in graduate school. Indeed, the next section presents the literature relating to the experiences of URM students in graduate school, and where applicable in STEM disciplines. A critical socialization lens applied to the literature demonstrates that URM students confront a host of challenges as they are socialized into graduate education that have little do with a lack of academic ability, individual student responsibility, or talent.

Research on Underrepresented Racial/Ethnic Minority Groups in Graduate Education

A review and synthesis of the existing persistence literature revealed various thematic areas of importance that affect underrepresented racial minority (URM) students' educational experiences and their subsequent persistence in their graduate programs. The literature review will be presented as follows: it will first begin with an overview of the experiences of URM graduate students at HBCUs and HSIs and a description of the educational environment of these minority serving institutions. The remainder of the literature review will be structured around the themes that represent graduate students' experiences at predominately White institutions. These themes will serve as section headings and include the following: 1) the racial climates at predominately White institutions, which is impacted by discrimination URM students experience broadly and discrimination they experience in STEM specifically, the various consequences of perceived discrimination, and the discriminatory experiences of female graduate students; 2) the pragmatic elements of the departmental context; 3) the relationship graduate students have with advisors and faculty; 4) the relationships graduate students have with their peers; and 5) the individual student level factors that have been linked to persistence.

While it would have been ideal to examine the literature specifically on underrepresented racial minority groups in STEM graduate programs, the scant amount of literature in this specific area necessitated a broader search of the knowledge base. Thus much of the research presented here examined the experiences of graduate students in STEM (but not specifically pertaining to URMs) or graduate students across multiple disciplines, since the challenges these students face can yield valuable insight into those URM students face in STEM. I acknowledge, however, that URMs in graduate education pursuing STEM degrees specifically will have distinct experiences both because of the disciplinary culture of STEM and their status as a severely underrepresented student population in a predominately White graduate environment. This review illuminates the contribution of this study on URM graduate students in STEM, as scant research is written on this topic across different institutional types, and explicates the emergent themes that characterize URM graduate students' unique experience in STEM that have yet to be fully documented.

Minority-Serving Institutions

The institutional context is an important consideration when examining the experiences of students (Perna et al., 2009), which also means that the designation of an institution as a predominately White institution (PWI), Hispanic serving institution (HSI), or Historical Black college or university (HBCU) also matters.

HBCUs in particular tend to provide a learning environment that is sensitive to students' needs and provide students with peer support, mentorship, role models, and a culturally relevant curricula, all of which contribute to students' development of social responsibility and academic confidence (Joseph, 2013) and can help explain better outcomes among URM students (Contreras, et al., 2008; National Academies, 2010; Palmer, 2010; Palmer, Davis, & Thompson, 2010; Palmer & Gasman, 2008), and URM students pursing STEM degrees in

particular (Contreras et al., 2008; Perna et al., 2009). Overall, HBCUs, and to a lesser extent HSIs, are generally known for their ability to successfully educate URM students to degree completion at both the undergraduate and graduate levels (Joseph, 2013; Stage et al., 2013), despite having fewer resources than their PWI counterparts (Harmon, 2012).

Of all the institutional types, the success HBCUs have in graduating minority students in STEM and ushering them to seek advanced degrees in the sciences is unparalleled (Hubbard & Stage, 2010; Thurgood et al., 2006). This success is attributed to their ability to provide a safe and affirming educational environment in which students are put first, held to high expectations, and given the support and encouragement they need to succeed (Hrabowski, 2013), especially in STEM disciplines (Hurtado et al., 2008a; Palmer et al., 2010a; Perna et al., 2009; Seymour & Hewitt, 1997). HBCUs also generally have a campus culture that engenders collaboration and values collectivism over individualism (Gasman, 2012), which is important given that students of color tend to place a greater importance on collaborative learning than their White peers (Seymour & Hewitt, 1997). HBCUs also send strong messages that students can achieve their goals and attain academic excellence (McNair, 2009) – a stark contrast to the negative preconceived notions regarding the ability of Black students at other institutional types (Cokely, 2000). Further, collaboration between faculty, staff, students, administrators, and the surrounding community is frequent and common (Freeman, Alston, & Winborne, 2008). Indeed students at HBCUs tend to develop strong relationships with their peers which help students feel a sense of community and that they fit in, which in turn contributes positively to their self confidence and persistence in graduate school (Herzig, 2004a; Swail, Redd, & Perna, 2003).

Another notable feature of HBCUs is that they tend to take an approach to education that recognizes the importance of culturally inclusive practices and acknowledges that the learning experiences of Black students are racialized in STEM disciplines given their normative and everyday encounters with race and racism (Terry, 2010). The learning environment

therefore engenders an ethic of care whereby professors and administrators appear to focus on students' academic and personal well-being (Hirt, Strayhorn, Amelink, & Bennet, 2006; Strayhorn, 2013). Compared to faculty at PWIs, faculty at HBCUs demonstrate greater dedication to teaching and cultivating relationships with students and have a firm confidence in their students' abilities (Fries-Britt, Burt, & Franklin, 2012). The overall environment at HBCUs is one that not only fosters frequent interactions with faculty (Carter, 1999), but also helps students create meaningful relationships with faculty (Essien-Wood & Wood, 2013; Palmer & Gasman, 2008; Palmer et al., 2010a; Perna et al., 2009).

There are a number of findings on undergraduate students at HBCU's that may translate to graduate students also attending them. Strayhorn (2013) described the role campus climate played in the success of undergraduate students pursuing STEM majors at a HBCU in a mixed methods study. He found that STEM students commonly referred to administrators and faculty as "family," which is demonstrative of the personal and supportive relationships students cultivate with faculty at HBCUs (Strayhorn, 2013). These types of relationships contributed to students' sense that they mattered and belonged, which is in contrast to the experience of many students attending PWIs (Strayhorn, 2013). Participants reported that it was important for them to be recognized or noticed by faculty in the classroom. Further, students who felt a higher sense of belonging tended to do better academically, which was an unsurprising finding given that belonging is typically "a basic human need that has the power to motivate and inspire human behavior" (Srayhorn, 2013, p. 42). An important finding from this study was that attending an HBCU did not automatically mean that all students found the environment to be welcoming. Students were more likely to leave STEM at HBCUs when they perceived the STEM learning environment as a cold, unwelcoming place; those who found the STEM environment to be welcoming and had meaningful interactions with faculty were more likely to persist in STEM (Strayhorn, 2013). This study indicates that just because minority students attend minority

serving institutions does not guarantee that they will all have positive perceptions of the climate, that the climate for students cannot be improved, or that students pursuing STEM majors will automatically feel positive about the classroom environment and their learning experiences.

Faculty at HBCUs tend to have what Mitchel and colleagues (2013) call double-consciousness, which means that faculty demonstrate an appreciation for the multiplicity of experiences students bring with them to the college context. This double-consciousness on the part of faculty may explain why in a study of Black male physics majors, students who had attended both an HBCU and a non-HBCU reflected that faculty at the HBCU they presently attended were far more engaging, motivating, and approachable than faculty at the non-HBCU institution from which they had transferred (Fries-Britt, Burt, & Franklin, 2012). In all, the safe environment that HBCUs provide appears to help students take risks that contribute to their personal and academic growth (Allen, 1992).

Although HBCUs produce a large portion of students who eventually earn degrees in STEM, most students of color are still educated at schools that are not designated as an HBCU (Hoffman, Llaga, & Synder, 2003). Further an increasing amount of URMs are now attending Hispanic Serving Institutions (HSIs) (Dowd et al., 2013). Although HSIs enroll a great deal of URM students – most of whom are Latino/a – few purport an explicit mission to serve Latina/o students (Contreras et al., 2008b), a stark contrast to HBCUs which were founded to serve Black students. Indeed a more fitting name for HSIs would be Hispanic enrolling as HSIs are, as defined by the 1998 reauthorization of the Higher Education Act (HEA), accredited, degree-granting institutions in which Latina/o students comprise at least 25% of the full-time equivalent student (Laden, 2004). Thus as the composition of a predominately White institution's student body changes and reaches the 25% Latino enrollment point, the institution can apply to change their designation to HSI status. Indeed most HSIs, with the exception of those in Puerto Rico, were PWIs that became HSIs; many of these transformed HSIs however did not make changes

to its practices and cultures which are still for the most part reflective of dominant Anglo norms (Contreras, Malcolm, & Bensimon, 2008b) wherein faculty attitudes and institutional practices are similar to those typical at PWIs (Stage & Hubbard, 2009). Therefore there is no guarantee that the campus climate at an HSI is supportive and welcoming to Latino students and other URMs, that Latino students will experience equitable outcomes, or that the needs of minority students will be met (Gasman, 2008). These realities may help explain why at least with respect to undergraduate students, Latina/o students at HSIs have similar levels of engagement as their counterparts attending PWIs (Nelson Laird, Bridges, Morelon-Quainoo, Williams, & Holmes, 2007). Latino students attending HSIs are also less engaged than Black students attending HBCUs (Nelson Laird et al., 2007). It remains to be seen whether this engagement pattern is similar for graduate students. Furthermore it is not uncommon for there to be an inequitable participation of Latinos and other URM students in high status areas such as STEM (Dowd, Malcolm, Bensimon, 2009)

Some HSIs however have made an intentional commitment to diversity, multiculturalism, and/or access (Contreras et al., 2008b; Garcia, 2013). Further HSIs are also more likely to host cultural events that may help students feel comfortable at their institution (González, 2010; Guardia & Evans, 2008) and generally employ a significantly greater proportion of Latina/o faculty and staff than non-HSIs (Garcia, 2011; Malcolm, 2010). This is an important contextual consideration given that Latina/o faculty and staff may be uniquely able to provide Latina/o students with supportive guidance, given a shared background of being first generation college students and the challenges that come with that status (Dayton et al., 2004).

Considering the unique ability of some minority serving institutions to create supportive environments for minority students pursuing STEM degrees, it is important to recognize that many HSIs and HBCUs are not major research institutions nor do they have the high level of resources needed to maintain a research enterprise. These institutions subsequently only

typically offer the baccalaureate and master's degrees. For example, out of the 103 HBCUs in the country, only 23 offer doctoral degrees (Gasman, 2014). Thus many minority students wishing to achieve a doctorate degree in STEM attend predominately White institutions. This reality puts an even greater responsibility on PWIs, with its greater access to resources, to better retain its URM graduate students in both master's and doctoral programs and ultimately become an improved gateway to the Ph.D.

The Racial Climate at Predominately White Institutions

Discrimination: URM graduate students broadly. Completing a graduate degree is commonly an isolating and solitary experience (Gardner, 2008), however this difficulty is exacerbated by a lack of compositional diversity in many graduate programs in which URMs are the only one of a few people of color in their programs and classes (Fries-Britt et al., 2010a; Palmer et al., 2011). Where there are few URMs in a given space, there is a greater likelihood that they are subject to negative stereotypes about their ability and qualifications (Gay, 2004; Hurtado et al., 1998). A dearth of faculty of color in STEM also contributes to the social stigma of URMs (Cole & Griffin, 2013). Consequently URMs often experience confrontations with racism, prejudice, and discrimination during graduate school (Lee et al., 2003) and perceive the graduate environment as being more racially discriminatory that their White peers (Nettles, 1990). Indeed the journey to the doctorate can take a very oppressive, discriminatory, and marginalizing nature for URM students (Castellanos, 1996; Gildersleeve et al, 2011; Ibarra, 1996; Solórzano, 1993; Turner & Thompson, 1993) as they encounter tokenization by peers (Gonzalez, 2002), low expectations and little support from professors (Gonzalez, 2007), and negative stereotyping (Benton, 2005; Steele, 1997; Taylor & Antony, 2000).

Other work has highlighted other challenges URM students encounter in graduate school. In Gildersleeve and colleagues (2011) study of 22 URM doctoral students for example,

the authors found that participants were asked to be the representative of their race, excluded from support networks, and reported that their life experiences, perspectives, or research interests were dismissed or invalidated by both faculty and other students. As a result of these negative experiences, participants censored what they did and said in response to racialized occurrences, questioned whether they fit in their programs and their academic worth, and had difficulty taking on the rules and norms of their disciplinary academic program. Participants also reflected feeling apprehension, insecurity, and doubt about their abilities but relied on their peer support networks to cope with these feelings and to manage racially charged incidents occurring in their programs.

In another study of the social experiences of URM graduate students, Johnson-Bailey and colleagues (2009) sent a survey to Black alumni from graduate and professional programs, of which 678 surveys were returned. In the survey students were able to mark how salient a given experience was to them. From the participants' responses, the authors found that there were five broad categories of social experiences that Black students routinely experienced in graduate education, all of which affected students at different levels of severity. The most salient experience was having had their academic ability underestimated by White faculty and students due to racist assumptions. The second most salient experience was feeling forced to represent one's racial group by professors, which carried the assumption that all Black people were alike, instead of a heterogeneous, variable group like other racial groups. The third most prominent experience was overt and subtle racism or discrimination perpetuated by White students that ranged from rude comments to direct confrontation. Black graduate and professional students reported that these experiences were highly stressful considering their severe underrepresentation at their predominately White campus and the overrepresentation of White students (Johnson-Bailey et al., 2009). The fourth most common experience was social avoidance or neglect by White students, consequently denying students equal participation in

rich social experiences and learning opportunities. The final and fifth most frequent experience was discrimination by White professors in which there was both a lack of trust and respect within the relationship.

Findings from this study run counter to the dominant narrative that says racism no longer occurs, or only does so rarely, in the graduate context. Instead roughly 57% of participants reported that they had personally experienced racism during their graduate work. Interestingly these Black students, all of whom had reached degree completion, explained that years later they still were resentful over their poor experiences in graduate school. Negative graduate school experiences diminished their desire to have any further participation in matters concerning their university and prompted them to tell other minority students to go elsewhere for graduate work (Johnson-Bailey et al., 2009). In reflecting on their social experiences, the Black students believed that their experiences were qualitatively different from those of their White peers and that White students experienced a friendlier, more positive campus environment (Johnson-Bailey et al., 2009). As a result of the negative experiences, a number of participants reported that their graduate experience was something they survived rather than enjoyed. Although participants' attainment of a graduate degree demonstrated an incredible resolve to be successful in the face of educational inequities, findings echo other research that demonstrates the endemic racism on both individual and institutional levels that URM students experience in their journey towards a graduate degree (Gildersleeve et al, 2011; Lewis, Ginsberg, Davies, & Smith, 2004).

More subtle forms of discrimination URM students face in graduate education is discouragement from pursuing scholarship on issues that affect the communities they come from (Margolis & Romero, 1998), little access to quality mentors or role models (Gomez & Fassinger, 1995; González et al., 2002; Solórzano, 1993; Turner & Thompson, 1993), and classrooms where the majority of professors are White, discussions of race or culture are

nonexistent, and where there is narrow acceptance of new ideas or point of views (Ellis, 2001). Another barrier to full participation for students from minority groups are biases or preference patterns of people (both faculty and students) from the dominant group, in which individuals tend to prefer to work with people who are similar to them (Cox, 1993). URM students generally can detect the subtle negative attitudes others have of them, which can lead them to perceive that they aren't fully welcomed in that environment (Rogers & Molina, 2006). All of the aforementioned challenges set a negative tone for minority students as they pursue their graduate degrees.

Discrimination: URM graduate students in STEM. URM students pursuing graduate degrees in STEM disciplines in particular have unique experiences with discrimination while attending predominately White institutions. URM students in STEM were more likely to feel lonely, question their belonging on campus, and feel as if their peers viewed them as incompetent on campuses where they were few in number (Seymour & Hewitt, 1997). On these campuses URMs may also feel a sense of otherness, which is related to what has been termed the imposter syndrome wherein students of color and women do not feel as they belong in academic intellectual spaces, that luck played a role in their success, and that it is only a matter of time before someone discovered they were a fraud (Clance & Imes, 1978; Gardner & Holley, 2011; Holley & Gardner, 2012).

Like students in other disciplines, URM graduate students in STEM often describe the graduate environment as chilly, alienating, unsupportive, and as perpetuating racial micro-aggressions (Oden, 2003; Smith, Yosso, & Solórzano, 2007). Unfortunately many do not voice race or ethnicity related incidents for fear that doing so would compromise the perception others have of them as objective and credible scientists (Johnson, 2007). In a study of STEM students attending a large PWI for example, Black female students recounted experiences with frequent microaggressive behaviors from faculty who encouraged them to pursue non-STEM majors,

questioned their academic abilities and intelligence, and evaded interactions with students outside of the classroom (Essien-Wood, 2010). These experiences with faculty can help explain why URM students reported having fewer socialization experiences with faculty at PWIs (Essien-Wood & Wood, 2013). Being "overlooked, neglected, or discriminated against by meaningful others in science" such as faculty or peers (Carlone & Johnson, 2007, p. 1202) is damaging to students in that it makes them identify less as scientists. In another study, Black females in graduate STEM programs reported having had to deal with unsubstantiated accusations of academic dishonesty (Essien, 2007).

In yet another qualitative inquiry on graduate students who recently graduated in the biological sciences at a predominately White institution, Black female participants reported an unwelcoming and unsupportive collegiate environment, which made it harder to persist (Justin-Johnson, 2004.) This perception of the environment resulted from a lack of supportive relationships with faculty, exclusion from study groups or feeling isolated within study groups due to few Black students, exclusions from social events by other students, and an overall difficulty in creating close bonds with faculty and peers. Students coped with these challenges by relying on their determination and personal motivation and the few supportive peers and faculty they had on campus (Justin-Johnson, 2004).

The literature suggests that racial incidents are not incidental or accidental, nor are they isolated instances from the norm in which a few ignorant students decide to act foolishly (Chesler & Crowfoot, 1989). Instead they demonstrate a deeper problem of "unresolved racial issues in college environments and in society at large" (Hurtado, 1992, p. 540). Students' perceptions of the campus climate of their institution – defined by the attitudes, beliefs, behaviors, policies, and practices of campus life – (Hurtado, 1992, 2002) and the climate of their programs have a great deal of influence on students' experiences while in graduate school (Weidman & Stein, 2003).

Students appear to have different experiences pursuing STEM degrees depending on whether they attended an HBCU or not – a reality that may also hold true for students at the graduate level as well. Indeed survey data revealed that students of color pursuing an undergraduate STEM major were more likely to meet with academic advisors, participate in study groups outside of the classroom, talk with faculty about academic matters, and have social/informal contact with faculty outside of the classroom or office hours if they attended an HBCU compared to their non-HBCU counterparts (Essien-Wood & Wood, 2013). Further the overall frequency of informal interactions students had with faculty differed significantly between students attending HBCUs and those attending other institutions (Essien-Wood & Wood, 2013). This finding suggests that URM students attending HBCUs have more academic integration experiences than their URM peers at non-HBCUs. Situating their research in the literature, Essien-Wood and Wood (2013) speculate that racial microaggressions may account for the engagement differences students had at non-HBCUs compared to HBCUs.

The various consequences of discrimination. The campus environment influences student participation and their daily circumstances (Golde, 2005; Yosso, Parker, Solórzano, & Lynn, 2004), with racially insensitive or hostile college environments having real consequences for students. Indeed discriminatory or prejudicial experiences in the classroom can undermine URM students' academic growth and social involvement (Cabrera, Colbeck, & Terenzini, 2001). Students who perceive their campus racial climate as hostile commonly feel unwelcomed or isolated, demonstrate a diminished sense of institutional belonging, and have difficulty adjusting to campus life (Hurtado, Carter, & Spuler, 1996; Hurtado & Ponjuan, 2005). Negative racial experiences also make it less likely that students will ask for help or guidance when contending with problems (Thiry, Lauren, & Hunter, 2011).

Unfortunately, negative stereotypes about people of color appear to be a universal experience in higher education (Taylor & Antony, 2000) and may contribute to URM students'

perception that they have to be more academically successful than their peers to show they belong (Gasman et al., 2004). For other students, negative stereotypes reinforce a belief that they are incompatible with academic life, which can contribute to non-persistence (Gasman et al., 2004). URM students may also contend with 'stereotype threat', which is a phenomenon of underperformance resulting from stressing about the possibility of confirming negative stereotypes and social biases that exist about the social group to which one belongs (Steele, 1997).

Racially hostile college environments also take a psychological toll on URM students (Allen, 1985; Fleming, 1984) as it lowers students' self-concept and increases self-doubt (Fleming, 1984; Thomas, 1980; Webster, Sedlacek, & Miyares, 1979; Willie & McCord, 1972). Perceived experiences of racism and discrimination are also associated with elevated distress levels, reduced overall life satisfaction, and decreased well-being (Feagin & Sikes, 1994; Feagin, Vera, & Batur, 2001; Noh & Kasper, 2003; Williams, Neighbors, Jackson, 2003), with subtle and ambiguous incidences often causing greater distress than blatant acts (Bennett, Merritt, & Edwards, 2004; Guyll, Matthews, Bromberger, 2001). Even seemingly minor racial events can make coping with every day challenges more difficult (Carter & Forsyth, 2009).

These experiences understandably make it even more challenging for students to be academically successful and reduce the likelihood that students will persist at their institution (Green, 1989; Hurtado et al., 1996). Indeed, many students leave STEM because of unsupportive and unwelcoming college environments that engender racism, prejudice, and social isolation (Elliot & Shin, 2002; Strayhorn, 2010). Alternately, students are more likely to perform well academically and persist when they perceive their campus as welcoming, supportive, and culturally inclusive (Gloria, Castellanos, & Rosales, 2005; Hernandez & Lopez, 2004; Hurtado & Carter, 1997; Hurtado, Milem, Clayton-Pederson, & Allen, 1998).

It is noteworthy that despite prevailing dominant beliefs, research shows that many racial minorities consider all other possible explanations to their experiences before attributing ambiguous incidences to racism (Carter & Forsyth, 2009). Having an experience with perceived racism dismissed by others – especially meaningful others – however can add to the injury of being the target of differential treatment, although how a person makes meaning of experiences they encounter will differ based on a variety of factors such as personal backgrounds and cognitive processing (Carter & Forsyth, 2009).

Discriminatory experiences of female graduate students. The culture of the department plays an influential role in how people participate in graduate school. Early on, women learn that the dominant culture of academia devalues behaviors considered to be feminine and should therefore limit discussions of personal problems, feelings of insecurity, or even complementing others for a job well done (Subramaniam & Wyer, 1998). In a study of both female and male doctoral students, Gardner (2008) found that female students reflected that they confronted sexist attitudes, an old boy's club, and perceived that others found their success to be threatening. An anti-feminine dynamic made these female graduate students question their place in the academy as students and as future faculty (Gardner, 2008). Further of the 12 doctoral students in Gardener's study who contemplated leaving their programs, took anti-depressants, or sought counseling – all but one were women. Similarly, in another study on STEM doctoral students relationships with their advisors, Rohlfing and colleagues (2010) found that females pursuing STEM majors faced a disciplinary climate that was unwelcoming to women. Those who decided to leave their programs before completion recounted that they experienced steep losses in confidence while in their programs coupled with little or no encouragement to persist (Rohlfing et al., 2010).

Because the culture in graduate school largely reflects White male norms and research values (Antonio, 2002), URM women experience graduate education in ways that are both

different from their URM male peers and White women. Indeed the intersection between their identities as both women and members of a minority racial/ethnic group makes URM women susceptible to multiple systems of oppression as they experience both sexism and racism in STEM environments (Carlone & Johnson, 2007; Justin-Johnson, 2004; Valenzuela, 2006). URM women often struggle most with being recognized as full and legitimate members of the STEM community (Ong et al., 2011). In a synthesis of the literature on women of color in STEM learning environments, Ong and colleagues (2011) concluded that the STEM social and cultural climate was the leading obstacle to persistence woman faced as they pursued their STEM degrees (Ong et al., 2011). Other studies demonstrated that relationships with faculty/peers and issues of an interpersonal nature presented more challenges for minority women in STEM graduate programs than structural barriers such as a lack of financial aid or research assistantships (Brown, 1994, 2000).

Black female graduate students in one study reported that they hid any signs of weakness because they didn't want to confirm negative racial stereotypes regarding the intellectual capacity and commitment of Blacks. These students persevered in the face of marginalization because they wanted to serve their communities and give back to their families (Sulé, 2009). Similarly, women of color in STEM often report that they are very conscious of how they dress, speak, and present themselves within their STEM academic communities in an effort to be accepted and to feel more like they belong (Joseph, 2007; Ong, 2005). As Carlone and Johnson (2007) wrote, "It is much easier to get recognized as a scientist if your ways of talking, looking, acting, and interacting align with the historical and prototypical notions of a scientist" (p. 1207). Perhaps a lack of recognition explains why URM women often underestimate their intellectual capabilities in academic spaces even though they are higher achieving compared to their peers (Hurtado, 1994). It is also noteworthy that URM women are also more likely to have significant responsibilities to their families, which can undermine their

academic success during their graduate work (Kerber, 2005; Mason & Goulden, 2002; Wagner, 2002).

Pragmatic Elements of the Departmental Context

Several elements affect the satisfaction, progress, and persistence students have within their doctoral degree programs. One element is the department context (Gardner, 2008), which includes the design of the graduate programs housed under the department, the policies of the department, the implementation of policies, and the culture around advising and student support (Golde, 2005; Bair & Haworth, 2004; Herzig, 2004a). Students tend to have shorter times to degree and higher persistence rates in departments where there is an abundance of support and guidance for students, faculty who are consistently involved with all stages of the doctoral process, a great deal of program structure including clear guidelines on expectations for the degree, and small entering doctoral cohorts (Gardner, 2007, 2008, 2010; Herzig, 2004a; Bair & Haworth, 2004; Golde, 1996; Nerad & Cerny, 1993). It is also helpful when departments make the implicit, explicit at all phases of the doctoral program so that there is no “insider” information (Lovitts, 2007).

Not surprisingly, most students reflected that they entered their doctoral programs with little understanding of the doctoral process (Wulff, Austin, Nyquist, Sprague, 2004). Specifically new doctoral students reported not knowing program expectations, junior students reported not knowing what to expect from the qualifying examinations, and advanced students reported not knowing how to approach the independent research and writing involved in a dissertation (Gardner, 2007, 2008a, 2010). Advanced students also struggled with becoming self-directed and independent researchers (Gardner, 2007) – a task that is not helped by a largely accepted faculty notion that the doctoral writing process is an individual scholarly endeavor (Calvert & Casey, 2004).

Doctoral students in a number of studies were unprepared for the lack of direction around the various steps in the dissertation process, which suggests that students need more regular check-ins with their advisor and structured research experiences that incrementally prepare them to carry out their dissertation work (Gardner 2007; Lovitts, 2001). An unawareness of the expectations or guidelines that must be followed to complete the Ph.D. can delay students' progression through their STEM degree and result in a great deal of frustration and confusion (Gardner 2007; Lovitts, 2001; MacLachlan, 2006).

Interestingly, some doctoral programs appear to have an intentional weed out process whereby the program takes in more students than it recognizes it can handle (Borum, 2010), which may contribute to why some faculty felt minimal responsibility for students' departure in one study (Herzig, 2002). Indeed in Herzig's (2002) study of doctoral students in mathematics graduate programs, a number of mathematics faculty admitted to ignoring first-year doctoral students and not providing them with meaningful experiences until the students proved that they had talent. Shockingly, the faculty viewed this treatment of students as an effective way of weeding out students who would complete the program from those who would not (Herzig, 2002). Some faculty also believed that the purpose of doctoral coursework and qualifying exams was to filter out students with less skill (Herzig, 2002).

The curriculum students encounter in their programs is another component of the graduate program that is linked to student satisfaction. Researchers found that doctoral students often cited that the curriculum and/or research agendas in their program were not socially or personally relevant or had no application to real world problems they were interested in addressing (Golde, 1996; Herzig, 2002). URM doctoral students specifically were dissatisfied with what they perceived to be a Eurocentric curriculum (Gasman, Hirschfled, & Vultaggio, 2008) that excluded diverse perspectives, voices of scholars of color, and ultimately neglected their development as scholars of color (Barnes & Austin, 2009). Understandably URM students

desired a STEM curriculum that was more reflective of diverse values and that demonstrated the social value of science and how science could improve conditions for communities of color (Bonous-Hammarth, 2000).

The distribution of assistantships conducting research or teaching in a department also matters to persistence because assistantships are linked to professional development. Assistantships also serve a great socializing function for students as they help integrate students socially and academically into their field of practice (Bair & Haworth, 2004). Specifically an assistantship affords students with greater opportunities to interact with faculty and other students thereby preventing isolation and helps students learn the norms and develop the skills necessary of their discipline – all of which has positive consequences to students' persistence (Bair & Haworth, 2004; Herzig, 2004a; Lovitts, 2001; Tinto, 1993), especially among URM students in STEM (Mwenda, 2010). It is concerning then that Black students in engineering, the sciences, and mathematics were between three and four times less likely than White students to receive teaching or research assistantships (Nettles & Millett, 2006). This finding suggests an inequitable distribution of assistantships in STEM disciplines and demonstrates that Black graduate students are at a distinct disadvantage with respect to apprenticeship opportunities and social participation at the graduate level (Nettles & Millett, 2006).

It would be remiss to accept that STEM graduate programs cannot do better in terms of including URM students in graduate life and effectively create socially and academically supportive environments. Indeed Rogers and Molina (2006) identified and described a number of practices employed by programs that had exemplary track records in attracting and retaining talented student of color in psychology graduate programs. These innovative practices included including minority faculty and students in recruitment activities; offering students attractive financial aid packages; having faculty personally contact prospective minority students; creating linkages with historical institutions of color to create a pipeline for students of color into the

graduate programs; having or approaching critical mass of faculty and students of color; offering a course that covers diversity issues; and encouraging students to engage in research that investigates diversity issues (Rogers & Molina, 2006). Exemplary institutions also specifically targeted undergraduate minority students of color for recruitment, provided them the opportunity to visit the department, and offered recruitment materials specifically tailored to URM students. Most departments also established a system that provided mentoring to students or facilitated peer social support. Faculty from roughly half of these institutions intentionally made efforts to respond to critical incidents occurring in their program and planned interactions or discussion groups to address concerns (Rogers & Molina, 2006). Finally, roughly half of the exemplary institutions offered professional development opportunities to faculty to build their cultural competencies or recognized faculty for their efforts in retention and recruitment (Rogers & Molina, 2006). Entire institutions – not just graduate programs – are also making inroads. The Massachusetts Institute of Technology for example reinvested in mentoring, took steps to improve the climate, and moved from a 'sink or swim' mentality to a notion that all students were promising and therefore should be valued. The institution also created a culture of caring in which the values and contributions of the broader community were celebrated. Consequently the numbers of minority students in STEM receiving doctorates went from 0% in 2007 to 11% in 2012 (Bertschinger, 2012).

The study by Rogers and Molina (2006) and those by other researchers suggest that transforming graduate education and empowering URM students in the academy will necessitate a multipronged strategy advanced by committed leadership. At the very least the institution and department share a responsibility for ensuring that there are protective factors (i.e. supportive relationships with others, formal support structures) in the educational context available to graduate students. Protective factors help students respond to challenges, shield them from absorbing the full force of negative or stressful events, and help students regain

comfort within their educational environments so that positive outcomes are more probable and so that students can succeed in spite of stressors, adversity, or struggle (Ceja, 2004; Henderson & Milstein, 2003; Richardson et al., 1990). When protective factors in the environment were lacking, students were forced to rely solely on their internal protective characteristics (i.e. an optimistic outlook, self-efficacy, sense of control over their environment), which made them more susceptible to personal, emotional, and academic harm (Henderson & Milstein, 2003; Richardson et al., 1990).

Relationships with Advisors and Faculty

Students in general. The relationships and interactions students have in the social and academic environments of graduate school and their perception of those relationships/interactions impact both degree progress (Girves & Wemmerus, 1988; Golde, 1996; Herzig, 2004a) and persistence decisions (Tinto, 1993), especially among minority graduate students (Vaquera, 2007). Because faculty both represent and guard the academic culture of their departments and institution (Anaya & Cole, 2001; Cox, et al., 2010; Gasiewski et al. 2012), they play a tremendous role in the academic and socialization experiences of students (Nettles & Millet, 2006) and represent a contributing factor in students' persistence decisions (Lovitts, 2001). Perhaps the most important relationship doctoral students have is with their faculty advisor (Baird, 1995), as advisors are the prime contributors to students' socialization into the disciplinary community (Lovitts, 2001, 2004; Nettles & Millet, 2006). Thus it is important that students connect with their advisors and find additional faculty who take an active interest in them (Lovitts, 2001; Sweitzer, 2009). These faculty-student relationships are consistently important throughout students' entire graduate journey although the nature of the relationships changes as students progress through their graduate programs (Gardner, 2008a).

Faculty-student relationships comprise of a number of different interactions and functions, all of which influence students in different ways (Cole & Griffin, 2013). Some of the various roles an advisor or other faculty play are as role model, in which they demonstrate the appropriate behaviors of academic professionals and as student advocate (Barnes & Austin, 2009). As an advocate of students, advisors represent critical sources of reliable information and other knowledge (Barnes & Austin, 2009), resources, and academic advising or counseling (Stanton-Salazar, 2010). Some advisors additionally act in ways that reflect the behaviors of a mentor as they bridge students' home culture and the culture of the institution, validate students' cultural backgrounds, and provide students with opportunities to participate in meaningful ways in the academic community (Kuh & Love, 2000), all of which are especially helpful to the success of students of color. Indeed multicultural mentoring, in which the mentor and protégé celebrate differences and in which both parties respect the cultural background and experiences of the other, optimizes learning and development within a relational context that keeps hierarchy to a minimum and maximizes collaboration (Williams & Schwiebert, 2000).

In a study of how exemplary faculty advisors – defined as faculty members who were one of the top producers of Ph.D. students in their departments over a five-year period (Barnes & Austin, 2009) – viewed their roles and responsibilities, participants reported that their prime responsibilities to students included helping their advisees be academically successful, helping them develop as researchers/knowledge creators, and providing professional development. Advisors met these responsibilities by collaborating with students on projects, treating students respectfully as colleagues, mentoring them, and advocating for students in ways that protected them from harm (Barnes & Austin, 2009). They described their relationships with students as being friendly, but professional; collegial in the sense that power structures were less hierarchical and more balanced; characterized by an ethic of care and support; accessible; and one in which they felt comfortable giving honest, candid feedback to students. Other important

roles of advisors were helping students cope with failed experiments and helping them select a doable dissertation project. Advisors have also been known to help students learn the political strategies necessary to survive in graduate school, which is part of socialization (Etzkowitz et al., 1992).

Research demonstrates that the quality and quantity of advising students receive in their degree programs vary widely (Fagen & Suedkamp Wells, 2004) and has important consequences to student outcomes generally (Minor, 2003) and degree completion specifically (Lovitts, 2001; Maher et al., 2004). In a thorough synthesis of 28 years (1970-1998) of literature written on doctoral student attrition and persistence, a reoccurring emerging theme was that high quality, close, frequent, and positive relationships with supportive and caring faculty and faculty advisors who offered good advice and career sponsorship was related to persistence (Bair & Haworth, 2004). Indeed faculty-student relationships characterized by social support, mentorship, mutual interest, trust, "collaboration, ongoing feedback, and flexibility" are needed to improve retention (Rogers & Molina, 2006, p. 152), because these type of relationships better position students to have successful graduate school experiences (Golde, 2000). Psychosocial and emotional support from a faculty member also seem go a long way in terms of student development (Johnson et al., 2007), success, and persistence (Antony & Taylor, 2004).

Validating experiences from faculty, and other students, are also immensely important as they reinforce a sense of self-worth and self-efficacy in students' abilities (Rendon, 1994). It is noteworthy that even successful students who are persisting can be dealing with obstacles with respect to self-esteem in STEM (Graham, 2013). Recognition from faculty can either draw students further into the field or keep them at the margins depending on whether students perceive the recognition to be positive or negative (Carlone & Johnson, 2007). Positive faculty interactions help reinforce students' belief in their ability to become a professional in their field (Coldbeck, Cabrera, & Terenzini, 2001). Not surprising, students in STEM who had a positive

relationship with their advisors were more likely to report being satisfied in their program (Nettles & Millett, 2006).

In qualitative interviews of three URM female students enrolled in different doctoral STEM programs, participants highlighted the personal aspects of their relationships with their advisors that went beyond professional and academic advising and noted that the personal support helped maintain satisfaction in their program and was important to their retention (Soto & Yao, 2010). Close ties with faculty are indicative of the experiences of those who finished their degrees (Pruitt & Isaac, 1985). Students who develop close, satisfactory relationships with their advisors also tend to have shorter times to degree (Ferrer de Valero, 2001). Overall completers tend to rate their advisors more positively than non-completers (O'bara, 1993). Non-completers conversely often cite many problematic features of their relationships with faculty in the department in general and their advisor in particular (Golde, 2000). Having an incompatible relationship with an advisor can erode students' confidence in their abilities and influence students' decisions to leave their programs (Golde, 1996). In a study of doctoral students across various disciplines, the science students who dropped out attributed their decisions to leave to an incompatible advising relationship in which they did not trust their advisors and did not interact with advisors often, which severely impaired their educations (Golde, 2005). Switching advisors or labs was also a rather difficult and seemingly public process (Golde, 2005).

In another study, doctoral students in mathematics overwhelming reported not receiving support or encouragement from faculty; this perceived lack of care prompted several students to leave without attaining the Ph.D. (Herzig, 2004b). The few that did report receiving sufficient support noted that being supported and receiving affirmative feedback from faculty they trusted contributed to their success in graduate school (Herzig, 2002). Other often cited problems in the faculty-student relationship include inaccessible faculty, little faculty involvement with new students (Gardner, 2008a), lack of mentoring and advising, and an overall lack of meaningful

interpersonal relationships with faculty and/or one's advisor (Nettles & Millett, 2006). Herzig (2004b) concludes that "without meaningful, mutual interactions with faculty [students] had few opportunities to develop their abilities…, to learn.., or to develop a sense that they belonged [in their department]" (p. 390). In reflecting about their experiences, students who left their doctoral programs before completion reported that if their faculty had been more supportive they would have likely stayed (Lovitts, 2001). In the absence of sufficient support and guidance, minority graduate students especially had to possess extremely high levels of commitment and savvy to persist (Hamilton, 2001).

As with any other interpersonal relationship, different types of advising relationships exist (Crookston, 1994). Some advising relationships are based on hierarchical power relationships in which the advisor explicitly tells students what to do; further, the relationships are focused on the students. Relationships that are less hierarchical and more unidirectional are posited to be more conducive to mutual learning between faculty and students (Crookston, 1994). Interestingly, students who are treated like junior colleagues – which would be reflective of a less hierarchical relationship – are also more like to complete their degrees (Girves & Wemmerus, 1988).

There are a number of additional findings on the student-faculty relationships of students pursuing STEM graduate degrees specifically that deserve comment. First, Herzig's (2002) study on doctoral students in mathematics demonstrated that faculty attitudes and beliefs with respect to teaching and learning profoundly influenced students' socialization experiences. Specifically via interviews with faculty, Herzig (2002) found that a number of mathematics faculty believed that talent was something students innately possessed; following this line of thinking, faculty assumed that some students would simply not have the talent needed to finish their programs. In a similar study, Herzig (2004a) interviewed six female mathematics doctoral students at a large public research university. Participants noted uncaring or even hostile

faculty, informal networks that they didn't belong to (i.e. the old boys club), bad advice or lack of advice all contributed to a delay in their completion of coursework or undermined their mathematics training (Herzig, 2004b). These findings are indicative of a possible hostile gender climate in STEM doctoral programs, which adds further complexity to the experiences of URM students, especially females.

In another study of doctoral students pursuing degrees across five disciplines at a single institution, Gardner (2010) found that students in mathematics and engineering most often depended on faculty members for support which contrasted with peers in non-STEM disciplines who more heavily relied on other students for the majority of their support. These findings suggest that advisors play an even more critical role in shaping the experiences of STEM graduate students. Further, engineering students talked about the ambiguity in knowing how to conduct independent research and the lack of direction from faculty advisors in figuring out how to tackle the dissertation. Of all the departments included in Gardner's (2010) study, the mathematics and engineering departments appeared to offer the least supportive environments and were also, perhaps not coincidentally, the departments with the lowest completion rates (Gardner, 2010). The extent to which students felt supported by faculty, peers, and the department as a whole ultimately influenced students' decisions to remain in their programs or leave (Gardner, 2007). Other research supports the finding that an overall student perception that advisors cared about their success, was a motivating factor for students and kept them progressing through their doctoral programs (Herzig, 2004b).

URM students in particular. Like their majority counterparts, URM students are more likely to persist in college when they have close, positive relationships with faculty and staff (Barnes & Austin, 2009; Grier-Reed, Madyun, & Buckley, 2008). Interestingly, for URM students, connecting to just one faculty member is associated with more positive interactions with other faculty (Nettles & Millett, 2006). Advising that is holistic and proactive is effective with

students of color (Museus & Ravello, 2010). An ethic of care – in which faculty demonstrate that they care for students by being available, offering helpful honest feedback and consistent mentoring, providing moral support, and treating students as a junior colleagues – is especially important to minority students in STEM graduate programs who perceive this type of caring behavior as contributing to their success (Mwenda, 2010). Interestingly the STEM minority graduate students referenced in the Mwenda (2010) study made no mention of the racial attributes of their advisors as being important to the student-faculty relationship, which may indicate that the racial background of advisors is less important than the mentoring characteristics and behaviors of the advisors themselves.

There is evidence however that Black professors reach out to students of color more frequently because of shared experiences with racism or marginalization in higher education (Griffin, 2012; Reddick, 2005). This additional concern from URM faculty shown towards students of color is beneficial given research showing that Black STEM students find attaining the level of socialization they need from faculty for proper development especially challenging. For example, Black graduate students pursuing STEM degrees in one study reported a difficult time getting the information they needed to navigate the educational environment, which can be an indication of fewer socialization opportunities (Gasman, Hirscheld, & Vultaggio, 2008). In another large survey study of doctoral students across 21 institutions that were among the 60 top producers of Ph.D. degrees, Black doctoral students in engineering, sciences, and mathematics reported the lowest ratings, compared to other racial groups, of the quality of their social and academic interactions with faculty (Nettles & Millett, 2006). These findings emerged even after researchers controlled for multiple factors including GRE scores, having a mentor, and other predictors of student interaction with faculty. Black students also had the least frequent interactions with faculty of any race; Latino students did not show differences when compared to other racial groups. The authors conclude that it is possible that racial prejudice or

bias against Black students played a role in this finding (Nettles & Millett, 2006).

Poor social interactions with faculty appear to carry into other academic experiences. Indeed in Nettles and Millet's 2006 survey study, Black students in the sciences or math were 2.5 times less likely than White students to exhibit research productivity. This finding may be at least in part attributable to the fact that Black students in engineering, the sciences, and mathematics were the least likely by a margin of at least 30 percentage points to have a research assistantship upon entering their programs or that Black students in the sciences and mathematics were also less likely to have a mentor than their White peers (57% vs. 76%) (Nettles & Millett, 2006). With respect to Latino students, they were 2.5 less likely than their White peers in math or sciences to present at a national conference (Nettles & Millett, 2006). Other research on minority and non-minority female graduate students corroborates the finding that minority students have fewer professional development and socialization experiences than their majority peers due to less mentorship from faculty and difficulty securing research or teaching apprenticeships (Turner & Thompson, 1993). Further the relationships Black doctoral students have with faculty appear to be more formal in nature, which may limit their ability to benefit from informal forms of information and influence (Ellis, 2001; Nettles & Millet, 2006). Also there is evidence that Latino and Black graduate students have more distrustful relationships with faculty (Daniel, 2007).

The literature on faculty relationships makes a noteworthy distinction between a mentor and an advisor: a mentor is "someone on the faculty to whom students turned for advice, to review a paper or for general support and encouragement," all of which goes beyond simple advising. An advisors conversely is simply a person who is "assigned by the department to act in an official capacity in such ways as discussing and approving coursework, or signing registration forms" (Nettles & Millet, 2006, p. 96). Students whose advisors also serve as mentors appear to have the most positive experiences in their doctoral programs (Nettles &

Millett, 2006). Although both mentoring and advising relationships are crucial to students' success, whether URM students have the same access to mentoring relationships as their majority peers is less clear. Survey research shows that URMs were less likely to have a mentor in graduate school (Nettles & Millet, 2006). Mentors are extremely important because they shield students from absorbing the full shock of the hardships that coincide academic pursuits (like isolation) and invest heavily in the success of their mentees (Nettles & Millett, 2006). In Nettles and Millet's study (2006) high quality mentoring and advising was the strongest contributor to a range of student outcomes for URM students including socialization, research productivity, and degree completion, all of which will likely have great implications for the later career trajectories of students (Nettles & Millett, 2006).

URM students in STEM likely have a faculty advisor or faculty mentor that is of a different race or sex (Nettles & Millet, 2006; Patton & Harper, 2003). This is not surprising given that the diversity within the faculty ranks in STEM disciplines is limited, which heavily underscores the necessity of existing faculty to be comfortable with interacting and mentoring students from diverse backgrounds and that they understand that students' needs differ (George & Malcolm, 2011). Unfortunately the understanding of students' differential needs vary vastly by faculty and the faculty's background in interacting with diverse students (Griffin, 2012). Another possible explanation is that it may be more challenging for students to find a mentor when they are perceived by some faculty as being less capable – even if these perceptions are unfounded and based on racial stereotypes – which likely makes it more challenging to complete a degree (Herzig, 2004a).

Experiences with racism perpetuated by faculty in both formal and informal settings (Cole & Jackson 2005) are one major barrier to satisfactory student-faculty interactions for URM students (Gasiewski, et al., 2012; Hurtado, et al., 2011). Black students have occasionally reported a belief that their professors avoided interacting with them in contexts that were outside

of the classroom; Black students also attributed unintentional racism or social discomfort on the part of faculty as contributing to fewer opportunities for them to engage in research or teaching (Baird, 1974; Duncan, 1976; Hays & Allen, 1982; Willie, Grady, & Hope, 1991). Dowd and colleagues (2013) posit that even when faculty are well-meaning and have the desire to help underrepresented groups attain equitable outcomes, unconscious discriminatory assumptions and stereotypical beliefs about underrepresented students' abilities sometimes get in the way of their efforts (Dowd, Sawatzky, Rall, & Bensimon, 2013). Indeed the language, attitudes, advice, and body language faculty exhibit in their interactions with students send subtle messages that can either affirm students or perpetuate inequities (George & Malcolm, 2011). Understandably because STEM faculty typically have little or no prior training on diversity issues, it is not uncommon for them to report being uncomfortable handling racial issues arising in the classroom (Gasman et al., 2004).

Unsurprisingly, a number of studies indicate that students of color attending PWIs gravitate towards faculty of color when looking for mentors and support (MacKay, 1997; Tierney & Bensimon, 1996; Williams & Williams, 2006), or seek out faculty who understand the cultural issues they experience while in graduate school (Patton & Harper, 2003). Other research supports the notion that URM students need culturally responsive advising that takes into account their experiences with discrimination and marginalization in higher education (Gardner, 2008a; Holmes, Land, & Hinton-Hudson, 2007; Mitchell & Rosiek, 2005; Mitchell, Wood, & Witherspoon, 2010). In a study of institutions that had higher than expected graduation rates of Latinos in STEM, researchers found a strong presence of a number of faculty members who held a critical consciousness and an understanding of the sociopolitical inequities affecting students (Stanton-Salazar, Macias, Bensimon, & Dowd, 2010). Although these institutional agents were helpful, a large number of them would have been needed to initiate larger scale cultural transformations that would change academic norms and traditions so that the world of

academia would be more inclusive of persons from diverse backgrounds (Dowd, Sawatzky, Rall, & Bensimon, 2013).

Although an advisor that shares the same race or gender as the student is not necessarily the best match and does not necessarily lead to better socialization experiences, the relatively low socialization opportunities for Black students in particular in engineering, the sciences, and mathematics illuminates a need for additional Black faculty in these fields (Nettles & Millett, 2006). Indeed the number of minority faculty in a given department or the number of faculty conducting research on issues related to race or ethnicity represent environmental factors that affect the experiences of students of color in graduate programs and is predictive of their success in graduate school (Flynn, Sanchez, Harper, 2011). There is also evidence that the social identities of students and faculty members have a great consequence for the frequency, quality, and productivity of student-faculty interactions (Cole & Griffin, 2013). This may be because faculty tend to choose student mentees based off of perceived similarities between themselves and the student, which given the dearth of faculty of color may work to the detriment of students of color who need mentorship the most (Garibay, 2013). To better meet their mentorship and emotional needs, URMs often seek advice and counsel from administrators, campus psychological services, and student affairs staff (Golde, 2000; Taylor & Antony, 2000). Finally Black doctoral students reflected that it was important for them to see people like themselves in the faculty and who excelled at science, because it made their own aspirations to become scientists seem more attainable (Gray, 2013). Unfortunately there is a severe lack of URM faculty role models in STEM programs at PWIs (Hoffman, Llaga & Snyder, 2003).

Relationships with Peers

Students in general. Doctoral students commonly reflected that graduate school could

be an isolating process especially when there was little collaboration among students (Herzig, 2002). Indeed experiences with isolation or exclusion were found to be a profound factor in students' decisions to leave their doctoral programs (Borum, 2010). Degree non-completers reported that social isolation or discontent with their social interactions with peers was detrimental to their persistence (Lovitts, 1996). These challenges highlight the need for positive interpersonal student-to-student relationships. Peer relationships characterized by moral support and friendship have been found to protect students from loneliness, increase students' satisfaction with their graduate experiences, and help students persist through their programs, especially in the first few years of coursework (Austin & McDaniels, 2006; Bair & Haworth, 2004; Gardner, 2007; Golde, 1996; Lovitts, 2001). Peers are important contributors to STEM graduate students' academic development and acquisition of skill via collaborative work on assignments, study groups for classes and qualifying exams, and the sharing of academic resources (Mwenda, 2010). Peers also represent excellent sources for students to discuss and test intellectual ideas (Lovitts, 2001). Chemistry doctoral students, for example, overwhelmingly spoke about the importance of peers – particularly more advanced students – for important information, guidance, and support, which were especially important in the face of infrequent feedback from faculty (Gardner, 2008a).

URM students in particular. URM students pursuing STEM doctoral degrees reflected that the academic support they received from peers in the form of study groups, academic advice, and feedback were critical to helping them be successful in graduate school (Mwenda, 2010). Other research corroborates the finding that social interactions with peers affect both academic achievement and emotional wellbeing (Hurtado, 1994) and play a critical role in the success of URM students (Gasman, Hirschfled, & Vultaggio, 2008). First generation graduate students more frequently relied on their peers when looking for guidance on how to navigate their programs (Gardner & Holley, 2011).

It is noteworthy however that URM graduate students experience peer interactions in distinct ways and face a more exacerbated form of isolation, precisely because they are often severely underrepresented in their graduate programs (Hamilton, 2001). Using qualitative data from 40 Black graduate students, Gasman, Hirschfled, and Vultaggio (2008) found that a reoccurring theme in students' narratives was they felt faculty and/or peers within their cohort did not support them. Negative experiences with peers and faculty lowered students' self-esteem and increased the incidence of contemplating leaving their programs (Gasman, Hirschfled, & Vultaggio, 2008; Graham, 2013). Lacking support, and in the face of few institutional support systems, participants made their own support groups comprised of other Black students, which was a difficult task to accomplish due to the fact that there were not many same-race peers on campus. Participants also relied on emotional support from practitioners and administrators (Gasman, Hirschfled, & Vultaggio, 2008). In another qualitative study on three URM female students enrolled in a doctoral STEM program, participants reported that their interactions with others in their program made them feel "different," and so interacting with same-raced peers contributed to their persistence (Soto & Yao, 2010). Indeed, although having positive relationships with all peers irrespective of race was helpful, relationships with other URM students provided a unique sense of comfort and support due to a shared understanding of challenges (Morelon-Quainoo et al., 2009).

Black graduate students frequently form same-raced peer groups as a means of warding off social and intellectual isolation and finding a much desired supportive community (Benton, 2005; Ellis, 2001; Patton & Harper, 2003; Taylor & Antony, 2000). Black alumni of graduate programs at one PWI expressed a belief that the individual's survival affected the group's survival and vice versa, which is indicative of the community and solidarity among the Black graduate community (Johnson-Bailey et al., 2009). Interestingly, the dynamics between minority peers is not always completely positive. In a study of URM STEM doctoral students, Mwenda

(2010) found that minority peers from PWI undergraduate institutions on occasion excluded minority students from HBCUs with respect to study groups. The students from HBCU undergraduate institutions perceived that their minority peers educated at PWIs considered them to be less academically qualified. STEM doctoral students coming from HBCUs or more diverse undergraduate institutions also reported experiencing more cultural shock in graduate school and having a rougher time transitioning than their peers coming from PWIs (MacLachlan, 2006). These finding suggests that educational background and students' prior experiences with majority cultures can contribute to the difficulty students have in fitting in (Mwenda, 2010).

Individual Student Level Factors

As indicated from the literature review thus far, the persistence literature demonstrates that what largely distinguishes those who persist from those who do not in their STEM programs has less to do with ability and more to do with the experiences students have while in their programs and the resources within the environment to which students' have access that can help them overcome, or at least tolerate, the challenges that arise (Seymour & Hewitt, 1997; Smallwood, 2004). Nonetheless it is also true that individual student level attributes (i.e. factors that relate to the student themselves such as demographic characteristics, their background, prior educational experiences, and external demands) interact with the environmental context of the graduate department to determine students' experiences in the academy and their ultimate persistence (Eissen-Wood, 2010; Becks-Moody, 2004; Henderson & Milstein, 2003; Richardson, Neiger, Jensen, Kumfer, 1990; Tinto, 1993). Indeed students begin graduate school with different levels of prior knowledge, contacts, and skills and all of these factors make a difference with respect to persistence (Gardner & Holley, 2011).

URM students, in particular, are more likely to be the first in their families to attain a doctoral degree (National Science Foundation & National Center for Science and Engineering

Statistics, 2012) and to come from families in which parents have lower incomes and less knowledge about the graduate school process (Hoffer et al., 2002). Such students often are not aware of the questions they should be asking or to whom, which forces them to have a high-level of self-direction just to keep up (Gardner & Holley, 2011; Holley & Gardner, 2012). This contrasts with the majority of doctoral students who have family members who not only have undergraduate degrees but advanced degrees and who use this history and the accumulated knowledge to guide their experiences (National Science Foundation, 2010). Indeed, having family members who are professionals within the student's pursued discipline is also associated with greater persistence in graduate school (Herzig, 2002).

There are also a number of personal and psychological variables that are related to students' intrinsic desire to reach graduate degree completion in STEM and include attributes such as individual motivation and determination, the importance students place on attaining the degree to reach their career goals, ability to cope with emotional stress, an early commitment to one's field, and the level of confidence students' have in their abilities in math and science (Bair & Haworth, 2004; Herzig, 2002; Johnson & Kritsonis, 2005; Powell, 1990; Soto & Yao, 2010; Walker, 2006). Confidence is an especially necessary component of perseverance especially in the face of failed experiments (Golde, 1996). URM students also reported using their personal faith and spirituality or their passion for their respective STEM discipline to push them through hardships and to maintain their determination to attain their degrees in the face of negative experiences (Borum, 2010; Joseph, 2007).

Researchers also acknowledge that individual differences such as past experiences will affect how individuals react to and make sense of current organizational contexts and will contribute to the outcomes of individuals (Detert, Treviño, Sweitzer, 2008; Murphy, 2002). Sweitzer (2009) posits that individual differences also affect the types of relationships students develop during their doctoral programs. The external demands of a students' life (i.e. work,

family, finances) are additional factors that may compete with the responsibilities of graduate school for students' time and energy (Nettles & Millett, 2006; Sweitzer, 2009). Indeed both men and women leave STEM because of the difficulty associated with striking a healthy and meaningful balance between their personal and school lives (Gardner, 2007; Golde, 1996, 2005). The combination of having significant family responsibilities, experiencing a department culture characterized by competition, and seeing few faculty strike a healthy balance between work and personal life contributes to non-persistence (Lester, 2013).

CHAPTER 3 METHODS

Qualitative inquiry is used to explore the complexity of URM students' experiences in graduate education because it allows for greater differentiation and detail in the description of students' experiences and how students feel about those experiences (Kidd et al., 1996). Quantitative methodology alternatively provides big picture information but less on the nuances of students' lived experiences and *why* events occur as they do. In addition to being a qualitative study, this study takes a constructivist stance in which it assumes that individuals socially construct their reality in interaction with their social world and therefore there may be multiple realities (Merriam, 2009). In other words, my paradigm approach assumes that people understand and perceive the world differently; because there is no "one way" to view reality, the findings offered in this study offer an interpretive portrayal of URM student's graduate school experiences (Charmaz, 2006).

Further a critical application of socialization theoretical frameworks will center race in analysis with the assumption of racial differences in students' experiences. This application will also enable the researcher to offer a critique of graduate education during data analysis in ways that explicitly and purposefully expose hidden power dynamics, inequitable or oppressive practices, and biased ways of thinking that appear to be neutral or commonsense notions (Baez, 2007). Indeed critical theory posits that these features will affect students' socialization experiences. Further because "the views dominant at any time and place will serve the interests and perspectives of those who exercise the most power in a particular culture" (Patton, 2002, p.100), the viewpoints of marginalized populations are often overlooked (Teranishi, 2007). Thus by focusing on only the perspectives and experiences of URM students, I try to honor their "voice" in graduate education, a context in which they are typically considered an outsider (Weiss & Green, 1992).

This chapter provides an overview of the methodological approach used in this dissertation. I begin with an explanation of the research questions driving the study, next

describe the data source and site selection process, and then explain the recruitment and data collection procedures. I subsequently provide a brief depiction of the facilitators of the focus group interviews and later describe the student sample and institutional contexts used in the study. The procedures that were used for data coding and analysis are offered next, followed by how findings are reported and the steps taken to ensure the trustworthiness of the research design. I conclude with my posititonality as a researcher on the topic of interest and the limitations of the study.

Research Questions

Using a critical socialization framework applied to constructivist methodology, the purpose of this study is to uncover the academic and social experiences, power dynamics, and programmatic/institutional structures URM students face within their graduate STEM programs that hinder or support degree progression. Particular attention will be given to how issues of race, ethnicity, and underrepresentation within the educational context have shaped these graduate experiences. Further, the multiple contexts in which this study is conducted will allow me to uncover how students' experiences converge or diverge by institutional context, since previous research shows that context matters, and matters greatly when it comes to student outcomes (Crisp et al., 2009; Museus, 2011). The overarching research questions that will guide this study are:

1. What are URM students' social and academic, both formal and informal, experiences at the graduate level in STEM disciplines?
2. What power dynamics are at play in URM students' graduate programs in STEM and how does race and ethnicity influence students' training and educational experiences?
3. What institutional structures, contexts, and/or processes can explain the difference and/or similarities in experiences of URM students?

Data Source and Site Selection

The data for this study uses a subset of qualitative focus group data from a larger retention project conducted by the Higher Education Research Institute located at the University of California, Los Angeles. The National Institutes of Health (NIH), National Science Foundation (NSF), and the American Recovery and Reinvestment Act (ARRA) generously sponsored the larger study. This dataset is well suited for secondary analysis as the original interview questions were broad and elicited rich and varied responses with relation to the topic of interest (Heaton, 2010; Thorne, 1994). Further, the research questions I ask in this study are directly related to the intention of the larger study.

The larger study conducted focus groups comprised of graduate students at seven institutions: three Hispanic-serving institutions (HSI), one historically Black college/university (HBCU), and three predominantly White institutions (PWI). These institutions were selected to conduct focus group interviews because they represented a diversity of geographic locations, institutional characteristics (i.e. control, size, racial composition of students) and had high rates of STEM graduate enrollment and degree completion among URM students. The seven institutions were also ranked among the top 50 institutions nationally to confer doctoral degrees to URMs from 2002-2006.

As the intention of this study was to examine URM students in STEM graduate programs as situated in their specific institutional contexts, I decided to select one institution from each institutional type. Thus the data for this study were from Midwestern University (MU), Latino Southwest University (LSU), and Historically Black Eastern University (HBEU). Because there was only one HBCU institution in the larger study, Historically Black Eastern University was automatically included in my data subset. Of the three PWIs and the three HSIs, an examination of the participant characteristics revealed that Midwestern University and Latino Southwest University had the largest number of participants who were both from URM backgrounds and were pursing or intending to pursue doctoral degrees.

Recruitment and Data Collection

Focus group interviews were conducted from December 2009 to April 2010. Multiple focus groups per institution allowed for cross-validation of findings within institutions. Although the larger retention study interviewed graduate students from both STEM and non-STEM disciplines to allow for possible comparison analyses of the experiences for the two students groups, the majority of the focus group participants were purposefully recruited from structured programs designed to support URM students in STEM, which were identified via the internet and institutional contacts the research team had on those campuses. For the purposes of this study, only the narratives of the URM students pursuing STEM degrees from the three institutions will be included in the analysis. I decided not to include White students in this sample to move away from comparative discussions that can reinforce Whiteness as normative. I also do not include the experiences of Asian students as they are not underrepresented in STEM and so will have qualitatively different experiences than Black, Latino, and Native American students. The purposeful sampling of URM graduate students in STEM programs provided rich information about the phenomenon of interest (Jones, Torres, & Arminio, 2006). According to Charmaz (2006) when sampling, it is not necessary to sample for population representativeness but to focus on sampling aimed toward theory construction.

In recruiting students for participation, solicitation emails were sent to directors of campus research programs, individuals working in institutional research, department chairs, and/or STEM faculty of each institution to obtain student contact information. Once contact information was secured, an open invitation for participation was next emailed to graduate students who often referred their friends for potential participation in the study. Students who showed interest via email in participating were sent a subsequent email to schedule the focus group interview. The research team sent emails to prospective participants reminding them to attend the focus groups. In order to enhance study participation, all students who participated in

the focus group interviews were provided food and refreshments and were given a $20 Borders gift card as compensation, which they received at the beginning of the focus group.

Prior to the focus group interviews, participants were asked to read consent forms which outlined the purposes of the research project, potential risks and benefits of participation, payment for participation, confidentiality, and explained that participation was strictly voluntary and would not affect students' current or future relations with their institution. (See Appendix A. for Consent Form). The consent form also explained that participants were free to withdraw at any time. Participants were given a minute or two to read the consent form and to decide whether they wanted to participate. Signed consent forms were returned to the researchers. Students were also offered the phone number for the Office for the Protection of Human Subjects (OPRS) should they have any questions after the focus group.

Prior to the interviews, participants were asked to complete a brief questionnaire, which gathered personal data on a range of relevant background characteristics (e.g., demographic information, educational attainment, and research experience) and identifiers (e.g. department/major, year in school, and email information). The questionnaire prompted students to self-select or self-describe their racial/ethnic heritage. See Appendix B. for more information on the questionnaire. Following the questionnaire the researchers briefly introduced themselves and provided background about the larger retention research project. The researchers also asked that participants not discuss with others the stories their fellow participants shared, so as to keep the conversation confidential. The researchers subsequently asked the students to describe their pathway to their current educational position, their year of study, and their major. These introductory questions served to establish rapport with the participants – which is a perquisite for gaining solid data - and ground later questions (Charmaz, 2006).

A semi-structured focus group interview protocol was utilized with the goal of covering a wide range of issues so as to better understand how students made meaning of their graduate school experiences and the motivations behind their persistence decisions. The flexibility that a

semi-structured interview guide provides provokes a conversation between the interviewer and interviewees; allows participants to describe what is important and meaningful to them; and yields exploratory, descriptive, and explanatory data (Patton, 2002). In particular the protocol from the original larger retention study was composed of nine overarching questions, six of which shed light on the areas of interest of this particular study. These six questions asked students about: 1) their transitional experiences upon entering graduate school; 2) their interactions with faculty in their department; 3) the quality of instruction and curriculum in the courses they had taken at that point; 4) their interactions with their peers; 5) how their identity as scientists shaped their identity; and 6) what their educational and career goal(s) were both immediate and long term. Students were asked on occasion to describe how they perceived departmental and institutional culture at their institution and comment on the climate for diversity. (See Appendix C. for a copy of the Focus Group Interview Protocol.) Probes and follow-up questions were used to encourage participants to provide clarification or further details to their responses on topics of interest.

Focus groups were chosen as the initial method of data collection because they create a social context where participants can listen to the responses and viewpoints of others and provide confirmatory or contradictory insight (Krueger & Casey, 2009; Marshall & Rossman, 1995; Patton, 2002). In this way comparisons can be drawn between individuals and verification of meaning can occur as the individuals within the group talk among one another (Kidd et al., 1996). Conducting interviews in a group setting also increases participants' comfort level in the interview process (Patton, 2002).

On average, focus group interviews lasted between 60 and 90 minutes and included up to six participants per session. On occasion, only one person showed up for a focus group interview, although more had originally indicated that they were interested in participating. In these cases, the one person was interviewed alone. Discussions were audio taped, then transcribed verbatim by an outside source with the names of participants changed to maintain

participant confidentiality. There were a total of 19 focus groups conducted across the three institutions selected for this study with a total of 74 graduate students, of which 53 were STEM graduate students who identified as being from a URM background.

Facilitators of the Focus Group Interviews

All facilitators for the focus group interviews were graduate students with the exception of one post-doctoral scholar and all were members of the Higher Education Research Institute research team. Two facilitators were Latina, one American Indian and Latina female, one a White female, one Black male, and one Asian American man. All facilitators were trained in interviewing procedures so as to standardize interview administration. Training included techniques on building rapport with participants and probing for responses so as to gain the most robust interview findings. Regular e-mail and in-person meetings were also held to allow interviewers to debrief, share findings, and discuss proposed changes to interview administration. Facilitators also completed weekly logs of participants contacted and interviews completed, as well as field notes at the end of each focus group interview to capture information not readily available on transcripts.

Student Sample and Institutional Contexts

To provide a clearer picture of the broader context of the three institutions used in this dissertation, I gathered information from the Carnegie Foundation, the Integrated Postsecondary Education Data System (IPEDS), and the Peterson's Guides about the size of each institution, the student body demographics, school classification as public or private, and the demographic of the surrounding community.

Midwestern University (MU) is a selective public research university and is the flagship campus of its state. The university annually enrolls roughly 44,000 students, of which 16,000 are graduate students. It awards roughly 9% of it STEM graduate degrees to individuals from URM backgrounds. Like Midwestern University, Historically Black Eastern University (HBEU) is also a selective institution. HBE however is private not-for-profit research university situated in

an urban setting on the East Coast and is designated as a Historically Black College or University. The university annually enrolls roughly 10,000 students, of which 3,300 are graduate students. It awards roughly 84% of its STEM graduate degrees to individuals from URM backgrounds. Moving to the southwest is Latino Southwest University (LSU), which is a public research university and is designated as a Hispanic-serving institution. The university is located in a suburban setting and annually enrolls roughly 18,000 students, of which 3,400 are graduate students. It awards roughly 23% of it STEM graduate degrees to individuals from URM backgrounds.

There were initially a total of 74 students who combined participated in the focus groups at Midwestern University, Latino Southwest University, and Historically Black Eastern University. As the intention of this study was to better understand URM persistence in STEM graduate programs, this sample was narrowed down to only those students who were pursuing STEM graduate degrees and who were Latino, Black, Native American or multiracial with one of the underrepresented racial group previously specified. Please note that according to the National Science Foundation (2006), “psychology (other)” counts as a STEM discipline as does “social” psychology. I therefore include students majoring in developmental psychology and cognitive psychology within my student sample. Furthermore psychologists often consider themselves as part of STEM since psychological knowledge is essential to scientific and technological innovation. In other words the implementation of technological advances requires the use of human operators and the understanding of human capacities and limits.

Of the 74 students interviewed across the three institutions, 53 met the inclusion criteria specified and represent the final analytic sample for the first phase of this study: Fourteen from Historically Black Eastern University, 16 from Latino Southwest University, and 23 from Midwestern University. Of the students included in phase one of the sample, 38 students (72%) were in Ph.D. programs and with the remaining 15 in Masters programs. With respect to racial/ethnic background, 27 (51%) are African American, 17 (32%) Latina/o, 7(13%) multi-

racial, and 2 (4%) Native American. In terms of gender, 22 (42%) are female. (See Table 2, 3, and 4 for a demographic break down of the participants by institution). Seventeen participants majored in an engineering related field, fifteen in a field related to the biological and biomedical sciences, eleven in the physical sciences (including mathematics, physics and chemistry), and eight students were in another STEM-related discipline (including majors such as environmental science and ecology), and the remaining two in psychology. Precisely 24 students or 44% of participants were the first in their families to earn a college degree.

Table 1
Institutional Characteristics of MU, LSU, and HBEU

	Midwestern University (MU)	**Latino Southwest University (LSU)**	**Historically Black Eastern University (HBEU)**
Size	~ 44,000	~18,000	~10,000
Graduate Enrollment	~16,000	~3,400	~3,300
Graduate Ethnic Enrollment	49% White 10% Asian 4% Black 4% Latino 0% Native American 2% Two or more 26% International student 4% unknown	36% White 2% Asian 3% Black 32% Latino 2% Native American 1% Two or more 15% International student 8% unknown	6% White 8% Asian 75% Black 2% Latino 1% Native American 0% Two or more 8% International student 0% unknown
Control	Public	Public	Private
Type	PWI	HSI	HBCU
Classification	Research University (Very high research activity)	Research University (high research activity)	Research University (high research activity)
Selectivity (Admittance rate of those who apply)	More selective ~40%	Inclusive ~80%	Selective ~55%
Total # of STEM degrees awarded	~1560	~100	~520
% of STEM degrees awarded to Percentage of URMs	~9%	~23%	~84%

Table 2

Demographics of Focus Group Participants from Midwestern University

Pseudonym	Sex	Race/ethnicity	Discipline
Hayden	Male	Black	Aerospace Engineering
Brandon	Male	Black	Applied Physics
Aaron	Male	Black	Biological Chemistry
Sadie	Female	Black	Biomedical Engineering
Maria	Female	Black	Biomedical Engineering
Cooper	Male	Black	Chemistry
Jasmine	Female	Black	Computer Science
Dominic	Male	Black	Electrical Engineering
Brady	Male	Black	Electrical Engineering
Colin	Male	Black	Industrial & Operations Engineering
Sean	Male	Black	Mechanical Engineering
Austin	Male	Black	Mechanical Engineering
Kate	Female	Black	Pharmacology
Max	Male	Latina/o	Biomedical Engineering
Charlotte	Female	Latina/o	Biomedical Sciences
Jordan	Male	Latina/o	Ecology and Evolutionary Biology
Chase	Male	Latina/o	Electrical Engineering
Abby	Female	Latina/o	Pharmacology & Cellular and Molecular Biology
Tristan	Male	Black & White	Physics
Carson	Male	American Indian & White	Bioinformatics
Amelia	Female	American Indian & Latino	Microbiology and Immunology
Jake	Male	Latino & White	Cognitive Psychology
Isaiah	Male	Latino & White	Biomedical Engineering

Table 3

Demographics of Focus Group Participants from Latino Southwest University

Pseudonym	Sex	Race/ethnicity	Discipline
Evan	Male	Latina/o	Electrical Engineering
Samuel	Male	Latina/o	Electrical Engineering
Mason	Male	Latina/o	Environmental Science
William	Male	Latina/o	Industrial Engineering
Brianna	Female	Latina/o	Industrial Engineering
Benjamin	Male	Latina/o	Industrial Engineering Operations Research
Anna	Female	Latina/o	Mathematics
Cameron	Male	Latina/o	Mechanical Engineering
Lauren	Female	Latina/o	Molecular Biology
Zachary	Male	Latina/o	Organic Chemistry
Alexis	Female	Latina/o	Physics
John	Male	Latina/o	Wildlife Studies
Avery	Female	American Indian	Biology

Steven	Male	American Indian	Fisheries Ecology
Liam	Male	Black	Mathematics applied to Biology
Landon	Male	Black & American Indian	Molecular Biology

Table 4

Demographics of Focus Group Participants from Historically Black Eastern University

Pseudonym	Sex	Race/ethnicity	Discipline
Victoria	Female	Black	Analytical Chemistry
David	Male	Black	Animal Behavior & Ecology
Kaelyn	Female	Black	Biology
Isaac	Male	Black	Chemistry
Aaliyah	Female	Black	Developmental Psychology
Julia	Female	Black	Genetics
Audrey	Female	Black	Genetics and Human Genetics
Savannah	Female	Black	Microbiology
Claire	Female	Black	Microbiology
Brooke	Female	Black	Pharmacology
Camryn	Female	Black	Pharmacology
Hunter	Male	Black	Physics
Brody	Male	Black	Physics
Morgan	Female	Black & American Indian	Pharmacology

Data Coding and Analysis

The transcribed audio recordings of the focus groups interviews were imported into MaxQDA 11 software to organize the data and aid in the analysis of transcripts (MaxQDA, 2011). To code the data using this software, the researcher highlighted relevant text segments representing each code and organized them into the appropriate thematic label; the software program maintained the link to the full original interview passage to allow the researcher to view the context in which quotes were extracted. MaxQDA also allowed the researcher to explore codes within transcripts to identify themes and counter-themes. The software additionally organized data so that by double clicking on a code, the researcher could gain access to all statements across the transcripts that included discussions pertaining to a specific code so that these statements could be reviewed together.

In coding the data, the transcripts were first read multiple times to establish familiarity and reread to note the researcher's reactions to the data and interesting points about participants' experiences and perceptions. The researcher also identified reoccurring patterns and themes within the raw data and noted segments that supported/negated theory or the literature and that specifically spoke to the research questions. These notes or memos of the emerging themes led to the development of a codebook whereby the emerging themes became codes and these codes were organized into categories to condense the number of codes (Charmaz, 2006). In this way both an inductive and deductive process was utilized in creating the codebook. Part of creating the codebook included setting definitions for each code that outlined its defining characteristics to allow for consistent and systematic coding (Charmaz, 2006). Within this definition the researcher also noted a description of how to know when a theme occurred so that it could be flagged, a description of exclusions to the code, and examples both positive and negative to avoid confusion when coding (Boyatzis, 1998).

The coding process was inclusive as opposed to exclusive, in that several codes could be ascribed to a single segment of text. In other words, students' statements and descriptions of their experiences could be relevant to several thematic codes. In these cases, the text was simultaneously catalogued into multiple codes in MaxQDA so that a single statement was coded as containing several themes.

Constant comparative analysis (CCA) (Glaser, 1978) was used to develop the codes and to revise and refine the codebook. Following CCA, I looked for instances that represented themes in the data and continued looking until the new data did not provide further insight (Creswell, 2013). During the initial wave of coding about 20% of focus group interviews across the three institutions were coded and then recoded at a later time point. The newer set of codes was subsequently crosschecked with the previously created codes to ensure consistency of coding. After this exercise, new codes and sub-codes were added where necessary and existing codes were expanded, defined, and refined. At this point in the coding process, as a

researcher I tried to remain open to all possible theoretical directions that could be gleaned from the data to allow for unexpected, new insights or discoveries (Charmaz, 2006). To ensure rigor in analysis and reliability of the data, the coding architecture was refined in an iterative process until coder agreement reached 80% consistency, which is considered substantial (Miles & Huberman, 1994). Once I reached this accepted minimum threshold of coding consistency, I coded the remaining focus group interviews. In later waves of coding, I used more focused coding to develop the most salient codes in the dataset and to specify possible relationships between codes.

CCA also calls for comparing cases to determine the extent to which findings apply to deviant cases that seem to fall outside the experiences of the norm. In this way I deliberately searched for instances of alternative experiences, less likely experiences, or variations in experiences because they refute and expand what we accept as truth (Stage, 2007) and avoid universalizing students' experiences (Kinzie, 2007). Codes were also compared across focus groups from the same institution as a way of cross-checking and corroborating evidence (Patton, 2002) and across institutions as a means of illuminating different experiences. When looking at the interrelationships in the codes to cluster them into overarching categories, also known as axial coding, attention was paid towards whether themes fed into or made possible other themes to move towards higher levels of abstraction and establish analytic distinctions (Boyatzis, 1998; Miles & Huberman, 1984).

In order to move beyond simple reporting of thematic codes, excel spreadsheets were used to visually display the data. This method allowed the researcher to systematically "see" the data and to view it in one place via the use of columns and rows (Miles & Huberman, 1994). In this way the researcher was able to draw more valid conclusions by comparing categories of information (i.e. the codes) in relationship to each other (Bair & Haworth, 2004). The use of matrices not only helped determine how codes interacted with each other, but was also a good

method to use to make contrasts and comparisons between institutions (Miles & Huberman, 1994).

Cross-Case Analysis

Visual matrices separated study results from each institution so that findings within each institution could be reviewed and so that themes across institutions could be juxtaposed, cross-compared, and integrated. In this way key concepts and themes from one institution could be seen in terms of the key concepts and themes of the other two institutions in the study (Bair & Haworth, 2004). The matrices were particularly helpful in visually depicting common and contradictory findings by institutional type.

Reporting of Findings

Some descriptive terms were used when reviewing the findings, which are important to explain. When indicating that "most" students reported a particular experience, this term indicates that the majority of students across all institutions reported generally similar experiences. Differences between students from different institutional types are discussed where warranted. If the majority of students from one institutional type report an experience that was different from the overall group, this was noted. The term, "few" was also used to describe experiences that a small number of students from the larger group shared that were deemed important nonetheless. When a very small number of students described an experience that was in direct opposition to general themes, these "negative instances" are noted. Quotes were also provided to illustrate points. Quotes have been edited in that conversational pauses and fillers (e.g., "ahhh," "ummm," "I mean," "like") were deleted unless the pauses or interjections (e.g., [laughter]) proved to be pertinent to the statements made. Despite these edits, care was taken to preserve the integrity and meaning of participants' statements.

Trustworthiness of Research Design

Qualitative research, along with any kind of research, demands that the researcher demonstrate that findings are grounded in critical investigation, well founded, and sound

(Rudestam & Newton, 2007). Since the traditional notions of reliability and validity do not easily transfer to qualitative work, alternative constructs such as credibility, transferability, dependability, and confirmability are recommended to demonstrate methodological and analytical rigor (Lincoln & Guba, 1985). Many of the suggested approaches for enhancing analytical rigor were incorporated into the current study.

Reliability refers to consistency in coding the data so that others can understand the themes and arrive at similar coding conclusions (Rudestam & Newton, 2007). To ensure reliability in coding I created definitions of each code as stated above. Credibility, also sometimes referred to as internal validity, concerns the extent to which conclusions drawn from the data mirror the actual experiences of those who participated in the study (Merriam, 2009). Credibility is strengthened when participants are knowledgeable experts of the topic of interest, when peer debriefing takes place, and when analysis of "negative cases" is included when drawing overarching conclusions from the data (Merrick, 1999). To promote credibility I shared preliminary findings with colleagues at the Higher Education Research Institute at UCLA who have been involved in the larger STEM retention project to ensure that my perspective and personal biases were not unduly influencing the creation of codes and the interpretation of the students' narratives. The utilization of peer review and being subject to tough questions by colleagues about data analysis and data interpretation, helped ensure that findings were as honest as possible (Rudestam & Newton, 2007). Transferability, also referred to as external validity, is the degree to which the findings from the study can be generalized to similar populations in other contexts (Marshall & Rossman, 1995). To promote the transferability of my findings I provided in-depth descriptions of the research procedures and descriptive information of both the participants and institutions included in the study (Banister et al, 1994; Marshall & Rossman, 1995). Triangulation is another way to enhance transferability and can be achieved by utilizing different data sources (i.e. multiple informants across multiple cases) to investigate research question (Marshall & Rossman, 1995; Merrick, 1999). By relying on multiple focus

groups at each institution, I obtained a great deal of data that could be compared and confirmed across focus groups and in this way allowed for a better understanding of the data (Rudestam & Newton, 2007).

Further, themes are referred back to the larger text to ensure that themes remained close to the data, were useful, had conceptual density, and exhibited explanatory power (Glaser, 1978; Glaser & Strauss, 1967; Charmaz, 2006). Also when presenting arguments, I used thick descriptions that vividly shows the points I make (Charmaz, 2006) in an attempt to increase trustworthiness and demonstrate the study's transferability to new contexts.

Positionality

Critical perspectives reject the notion that research can be neutral (Kinzie, 2007). Indeed qualitative research requires that the researcher analyze and interpret the data, all of which is influenced by the researcher's values, backgrounds, and history (Creswell, 2013). As such qualitative research requires that researchers be reflexive about their background experiences and how that in turn shapes what they see and how they see it (Charmaz, 2006). As such my interest in pursing this line of research are tied to three experiences. First, in high school I was always academically successful in math and science and thought I'd pursue a STEM major in college. I ultimately never did because of discouraging overall academic experiences in my first introductory calculus class as an undergraduate. In short I was floundering in the class despite efforts to study and seek help during the TA's office hours. When I sought council from the faculty member teaching the class his advice was simple, "Talk to your TA or drop the course." My parents, although supportive of my efforts and sympathetic to my struggle could not help me with homework problems or offer any further guidance on what I could do to perform better in the class or who I could go to for advice.

Second, as a Latina I am familiar with the experiences of marginalization, alienation, and undervaluation that can coincide attending a predominately White selective institution where deficit notions of URM students are embedded within the campus environment. My personal

experiences of feeling pressured to conform to racial norms as an undergraduate and graduate student in a feeble attempt to manage the perceptions peers and faculty had of my academic ability and my worthiness of being a student are also memorable and shape how I view students' experiences. My work as an academic advisor for the Academic Advancement Program further demonstrated to me that there are collectively different experiences between URM students compared to White students. Although I recognize that the experiences of URM students will not be monolithic given other social identities they possess, I agree with the opinion of Howard and Denning del Rosario (2000): "In order to adequately address racism in education, pedagogy and dialogue about race and racism, we must focus on race, as distinct from culture, gender, class, or other issues" (p. 128).

Finally, as a current doctoral student in education, I know that the path to the Ph.D. can be a painfully arduous undertaking. From my experience and from discussions with my doctoral peers, I know that it is common for graduate students to question whether they belong in academia, whether they have what it takes to be successful, and to feel at times as though perhaps the Ph.D. was not the best path to pursue. With access to the right people, engagement opportunities, and resources however, pursing a graduate degree can also be a wonderfully rewarding task and a time of personal and professional growth. All the aforementioned experiences – and others that I do not have room to mention here – drive my motivation to pursue educational research that addresses both persistence and racial inequities that exist in higher education. These experiences also fuel my passion around improving higher education so that students from diverse backgrounds can be successful in the fields they wish to pursue. Nonetheless I recognize that these experiences are powerful shapers of my personal biases and may have an impact on the analysis and interpretation of this study (Patton, 2002).

Limitations

Despite rigor in data analysis, there are some limitations of this study that must be considered when considering the findings presented in the next several chapters. First it should

be noted that the students participating in this study represent a self-selected and highly motivated sample. So while the goal of qualitative research is not necessarily to generalize personal narratives (Charmaz, 2006), it is important to note that findings may be skewed towards a select group of students with their own idiosyncrasies, which may not be reflective of the general population of URM graduate students pursuing STEM advanced degrees (Rudestam & Newton, 2007). However, student participants varied across discipline of interest, length of time in their program, program type (i.e., masters versus Ph.D. students), gender, and ethnic/racial background, suggesting that the sample does in some part represent the general population of URM graduate students in STEM. A related issue is that the experiences students recount in this study reflect "social context, time, place, biography, and audience" (Charmaz, 2006, p. 68) and may not be characteristic of students attending other institutions or institutional contexts that differ in size, culture, history, and other key characteristics. Therefore, it is difficult to determine the extent to which conclusions derived from this study will be representative of the larger context of graduate education. Further, it cannot be assumed that the factors that affect underrepresented racial and/or ethnic minority students at this institution represent or explain the experiences of all underrepresented racial and/or ethnic minority students at every institution (Leggon, 2003).

Second, although focus groups offer the distinct advantage of being socially oriented (Kidd et al., 1996), it is possible that some students felt hesitant to share additional experiences that differed greatly from the group or freely offer minority perspectives to avoid a potential negative reaction from others (Patton, 2002). Students might have also been reluctant to talk about their negative experiences with other students or with researchers, especially if they thought there might be negative repercussions to that sharing. Although focus groups were effective for an initial exploration of students' perceptions and experiences (Patton, 2002), they limit opportunities to thoroughly examine any one person's experiences (Bryan et al., 2012).

Third, because the data was collected as part of a larger project, interview questions and probes were not specifically tailored to answer the research questions in this study and prompts may have privileged the importance of some topics over others. Finally, this study investigates students' graduate school experiences at only one point in time at only three institutions. A longitudinal design with regular student check-ins with students would have admittedly been a more ideal method to capture how students' experiences occur over time and the dynamics at play that lead to persistence or attrition decisions.

CHAPTER 4

STUDENT EXPERIENCES IN STEM:

"GRADUATE SCHOOL ISN'T SOMETHING YOU CAN DO BY YOURSELF"

After reviewing the prevalence of graduate student experiences across Historically Black Eastern University (HBEU), Latino State University (LSU), and Midwestern University (MU), three general areas of experience emerged as affecting URM students at the graduate level in STEM disciplines: Transitional Issues, Relationships with advisor/PIs, and Relationships with Peers. Within each area of experience are central themes and subthemes that were identified and analyzed. These findings address the first research question: What are URM students' social and academic, both formal and informal, experiences at the graduate level in STEM disciplines?

One important detail to keep in mind while reading the results is that the students at HBEU and MU were comprised of mostly doctoral students, with 100% and 91.3% being students pursuing the Ph.D. at those respective institutions. Alternatively, only a quarter of the LSU students were doctoral students with the rest being master's students. Because of this point, and the fact that each institution provides a somewhat different learning/training environment, some central themes and/or subthemes are more prominent at one institution compared to others, while others emerge at one institution but are absent from another. There are also many issues that transcend institutional type, which are identified. The implications of convergent and divergent findings across institutional type will be explored in the conclusion chapter. Throughout the chapter, where a central theme is presented, I will first discuss issues that cut across two or more institutions, followed by issues that seem to be unique to each institution. Further, rival experiences that few students experience but that were mentioned have also been identified and will be presented alongside the theme for which they serve as exceptions.

Transitional Issues

Research demonstrates that successful adjustment to the graduate environment is critical to retention in graduate school (Nettles & Millet, 2006); students' narratives gathered from the focus groups support the assertion that the first few years of graduate school is a salient (and memorable!) aspect of students' overall experiences with unresolved transitional difficulties having enduring consequences. In describing their transitions to graduate school, students spoke generally about six overarching themes: 1) building a strong base of social support; 2) knowing (or not knowing) what to expect in graduate school; 3) the ease or difficulty of classes; 4) the ease or difficulty of learning how to conduct research 5) the academic demands placed on students' time in daily life and/or over the long term; and 6) concerns regarding family planning and management, which seemed incompatible with the demands of graduate life.

Building a Strong Base of Social Support as Told by MU Students

Students at MU were unique in that out of the three institutions, they were the only ones to speak about the importance of building a strong base of social support as soon as they arrived on campus. This may be because some students reported having to make a rather big move geographically for graduate school. It is expected that many more participants, beyond simply the handful that spoke about on it, had moved a great distance seeing as MU is a highly sought after Research 1 institution. In any case, moving across the country alone was often times a frightening endeavor primarily because the student was abandoning their previous go-to sources of social support:

> Coming out here though – coming across the United States all by yourself is a little bit scary. You have a foundation at home. Your family is there. Your friends are there. And then you move somewhere so far away and you don't know anybody at all. I didn't know anyone when I came out here. And I got an apartment by myself because I was scared. I didn't know if I should move in with

people or not. – *Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology, MU*

A related transitional task MU students faced, irrespective of the distance they had traveled for graduate school, was building a strong base of social support. Three MU students mentioned how having a strong circle of friends, ideally before school started, was crucial to their transitional experiences. Sadie, for example, connected with old friends from her undergraduate institution who were also now attending MU. Her sister was also in her program:

> A little bit about my transition - so mine was not quite as traumatic as some other people's, but that was because I already knew some people who were already here in the graduate school… who had gone to my same undergrad, so basically they just took me in and all their friends became my friends. I also brought my twin sister with me, so that was also beneficial. – *Sadie / Black, Ph.D., Biomedical Engineering, MU*

Jake went to MU for a summer class, right before his graduate program officially started:

> I did come out slightly early, about a month early – we have a summer training course in methodology and analysis, so I came out for that. I had known a few of the kids from the recruitment weekend that they had last February, which was nice, so at least I knew some people out here. – *Jake / White and Latino, Ph.D., Cognitive Psychology, MU*

Aaron didn't know people prior to starting his graduate program, but came in through an academic support program that did a fantastic job at connecting students to one another via multiple social events and a cohort approach to taking classes.

From these narratives, it is clear that cultivating personal relationships that mirrored friendships with peers was an important aspect of transitioning to the university. More about students' relationships with peers will be presented later in this chapter.

Knowing (or Not Knowing) What to Expect in Graduate School

Knowing what to expect in graduate school, or the reverse not knowing, was another important aspect of students' transition experiences – furthermore this was important to

students across all three institutions. As students acclimated to graduate life, it was clear that some were more informed than others. A few felt unprepared because they didn't know much about the graduate process in general. Audrey and Isaac, both from HBEU, reported that they were not aware of what to expect in graduate school before starting. Audrey, for example, had a "foggy" familiarity with the process to a master's degree at the time that she applied. She was thankful that she completed a master's degree first, instead of jumping straight into a Ph.D. program like other students, because it gave her time to gradually develop the commitment and focus that the Ph.D. she was currently working on would eventually require:

> I did the masters and I'm happy I did it that way because if I would have done the Ph.D. [right away], then I don't think I was ready for it at that time. I think there was a process I had to go through first. The okay, this is what I want to do. You need to reevaluate the way you do things. This is how you're supposed to study... So everything happened for a reason. So then I reapplied for the Ph.D. program. – *Audrey / Black, Ph.D., Genetics and Human Genetics, HBEU*

Like Audrey, Isaac "knew nothing about the Ph.D. process before entering it." He explained:

> I think the Ph.D. is… a legacy concept. It's the thing where you're not really familiar with it unless you have had somebody who is very close in your family that's done it or had a mentor that was one. It's sort of a legacy concept where you don't really get exposed to it. – *Issac / Black, Ph.D., Chemistry, HBEU*

Tristan and Dominic, both from MU, also didn't know enough about the graduate school process at entry to be able to hit the ground running. Dominic pointed out that as a new student he "didn't know what [questions] to ask." Similarly Tristan had no idea what he was getting himself into:

> I do feel like I'm sort of on my own…. Really I didn't know what grad school was like before I got here. So part of the reason I flailed for a year or two was [because] I didn't know what would come afterwards. – *Tristan / Black and White, Ph.D., Physics, MU*

Because of his struggle to get up to speed on what was going on, Tristan thought "it would have been nice to have a student support group" so that students "could learn

right when [they] got here some of key things" necessary to get adjusted. He also wished someone would have told him that grad school "was also a professional atmosphere" and that it required "savvy."

Samuel was the only student from LSU who described the transition to graduate school as "rough." This response may be because he was still trying to figure out the institutional culture at LSU as both a new student to the institution and as an international student. Samuel explained that he had to actively seek out guidance when he first arrived on campus, which was complicated by the fact the "people are so busy here." He shared that his undergraduate institution in Mexico "was more structured" and offered an "orientation within the department for new people." As a consequence, "you knew what you needed to do." Samuel wished out loud that LSU offered the same sort of guidance to graduate students. Although Brianna had a smooth transition to graduate school at LSU due to having gone there for her undergraduate degree, she supported Samuel's assertion that there wasn't much structure in graduate school. She added:

> It was a smooth transition, but sometimes I think if I were new [to this campus], I would be so lost [because] nobody sits with you and tells you [stuff you need to know]…[My advisor] does give you suggestions and stuff, but how the department works and what you should be doing, I wouldn't know if I had not been here before. Like I said, it was a smooth transition for me, but I can see how it would be challenging for anybody else that just shows up and needs to suddenly be enrolled and know which classes count and which ones don't. – *Brianna / Latino, MS, Industrial Engineering, LSU*

Chase, a student at MU, also pointed out that graduate school was "a lot less structured and much more autonomous."

In the face of little structure to the graduate program, students' advisors played a crucial role in informing students on what they needed to know to be successful in graduate school. Tristan did not receive much guidance from his advisor while transitioning to graduate life:

> Somehow I fell into having a vision. It wasn't someone who came in and said, "Hey, this is what you should do." I got lucky. If I had known ahead of time to set an end-game and know that you have to do some soul-searching and come up with that end game yourself or with some help. Those two things: independence and setting that end-game are really important. And I didn't fall. I felt like I was falling flat. In retrospect I wasn't; I was just going through some rites of passage. – *Tristan / Black and White, Ph.D., Physics, MU*

Sean was a bit luckier and was grateful that he had an advisor who helped him acclimate to graduate life by explicitly outlining expectations and coaching him when he fell short:

> [The] one other thing that helped [with the transition to graduate school] too was that my advisor, he's just a good advisor. He's just very personable. He definitely sets the bar high for all of us. But he's a guy that I feel pretty comfortable with. And so it's easy to talk to him… He still wanted me to balance [my school responsibilities] better, but he was at least willing to be patient with me as I was going through that process. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

The topic of faculty advisors will be explored in more depth in the findings section titled "Relationships with Students' PI or Faculty Advisor."

Although there were students that expressed sentiments of not knowing what to expect in graduate school, fortunately there were many more who seemed ready. One explanation, at least for some participants at LSU and HBEU, is that students remained at the same place for their graduate degrees as they did for their undergraduate degrees. This undoubtedly would have been helpful when it came to transitioning because it would have meant that students were already familiar with the institutional culture and likely knew some of the faculty in their current department. Brianna, Avery, Evan, Mason, Benjamin, Anna, Cameron, Lauren, Alexis, and Landon all completed their undergraduate degrees at LSU; interestingly none of these students

reported feelings of being “lost” while in graduate school. In a similar fashion, David, Claire, and Aaliyah, completed their bachelor degrees at HBEU.

Amelia, Charlotte, Sadie, and Colin – all from MU - also seemed to have more seamless transitional experiences due to their involvement in structured programs. Indeed, the demands of graduate life did not seem to surprise them, likely because one of the purposes of these interventions is to prepare students for various aspect of graduate school:

> [In the Minority Biomedical Research Support Program] we had a workshop where we went through and we talked to students who had already completed their first year of graduate school. So they would come back and they would tell us what it was like for them, what they had to do as far as filling out applications, as far as funding. They would tell us about websites that we could go on and look up all the different fellowships that we could apply for. So it was really good for me to be in that program. So I think that they prepared me very well. – *Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology, MU*

> In undergrad I learned you could go straight to a Ph.D. program. I was like, “Maybe, I don’t know. I don’t really know anything about it.” But then I got invited to join MARC (the Maximizing Access to Research Careers Program)… every week we had recruiters come. We had people talk about graduate school and what it was like and funding and what you actually do and how long it takes to get a Ph.D. And we had people come and talk about their own labs... And they would also help us go to conferences… So that’s where I learned, pretty much everything about the [the graduate school] process. – *Charlotte / Latina, Ph.D., Biomedical Sciences, MU*

> I did the Meyerhoff Scholars Program.... So starting from your freshman year, you have to go to different visits, different colleges from across the country, different departments come and talk about their graduate programs and some of the research that’s being done. And they usually also will bring a student or two so you can talk to them a little bit about their research experiences. So you have to attend so many of those…talks, and then you’re also required to do… research-based internships at other universities… They did a good job also of exposing us to people who worked in different industries that had Ph.D.s, and we’d talk about why it was beneficial for them to have done so… And from having done the Meyerhoff [program] I had a good understanding that I’m going to be doing a lot of work [in graduate school]… so at least I had a little bit more of a realistic expectation than some of my other peers when they came in. I knew I just was going to be doing a lot of work and maybe not have a lot of free time, at least initially. – *Sadie / Black, Ph.D., Biomedical Engineering, MU*

> [Undergraduate research programs] bring in people to talk to you about how to talk to professors, how to approach them, and they'll do these socials where they'll bring a lot of professors so you're forced into talking to them and you get used to it. I used to look at professors like they're way up there, like you can't even approach them. But after [I went through] that program it became easier. – *Colin / Black, MS, Industrial & Operations Engineering, MU*

The Ease or Difficulty of Classes

Completing coursework and strengthening discipline specific content knowledge was another transition students had to make across all three campuses. For a small few, classwork didn't seem to be a source of stress at all. Max, Carson, and Sean were not surprised by the difficulty of the classes at MU and seemed to handle this aspect of graduate school effortlessly:

> My first year and a half consisted basically of taking classes. In my program it's more flexible than so many other [programs]. Chemistry is very structured. You have your lab rotations. So my first year and half I was getting classes out of the way for the master's requirements and in my downtime looking for a lab. So that transition wasn't too difficult because I was just taking classes again which I had been used to in undergrad. [Classes were] maybe a little more difficult, a little more specialized, but nothing I couldn't really handle. – *Max / Latino, Ph.D., Biomedical Engineering, MU*

Before starting graduate school, Carson took a few classes at a nearby university to increase his GPA. Being around other graduate students during that time taught Carson "as long as you make it through your first year of coursework, you'll be okay." So Carson "knew the first two years were going to be rough." Luckily for him, "it all worked out." Sean also had no complaints about the difficulty level of his classes:

> For me the transition wasn't too bad because just the way I did things in undergrad, people thought I was crazy. I probably worked harder than I had to for a lot of stuff in undergrad. The way I approached my work in undergrad, honestly to a large extent was no different than how I did it in graduate school because I was pretty intense in undergrad. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

Cameron, an LSU student, remained within the same discipline in graduate school as he had for his undergraduate degree. He also took "an extra semester as an undergrad because of all the

extra math classes" that he wanted to take and "the experience in those classes did help [him] a lot with [the] master's [degree] because it's very math intensive." According to Cameron graduate school required "going even deeper into the material than you do as an undergrad." Evan, another LSU student, commented that classes in graduate school were either "the same or harder" in difficulty level but definitely "more time consuming." "That's the only difference," he noted.

Morgan and Camryn, both from HBEU, were the only students who spoke about struggling with classes, not so much with the content they were learning but the rapid pace of classes when considering other responsibilities that they also had to meet. Further, at LSU and MU, were students who were playing academic catch-up and were having more difficulty adjusting to classes as a result of switching areas of study between undergrad and grad school. Benjamin for example was the only student from LSU that had a bit of difficulty with classes. This difficulty stemmed from the fact that he earned his bachelor's in mathematics from LSU, but later switched his area of focus and pursued a Ph.D. in industrial engineering. Because of this switch, Benjamin had a great deal to learn with respect to content knowledge although he didn't seem particularly stressed about having to do so. He shared, "I don't have an undergraduate degree in industrial engineering. So I don't have a clue how those courses go." Benjamin was fortunately able to identify professors from his undergraduate days that he could go to for help and additional guidance. Dominic, a student at MU, was under a similar circumstance in that he changed his area of focus for graduate school:

> I came to do electrical engineering but my emphasis changed. So here I'm doing electromagnetics. But in undergrad, I did communications and signal processing– also in electromagnetics it involves a lot of mathematics and I didn't do that much mathematics in my undergrad. So I had a hard time coping, both in terms of research and in terms of my classes. – *Dominic / Black, Ph.D., Electrical Engineering, MU*

In retrospect, Dominic wished he had known to request from his advisor permission to only take foundational classes his first year and to hold off on conducting research so that he could better understand the disciplinary material and focus on learning. He added, "[Other] graduate students, they were already coming with the material. So [my advisor] was treating me like a graduate student, thinking 'Here, you can catch up on research and read stuff.'" Catching up at MU was not an easy task, however, as Charlotte demonstrates:

> My background in biology is more ecology… I'm now in the biomedical sciences… The thing was the classes… that's been difficult. And I'm still learning – part of me is like very surprised at how fast you have to learn those things but that you can learn those things. And so it was really difficult. But I'm still here. I made it through my first semester and I'm finishing my second. – *Charlotte / Latina, Ph.D., Biomedical Sciences, MU*

Students needed to hit the ground running in classes because the graduate programs at MU seemed to have, what Kate described a "throw you in and sink or swim" mentality. Abby agreed:

> I had a rough time transitioning because everyone has a different background. I had all chemistry and math, but you were expected to take certain courses in genetics. The idea is, like, "You're a grad student. If you were able to get in, you should be able to handle it." They don't really stop for you, so it takes a little bit [of time to catch up]. – Abby / Latina, Ph.D., Pharmacology & Cellular and Molecular biology, MU

Considering the narratives on coursework above, it seems that students at HBEU and LSU weren't particularly concerned about their performance in classes. Although a few students from MU had the same sentiment, as a whole many more students from MU compared to the other two institutions were struggling to keep up with classes.

The Ease or Difficulty of Learning How to Conduct Research

In transitioning to graduate school another task students encountered across all three institutions involved conducting research. Some students felt prepared for graduate school because they were involved in undergraduate research, which helped them acquire useful skills

that were transferrable in grad school. For example David, an HBEU student, noted that the transition to graduate school was seamless and attributed this partly to his involvement in undergraduate research wherein he completed his own research project. This experience prepared him for the type of work he would be doing in graduate school. He elaborated on other experiences that were helpful:

> I had the opportunity to TA in my senior year. To co-TA for a class with three other TAs. So being in a position where I was responsible for students under me, where I was responsible for conducting my own research, presenting my own research, and where I'd started to apply for funding – all of those things helped me [in] grad school, which with the addition of some new classes, it was very much the same thing. One other thing I would add is that that my double major actually helped because in the classics we do a lot of writing and it's very important for you to critically analyze a text and things of that nature. That experience with critical analysis of a text and experience with argumentative writing as well as my research experience and TA experiences in undergrad helped me to transition to grad school. It's like I had a mini grad school before I got here. – *David / Black, Ph.D., Animal Behavior & Ecology, HBEU*

Laura, Landon, and Brianna, all from LSU, also had conducted research prior to graduate school; their research experiences were unique however in that they conducted research during their undergraduate careers with the very same individuals that would become their faculty advisors in graduate school:

> I worked for one semester with my advisors that I have now. I took her genetics course and I really liked it so I asked her if I could work in her lab for credit. I didn't work there as a job. Initially, I wanted to go to medical school. That was my intention. But then I really liked the research and I thought that's what I wanted to do, but I wanted to be sure before I got into graduate school. So I worked with her for my last semester before I graduated. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

> The transition was pretty easy 'cause I'm working on the same project in the same lab [that I used to when I was in undergrad]. So it was a pretty easy transition. – *Landon / Black and American Indian, MS, Molecular Biology, LSU*

Brianna proceeded with her master's degree in the exact same department in which she completed her undergrad degree. Because industrial engineering was a small department with

only five professors, Brianna had prior experience working with every faculty member. Overall she said the transition had "been great" for her and it "didn't even feel like that much of a transition" because she was "working with the same department and same people."

Steven also had research experience prior to starting his graduate degree. As someone who completed his undergraduate degree at a different institution, he found the previous research experience to be "fundamental" preparation for the research he was currently conducting:

> I did have some research experience, too. I worked on two independent projects in undergrad and I worked for three other post-doctoral researchers. And then before I came here I worked for a year on a research project at [another major university]. That was key for me was having research experience as an undergrad and somebody to push you to do it. I think that's fundamental. That's how you get interested in graduate school. [So] yeah, undergrad research is a must. When you present, you're presenting at meetings and you're writing papers and essentially like I was an undergrad, I did a research project for two years – an independent research project that we're publishing it now. So it's like you already did a master's project. You come in and know what you need to do. And I think that helped a lot with the classes you take. – *Steven / American Indian, Ph.D., Fisheries Ecology, LSU*

Amelia, Sadie, and Colin, students at MU, participated in various structured programs geared towards preparing students for graduate school. These programs also helped students become familiar with the different stages of conducting research:

> The MBRS (Minority Biomedical Research Support Program) that I was in, we had a lot of workshops. [And] giving oral presentations was required of us. Every month, each student would have a day where they would go up and present their research. So you had to be in a lab, you had to be doing research. You would have to present posters and give your oral talks. And we would be evaluated by not only the faculty, but our peers as well. So it was scary but it was a really good experience to get us prepared for coming to graduate school. – *Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology, MU*

Having the skill set to conduct research was about development, and more often than not, students had a great deal to learn with respect to technical procedures because they didn't

have enough experience during their undergraduate years. Interestingly, students at LSU and MU, but not HBEU, shared concerns about their ability to conduct research:

> I'm not used to doing the research side of things, so trying to put a greater focus on research than on the course work – I'm still working that out. One thing I wish I had done if I would have known – I wasn't really thinking about it as an undergrad. I would have tried to do a lot more research instead of working at a machine shop here in town. I would have tried to get support for a professor to work 20 hours a week on their research. – *Cameron / Latino, MS, Mechanical Engineering, LSU*

> I wish I had more undergraduate research experience. I just had one semester. I loved it. I thought it was great. But oh my gosh, I would have done so much better if I would have had more [research] experience. It's true in my field as well. Having those research techniques or procedures down is what most of these classes are about. The techniques and what they're used for and why you're doing them. That's what all these classes help you understand better. I can see it now. If I had had an experience as an undergrad, those classes would have been a lot easier. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

> Some sort of research would have helped, because when I started doing research [my advisor] was like, "Oh, well, here's how you run these calculations. You do this and this and that's how you run them. If it stops, this is what you do to restart them." But the theory behind it – he had to explain to me when he had time. There was no class or anything that would help with that. Like I said, that just might be physics, but that would have helped. – *Alexis / Latina, MS, Physics, LSU*

MU students who did not have much experience conducting research as an undergrad also struggled due to lack of technical skills:

> The one thing I think was a challenge for me was trying to just do research. That's the one thing I think I would have liked to have had, an undergraduate research experience – just to understand what it is and like how to approach things like that… And so maybe if I had just an idea about what it takes to do research I might have approached things a little bit differently. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

Tristan and Charlotte both participated in research as undergrads, but nonetheless were still unsure of their skills as researchers, perhaps due to the quality of research experiences in which they were involved previously:

> I had a little bit of research experience, and that helped a little bit, but if I would have had more research experience in undergrad or I had taken time off and done a real job and lived a real life, then I would've maybe had more of that confidence [to know that I can do this]." –*Tristan / Black and White, Ph.D., Physics, MU*

Charlotte joined an environmental micro-lab the last year of her undergraduate career and also completed a summer internship, but "didn't really do much but learn some of the [lab] techniques." Even though she was in the second semester of her first year of her doctoral program, Charlotte still didn't "feel like a scientist" or a researcher. She explained why:

> Some classmates of mine, they came in after working for a few years. So they have a lot of lab experience that I don't have, and they have a better grasp of understanding experimental techniques and things like that. So I will at some point have a better grasp of those things and then I'll feel more like [a scientist]. But I also feel like an observer in a way… I'm just a participant observer. Like I'm in it but I'm not fully integrated in it. – *Charlotte / Latina, Ph.D., Biomedical Sciences, MU*

Zachary, an LSU student, also had research experience but found it minimally helpful:

> Well, the research I did as an undergraduate or rather in high school was analytical chemistry… whereas now it's more synthetic. So [having prior experience doing research) is not directly related, but it just helped me handle a beaker better. Besides that, no, it wasn't really much help. – *Zachary / Latino, MS, Organic Chemistry, LSU*

To conduct research students also had to managing the frustration and stress of failed experiments, and maintain the motivation to continue making progress on the research, both of which were not easy to do. John, from LSU, explains why in becoming a researcher, patience was a necessary virtue to acquire:

> If I can't get a certain amount of data within a certain amount of time, then I'm [screwed]… this field season I'm pretty sure I know what to do… But it's so volatile, especially in the field where you're dealing with weather and just anything can come up… So it can mean a week where I'm not getting any data because the truck is broken. The only things that could alleviate [the stress] are the things that are under my control, which most of it is the data collecting. – *John / Latino, MS, Wildlife Studies, LSU*

A patient advisor was also helpful. Cooper, from MU, luckily had a "very supportive" PI in the face of having it take "three years to get [his] first project to work." Although it was a "horrible" experience, the research "ended up being something really, really nice." Max similarly had to deal with frustrating research failures:

> I think more importantly just with handling your own research or managing it, the frustration that comes along with all the repeated failures – so that's the stage I'm at now. I made it over the first hurdle and I'm in a pretty stable position now. – *Max / Latino, Ph.D., Biomedical Engineering, MU*

Maintaining the motivation to steadily make progress on research was another hurdle. While describing the challenges he encountered in graduate school, Chase admitted "everyone goes through a time when they want to just bail out." Acknowledging that he was not alone in this sentiment, Chase noted, "I think that's natural." Unlike Chase and Sean, Austin appreciated the independence of conducting research without someone telling him what to do:

> Doing the REU (Research Experience for Undergraduates Program) at [MU], I just loved the autonomy that you have. I was able to get up at eight, go in the lab and just work all day. And I just loved that about research. Not having my day interrupted by classes was just unique to me and I really enjoyed that. The first summer I was here was just a good time for me. I just could get up, go to lab and just do research. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

Brandon also enjoyed conducting research, but only on research projects for which he was completely in charge of the design:

> I came here for a Ph.D. in applied physics. I almost left after my second year because I absolutely hated it. I didn't like…spend[ing] 12 hours in a lab doing nothing. I enjoy talking to people and being outside. So I somehow was able to reassess things, and through the help of a lot of people I was able to propose my own project that I ended up getting funded for and all this good stuff. – *Brandon / Black, Ph.D., Applied Physics, MU*

For a Max, finding a compatible research lab simply took a bit of time:

> Finding the lab wasn't too bad either. Like I had mentioned before, I found this neural engineering lab that I knew I wanted to be a part of. Before I even was

accepted, their project was on stand-by or wasn't a good fit, so I looked at another avenue with a collaborator. And so my lab socialization stage didn't start until my second year here. – *Max / Latino, Ph.D., Biomedical Engineering, MU*

The Academic Demands Placed on Students' Time

Another task students from all three institutions encountered as they adjusted to graduate life was learning how to manage their time so that they met the numerous and varied academic responsibilities inherent of graduate school in addition to the demands natural of everyday life. Indeed juggling classes, TA'ing, and time intensive research was an art form that many students struggled with mastering. Mason, Steven, Benjamin, and Lauren, all LSU students, talked about the centrality of time management:

> What is different [in graduate school] is the greater independence. Like right now I'm expected to do my research and to keep at a [steady] pace. If I fall behind it's my own fault. So it's just really difficult to stay on top, to motivate yourself to not procrastinate. – *Mason / Latino, MS, Environmental Science, LSU*

> Motivation was number one. You had to get things done on your own in a timely manner. And what's difficult in graduate school is that you have these times where it's a very lull time. You don't know what to do - you're working slowly and just waiting for the next step to happen. Then there are extreme times of stress and getting things done in two weeks, [where] you're working 18 hours a day. – *Steven / American Indian, Ph.D., Fisheries Ecology, LSU*

> This semester has been a little more stressful just with a lot of extra work. I think during last semester I was working 14 hour days [in the Army as an operations research analyst] for about four months while [going to] school [where I am taking two courses]... So I have a feeling this March is going to be like that again. – *Benjamin / Latino, Ph.D., Industrial Engineering Operations Research, LSU*

> My most difficult thing was time management. I had to really focus and learn how to manage my time. As an undergrad, when I worked for that one semester, I had my set hours that I could work and do my classes. I'd go in and do what I could in that time and then get it done the next day or the following week. My classes came first. In graduate school, you have to balance everything. You can't just do classes, you have to have time for research and if your class ran late or you had to spend more time doing homework, you still have to finish whatever research you have to do, even if that means coming in on weekends. [In undergrad once] I left work I had personal time at home. With graduate school it's not like that. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

MU students were in agreement with students from LSU about the importance of time management:

> It was really a challenge for me my first year or so, trying to balance [research] in with coursework… And so trying to balance the two, especially in those early years, was kind of challenging. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

Jake was relieved that he was "not the only one" who thought the transition to graduate life was challenging. He explains:

> Once classes started, you definitely jump into everything, and it's a lot of work and a lot of reading and very different, especially after I had taken a little bit of time off. I wasn't really juggling classes on top of research [well]. – *Jake / White and Latino, Ph.D., Cognitive Psychology, MU*

Although Tristan did not speak about difficulty managing all the responsibilities of graduate school per say, he was aware of underlying research expectations, which from the way he describes it, seemed unrealistic to him:

> I know that subconsciously people will say, oh, he's not working 20 hours a day on [research], so maybe he's not serious about it. So that's there. It's not a super-hurtful thing, but it does show up in a negative way sometimes. – *Tristan / Black and White, Ph.D., Physics, MU*

High expectations from the program combined with personal high expectations meant that it was difficult to have a firm separation between one's personal life and school responsibilities:

> Going from a job where at the end of the day you're like, "Hey, see you guys tomorrow," and I'm just completely not going to think about this, and then going to school, where you've always got to be thinking about the work. And if you're not doing it, you're probably thinking about it all the time. – *Isiah / White and Latino, Ph.D., Biomedical Engineering, MU*

> You're consumed by it all [in graduate school]. You're always thinking about either your classes or the research or whatever deadline you have. So it's a really big thing for me, learning how to manage that time and especially still have

> time for my family and my husband and everything else. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

Brooke, Aaliyah, and Morgan, all from HBEU, would also agree that graduate school was all consuming. Brooke specifically was of the opinion that graduate school was a lifestyle choice and it was presently "the only thing that [she] had time for." She added, "So other than [the grad school life] I feel like I have no life. I feel like this is my life." Aaliyah was of a similar opinion – being a graduate student was at the center of her identity:

> In everyday life, I'm always thinking about research. I'm always thinking about, okay, how can I add this to my dissertation topic? So I feel like it's the majority of my identity right now. It is my identity. All my friends that are close to me are in the program as well. – *Aaliyah / Black, Ph.D., Developmental Psychology, HBEU*

Morgan was trying to come to terms with the fact that she would have no social life for the next three years:

> There's a concept that I've been trying to grasp that at least for the next three years this is it. This is what I do. This is what I invest in until I finish, and then I move on to my next move… This takes up everything… First of all, there's no social [life]. This is it. This is the extent of [being] social: going to class or studying on the phone – *Morgan / Black and American Indian, Ph.D., Pharmacology, HBEU*

Finding balance was not always an easy task, especially considering the high expectations students had of themselves. In handling their responsibilities, students used different approaches. For some, meeting expectations meant that other important areas in students' lives were often neglected with the hardest hit area of students' lives being with respect to their social life. Isaac and Hunter for example were fighting to balance the time demands of graduate work with their social needs. Both felt the isolating effects of graduate school:

> It was about balance for me as well. I'm in the chemistry building 14 hours sometimes, which means I don't see anybody the whole day other than my

> advisor and my group mates… And so it gets to be really isolating. – *Issac / Black, Ph.D., Chemistry, HBEU*

> One conflict since starting graduate school: The time demands since there are all these requirements that I have to deal with. I have less time for social engagements with people that I would regularly socialize with. I'm not calling them as much as I used to or spending as much time with people that I used to. – *Hunter / Black, Ph.D., Physics, HBEU*

Two students from LSU and one from MU found that they too had to reduce their social circles to have enough time to devote to their studies:

> I've actually heard [that] some of the grad students after a while started surrounding themselves with people with a similar lifestyle in terms of the amount of work [they have do]. They would lose friends who just didn't understand how busy they are. Explain to someone how busy you are and it was really a difficult thing for people. – *Cameron / Latino, MS, Mechanical Engineering, LSU*

> The friends I had in high school that are still here in town – I just don't have time [to hang out with them]. I would like to have lunch with them someday, but it doesn't happen. Something always comes up. – *Alexis / Latina, MS, Physics, LSU*

> This is my second year so I'm still taking classes. So [grad school] feels more like a job. Time management doesn't really afford me as much time to be as social as I used to be in undergrad. So in that regards I'm fairly insular. I only have a small niche of friends that I hang out with. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

Other students were unwilling to sacrifice time with friends and engaging in enjoyable non-school related activities. Evan protected his time by drawing boundaries on when he would and would not work and even articulated these boundaries to his advisor. In trying to reach a better balance, Evan was also planning on quitting his position as the program ambassador to prospective engineering students – a role he had filled for the last two years. The job was just too "time consuming" and became more "difficult" to manage as he became a more advanced student. For Brooke, it was important to her that she remain a well-rounded person who could relate to scientists and non-scientists alike:

> Everyone's saying they want to cut some people off because [those people] don't understand [what life is like in graduate school]. I have trouble accepting the fact that I need to trim some people off. When I used to think of people with Ph.D.s, I thought of people that were weird, they were in their own little world, that's how I saw them. And for some reason, I still don't want to be one of those people that can only talk science. I want to be able to fit in and know what's going on outside of the laboratory. Like I don't watch TV. I don't have a radio. So sometimes I'll sneak and go on YouTube to try to see what's really going on… I still want to do the things that I used to do. – *Brooke / Black, Ph.D., Pharmacology, HBEU*

So that he was able to progress through his degree but also continue to engage in activities that were important to him, Cooper budgeted his time to include personally fulfilling activities, even if allocated time for these activities was vastly outweighed by the time devoted to school-related responsibilities:

> Because of the nature of the research…I'm in a [lab] space…60 to 70 hours a week – everything is planned around that. So my social activities, my friends, planning dinner with my partner – all these types of things take time and I have to be very regimented about it. – *Cooper / Black, Ph.D., Chemistry, MU*

Cooper lightheartedly explained that he "went straight from undergrad to graduate school. So [I] don't know what it is to have a weekend off." But in the rare occasions that he found himself in social situations, Cooper was concerned that he talked too much about chemistry and graduate life to people who were not students and would therefore care little about that aspect of his life. "I'm trying to find other things that I can do and I'm interested in so when I go to social events I try not to talk about it," he explains. For Cooper, similar to Brooke from HBEU, reaching a balanced life was not only about how he spent his time, but also about being a well-rounded individual and not simply a chemist.

Generally speaking, students from HBEU and MU shared narratives that suggest they had a rather rough time transitioning and that they were exhausted. Morgan and Camryn, both from HBEU, did not have the luxury to contemplate their social needs as they struggled to get used to the rapid pace of classes:

> Biochemistry - we learned that [book] cover-to-cover plus all the other responsibilities. You had outside class responsibilities, to your lab, or to your fellowship. You might have to work. So I think that that's something that when you adjust, all of that comes at one time. – *Morgan / Black and American Indian, Ph.D., Pharmacology, HBEU*

Camryn also had an unusually rough transitional first year because her fellowship required her to TA on top of conducting research and taking classes. In the face of all the academic demands of graduate school, Camryn struggled to maintain motivation even though she was still only in her first year:

> Last semester was absolutely ridiculous and crazy… seriously like I wanted to crawl under something and just stay there for years. That's how bad it was. The transition is difficult… This semester I find myself mentally not even wanting to go there. – *Camryn / Black, Ph.D., Pharmacology, HBEU*

Audrey was understandably already "tired" because she "had been in school straight [and] did not take a break." She was also struggling with tempering feelings of high expectations and self-doubt:

> It's more an issue of myself… I understand and I can do that, but as far as confidence in me knowing [the content of my topical area]… I'm harder on myself than other people can be, so it's just "do I know this like I should"? It should be popping out of my mouth right now, not just [me] sitting here thinking, "What?"– *Audrey / Black, Ph.D., Genetics and Human Genetics, HBEU*

Similar to students at HBEU, there were several at MU that struggled a great deal. Isiah explained that overall the transition to graduate school "was traumatic" and "really sucked." Thankfully, by his second year, he felt like he "figured this out… So that made it definitely easier." Dominic and Austin also felt mentally burnt out, even though both were only in their first years of graduate school, due to the multiple demands on their time and not enough time between undergrad and graduate school.

> Coming here, I was burnt out 'cause during my undergrad, I never really had some vacation. Like I was always working while in school. Every summer, I always had a job. So as soon as I finished my undergrad, I only had three or four

> weeks of break time and then from there I went to a co-op and then I finished my co-op about a week before classes were supposed to start over here. And worst of all I drove from [the west coast], so by the time I got here, I had to immerse myself into all the stuff I needed to take care of and it was tough. So I realized I was burnt out and I should have taken time off to relax before coming here. – *Dominic / Black, Ph.D., Electrical Engineering, MU*

> Finishing undergrad I just felt mentally done with classes. I knew I wanted a Ph.D. but I didn't want to sit in another classroom ever again. For me even now it's like a real stress for me to even get up to go to class. I really don't want to be in class. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

Concerns Regarding Family Planning and Management

Only students at HBEU and MU reported stress associated with the interference of graduate school with family planning and management. (It is understandable that LSU students would not share similar concerns seeing as of the 16 participants from LSU, 12 were master's students; since finishing a master's degree requires far less of a time commitment that completing a Ph.D., it is less disruptive to one's personal life.) One specific concern students (almost all being female) expressed had to do with being in a graduate program during the prime years of courtship and childbearing:

> [Getting marriage and having children is] a bit of a concern of mine. (Laughter) Because I look at the Ph.D. comics a lot, and one of them is like what are the odds of you getting married? And they're like, "Oh, the odds are slim." And then the female cartoon says, "Oh, but the odds are odd." So you have to read it to see. So that is something that I think about all the time. Am I ever going to get married? Am I ever going to have a family? But then at the same time, I just think about my goals and how important it is for me to achieve those goals. And I know that if it's meant to be, it'll happen sometime along the way. I don't necessarily go looking for it. But that's definitely a topic of conversation. – *Julia / Black, Ph.D., Genetics, HBEU*

Victoria who was 28 years old at the time of the interview and engaged also thought about "how long is this really going to take" to finish her degree. Although she knew she would spend "five to seven years in graduate school" she admitted, "I want to be married and my baby-making days are coming to an end." Victoria shared that she also wanted "to do more high-quality

research and... to be published," but didn't "want it to take seven years" to finish her degree. She added, "I can handle four and I can handle five, but when we start creeping around six, then that's really scary." Chase, a student at MU, also spoke about how being in a graduate program seemed to delay the progression of his personal life with respect to building a career and family compared to others in his community. He was notably the only male across the three institutions to speak on this matter:

> Not a lot of people in my extended family have gone to grad school or gotten Ph.D.s… I'm from Texas. So I'm away from them most of the year. So I see my aunts and cousins usually just once a year. And it's always, they're making progress in their careers and industry and moving on with life. Kids, family, all that stuff. And so, it's like, 'Oh you're still in school?' [And I am] like, 'Yeah, I'm still in school and hoping to graduate next year.' So in that context I feel a little bit like I'm just running but standing still. Because I come back every year and other people [say], 'I'm in my fourth year at this company. We're doing this, that.' And [they are] like, 'What? You're still working on the Ph.D.?'– *Chase / Latino, Ph.D., Electrical Engineering, MU*

Kate and Abby, both MU students, were more concerned with the time they would likely spend in a postdoctoral position and the difficulty of balancing the great time demands of that position with family life. Although Kate was determined to "find a way to figure it all out and be happy," her concerns were as follows:

> Now you're supposed to do more years as a post-doc. Before it was one or two [years], and now it's more like three, four, five. So do you want to be in this place at that time, starting your families, getting married, and having kids? Those are things that will factor into it for me. – *Kate / Black, Ph.D., Pharmacology, MU*

Abby, who was in the same focus group as Kate, was in agreement:

> It's really hard, yeah. Having a post-doc and having a kid. Because as a post-doc you're expected to put in more hours, like double the amount of time you put in as a grad student. And as a grad student you could come up with excuses, but [as a post-doc] it's like, you have a degree, you're a doctor, you're supposed to be able to suck it up and do it. So I don't know for guys, but for us [as women], if we want to have babies, you have to become the multi-tasker of all multi-taskers. In a way, sacrifice your career a little bit if you want to pop a kid. Yeah, I'm

> getting depressed. – *Abby / Latina, Ph.D., Pharmacology & Cellular and Molecular Biology, MU*

Ultimately, Victoria's personal desire for marriage and family seemed to be in opposition with her desire to become a well-published researcher and scholar. Indeed, Victoria reported that her personal goals for husband and children factored into her decision to not pursue a faculty career route in the future. In her own words, "having to be a faculty member and entertain a husband then try to entertain the idea of having kids while trying to get tenure, that would be crazy."

Sadie, who was roughly the same age as Julia, was unique in that she was the only female who was openly unconcerned with the time it took to be in school:

> As far as the time to degree, I looked at that when I looked at the programs. I didn't want to be here forever, but I figured, "Oh, it took me five years in undergrad, so if it takes five or so years in grad school, that's fine." I'm not in a hurry, 'cause like I said, I have the whole rest of my life to work and I thought it was also a good time to learn a little bit more about myself and some of the things I'd be interested in doing later on. So I wasn't overly concerned about the timing. – *Sadie / Black, Ph.D., Biomedical Engineering, MU*

In sum, it is notable that several female students were worried that their window to create a family was narrowing while in graduate school and/or were concerned that the time commitment academia required seemed to be antithetical to family planning.

Relationships with Students' PI or Faculty Advisor

In describing their relationships with faculty, students spoke specifically about their advisors or PIs (principal investigators for the research project they worked on) and the overall ethic of care demonstrated by the faculty as a whole. Across the three institutions, students shared numerous stories of frustration, satisfaction, conflict, and support with many experiences seeming to overlap across the three institutions.

Experiences with Advisors or PIs

In reviewing students' experiences with their advisors and/or PIs, I will first review the negative aspects of these relationships followed by those that are positive and end with three take away lessons students impart.

Negative experiences. Notably, students at HBEU had almost no negative comments about their advisors. Only two surfaced with one being minor. Victoria for example shared "if my advisor – if he would just stop acting like a jerk then…" but never finished her statement and instead started talking about an unrelated issue. Brody admitted that his advisor could be "very difficult to work with." Students at LSU and MU had a far greater number of negative comments regarding their interactions with their faculty advisors or PIs that dealt with one of two areas: 1) not getting enough face time with a busy, inattentive, or inaccessible advisor and 2) having some degree of conflict with an advisor.

Perhaps the biggest complaint students had about their faculty advisors overall was that they were poorly advised due to having little contact with their faculty advisors. At HBEU this was not cited as a problem by any of the students. At LSU however two students gave accounts of having faculty advisors that they rarely saw; and each noted that this infrequent interaction made graduate school even more difficult. Steven speculated that the consistently sporadic contact he had with his advisor was a result of his advisor having little interest in his research:

> I might see [my primary advisor] or talk to her once every two or three months. So there's very little interaction between all of us. And honestly, the feeling that I get – and I would never ask this – but I don't think they're interested in my research. They gave me the leeway to do what I wanted to do, but don't want to really get involved and understand what I do. – *Steven / American Indian, Ph.D., Fisheries Ecology, LSU*

Steven went on to say that this inattention had "been pretty consistent," which to him was probably "a good thing" seeing as he didn't "get used to having people there to lean on." Making

matter worse, in the absence of advisor guidance, Steven couldn't even rely on his committee members for direction:

> It's very difficult to set things up with [my committee]. Very difficult to get consultations with them. As a matter of fact, we were supposed to have a meeting yesterday – they didn't show up. So it's been real hard when you really need that information from them, it's really hard. – *Steven / American Indian, Ph.D., Fisheries Ecology, LSU*

A good committee was supposed to serve as an extra source of support that could address the hardships that emerged in the event students had an inattentive advisor. Compared to Steven, Lauren had the exact opposite experience:

> I was fortunate enough that I didn't get completely stuck with an advisor that wasn't helping at all, but you usually form those committees so that if your advisor's not helping you find a job or helping you with a project, [you have] two or three other professors that are on your committee that are going to vouch for you and help you with that project. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

Lauren was grateful that she had her committee formed early on as a graduate student and that they were always ready to meet and discuss her thesis. She continued to say:

> My committee, they were very good. They were making the best effort to understand my project because obviously they come from different backgrounds so they're not going to know exactly what my project is. But they did take the time and effort to understand and ask the questions that they needed to ask so they could help me with my project. So they each think differently and are concerned about different parts, so they're very supportive and very understanding. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

Alexis was another student who had infrequent contact with a faculty advisor. For Alexis, however, this inattentiveness was especially devastating because she had grown accustomed to a great deal of support and contact with this very same advisor during her first year, which rapidly changed due to the changing circumstances of her professor:

> When I came in, the first year I spent with my advisor, he was very good. We would meet once a week. I have papers I read and if I didn't understand this and

> this, he'd explain... And then I didn't pass my qualifying exam, and then I started doing bad in my courses and then his research started focusing somewhere else…he got a ton of money to go to [another city] and do research. And all of a sudden, all his time and energy went that way and those of us – he took on so many students, he didn't have time to meet with anybody at all. He'd give us 15 minutes in the morning. So all of a sudden, it was like, 'No you do it by yourself.' And so it's been hard. – *Alexis / Latina, MS, Physics, LSU*

Interestingly, Alexis confided that she had started off as a doctoral student in the physics program but had to eventually take a master's degree in part due to the fact that she didn't pass the qualifying exam. Elaborating on the topic Alexis stated:

> [The master's degree] all they were going to let me do – at least here. I could always try somewhere else. Now I'm all of a sudden, instead of graduating with a Ph.D. in maybe three years, I'm only going to graduate with a master's this summer. – *Alexis / Latina, MS, Physics, LSU*

Alexis was reportedly having a hard time managing classes with research; her advisor, instead of being sympathetic to the struggle, simply pressured her to put research first. Clearly an absent and unsympathetic advisor was of a real consequence to students.

Like Steven and Alexis, Jasmine over at MU, had little contact with her first advisor. The infrequent contact was due to the fact that Jasmine's faculty advisor had a hand in industry and therefore had little time to invest in his students:

> I've had two advisors. And the first advisor was extremely hands off and he actually had an outside company. And then, the company started to do all kinds of crazy stuff, so he started spending less and less time with the students. So in that regard, he was very hands off and just everything off – eyes off, email off, everything. – *Jasmine / Black, Ph.D., Computer Science, MU*

A related issue to not having enough contact with one's advisor was having an advisor who used the pedagogical approach of giving students full independence, which at times could feel like neglect:

> [My advisor] does sort of foster an attitude of benign neglect, and that can be really problematic because in order to do what I'm doing, I had to in a lot of ways really switch what I was initially trained to do…. And he has not been very good at getting me the training I need, so I've wasted a lot of time and resources

> learning on my own and making my own mistakes. Of course, he thinks that's part of the process, but I don't know if that's really pedagogy or if that's just the easiest way for him to do it. – *Isiah / White and Latino, Ph.D., Biomedical Engineering, MU*

Little direction from one's advisor contributed to a feeling of "being lost" by newer graduate students:

> My research advisor is…a new faculty [member]. So he's very focused on his research, getting stuff done. He's not the guy who's going to hover over you… I've really had to learn everything on my own these first two years… Everything in the lab, all the devices I've had to [learn on my own]… The other day, I found out I was doing something completely wrong with my work. I figured it out on my own and then when I told him he was like, 'Oh, I thought that's what you were doing. I thought you were doing the other thing the whole time.' I was like, 'I thought so too but no one caught it.'… I don't know if it's communication in our program or what it is. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

Although a few students liked having the independence to make their own decisions as opposed to having an advisor that micromanaged their every move, this independence was welcomed only to a limited extent:

> My advisor certainly gives me a lot of freedom as to what classes I take and even what research I do, which sometimes is good and bad. Sometimes I flounder around, sometimes I'm really, really grateful that I have that freedom. I've seen other people in my department - their course schedule and their entire [research] outline is dictated by their advisor – *Hayden / Black, Ph.D., Aerospace Engineering, MU*

> In general [my advisor] is fairly hands off, which is a good thing. Again, I don't know if I want someone just hovering over me every five seconds. But biweekly meetings is his way of trying to make sure that we're still moving along or if there's some issues, maybe we can get them resolved. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

Another reason for poor advising and guidance, albeit much less common, was having an advisor who was unfamiliar with the protocol within the department or who was absent minded, both of which could be costly to students. For example, John at LSU, explained that a potential result of an inconsistent advisor was a prolonged degree completion process. In reflecting about his experience with his advisor, John stated:

> One thing that I wish I could redo is… I think if I would have researched a little bit more I probably wouldn't have applied [to work] with [my current advisor]…cause some of her grad students take a while to graduate…You don't want to be here for six or seven years. – *John / Latino, MS, Wildlife Studies, LSU*

When asked to clarify why it took these students so long to graduate, John explained that it was because his advisor was "a little flaky." Students who found themselves in these situations, had to be very proactive to advocate for themselves and make sure they were getting their needs met:

> As far as me getting to [MU], there was some mix-up with my application. Cause initially what [a professor is] supposed to do is tell the department, 'okay, I'm interested in this student, fly them out to [MU].' But [my advisor] didn't know the rules or protocol so he told them, 'Oh, he was already here in the summer so you don't have to send him out here again.' And essentially [MU] overlooked my application because of that. And I called [my advisor] up and said, "Hey, man, what's up? Am I not getting in or what?" And then he realized what he did and he worked that out. So that showed me that he actually cared enough to work that out. So I know he's a good guy. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

Finally it was rare to hear of negative vindictive behavior on the part of faculty, which may be a function of interviewing people who were still persisting; nonetheless, only Carson faced intimidation from an advisor who he eventually left for a more supportive one. Students did have varying examples of conflict with their advisors, however, but the conflict was of a far lesser degree. For example, multiple students at LSU spoke about the fact that their advisor had expectations for them that were unrealistic. Alexis shares her frustration with a PI who gave students tasks without first teaching them how to accomplish them or checking for understanding:

> It was difficult because [my PI] did not have the time to teach me the theory behind [certain concepts]. And with the specific program he used, he would give us, as a group, a task and say, "Okay, I want you to model aluminum with this and calculate its energies." So we'd all sit there and be like – "so what did you get? I don't know, what did he want us to do? I don't understand. Well who's going to ask him? I don't want to, he's busy." – *Alexis / Latina, MS, Physics, LSU*

Advisors placed a fair amount of pressure on students, which on face value was not an issue. Students took issue with unsympathetic advisors in the face of difficult or uncontrollable circumstances, especially when the student was doing the best he or she could. John explained:

> I do a field season every summer…just the pressures of my advisor saying, 'You need to get this done. This needs to be done now. If you don't get it done now then you're pretty much [screwed].'… So that pressure is the hardest part of being in grad school. My advisor doesn't know how to deal with stuff either, so I get a lot of the flack because sometimes things are out of my control. I need to get this stuff done and then I'm frantic. – *John / Latino, MS, Wildlife Studies, LSU*

Another student spoke about his advisor having unrealistic expectations of his time and wanting more to be done when the student was already operating full throttle:

> My mentor gives me a lot of pressure. 'Cause I have a weekly meeting with him and he's like, 'Okay, let's see what you have done.' I show him and then he's like, 'Well that's fine, but you should get more done.' I was like, 'okay... – *Evan / Latino, MS, Electrical Engineering, LSU*

In response, students had to learn how to handle their advisors' demands and communicate their needs in the face of those demands. Advisors who had high expectations of students but who gave vague explanations of what they wanted or who sent subtle, unspoken cues that questions were not welcomed were detrimental to understanding what it meant to be a researcher and scholar. Further, since asking questions is critical to learning new things, not affording students the opportunity to do so during the learning process was clearly antithetical to cultivating talent.

Other points of conflict arose from well-meaning professors as we see in a number of narratives from students attending MU. Jake, for example, had to get used to his advisor's way of communicating feedback, which at times felt more critical than constructive:

> I've had my ups and downs with [my advisor]. It hasn't been completely smooth, and I know she's had slight issues with other people. Overall we've worked most of our stuff out, and it's much better this semester… I definitely believe my advisor now is pretty supportive of me, but sometimes she doesn't show it in the best way, or she gets overly critical and will just tear a paper completely apart,

> and (Laughter) learning to respond to that stuff has [taken] a good part of this first year, and trying to get along with her. – *Jake / White and Latino, Ph.D., Cognitive Psychology, MU*

Maria stated that she had to learn to trust her advisor's plan for her academic trajectory; specifically she talked about feeling "a little rushed" to defend her dissertation but that if her advisor thought she was ready to do so, then she should believe it. Another area of concern that arose during the focus groups was feeling pressured from an advisor to pursue a specific career trajectory:

> Professors want people that they've mentored to be like them, especially when they see the aptitude. My advisor is one of them. She's had so much talk for the last two years, 'He's going to be a professor. He's going to be a professor.' And I'm like, 'Wait a second. I don't want to take any more engineering courses. I'm going to take business courses and I'm going to sit in on engineering courses.' And she's like, 'Yeah, fine, fine.' I didn't hear any more, 'He's going to be a professor' after that. – *Hayden / Black, Ph.D., Aerospace Engineering, MU*

Finally, being co-advised had the potential of producing conflict if the advice of one advisor was contradictory to the advice given by the other:

> I'm only a second year… one of my advisors I think his agenda is he wants me to go to academia. So he wants me to teach. My other advisor, as I said, being new he wants me to focus on research. So that's going to be an interesting dynamic over the next couple years how that works out – *Austin / Black, Ph.D., Mechanical Engineering, MU*

Although Austin presents an unusual case of being co-advised and hadn't run into problems at the time of the interview, potential problems can arise when advice from one advisor is in direct opposition to the advice of the other, due to different value systems. Different and seemingly contradictory faculty values put students in very precarious positions. This is something that programs should keep in mind when assigning faculty advisors.

Positive experiences. On the flip side students, across all three institutions, shared numerous positive comments about their PIs and faculty advisors. There were four main characteristics that students appreciated in faculty advisors: 1) the quality of being

approachable and accessible; 2) the desire to support students in their development as demonstrated by connecting students to important resources or training opportunities; 3) the tailoring of advising to best meet the needs of students; and 4) the free expression of recognition, support, and encouragement directed to the student. Please note that the first two characteristics were mentioned across all three institutions, while the last two were only articulated by MU students.

With respect to faculty approachability and accessibility, some faculty advisors at HBEU were highly involved in their students' graduate lives and readily offered "professional development advice," or coaching on mistakes. David was impressed with the manner in which his advisor gave feedback:

> As far as giving feedback, my PI… he has always been really good with that, even in undergraduate. So what he's done now is he's giving me feedback but it's a different type. It's more like he's coaching me on how to correct a lot of my own mistakes, or how to pick up on a lot of my own mistakes. But the relationship in a lot of ways has become more relaxed but I think that's in part because now I know who I'm dealing with and how to take certain criticisms or not. – *David / Black, Ph.D., Animal Behavior & Ecology, HBEU*

Savannah explained that the reason faculty advisors worked hard to ensure their students' success was because student failures reflected the faculty's failure to serve and train students effectively and thoroughly:

> The support is amazing. The [faculty] are so down-to-earth. I can send a quick e-mail to my professors and if I need to see them, they're there. They're always looking out, I should say. So that's one thing I definitely love about [this institution]… the faculty is amazing as far as support and understanding. Even my PI, he's so understanding… If I mess up on [something] he's like, "I feel bad because I should have told you this and that's because it's my duty to train you." I just love it. The support has been great here. – *Savannah / Black, Ph.D., Microbiology, HBEU*

The fact that some faculty were so approachable at HBEU may help explain why students felt fairly comfortable having frank discussions with their advisors about traditionally taboo topics, including one's career plans for the future.

Some faculty advisors at LSU were also very involved in their students' academic lives. Brianna described her current advisor who was highly interested in her research projects:

> He has turned out to be fantastic just because – well, I think he's a great teacher and I also think he's very – it might have something to do with being new, but he's very involved with his projects…I think I'm the first person he actually works one-on-one with. So he's very into my thesis and very into my projects and very into my future for some reason…. So for me it's been a great experience so far. – *Brianna / Latino, MS, Industrial Engineering, LSU*

From students' accounts, advisors were effective when they gave good feedback, had regular check-ins with students, made time for informal meetings as needed, were approachable, and were willing to mentor students. Students were happy as long as they felt their needs were being met. Further, advisors who had high expectations of students were respected and regarded positively, as long as they were also caring:

> I have an awesome advisor… [and] she's one of the top researchers in the country. She's just an awesome person to work for. She's really easy going, easy to get along with as long as you do your research and don't slack off, you're good. – *Landon / Black and American Indian, MS, Molecular Biology, LSU*

Avery had a similar experience with her advisor. She describes her advisor as "tough in a good way" and described an experience where her advisor pushed her to present research in the department's monthly seminar. As Alexis demonstrates, when professors provided guidance through difficult processes, students seemed to be capable of things they didn't think was possible prior:

> [My advisor] had me go to a conference right away. The second semester, I went to a conference and we were there very late during my project. He would have me do my presentation over and over and over until I had it perfect. He was very pushy and I was very stressed, but he helped. I felt like he was very proud at the end of my presentation. – *Alexis / Latina, MS, Physics, LSU*

Many advisors at MU were also accessible and approachable; seven MU students shared rather positive stories about their advisors:

> My advisor, well, right now he's on sabbatical. But even with that I give him biweekly updates via email. Just something short. And usually when he was in town, we'd meet biweekly to talk about research… But yeah, the communication's pretty open. And if there's really an issue, even now with him being on sabbatical, if there's really something pressing I can send him an email about something and say, "Hey, I've run into some issues [with] what to do or [I'll ask] what do you think?" Or if there's a paper I want him to look at that I've written [I ask] 'Here, could you look at this?' He responds in a fairly timely manner. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

> My advisor dedicates a lot of time to meeting with the students. I meet with him once, maybe twice a week. Just depends on the week… And three or four days a week he probably schedules 2 to 2 ½ hours of meeting time with [his] students. So he schedules it. We come in and discuss an update or whatever. – *Chase / Latino, Ph.D., Electrical Engineering, MU*

> [My advisor] was on sabbatical for most of my first year. Now he's back… he tries to keep me integrated with his research group as much as possible. So he'll have me come in and do like a short talk about my research or a longer talk, whatever the case may be. So he tries to be present all the time, as much as he can. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

> Typically I have a meeting with my advisor every week. If I don't show up, that's a problem. And I've heard that most of the other advisors in the department do the same thing. So they're very interested in getting me out the door and getting me out the door successfully. – *Tristan / Black and White, Ph.D., Physics, MU*

Tristan speculated that since he cost his program grant money (i.e. they were investing funds to financially support him), they had a strong incentive to make sure he was successful and out the door as soon as possible. Whatever the motivation for the accessibility, students liked when faculty were open to having brief meetings and answering questions. Students were quite grateful for these meetings since they recognized how busy their advisors were with other responsibilities.

The second quality students wanted their advisors to exhibit was a desire to support students' development as demonstrated by a willingness to connect students to important resources or training opportunities. One task in particular faculty advisors at HBEU seemed particularly good at was connecting students to other resources and networks, and encouraging them to apply for outside opportunities such as fellowships, grants, and internships. Julia explains how she was referred to different engagement opportunities:

> Well, actually, this summer I'll have the opportunity to intern at NIH for their summer internship program. And [there are] a number of the opportunities the faculty members inform you of. They realize that they're quite limited in some of the services they can provide. But they're also helpful in that they will do some research and let you know, 'Oh, this is something you should look into. Or I do know this colleague from this institution and he or she would be very helpful.' – *Julia / Black, Ph.D., Genetics, HBEU*

Many students at LSU talked about how their advisors went over and above the regular advising and were supportive of students in more ways than one. Like advisors at HBEU, one way faculty advisors at LSU supported their students was by connecting students to opportunities outside of the institution for internships or getting masters students in contact with faculty that would make a good match for further graduate study:

> [My advisor] is setting up the internships at some pretty prestigious labs that I can go to and just get hands on experience, and network with the top scientists in the field. – *Landon / Black and American Indian, MS, Molecular Biology, LSU*

> [My advisor is] really supportive of what I want to do. After I finish this semester's program I want to do a Ph.D. in marine biology. So she's right now looking for professors that could be potentially good mentors for me for my Ph.D., and she's basically doing my research for me [to select] a Ph.D. school… So she's really trying to get me the most information she can give me. – *Avery / American Indian, MS, Biology, LSU*

Multiple students in master's programs talked about advisors who encouraged them to get the doctorate. In an attempt to steer master's students to the Ph.D., advisors encouraged students at that level to learn as much as they could, gain experiences with teaching or in other labs, and

participate in internships. Although several students had the feeling that their advisors wanted them to stay at LSU for the Ph.D., advisors seemed generally supportive of students pursuing a graduate program at another institution and did what they could to best position students for enrollment in a doctoral program. Some advisors simply agreed to write their students a letter of reference; others insisted on collaborating with students on research so that the student could get a publication in before starting the doctorate.

The reason why MU faculty connected students to resources seemed to be a bit different than the reasons why faculty at HBEU and LSU connected students. For the latter, the institutions did not have the proper resources to provide various training opportunities 'in house'. (This point will be further explored in Chapter 6). For the former, connecting students to an impressive list of contacts in industry or academia was about professionally broadening students' network so that they were best positioned for the job market. In positioning student for the job market, professors encouraged students to teach, attend conferences, publish papers, and/or engage in interdisciplinary work by collaborating with people in other fields:

> My advisor especially encourages a bunch of collaboration and talking [with people] not just within our lab team but also outside the lab… if we have the time to do it, we can do these interdisciplinary projects, that's great. But one thing I would actually say is in our lab he actually has started an interdisciplinary program where now we're looking at like design optimization not by like just from an engineering perspective but also accounting for policy… So yeah, he definitely does encourage some of the interdisciplinary work. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

Although many advisors didn't seem to mind either way which career direction students planned to pursue, they wanted students to let them know of their plans so they would have time to position students favorably:

> With my advisor it doesn't particularly matter if you tell her you want to do industry or a post-doc, but she wants to know earlier so that when it comes to a point when you're in your fourth year, she can start thinking about what type of industrial connections she has to try to get you a job, or what type of people she has heard that want post-docs that you may be interested in so she can prepare

> and be ready to make these recommendations. – *Cooper / Black, Ph.D., Chemistry, MU*

A couple of students had advisors that had a concurrent hand in industry, which was beneficial for students when it came to getting career advice:

> Well my, my current advisor…helped to co-found a company which was a spinoff of a technology that he's developed in his lab. And so I get to see what it would be like if I were to become a faculty member who probably did become an entrepreneur as well. So the faculty members that I have are good models for my future aspirations. – *Maria / Black, Ph.D., Biomedical Engineering, MU*

> [My advisor] also had a spinoff from some of the work we've done in our lab, so he also has some of the small business startup [knowledge] in case I develop some entrepreneurial interests. So he could help me in trying to navigate that as well. We've had people in our lab go both to industry at large and small companies, as well as we have a couple going into academia now. So I think either way I'd be prepared. – *Sadie / Black, Ph.D., Biomedical Engineering, MU*

The third quality that students found beneficial was when advisors tailored advising to best meet the needs of students. Curiously, only students at MU spoke specifically on this issue, although it likely beneficial to students irrespective of the institution they attend. In any case advisors who were well-liked didn't take a one-size-fits-all approach to advising, but rather found out where students' passions lay and considered their strengths in determining what actions were appropriate when dealing with students. Maria's advisor, for example, was especially good at "helping [her] figure out what it is that [she] wanted to do or what's [her] best fit." Part of tailoring advising to fit a student's needs, meant that the advisor didn't give up on a student just because he or she didn't fit a particular mold:

> I'm fortunate to be around a few professors who are open-minded. I'm not sure about the rest of the department; I don't get the feeling that all the professors are like, "Ah, do whatever you want." The guys that I'm hanging out with, they're like, "Oh, well, I can understand how you might not want to do this." And I've been also just open about how I'm interested in more than just physics, so they've not pushed back on me too much. And I know that my officemate is like, "Oh, I hate grad school. I don't want to do this forever." And he told me – we have the same advisor; he told our advisor that, and [my

> advisor] said, “Well, I had this one idea for your Ph.D., but maybe we’ll try to do something else instead.” [My advisor] is still like really working with him and he’s still like, “Yeah, get this done,” but he just was taking a different tactic. – *Tristan / Black and White, Ph.D., Physics, MU*

A fourth quality that a number of students wanted their faculty advisors to have was the free and frequent expression of positive recognition, support, and encouragement as directed towards the student. More on this topic is discussed under the section heading ‘Faculty Ethic of Care’ wherein students across all three institutions speak about encouragement and support more broadly as it relates to all faculty, and not just their faculty advisors. Nonetheless MU students craved positive recognition from their faculty advisors for a job well done. Positive reinforcement helped push students along in the face of self-doubt or other difficulties:

> Sometimes I’ve been harder on myself than my advisors have been on me. But it’s because of how I perceive their thinking. But a couple of times my advisor and I had to meet. [And during one meeting] he and I had – we went on a sort of research trip together, and we were having dinner and he said, “You’re good. I think you’re going to do well.” And I remember that and I hold onto that. That was four years ago. – *Tristan / Black and White, Ph.D., Physics, MU*

Similarly, an advisor’s support and encouragement was crucial in the face of failed experiments, which were demoralizing and the cause of much frustration. Indeed it was extremely important to students that their advisors support them in the face of difficulties, as Isiah articulated:

> I’m actually on really good terms with my advisor. He’s generally really supportive, and he’ll go to bat if you need something. – *Isiah / White and Latino, Ph.D., Biomedical Engineering, MU*

Similarly, after recounting an experience with a difficult lab mate, Cooper explained that many people would have quit after that incident, but “at the end of the day, it was about [his] relationship with [his] PI and that was golden.” Students also were appreciative of advisors who supported their STEM-related work working with communities they cared about:

> The program just really didn’t know what to do with me and fortunately this new [faculty member] came in… And he’s a member of SACNAS, which I’m a member of which is Society for the Advancement of Chicanos, Hispanics and

> Native Americans in Science. He's a mentor in that and he took me – he never asked what happened [with my old advisor that I had a lot of conflict with]. He just took me and has lobbied for me in my program. – *Carson / White and American Indian, Ph.D., Bioinformatics, MU*

Three take away lessons. Beyond a simple discussion of what faculty advisors did well, and what they did poorly, in their interactions with students, there were three quite important take away points that students raised. First the advising relationship only increased in importance once coursework was completed and interactions with peers became less frequent and regular:

> When you're starting you have to take classes… But after you join a lab, it's more about the interaction you have with your mentor and that relationship. Like, I joke with my mentor, he's really nice, but other people don't feel that close to their mentors. And…after a point it's just like your research and your relationship with your mentor [that] is going to get you by. – *Abby / Latina, Ph.D., Pharmacology & Cellular and Molecular Biology, MU*

Second having a good relationship with one's advisor didn't mean that the relationship was not without rough patches; it did mean however that both parties tried to understand each other respectfully. Talking about his advisor Sean shared that "there are some times [when] we've had our clashes a little bit about different things. But I think he understood where I was coming from … And he was willing to be patient with me."

Third, seemingly productive and healthy advising relationships seemed to be about balance. At LSU Lauren and Alexis had advisors that balanced well the act of giving students guidance and doing what they thought would be helpful given the students' interests while also giving students room to choose their own path:

> Most of my interactions are mainly with my advisor. She's very good at letting me know what I should be taking. Ultimately, she left it up to me, which I thought was just great. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

> My advisor at first was like, 'Are you going to do this and this and this?' He had three projects planned out – 'That's going to be your Ph.D… Then you're going to go get a

> post doc.' That's when I first came in [to graduate school]. And as we started working more together, I think now he has the point of view that he would probably tell me, 'You do what you want to do.' He knows I've had a rough time. He has told me only do the Ph.D. if you want to. He told me he's seen some people that go through and start their Ph.D. and they just hate it. He said some people just quit coming because they can't do it. It's too much stress. So he says if that's something you really, really want, go ahead and go for it. If not, then you don't have to. – *Alexis / Latina, MS, Physics, LSU*

At times, developing students meant making them figure out the solution to problems on their own, perhaps in a way to push them to become independent thinkers:

> Sometimes I feel like if I ask a question, [my advisor] wants me to figure it out myself so he doesn't give me a direct answer. That might be better for me, though, in the long run. – *Mason / Latino, MS, Environmental Science, LSU*

At MU the same lesson about balance arose: caring advisors were somewhat hands off allowing students to make decisions with respect to their research and figure out problems on their own, but did so while having regular check-in meetings to make sure that students were progressing and to address any concerns that students may have needed help resolving. By not laying out each step, advisors helped students become independent researchers:

> [My advisor] is hands off by force… if you ask him for a lot of guidance, he'll back off and just tell you, okay, go figure it out on your own. After a while you figure that out. But he is available to answer questions and he does meet with us once or twice a week. – *Chase / Latino, Ph.D., Electrical Engineering, MU*

Chase held the opinion that advisors who "just tells you step by step what to do" might help students get the work done quicker – which he speculated "might be in your advisor's benefit" – but getting the work done quicker "may not be the best for the student" if they wanted to become a researcher. The go-and-figure-it-out-independently approach did not work for all students, however. In some situations, it was imperative that the advisor altered their approach to guidance and teaching, which touches again on the importance of tailored advising:

> Nowadays, [my advisor] has been more flexible and eventually he figured out that I was struggling so he was like, 'Okay, I'm going to try and help out,' but initially he was tough. He was really harsh. Like if he said that I should try this for a given period, I needed to try before the given period. If not, he was going be

> angry…. And initially I was scared to go see him for advice and eventually he just spoke to me and said, 'You need to come to my office every day because it seems you don't understand this stuff.' So when I started coming to his office every day, things started becoming clearer. I could see that he was frustrated because I remember he would explain something to me like three, four times... For some reason he had kept his patience. – *Dominic / Black, Ph.D., Electrical Engineering, MU*

Faculty Ethic of Care

Students had a great deal to share about the care and concern the faculty, not just their advisors, exhibited towards students. The way participants talked about these qualities differed however. At HBEU, when students talked about what they liked about their professors, they had a tendency of comparing those experiences to negative experiences they had at other institutions. Alternatively at LSU and MU, students spoke about faculty ethic of care in terms of receiving holistic care from faculty wherein their academic and personal needs received attention. Thus, going forward I will first present narratives from students at HBEU followed by the narratives offered by students from LSU and MU. I then present negative experiences students had with faculty, which to them were demonstrative of a lack of care. I conclude by citing the implications of faculty of care for department culture across all three institutions.

Faculty ethic of care at HBEU. When prompted to speak about the faculty, students at HBEU had generally positive comments to share due to the great deal of support they received from professors who reportedly knew students by name and seemed like they genuinely cared about what happened to students. This level of concern seemed to be lacking at students' previous institutions:

> [My undergraduate institution] is not a place for individuals of underrepresented groups, period. I went the first time to my pre-med advisor, and my science GPA was a 2.5. And he said, 'Well, your science GPA's a 2.5? What do you want to do?' And I said, 'I want to go to med school.' He said, 'Hmm, pick another profession.' I said, 'Excuse me?' He said, 'Okay, you need to have a GPA of a 3.8, and you need to get a 30 on your MCAT to even think of getting into school.' And that was the first and last time I went to him. And almost every single professor was worried about research. They're not worried about what you're

> doing. They're getting paid for doing research… I didn't think they really cared too much... But definitely I had a different feeling when I came to [this institution]. I can talk to my professors candidly. I can speak to them about what my concerns are, and I can feel like they can give me at least a response that makes me feel like they are. They may not care. I don't know. But at least they're pretending. – *Camryn / Black, Ph.D., Pharmacology*

Indeed an important aspect of feeling cared for was feeling like professors were approachable:

> I think it's different here. Even my ability to feel like I can approach my professors is completely different. At [my undergraduate institution], it was difficult to approach those people (faculty). It was very, very difficult, especially when you saw they may interact with people of different colors in different ways. You may approach them, and they have this standoffish view, when you saw the previous student may have approached them, and they had a completely different demeanor altogether. – *Camryn / Black, Ph.D., Pharmacology*

Julia confirmed that at HBEU she could go to any professor's office with a question, even those who weren't Black:

> Even though I'm here at [HBEU], my faculty members, a number of them are White, and that was the case in my undergrad as well. But here, I don't have any problems, like as far as feeling comfortable, sharing information with them… I genuinely feel as though [the faculty] are different people. in undergrad, in a sense, I was set up to fail… But here, there's a big difference. You can see the distinction. My professor will go out of his way to schedule appointments with me to make sure that I get all the answers I need or I find out about opportunities. Whereas at [my previous institution], when I did work up the courage to go meet with that particular professor, I didn't feel as though anything was accomplished. At times, I felt like I was more lost when I walked out of his door than when I walked in. – *Julia / Black, Ph.D., Genetics, HBEU*

Having attended HBEU as an undergraduate, David noticed that professors treated graduate students more as a "potential colleague" and he seemed to like this new dynamic in his relationships with the faculty. He elaborated:

> I've had a very positive relationship with most of the faculty that I've had in classes. In terms of being able to speak with them and not feel like they're talking down to me, but that they're really actually having a conversation with me and actually value my opinion. – *David / Black, Ph.D., Animal Behavior & Ecology*

Camryn concluded that, “Here you have a relationship with your professors.” Isaac agreed that the graduate experience at HBEU was “way more personal” at least in comparison to his undergraduate experience. Issac had a more practical explanation for the ethic of care exhibited by faculty. In essence, he attributed the close personal relationship students had with their advisors to what he termed “mutual investment” whereby both parties were interested in and highly motivated to produce high quality work.

Faculty ethic of care at LSU and MU. Students at LSU and MU appeared to want a relationship with faculty wherein faculty cared about their well-being, even in areas that were beyond the scope of the classroom or lab. Students, at the very least, wanted faculty to know their name. Indeed, small acts of concern and care were memorable:

> When I got approved for the Ph.D., I had to e-mail both the professors if they had time to meet ‘cause I just wanted to talk to them about what the research topics were and I wanted to see who might lend themselves better to be my advisor. But one of the professors I had told him, ‘What times do you have available because I have to take my daughter to an appointment.’ Well as soon as I walked in [to meet with him he’s like], ‘How’s your daughter? Is she okay?’ The first time I ever met him that’s exactly how he was. Before anything in school he’d go, ‘Tell me about yourself.’ He didn’t ask anything education-related or work. He just wanted to ask me personal level questions. That was a little different. – *Benjamin / Latino, Ph.D., Industrial Engineering Operations Research*

Students at MU especially wanted to feel valued as a person and not just as a producer of research:

> At the meeting, [my advisor will] make sure, “Oh, what are you doing for Easter? When is the next time you’re going home?” Just trying to make sure I maintain that balance. I think it helps because he has kids that are my age, too. And they’re in college, so he’s like, “All right, well my son is getting ready to come home for this. So what are you doing?” So my relationship is very, very good with my current advisor. – *Jasmine / Black, Ph.D., Computer Science*

> The PI that I have now, he’s really great… He comes into the lab at least two, three times a day just to like, say, “Hey, what’s up guys? What are you doing? What’s new with your project? What are you working on? What did you do this

> weekend? What are your plans?" – *Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology*

Amelia went on to say:

> It seems like [my PI] wants to really get to know us and be our friend on a certain level, as well as be a parenting figure because he just wants to make sure we're doing okay. And I like that… I think that's really important.

In short, Amelia and others wanted their professors to care about them as a whole person and took comfort in knowing that their advisors were concerned if something went wrong. They also wanted to know that if they had a problem with anything – classes, their PIs in a different lab – that they could talk about it with their advisor:

> I can only speak to my department, but it's like a little family. They really do look out for you. I had a situation where I had to switch mentors. And I had professors coming up to me who I had never talked to about the situation. "It'll be okay. You can come rotate through my lab if you need to." And I'm like, "Well, I never talked to you before," but word travels like a little family, it's a little gossip. But they weren't doing it in a negative way. All in all they were looking out for my best interests. It felt good to want to stay there and know that they wanted me to stay there too. – *Kate / Black, Ph.D., Pharmacology*

Despite the close-knit feeling in her department, Kate knew to maintain a certain level of professionalism in her relationships with faculty:

> I love my department. I think I could talk to anyone if I wanted to. I don't really get personal with any of my professors or mentors, but if a personal situation came up that took away from me being in lab, my mentor would be understanding of that. But, I don't call her up when something's happening, because you have to have a certain level of professionalism in your relationship. – *Kate*

Caring advisors also seemed to be interested in students' future beyond graduate school, as alluded to already. Charlotte was impressed with her advisor's level of interest in her: "And even on a personal level [he would ask me], 'Have you thought about a lab yet? What are you thinking of for the future?"

Interestingly students considered the friendliness and responsiveness of professors in class, as signals that they cared about student learning. If professors proved to be friendly in the classroom, Benjamin explained that he would go to their office hours when they were posted to be available. A few professors, however, seemed inapproachable in class and so Benjamin did not seek their help at all, even when he had questions. In seeking help for classes, Benjamin recounted experiences wherein faculty were unwilling to provide the extra assistance for one reason or another, but explained that this unwillingness was rare:

> I had [faculty] tell me, 'I don't have time.' Or 'Can you come back?' Or really, 'what? I don't know. I didn't teach that class...' But that was rare. I think that happened twice.

Certain personality characteristics were also more conducive to the interpretation that faculty were caring. For example, Brandon loved his advisor's contagious positive demeanor: "My advisor… she was very welcoming, a very exciting person... And I've been here for two years and enjoy it." Indeed students tended to have positive perceptions of faculty when the faculty had outgoing personalities and interacted with them on a social level. Aaron described his advisor as "very nice" and enjoyed the "social events" that his advisor put on for his lab. Jordan had a similar experience:

> In my case, in my department, it's big and most of the interaction is within the lab. So I think the interaction you have with your advisor depends on a lot on the advisor's style. In my case she's really open for parties, and so we get together at her place every few months. – *Jordan / Latino, Ph.D., Ecology and Evolutionary Biology*

Benjamin, as a student splitting his time between two departments, noted that how people approached social interactions varied, perhaps because the differences in personalities within departments:

> For me the culture in the engineering department is different than math and physics. Those guys are completely different... [The] culture of math in general has lent itself to a lot of fun jokes and stuff. – *Benjamin / Latino, Ph.D., Industrial Engineering Operations Research*

Negative experiences with faculty demonstrative of a lack of care. Victoria was the only student from HBEU who expressed sentiments that suggest the faculty took a less than caring approach to student treatment. Being that she spent "22 hours a day" in the chemistry building, she drew on multiple experiences interacting with faculty that negatively colored her perception of faculty. She stated:

> It's hard-core in chemistry and it's unfortunate, but it could be because of a cultural [thing]… [Going through graduate school] is really like a hazing process that I have to go through, which is [graduate school] but I just don't think it should be that way. I'm already dealing with trying to think and figuring out how to think, but [for faculty] to throw unnecessary obstacles in my way I feel like I should not be getting that here. Maybe at [an IV league school] or maybe at [a predominately White institution] or something like that, but not here. Yeah. It's tough. – *Victoria / Black, Ph.D., Analytical Chemistry*

In another description of her experiences, Victoria shared that faculty withheld help until a student could "figure out how to get [their work done]" and only then would they "show up to your committee… and possibly pass you." Essentially in Victoria's department, students had to prove that they were worth the investment before faculty would provide help.

At LSU, aside from the occasional inapproachable or inaccessible teaching professor (as mentioned by Benjamin), only three students from LSU had negative comments to say about people in their department. "Personality wise you can have a lot of people that are dicks," John, a Wildlife Studies student, explained. Finally, William who was a master's student in industrial engineering, held the impression that some of his professors did not care about cultivating students' talents:

> My other professors, they're like, 'You are a master's student now. I don't care if you do the homework. I don't care if you come to class or to the exam. I don't care what you do.' – *William / Latino, MS, Industrial Engineering*

Finally, it is likely not a coincidence that the only two master's students from the MU sample both reported being highly disappointed with the level of mentoring they

received and the lack of care they received from faculty. Brady for example had aspirations to pursue the Ph.D. but didn't know how to go about the process since he "never received that interest and guidance" from faculty in his electrical engineering department. He went on to share that professors had not invited him "to do any further work outside of work that I've asked for myself." As a result Brady reflected, "I feel like I haven't necessarily been served in the sense of how to continue on [to the Ph.D.] as far as the department is concerned." Colin also shared that he felt severely neglected as a master's student in industrial and operations engineering.

Implications of faculty ethic of care for department culture. The faculty ethic of care seemed to have important implications for the culture around helping others and providing mentorship in each department. Although I have not yet discussed students' relationships with their peers, of all the students across the three institutions, those at HBEU seemed to be the most willing to help one another; this finding is not too surprising seeing as the faculty at HBEU showed the same wiliness to help students. Similarly students in some departments at LSU were shown "by example" from faculty what it meant to be a good mentor, as reported by Steven in the fisheries ecology program. Likewise, in the molecular biology program, students learned how to become mentors "indirectly by example" via the interactions between the senior researchers and the other graduate students. Nothing about mentorship was explicitly stated, but the program seemed to follow a practice of hands-off guidance:

> When I first started working, I was assigned a graduate student as an undergrad… It was so annoying when I first started because I would ask a question, and [coming from] undergrad you expect [the more advanced graduate students] to just to give the answer. Instead they'd give you an article to read – a journal article. It drove me crazy, but they wanted me to think. They wanted me to figure it out for myself. And now I see myself doing it…I have undergrads that I get to train and teach and show everything. And when you get new graduate students it's the same thing. They're given a project and then they do something they decide what they're going to do, but they don't always necessarily know

> where to start. There are simple techniques – a lot of techniques – as to how you do this process and things like that. – *Lauren / Latina, Ph.D., Molecular Biology*

At MU, faculty also seemed to set the tone for lab culture, whether it was social, caring, and collaborative – or not. For example, students who relayed that their PIs expected them to work on research together met this expectation. Advisors also set expectations for helping behavior among students:

> My advisor is very supportive. I think he does a good job of fostering group culture to where everyone in our lab is very helpful to others. And he even does it so that some of the projects – like, everyone obviously has their own things that they're supposed to be specialized in, but there is some crossover so that you are working with other people within the group and outside the group on different collaborations, so you can get some exposure to other areas. So that actually is good. – *Sadie / Black, Ph.D., Biomedical Engineering*

Relationships with Peers

Across the three institutions, students who commented on their interactions with peers had overwhelmingly positive stories to share, although there are several students who had experiences that were to the contrary. Peers could be classmates, program mates, or lab mates. Students' narratives regarding their peers were organized by six broad themes: 1) peers as points of comparison; 2) experiences with international peers; 3) peers as motivators; 4) peers as teachers; 5) collaboration or competition in the lab and/or classroom peer environment; and 6) peers as friends. Note that some themes were not applicable to one or more institutions.

Peers as Points of Comparison

Several students from LSU and MU compared themselves to their peers, although the prevalence of doing so was much more common at MU. Further comparisons were almost always in a negative nature in which students didn't feel as though they measured up to people

in their programs. For example, Cameron at LSU mentioned feeling less academically prepared than his peers:

> There are a lot of people who are a lot smarter than I am. It's like… in high school I was the cream of the crop and I wasn't even really doing anything. I was just doing whatever the teachers told me to do. But since a lot of people in high school weren't doing that, I stood out. And then I get to college and I'm with my peers, my equals, like other people who actually would do what they're supposed to do. And then when I get to grad school there's a lot of people doing above and beyond what they're supposed to do and I'm trying to – not catch up, but trying not to get too behind. – *Cameron / Latino, MS, Mechanical Engineering*

The fact that Cameron was the only student at LSU to report feeling uneasy about where he stood academically compared to peers may be a reflection of the rigor of the classes offered at LSU, which in another section students relayed were time-consuming but not necessarily difficult; the fact that many of the classes graduate students took were also with undergraduates may explain why classes seemed more manageable to the LSU participants.

Being in graduate school definitely caused some MU students to be acutely aware of their weaknesses; indeed, opportunities for talent development instead seemed like glaring deficiencies when comparing oneself to peers:

> I'm now in the biomedical sciences…, which I had some experience with but it wasn't in depth like a lot of my peers. So I was feeling like an outsider a little bit - like the learning curve was going to be really steep for me in particular. So in a way, [feeling like an outsider] was my identity for a long time. It still is because I haven't fully grasped a lot of the concepts that would come more natural to other people. So that influences how I see myself within the larger context of graduate students in the biomedical sciences. So I still don't feel like I completely fit in. – *Charlotte / Latina, Ph.D., Biomedical Sciences*

Unlike Charlotte, Cooper had a more positive way of thinking about what he didn't know and how he could use his peers to his advantage:

> So when I came here…academically I knew I had some gaps compared to my peers… So there were people who knew the specific theories [talked about in class] more than I did. I think what I did well was to recognize, 'Hey, they know it

> and I don't so I should just ask them and learn from them to see how to do it.' So that was fine. – *Cooper / Black, Ph.D., Chemistry*

Some used the perception that peers were more advanced in content knowledge as a motivating factor, but still struggled with managing their feelings of self-doubt:

> I would say as far as academic goes, it is a bit challenging… I was at the top of my classes back home. I was doing really well. And I came out here and everyone is one of those people who was at the top of their class. Now I'm at the bottom of the class. So it was difficult at first. And I felt like, "Oh my gosh, am I going to make it? Am I going to pass my classes?" I felt like I had to study a lot more than I ever did before. So when everybody was going out partying I was like, "No. I have to still read these chapters and get this done," so I could keep up with everybody else. – *Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology*

Charlotte was of the opinion that many students seemed to feel the "imposter syndrome." When she was thinking she "must be stupid" because she was having trouble with a class, it helped to vent to classmates and ask them how they were faring. From these discussions, Charlotte's was amazed to learn that even the people she regarded as "really smart" were having difficulties.

Two participants from MU explicitly shared the perception that international students were better prepared for the content material encountered in graduate school. Jasmine, for example, shared, "A lot of my international colleagues, they've already learned what we're learning on the grad level." Similarly, Dominic noted:

> A lot of international students, they have a much better mathematics background coming into the class. So me and someone else would be in the same class but that person probably already done this or seen this before and I haven't. So they easily comprehend stuff and I don't. I feel like there is a need for me to try and catch up if I want to compete with them. I have to catch up and work harder. – *Dominic / Black, Ph.D., Electrical Engineering*

Maria, an engineering student, added that she had heard of international students "correcting the professors" in math classes. In her experience, she found that international students

"remember [course concepts] by heart and they learn things in much more complex sense than we do at a younger age."

Experiences with International Students

According IPEDs, at the time the interviews were performed in 2010, HBEU, LSU, and MU had 8%, 17%, 24% of graduate enrollment consisting of international students respectively. Thus, it is not surprising that when asked to describe their relationships with peers, many students at LSU and MU had a great deal to say about those who were international students. (Curiously, even though there were international students at HBEU, there was no mention of international peers among any of the graduate students participating in this study.)

In responding to a question about how international students contributed to the learning dynamic, students at LSU and MU commented that internationals had a strong work ethic and were extremely smart, seeing as they had been preparing for graduate school from seemingly an early age. Indeed, a number of students perceived their international peers to be more prepared for graduate school than domestic students. Anna added:

> In my field some international students, especially from Europe, they're more prepared in math and in Asia, too. When they were in college, it's just that they took more math courses rather than a mixture of courses like we take in the U.S.
> – *Anna / Latina, MS, Mathematics, LSU*

How domestic minority students felt about their international peers was important precisely because for some participants, international students comprised a great proportion of their program or lab. This was the case at for students at LSU, but was much more prevalent among students at MU (like Amelia, Dominic, Chase, and Maria to name a few). Brady, for example, claimed that at MU "about 80 percent of [his] program [was] international students." Zachary, a student at LSU, reported similar circumstances:

> In my undergraduate [I had] larger classes and people with similar backgrounds as mine. Here [in graduate school], well class is about eight to six people and that vast majority of them being foreign. So it's very different, but we get along fairly well. *–Zachary / Latino, MS, Organic Chemistry, LSU*

When speaking about their international peers, not one participant at LSU shared views that were slanted strongly negative or positive. The opinion seemed to simply be that international students stuck together and didn't go out of their way to interact with students of other nationalities. Brief interactions of a strictly academic nature with international students seemed to be common, but none of the LSU participants reported any further meaningful interactions:

> In my department, there are a lot of people from India. They don't see it as a competition. They're very reserved. They're very shy. If they know something [with respect to course content] they won't tell you. You basically have to ask them. They will tell you, they just don't think that you cared… It's very weird. – *Samuel / Latino, MS, Electrical Engineering, LSU*

At MU, Chase, Dominic, and Maria observed that international students, frequently studied together too. Chase, a Latino student in electrical engineering, shared that the international students in his program signaled, via one-word answers to questions, that they were not interested in studying with him. Dominic made the same observation of the international students in his lab. He added that he anticipated the reactions he would get from these peers before trying to reach out to them to form study groups:

> If [international students] come from the same country, they come into my lab with a certain sense communal relationship. So they interact among themselves and they help each other. But for someone like me, I came in not knowing anybody. If I try to like reach out to somebody, I have to be careful [and ask myself] 'What response am I going to get from this person if I try to reach out?' So it's a bit difficult to say to yourself, "Okay, I'm going to be friends with this group of people because I know this certain group of people, they have connections for this particular class because they already had this communal relationship among each other,

> which gets passed down from previous students to the current students." – *Dominic / Black, Ph.D., Electrical Engineering, MU*

Maria was in the same focus group as Dominic and agreed that international students had a "communal thing" going on and that "they have relations with certain courses." She added that the international students were more likely to work with others if they saw that it was "worth their while," and if they saw that the student had "the ability to contribute something."

On a social level, students at LSU and MU spoke about having difficulties getting their international peers to participate in non-school related events that would have been conducive to peer bonding. Brianna for example shared that certain foreign student groups, like peers from India, pretty much kept to themselves. She indicated that although she had some sort of relationship with everyone in her engineering master's program, the slight exception was with her international peers:

> It's not in any way dislike or like… they really don't try. They self-segregate and they seem happy to do it. They talk their language, they really don't mingle. It doesn't bother me at all, it's just one of those things. – *Brianna / Latino, MS, Industrial Engineering, LSU*

Zachary felt that the only divide between international and domestic students existed "on a personal basis" wherein cultural differences complicated interactions; he felt, however, that most people were "willing to bridge that gap" between the cultural divide. Alexis had a similar comment but indicated that, at least in a purely social respect, the cultural divide was too vast to bridge:

> I also wanted to comment on the women and different nationalities. In physics there are a lot of graduate students from Nepal. There are actually a few of us that are American. It's hard because it's that cultural difference. They all stick together and we try, but some of them aren't allowed to drink – and almost every grad student is like 'Hey, let's go out for a beer on Friday evening' and they don't come with us. It's because some of them aren't allowed to be near a person that's drinking or to be around a person that's drinking. So it's hard to actually make it one big-happy-family thing. – *Alexis / Latina, MS, Physics, LSU*

Like students at LSU, students at MU also had a hard time getting international students to hang out with them on a social level. For Brady and Carson, it was a bit demoralizing that their repeated invitations to socialize fell on deaf ears:

> I try to connect with international students because I recognize that this must be a really difficult thing for them to try and develop an identity around here – to know what's going on. Because I'm from [this city], I try to reach out to students, but no one has ever taken me up on it. I'm pretty social in nature, so that's shaded my view on – well, my whole graduate school experience. – *Brady / Black, MS, Electrical Engineering, MU*

> I invite [the international students] to [powwows], but then I hear of other times where they've gone to dinner and I haven't been invited, but it's generally Chinese food and I don't like Chinese food. [Laughter] So I wouldn't have had a good time anyway. But still, it's the thought that counts. – *Carson / White and American Indian, Ph.D., Bioinformatics, MU*

One student offered an explanation as to why international students would not invite domestic peers to their social events:

> The Chinese friends I had, they would always have me over for dinners. So liking the food really helped… Then a friend of mine made the point when they invited me over for dinner – after I said, "Yeah, I'll try anything five or six times to see if I like it or not." He said, "Yeah, I know. That's why I invited you, because I knew you would respect our culture and our food and you wouldn't say it's disgusting." So he certainly thought of that when considering whether to invite me into his home, how I would treat the culture and the food. – *Hayden / Black, Ph.D., Aerospace Engineering, MU*

Peers as Motivators

Student at HBEU and LSU had overwhelmingly favorable perceptions of their peer interactions and repeatedly spoke about peers as being an important source of motivation. (MU students did not speak about their peers quite in this manner.) In some departments at HBEU and LSU, peers seemed to push each other in supportive ways to reach their maximum potential. Benjamin, a student at LSU, commented, "I think that competitiveness [in my department], it's jokingly. We'll push each other [to be] better." Steven had a similar comment:

> There's a huge competitive component, albeit unspoken, among the graduate students. But we're absolutely competitive in terms of who knows more about fishery colleges or statistics. But it's a constructive competitiveness. So I find it interesting that there's not in your departments (referring to other students in the focus group), but there's distinctly one in ours. But like I said, it's a good one. It drives us all to be better biologists. – *Steven / American Indian, Ph.D., Fisheries Ecology, LSU*

There was also a sense of competition in Savannah's department at HBEU, but the competition, according to her, was also a positive one in that it compelled students to be the best they could be and to progress through their degrees. Apparently, having peers that were doing good work motivated others to do equally as good of work – or better. Competition in this sense did not require students to engage in destructive behavior with one another. Savannah elaborated:

> As far as the selfish, 'I'm going to pull you down so I can be on top' mentality and competition, I really haven't [experienced that]. I mean, we can be competitive… [But it's more like], "If you're going to study, I'm going to study harder than you or be better than you." But it definitely wasn't a negative experience. Not at all. – *Savannah / Black, Ph.D., Microbiology, HBEU*

Interestingly how students motivated each other was a bit different at HBEU compared to LSU. At HBEU students motivated others by holding each other accountable for meeting graduate progress deadlines. If there was an obstacle in the way of meeting a deadline, students felt responsible for helping each other through it:

> [When] we came in – I think there were eight of us, but two of us – me and another person – were on the research side. The rest were counselors. But me and a genetic counselor, she's in the Ph.D.. So she's about to finish and I'm still going on and we meet together like 'Okay, we're support to meet on Friday to talk about where we are and what we're supposed to do this week'…. So we keep each other on track. And then another person, she's like, 'I don't know what I'm doing. I'm just here.' I'm like, 'Okay. I'm going to stay on you, and you're going to stay on me. So this summer, you need to be in candidacy because I'm going to be applying for the fall.' So we try to keep each other in track like that. And then I just took the written part of my comprehensive and three other girls in my department were like 'Okay, who are we meeting with this week and what time? Are you free this time? We have to go see Dr. So-and-So 'cause he wants to

> give us practice questions.' – *Audrey / Black, Ph.D., Genetics and Human Genetics, HBEU*

At LSU alternatively, graduate students who had similar research interests would get together and discuss or further develop research ideas. These meetings were a source of motivation to produce quality work as feedback served to elevate students' work:

> I've consulted with other researchers for a lot of my stuff and grad students were imperative to the success of my research because they were the only ones who were willing – and you have to be willing as well – to sit down for four or five hours [to do so]. So yeah, that is imperative for success. – *Steven / American Indian, Ph.D., Fisheries Ecology, LSU*

> I communicate with people in my classes particularly really well. We meet every week and buy pizza and critique each other's work, critique each other's presentations and posters. So within the lab it's pretty good…. It's a great experience. – *Landon / Black and American Indian, MS, Molecular Biology, LSU*

Peers as Teachers

Across all three institutions, many graduate students described their interactions with peers in ways that suggested that students often acted both as teacher and as student. At LSU, for example, it was common for students to share knowledge when it came to understanding disciplinary material or a particular concept. Liam, for example, explained that in the three years he had been in his department, he had not known people to be selfish. Liam didn't feel bad sharing knowledge with others because in his point of view, explaining something to someone else helped him "understand [it] better." He also believed that people who were unwilling to collaborate on research would not progress very fast in publishing papers. Indeed, it was in a student's best interest to share knowledge. Benjamin described how knowledge was circulated in his department among his cohort:

> A lot of us will pass around e-mails. 'What classes are you taking this semester? I'm going to take this one.' We share that knowledge back and forth. Like "Oh, that's a great class. I can actually give you all the notes now. If you need help with the homework let me know…" So we're always there to help each other…

> it's great to be able to have that environment. – *Benjamin / Latino, Ph.D., Industrial Engineering Operations Research, LSU*

In the rest of Benjamin's narrative, he reveals that he often used his peers to borrow books or to learn what to expect from a class. He also observed that doctoral students often "share any and all information they have" with the master's students. Master's students simply had to walk up to a more advanced student and ask a question. He added, "It's just a definitely very open campus in that sense... The majority of [advanced students] understand the boat you're in and they're willing to have one big boat where everybody goes together. I think that's the feeling I got from [the math and physics] departments."

In almost the same way, Aaron, a bio-chemistry student at MU, implied that students willingly and eagerly tried to answer each other's questions in his program. Austin had a very similar story to share:

> I really like the way our lab interacts. Pretty much everyone can just walk up to the other person and be like, 'Hey, explain this biology to me' or 'Show me how to use this machine' or whatever the case may be… [so] as far as, sharing information, yeah, it's pretty open. No one's like trying to hoard anything. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

As expected, advanced students played an important role in the education and training of more novice students. Thankfully across all three institutions, advanced students demonstrated a real concern for making sure that those coming in after them prospered and were set up for success:

> For me, it was helpful that everyone's willing to help and work together. Also… advanced students, they were also willing to help me further along. There was no competition. [The help] is usually just between the graduate students in my department. I haven't really interacted much with the larger university population. – *Hunter / Black, Ph.D., Physics, HBEU*

> I have lab mates who are doing really well, so they set up a competitive environment that way but they're always there to help if I need a hand. If I don't know how to deal with putting together my paper or, for instance putting together my application for candidacy, one of my other lab mates had already done it. So I said to my of my peers, "Look I have no idea what I'm doing here. This

> application seems really simple. I know it can't be that simple because a lot of people are having trouble with this." And he walked me through and showed me, "Look, this is what I put together for mine, if you want to take a look at it, take a look at it," and I could see the form and go, "Oh, that's what that means. No wonder people have problems with this because that's really confusing." So I had a leg up there. – *David / Black, Ph.D., Animal Behavior & Ecology, HBEU*

Students at HBEU didn't just help each other with small tasks, like answering a question on how to use a piece of equipment, but assisted each other in very real (and time consuming) ways:

> Within our lab we're very collaborative. "You need a hand with this?" "I don't know how to do this." "Let me help you." I spent a couple hours a couple weeks ago just helping my lab mate set up her traps and dig trenches... We do stuff like that. Across fields, it becomes a little more difficult unless you're doing something that's a collaboration but I volunteered myself a number of times to read my colleagues papers. They're always letting me know if there's an ecology opportunity that they've heard of and we bounce information back and forth, things of that nature. So it's not really competitive. – *David / Black, Ph.D., Animal Behavior & Ecology, HBEU*

According to David, it was within the context of the lab that students received the "brunt of the support."

More advanced students at LSU also trained novice ones with respect to lab techniques. Mason was one of the first graduate students to work in his advisor's lab. He explained:

> So everyone who has come after me,I've basically taught them just the basics and then after that they go along with whatever they're supposed to do. I have had to do quite a bit of training. So far, maybe four or five students and on different levels; master's, one Ph.D. and several undergrads. – *Mason / Latino, MS, Environmental Science, LSU*

Lauren had a similar experience and learned to pass the favor forward to newer students:

> When I started working in the lab, it was a pretty big lab. There were about 20 people, including undergraduate and graduate students and a couple of senior researchers. So most of my contact was with the senior researcher... and working with the other graduate students – and that's who I learned from. Going in, I had no research experience. I didn't know how to do anything, so it was a little bit difficult to get into the pace of things. But all the other graduate students understood. They'd been in the same place I was. So they were very understanding and very helpful. And I see that now, because now

> that I've been there awhile, I help the new students that come in because I know how I was when I first started. So most of my interactions in learning are from other graduate students because that's who you see every day and that's who you work with. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

Aaron, a doctoral student in biological chemistry at MU, had a similar story to share; he noted that "older students help out the younger students, and that's what you do when you get your own lab, you help out the younger students." The same collaborative spirit was present in Austin's lab at MU with "other grad students or post docs pretty much taking [him] under their wing and saying, 'Okay, this is how you do this.'" Austin went on to say that much of his learning of lab techniques had been from peers since his "advisor isn't necessarily holding me under his arm and saying, 'Hey, here's how you use the SEM machine or microscope.'"

Students at HBEU and LSU, also acted as both teacher and learner within the context of the classroom:

> When it comes to the classroom and performance, everyone's very supportive. If we need to get a study group together, everyone's down. So everyone's been very helpful in that aspect. – *Julia / Black, Ph.D., Genetics, HBEU*

Students at HBEU seemed to learn a great deal from each other as Hunter confirmed "I feel like [I] actually learn more from my fellow students and just interacting with them and working together with them trying to solve problems on our own."

Students also seemed to study together often at LSU and relied on each other to complete class work. Evan, for example, reported that he and his peers would "divide homework so we can finish everything quicker and at the end, we can explain to each other what's going on with a problem." Cameron similarly found fellow students to be rather helpful:

> If they're in the same class or something we're working on the same homework, of course. If they understand something and I don't they're always happy to help me. And if I understand something that they don't – somehow, miraculously – I'll help them out as much as I can. So I don't really see a bad competitive spirit

from most of my classmates. – *Cameron / Latino, MS, Mechanical Engineering, LSU*

Alexis, a LSU student, was of the opinion that it was “almost essential to work in a group with… homework.” She explained that in her statistical mechanics class and her quantum course, she and her study group of two to three people would spend two weeks on homework problems. “It definitely helped a lot,” she reflected and added, “Unfortunately classical mechanics was one of my first courses [that] I didn’t do the group work thing. That’s probably why I partially suffered.” It is notable that students at MU did not talk about connecting with other students in an effort to complete course assignments or study for classes like students at LSU and HBEU did.

Collaboration or Competition in the Lab and/or Classroom Peer Environment

Across all three institutions students had varying opinions of how the learning environment felt, with some students offering narratives that cast their peer environment as unfriendly and competitive and others sharing stories that made their programs seem rather collaborative. For example although the comments participants at HBEU made about peers were overwhelmingly positive, there were still two students that offered statements that could be interpreted as slightly negative. The first was stated by David, who mentioned that he didn’t feel much competition in his immediate department but did within other spaces on campus:

> Across campuses it can get more competitive, like microbiology and the bio department versus in the med school, they're, "Well, we don't want you coming up here, taking our ideas," things like that but within the department it's usually pretty solid. – *David / Black, Ph.D., Animal Behavior & Ecology*

The second statement was from Victoria. Her comments indicate a somewhat damaging level of competition existing within the chemistry department.

> Sometimes I come across people who give me non-verbal cues like, “I got mine. You figure out how to get yours,” type of thing and that bothers me because this is an HBCU. If that makes sense? Yeah [these are from other Black professors] or even people who are a year ahead of me or in a post doc-type thing, and I just

> don't believe that it should work that way. – *Victoria / Black, Ph.D., Analytical Chemistry*

Victoria went on to say that she felt HBEU ran on a self-serving model more than a mentorship one, which contrasted with her personal style of helping others. She is the sole exception to this sentiment, however.

Students at LSU also had different reflections about their programs. For example, Lauren stated that she didn't feel any competition in her interactions with lab mates:

> If you're working on the same project, it was like a graduate student that was about to graduate with a graduate student that just started and maybe an undergrad, so you were all at different levels. You were all working on the same project to get a paper out or to finish something. There wasn't a level of competitiveness because you were all contributing to the project. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

Conversely, William had an opposite experience in his lab; he nonetheless was the only student at HBEU to indicate that he experienced competition in the traditional sense from peers:

> For my research [lab] we are a group of four people. Every time that we have to present a poster, like the [discussion] of who goes first, like who is the first author for that research project. So that's like a competition that we have among us. Maybe I did the data collection and somebody else did the interpretation of the data, but he wants to go first, but I did the most work. So we have a little bit of competition with the poster presentation and with the publication. So that's the main problem that I have with them. – *William / Latino, MS, Industrial Engineering, LSU*

MU students also had peer environments wherein a great many seemed collaborative although there were a few competitive ones too. With respect to collaborative departments, Hayden shared that he had no issues at all connecting with peers in his lab for research projects:

> It's certainly collaborative more than competitive, and then we socialize outside the lab. We have common interests so we get together. In my lab, there's this attitude of – my advisor really wants you to be doing research that you're interested in. So you latch onto something and you do research and then people

> just naturally group up. Then the groups dissolve after they publish something and then other groups will form and they'll do research on something else. And so it's really – we're just sort of playing with problems, if you will, and publishing. – *Hayden / Black, Ph.D., Aerospace Engineering, MU*

In another focus group, Kate also reported very collaborative interactions with peers in her program:

> It's very collaborative within the department… I've seen people from different labs get on each other's papers. [For example, one student will say to another student] "You can help me do this because you're good in this technique, and your lab does that," so you both get a publication out of it. So I've seen very collaborative efforts, a lot of them. – *Kate / Black, Ph.D., Pharmacology, MU*

Charlotte also indicated that her program had a collaborative feel to it and that it was a place where students wanted to work together and support each other. She reportedly didn't feel a sense of competition wherein people were "catty" or didn't want to share or study with her. Amelia and Sean agreed:

> One of the reasons I chose to come [to this institution] was because I felt that everyone was so collaborative. When I interviewed out here and I talked to a lot of the students, I could tell that they were really happy. And they were working with people in their other labs. And they were helping each other. I've heard horror stories where people are so competitive that they'll sabotage other peoples' experiments. Or they won't want to share their knowledge with someone else because they want to get ahead. – *Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology, MU*

> From a lab perspective, I don't know if we're cohesive per say, but it's definitely like we're fairly friendly in terms of we will help each other if there's a need…. my advisor's complained cause our lab in former years has been more cohesive. So we're not exactly outside of the lab cool hanging out all the time. But at least while we're in lab if someone needs help we're there to help them. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

The sharing of information and collaborative spirit, however, seemed to be more of a function of the department culture rather than of the overall graduate school culture at MU. Abby, for example, explained that in pharmacology, people were very collaborative but she was "part of another program and they were competitive." The collaboration could also only be specific to

certain students who were more predisposed to want to work with others. For example, Maria shared that in her courses, she actively sought out her peers to study and work together and that she mostly "could find at least one or two people that I could work well with and that aren't going to compete against me but just want to encourage me and see us both do well." Although when describing her experience with peers she described everyone as "usually not competitive and supportive of each other" she did qualify the statement saying that it may have been because the people she was "attracted to" for studying were people she had observed as having non-competitive demeanors.

Although some students experienced inclusion and a free sharing of resources and knowledge within the context of the lab and classroom, others experienced the exact opposite. Three students, Dominic, Chase, and Brady indicated that they perceived their peers to be competitive rather than collaborative. Dominic had experiences with peers in his lab and classes who were at times "not interested in helping" him. He also said that he couldn't "go up to just [any]body" for help and instead had to "choose friends wisely" otherwise he'd "be on [his] own for a long period of time." This "competitive and individualistic" behavior that Dominic encountered came from both international peers and other domestic students.

Chase had a similar experience with lab mates who were unwilling to collaborate with him. He explained that he thought it was because the lab mates were coming from a territorial mind set about the research they were doing:

> I think it's because they [think], 'This is what I've worked on and I'm going to publish this and this is going to be my degree and so I don't want anyone else to help me.' Primarily I think it's like, 'This is my work, I don't want someone else to come and jump on at the last minute.' – *Chase / Latino, Ph.D., Electrical Engineering, MU*

Brady thought the competition stemmed from students trying to distinguish themselves from one another and rise as the shining star:

> My program is rather competitive, more so than collaborative. And maybe my viewpoint is skewed because I was a winter admit. But I even still took a lot of the courses, even last term, where I had a lot of the students that are also in first-year courses together…[and there was] a lot of people trying to prove themselves... There are some people that I do tend to group up with in the courses that I took last term... But that was one of those forced situations. – *Brady / Black, MS, Electrical Engineering, MU*

Peers as Friends

Students at all three institutions relied heavily on classmates to make it through graduate school. A few formed very close friendships with their peers as a result of the copious amounts of time spent studying together. At HBEU, Savannah was enamored by her classmates:

> I love my classmates as well… When I matriculated into graduate school, there were three young ladies. We actually all were accepted into the same funding program as well. And we all had time off from school and we had so much in common. From day one, we studied [together]. I wouldn't have made it without them. But from day one we were like a clique. Actually the department called us 'The Three Stooges' because our first two years of classes, we were always together. Always together. We came and started the day together and we ended the night at least 2:00, 3:00 in the morning. We always stayed together. We always studied together. We were always together. All the time. They've been so supportive. And it hasn't been an issue of I'm going to keep my answers. If there was a certain concept one of us didn't grab, they were quickly eager to share. So I love my classmates. – *Savannah / Black, Ph.D., Microbiology, HBEU*

The collegiality among students at HBEU was not only apparent in students' statements about their experiences but even was demonstrated during the focus group with one non-STEM graduate student mentioning that she would attend events put on by the graduate school "but [didn't] exactly want to go by" herself. In response, Julia offered the student – who she had just met –- her phone number and encouraged the student to call her so that they could go together.

A few students at LSU also relied on peers as a source of emotional and/or social support throughout the course of their programs, although the strength of those relationships didn't seem to be nearly as strong as those present at HBEU. Some students (John and

Brianna) reported getting social support from formal organizations offered through their department, the graduate school, or a professional association on campus and reflected that they sometimes grabbed a beer or dinner with peers from these organizations. For others, like Benjamin and John, the support was gained through informal relationships with people in their programs:

> I talk to a lot of the people that we're going through the program together. A lot of the people I seem to hang out with or took courses with… [and] there's another guy in my division at work that just started the Ph.D. program, too, so having that friendship there to support each other as we go through this is definitely a plus to help keep going. – *Benjamin / Latino, Ph.D., Industrial Engineering Operations Research, LSU*

> [With respect] to the interaction with my peers, in grad school we have a small department. So we all get along. We all go get a beer. 'Hey, come over. I'm having a barbeque.' So it's pretty good for us, a little group. – *John / Latino, MS, Wildlife Studies, LSU*

Even still, there were a rare few that were either self-described "loners" like Avery (*American Indian, MS, Biology*) or who reported that they "just prefer working alone" like Anna (*Latina, MS, Mathematics*) and so likely didn't have a large interest in forming deep personal friendships with peers.

There was a much wider range in the extent to which MU students relied on peers for social and, in some cases, emotional support. On the one end of the spectrum were students who really liked to spend time outside of class with their peers. One of Amelia's biggest sources of support and friendship, for example, came from people with whom she had classes. Because everyone seemed to be "going through the same thing," her friendships with these people served as "a big support group" in itself. Like Amelia, Colin's friends were classmates. He, however, wanted to expand his social circle, which apparently was not an easy thing to do:

> Most of the people that I hang out with, it's the same people that I'm in classes with, same people that I see all the time. And I don't know, sometimes I feel like I want to just go hang out with a whole bunch of different people, but I'm like, "I

> don't know these people. I can't just show up (Laughter) and be like, 'Hey, you want to hang out?' – *Colin / Black, MS, Industrial & Operations Engineering, MU*

Three students in the same focus group (Abby, Kate, and Jordan) laughingly revealed that a majority of the out-of-class interaction with peers occurred at bars, especially during happy hour. Further Hayden, who had especially positive and close bonds with the people in his lab, also mentioned the analogy of peers not being just friends but more being like family:

> And then outside [of lab],… we really just think of the others as friends. When we're done working it's, "Hey, do you want to go get a drink or what are you doing for dinner?" Things like that. We call each other up. It's almost family. It's nice to be so close. I'm sure all labs aren't like that, but it's nice to have that attitude running through the lab. I don't know if it's ever too relaxed, but certainly when we go to conferences, when we have presentations for the Air Force, for example, we're professional. In public we're always professional. But yeah, it's very close. – *Hayden / Black, Ph.D., Aerospace Engineering, MU*

On the other end of the spectrum were people who did not get along with or like people in their program due to experiences with uncooperative peers, exclusion, or difficult personalities. Isiah, for example, just didn't like the uptight nature of his peers:

> I didn't really care for a lot of the people I was meeting here. I found there to be sort of this attitude that this school was this incredible place, and that everyone's incredibly proud of themselves for being here, and it was just, you've got to go to school somewhere, right? I mean, people need to relax a little bit – and I'm still adjusting to that, five years on. And I don't know if it's a Midwestern thing or what, but this place seems to maybe have a little bit of an inferiority complex when it comes to an Ivy League school, so it overcompensates. And it's just, "Man, just chill out. Seriously." – *Isiah / White and Latino, Ph.D., Biomedical Engineering, MU*

Jake had similar complaints about the people in his program. Unlike Isiah, however, the fact that Jake didn't get along with people his program was a source of stress:

> Being forced to interact with people that you don't feel completely at ease with is – I don't know. I don't get along with everyone in my program. I feel like some of them are just way too Type A and I can't handle that. (Laughter) But it's stressful, very stressful. I get to start teaching in the fall, so we'll see how that adds to [the stress]. – *Jake / White and Latino, Ph.D., Cognitive Psychology, MU*

Austin also was not a fan of the personalities he encountered in his program:

> Coming to grad school, now you have people from all over the world in this small space. And they're all coming in with their own mindsets about life…I think this way but you don't think this way, and in the beginning there's this clash…of personalities. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

Austin went on to say that in the beginning, when the program first started, the people "were always, [like] 'oh, let's go out, let's go do this together.' And then everyone was together and there was this tension." Austin eventually made a set of friends outside of his department with whom he was completely comfortable. At the time of the interview, Austin got together with people from his department only "once every five months" and then everyone went their "own separate way." In this manner, Austin was able to avoid as much as possible the tension that arose when he was with his peers. He did, however, "play soccer with a couple of [his] lab mates" with whom he would "chit chat" but didn't have a relationship that was "super tight or super cohesive."

Dominic didn't have the best social relationships with his peers in his department either; some students had apparently said rather "mean things" to him. Cooper didn't like the personalities of people in his lab who often resorted to passive aggressive behavior when they had an issue with him:

> I joined a lab that was new, that my professor had started in 2003, and the original people in the lab were very territorial…. And I came the summer before the semester started…my very first week, there was a student who was concerned about sharing lab space. And so instead of coming and talking to me and the other person she had an issue with, she decided to, at night, clear all the stuff off of our bench, put tape and a sign where our spaces were. And to anyone in any workspace, it doesn't make sense. It's rude. So I brought that up to her in the morning and there was just a big conceptual gap about how that was unprofessional and how that was not acceptable. And there was crying and there was all this other stuff, and that just really showed me that I'm a person who likes to deal with [conflict] directly and I have to really temper the way that I act in order to not have tears. – *Cooper / Black, Ph.D., Chemistry, MU*

Brady reported that although his interactions were "cordial" with people in his program, he "never spent any time with anyone outside of classes or outside of meeting up at the library – ever." It is important to note that earlier in the session, Brady reported that most of the students in his program (roughly 80% he claims) were international students, which may be why he didn't interact with peers often. Like Brady, Carson did not socialize with the peers in his program, not because he didn't desire such interaction but because no one seemed to be interested in hanging out with him:

> I worked hard to have relationships with people, but I'm into tailgates and drinking beer and I like to go fishing. I haven't found anybody, really, in my program that I have common interests with. I spend time with my wife and her friends or friends I've made in the Indian community, or that we've made together in the Indian community. I think sometimes it hurts my feelings because I feel like I've tried to have relationships and invite them to – invite people in my program to barbeques at my house or just whatever I can think of. I'll invite them to barbeques or powwow. – *Carson / White and American Indian, Ph.D., Bioinformatics, MU*

Interestingly, Jasmine was the only *female* student who reported somewhat chilly social relationships with people in her program in computer science; perhaps it's because in her program, she was reportedly one of a very few women. She reflected that her interactions with peers were "minimal" and went on to say, "I mean it's not negative. The people I do interact with, they're fine. There's about four [of us] that we might go to [a local bar and restaurant] on a Friday or something." She also added, "I do have friends in the department but I don't go out of my way to make friends." The fact that Jasmine's department peers didn't seem very enthusiastic to work with her in the classroom context may have negatively colored her perception of them in social spaces.

From students' stories about their transitional experiences and their experiences interacting with peers and faculty across all three institutions, it appears that thriving in graduate school and doing so happily, required a human component wherein people cared about the one

another and wherein collaborative efforts contributed to students' success. In other words, students all seemed to be willing to shoulder the numerous responsibilities inherent to graduate life. However, students were most happy and seemed to be the most successful with coursework and research when faculty stepped in to provide guidance (but gave students enough room to make autonomous decisions) and when peers ideally did not let their peers fall behind but at the very least followed an ethos of collaboration rather than competition. Indeed, across all three institutions some students studied together, motivated each other, and helped each other through difficulties inherent of graduate work. As Audrey from HBEU stated, "I don't think [graduate school] is something you can do by yourself." Many students' narratives would suggest the same sentiment. In exploring relationships with peers and faculty in their programs, numerous power dynamics emerged, which also affected students' experiences within their graduate program. The next chapter addresses this point.

CHAPTER 5

POWER DYNAMICS IN STEM GRADUATE EDUCATION

Power from the individual standpoint is traditionally conceived as the ability to influence the behavior, self-perceptions, or thinking of others (French & Raven, 1959). Using this definition of power, power dynamics among people tend to be shaped by multiple factors including having unique access to information, resources, or people in powerful positions (Hinnings, Hickson, Pennings, & Schneck, 1974; Pfeffer, 1981), having the ability to produce an affective response from others within interpersonal relationships, having a perceived expertise, possessing an authority inherent to one's position within an organizational structure (Ragins & Sundstrom, 1989), and/or one's position in the social hierarchy (Omi & Winant, 1994; Bonilla-Silva, 2001). Furthermore, since people belong to multiple social groups, power is thought to exist on a continuum based on the multiplicity of social identities, wherein individuals have differential power partly due to power differentials between social groups in society (Ragins, 1997). Thus, a common experience for people from underrepresented groups – whether it be by race, sex, or another social identity – is possessing less power than majority counterparts (Cox, 1993) due to asymmetrical power relations in the larger society within which institutions are nestled (Ragins, 1997; Omi & Winant, 1994; Bonilla-Silva, 2001)

A brief discussion of power here is important because it introduces this chapter wherein I address research question two, which focuses on the power dynamics at play in URM students' graduate programs. Although I note power dynamics as they relate to the traditional definition of power outlined above, I posit that power in relation to students' graduate programs can additionally be seen as the capacity to constrain or support students in ways that affect their motivation, well-being, perception of others and the program, and productive performance, precisely because all of these factors combine to either push students along in their degree programs or drag them down (Amabile & Kramer, 2011). Further, I posit that even unconscious

or inadvertent uses of power in competitive environments are legitimate when they increase one person's success at the unnecessary expense of others.

With the preceding in mind, this chapter is structured as follows: first, I revisit some of the interactions students had with faculty and peers as they relate to the expanded definition of power I outlined above. Rather than include quotes I have already used to illustrate points made in Chapter 4, I include the name of the student(s) in summarizing statements. While investigating power dynamics, sexism and gender issues emerged as being a contributing factor to the treatment and lived experiences of women in this study, which I discuss second. I also investigate the role race, diversity, and racism specifically had on students' training and educational experiences and the power dynamics that are revealed via their narratives, which is discussed third. Throughout discussions of power, I recognize that students had the power to autonomously take action to overcome some of the challenges they encountered in order to regain some level of control over their graduate experiences and so I also identify instances of agency where they occur. I end with students' motivations in attaining a graduate degree because this seemed to be a resilient force behind their daily decision to continue in their programs despite the challenges they encountered. Motivations, therefore, represent a survival strategy and students' power to influence their own outcomes, namely to remain in graduate school. Findings are structured so that I focus on each major theme and how it is illustrated across the three institutions, with notations on how campuses differed where they exist.

Power Dynamics in Students' Relationships with Faculty

All relationships are about power to some extent. An application of literature from business leadership to the data makes it quite clear that faculty (and peers which are discussed later) are powerful precisely because they have the capacity to support or constrain students in ways that push them along in their degree programs or drag them down. Specifically, there are

two types of supporting actions provided by faculty advisors – as individuals sanctioned to guide students – that positively impact their motivation, well-being, perception of others, and ultimately their performance while in graduate school. These supporting actions represent more level power dynamics between students and their faculty advisors and constructive uses of faculty power.

Faculty Power to Facilitate Degree Progression

The first type of supporting actions faculty advisors provided that were demonstrative of the power they had to support students were directed to the task or project at hand, which in this case was successful progression through the graduate degree and all the functions that progression entails (Amabile & Kramer, 2011). Theoretically, actions can include providing help with a task, training or educating a person in ways that adds to a person's skills set, or supplying sufficient resources to complete a task. In relation to the data, faculty advisors at all three institutions wielded power as gatekeepers to great resources, information and knowledge, opportunities for skill development via training, and social networks that helped students be successful in graduate school or at minimum lessoned the difficulty inherent to the pursuant of a graduate degree.

For example, at HBEU, faculty were rather accessible meaning students were easily able to get a hold of the faculty when they had a question on an issue or needed guidance (Aaliyah and Savannah). These faculty behaviors empowered students to get the most out of their learning experiences. Indeed, students at HBEU seemed to feel comfortable asking questions (Aaliyah, Savannah, and Camryn), seeking help or clarification when they were struggling (Julia), and having frank conversations about their future plans (Morgan) – all of which was necessary for the cultivation of students' talents and the appropriate tailoring of training so that it aligned with students' desires and needs. Further at HBEU, the faculty seemed

to intentionally use their contacts and influence to best position their students. If faculty knew of a research opportunity (as in Julia's experience), even if it was outside the bounds of the university, students were informed and encouraged to apply.

Similarly, at LSU although professors were not always accessible (Benjamin and Alexis), they seemed to give personalized and thoughtful feedback on students' work. These faculty members could therefore justifiably hold students to high expectations, as constructive feedback inherently served to elevate students' work. By scaffolding students through difficult processes LSU faculty bolstered students' confidence and taught the lesson that with hard work and practice, they could achieve tasks that they previously thought were not possible (Alexis and Avery). Also, it is notable that instead of being territorial over advisees (which would represent a negative use of power), LSU faculty encouraged students to gain a variety of experiences – even if it was conducting research on another faculty member's project, which further illustrates the value LSU faculty placed on the development of marketable skills and the pursuit of personal research interests. Further, by collaborating with students on research (which is undeniably mutually beneficial) *and* recognizing the important contributions of students by allowing them to be an author on published works, LSU faculty expanded who was perceived as having the expertise to speak on a given topic and made students more marketable if they wished to pursue additional graduate study (Avery and Langdon).

At MU, similar examples of faculty support emerged. The vast spectrum of student experiences with faculty, both positive and negative, show that there is a delicate balance to be achieved between directly telling students what they need to know to scaffold learning and stepping back to encourage students to discover new material so that they can become independent thinkers (Chase) and make their own decisions (Hayden). Considering the intensive training inherent to any rigorous graduate program, especially those in STEM, wherein faculty are teaching not only approaches to scientific and technological thinking, but also applied

procedural skills, students at all three institutions needed to feel as though the tasks in front of them were manageable; faculty helped to create this impression.

The second set of supporting actions provided by faculty advisors – as individuals sanctioned to guide students – that positively impacted performance and progression through the degree were those directed to the student that provided psychosocial nourishment and contributed to the students' joy or satisfaction. Actions that can deliver these functions can theoretically include actions like showing respect, sharing words of encouragement, offering emotional comfort, and recognizing a job well done (Amabile & Kramer, 2011). Student narratives show that faculty advisors across the three institutions provided many psychosocial functions to students. Namely, faculty often extended friendship, acted as positive role models, listened to students' personal problems, valued students' opinions, and believed in students' capabilities to achieve – all of which went a long way to provide students with the strength to look ahead and progress forward even in the face of challenges. Indeed, the whole emotional tone of a tough situation was transformed when faculty advisors provided support.

Students' statements about their professors at HBEU, reveal that faculty treated students with kindness, concern, and respect which made them highly approachable in the eyes of students (Aaliyah, David, Camryn, and Julia). Further, by valuing students' contributions to discussion and research (David) and by treating students fairly with patience and compassion (Aaliyah), HBEU faculty did their part to draw students more deeply into the field of practice and to bolster their confidence as researchers and scholars. In this way, faculty established a relational dynamic with students that was more balanced rather than hierarchical in nature and created a safe space to learn and make mistakes (David). At LSU there were similar stories; faculty seemed to be quite approachable as demonstrated by their friendliness, patience, and responsiveness in class (Brianna and Alexis). Indeed, small acts of faculty concern and care

went a long way in motivating students to continue through their programs and do so happily (Benjamin).

Students at MU also shared many examples of faculty providing psychosocial functions, with students being better able to handle tough situations when their advisors saw students' distress and subsequently offered reassurances or humility and empathy. For example, Cooper explained that many people would have quit after having repeated points of conflict with lab peers but his positive relationship with his advisor helped him stay. Advisors also gave positive reinforcement to students and thereby urge students along in the face of self-doubt or the frustrations that resulted from failed experiments. As Cooper explained:

> I think my advisor's been very, very supportive. As a matter of fact, it took me three years to get my first project to work. That was horrible. It ended up being something really, really nice, but even in the context of my PI being very supportive, there's a dramatic difference. – *Cooper / Black, Ph.D., Chemistry, MU*

Students also learned to manage the frustration that came with failed experiments on their own. Max, for example, was able to deal with the less glamorous side of research by relying on his refusal to quit and systematic way of viewing problems to identify a potential solution. Taking support a step further, students felt more secure in their relationships with their advisors when they knew their advisors would use their power to "go to bat" for them (Isiah) as needed. For students, as individuals who are not able take action for themselves in certain situations because of a lack of influence, knowing that their advisor will firmly support them is affirming.

Students' narratives at MU, furthermore, demonstrated that faculty set the tone for the interactional culture among peers in the lab environment (Aaron, Kate, Amelia, Hayden, Sadie, and Jordan). For example, faculty decided what kind of peer mentality to support: one that exhibited much gratitude and pride in seeing that everyone succeed and was glad to help others or one that saw the success of others as a representation of one's own personal failure and, therefore, rewarded the close guarding of information. Faculty have the power to elevate or

diminish the program here based on how they intervene when they see students behaving in ways that are counterproductive to teamwork and lacking in decency. Because this is so, faculty have the power to stamp out toxic patterns of competition and to be models of cooperation, decency, and inclusivity. Indeed, an enduring example of how a program expects people to interact is relayed through how faculty treat other people. Faculty whose treatment of others encompassed essential elements of human fulfillment such as kindness, mutual respect, perspective, cooperation, and fair play sent a message that peers should behave in a like manner. In this way, faculty had the power to create an academic climate that made a difference in students' lives, even if it just made the process to degree completion more enjoyable.

It is noteworthy that students' accounts of faculty actions across the three institutions implies that some faculty acknowledged that different students had different needs and perspectives but could nonetheless be strongly nurtured, so long as the attention they gave students was individually tailored. A lesson: treating students fairly meant meeting their needs, not treating them equally per se. The perfect example being that it was not uncommon for a faculty member at HBEU to tutor a student for hours when said student needed more intensive clarification (Claire). These very same faculty members could have declined to do so on the grounds that it would be unfair not to offer the same personalized tutoring to everyone else, which would not have been feasible.

Faculty Power to Make Degree Progression More Difficult

The two sets of supports outlined by Amabile and Kramer (2011) have an opposite set of constraints. The first includes actions that fail to provide support or remove a barrier to progress, or those that interfere with the progression of the work at hand. The second includes interpersonal conflict, disregard for emotions, or any other actions that are discouraging, evoke fear, frustration, or apathy, or that chip away at the targets' confidence or sense of being valued.

Both represent negative uses of power on the part of faculty and the presence of a hierarchical power relationship between an advisor and his or her advisee. Faculty advisors can, therefore, use their power to not only help students advance within the program with supportive actions (Ragins, 1997), but can also buffer students from harm by removing or limiting the influence of constraints (Ragins, 1997), thereby reducing the possibility that students become overwhelmed.

At HBEU, there was only one example of a student consistently experiencing constraints at the hand of faculty in her program – this student was Victoria and she was in the chemistry doctoral program. Faculty in her department withheld help from students until they proved themselves academically worthy of such assistance. By doing so, faculty reaffirmed who was in charge (and who was not), and maintained a rigid hierarchy of power wherein students were at the mercy of the faculty. Although it is unknown precisely from Victoria's narrative how this power dynamic influenced her own training experiences, it is clear that it negatively colored her perception of her department. That Victoria spoke negatively of the people in her department is understandable given that it is just fundamentally difficult to maintain a positive and trusting interpersonal relationship with faculty when they choose to make the lives of students harder than necessary while acquiring the appropriate training.

Similarly, at LSU, there were several examples of faculty whose behaviors towards students provoked stress, which became part of the dynamic within their relationship. For example, faculty who set high expectations for tasks without first teaching students how to accomplish them or checking for understanding (Alexis) misses a great opportunity to more intensely cultivate the talent of students who were eager to learn; they also inadvertently produced anxiety. For students, the thought of not meeting an advisor's expectations was upsetting (Alexis and John). Similarly LSU professors who set unfair demands for work productivity that ran counter to what was realistically possible and achieving a healthy life balance (Evan) or without consideration of uncontrollable barriers to productivity (John), also

invoked the worry of falling short and not meeting expectations. For students who were subject to such faculty behaviors, they operated in a learning environment of uneasiness (John) and self-doubt (Alexis).

Also by dismissing students' concerns (e.g. Alexis's advisor telling her to focus on research and not worry about classes even though she was failing), some LSU faculty missed an opportunity to provide much needed advising and taught students to stay quiet on matters that impeded their ability to be successful; in other words, the lesson learned here was that struggles were to be handled independently. Bullying was also evident in at least one LSU department. Zachary, a master's student in organic chemistry at LSU, for example shared that he witnessed professors yelling at students in his department. Although the yelling was not directed at him, aggressive behavior often contributes to the construction of an atmosphere of distrust and sends a message that instead of coaching students to perform better, punishing them for falling short is an acceptable practice in the department. The use of bullying tactics to influence students is a clear enactment of power. Indeed, in any relationship, an unhappy and potentially debilitating power imbalance is created when someone shames another person to the point that the person on the receiving end is afraid to ask questions or make a move independently for fear of being perceived as dumb or making a mistake. It is no surprise that a student will question why they are pursuing graduate school when they are subject to bullying or have to walk on eggshells to please a punitive advisor.

Finally, there is an example at LSU in which a student's advisor and committee seemed to not care about the student's research or progress (Steven) as demonstrated by the sparse feedback they gave the student on his dissertation, their constant inaccessibility, and their absence from meetings that were previously agreed upon and scheduled. Steven is an American Indian doctoral student in Fisheries Ecology. Although he was the only student that reported an experience such as this, the underlying point is that faculty who opt not to rally

behind their student and leave him scrambling to navigate the graduate process for himself, exhibit a passive demonstration of power.

Recognizing the immense role faculty played in their educational journeys, students at MU tended to defer to the judgment of faculty and were constantly scrambling to prove their worth to secure the faculty's approval. For most students, there wasn't a problem with this dynamic. The problem lied in situations where an advisor's primary concern was not with the success of her student but with the power dynamics between her and the student (Carson). Indeed, this is not a mentorship but a demonstration of a power differential. When MU students said that they were "scared" (Dominic) to seek advice from an advisor, this was a signal that something was wrong with the power dynamic of the advising relationship.

Further, students' stories at MU show that having a good relationship with one's advisor didn't mean that the relationship was not without rough patches (Jake and Sean); it did mean, however, that both parties approached disagreements as equal partners meaning they tried to understand each other respectfully. Maria's story about her advisor in biomedical engineering showed that in the face of differences of opinion between student and faculty advisor, the opinion of faculty prevailed, unless students used their own agency to change advisors to one whose opinions were more aligned with those of the student as Carson did. Carson's story of his initial advisor demonstrates that doctoral students cannot easily exchange an ill-fitting advisor to someone who is more supportive without potential serious repercussions. However, seeing as respect is a two-way street, intimidation doesn't belong anywhere in the mentor relationship. The fact that Carson and Dominic, who were both doctoral students, had gotten through the conflict in their advising relationships at MU with their optimism intact is notable.

In sum, from students' collective stories across the three institutions, it is clear that inaction and withholding support was a type of power dynamic that served as a roadblock to student progress as it affected outcomes related to skill acquisition, professional development,

opportunities for socialization, and psychosocial outcomes. In other words, inaction had powerful consequences, too.

Student Resilience as a Powerful Force to Overcome Faculty Barriers to Degree Progression

When faculty advisors fell short in providing students with the two types of supporting actions needed to support their performance and progression through their degrees, students enacted their own agency in an attempt to fill in the gaps. For example, students had the power to amass certain opportunities for themselves. Julia, a doctoral genetics student, relied on her 'I-get-stuff-done' mentality and her propensity to research available opportunities and scholarships existing both in and outside of HBEU. She was also unafraid of asking people, with whom she came into contact, for help or advice. When speaking about how she had gotten over hardships in graduate school and why she had been so successful thus far, Julia said that "giving up" was not an option. She added:

> I just think of my character, like my personality. I'm not necessarily one to sit back. I know everyone experiences problems and I've had my fair share. But I'm not really one to sit back and whine and complain about it. I'm all about solving the problem… Opportunities aren't necessarily always presented to you on a silver platter. Sometimes you have to go out and you have to search for those on your own. And I put myself in places where I could meet my colleagues in the dental school or the med school. So I believe in stepping outside of the box. – *Julia / Black, Ph.D., Genetics, HBEU*

Julia also actively sought resources to make up for the shortfalls in her program and get the training and experiences she needed:

> [The faculty] are overworked and underpaid. And I know that they're overwhelmed, so they can only help us so much. So we really have to sometimes go outside of [Historically Black Eastern University's] doors and find help or find support or find other mentors. And that is also part of the responsibility of the individual. I knew when I came to [this city] that I wanted to get my foot in the door at [a particular research institute]. And I knew that I was going to have to do part of my own research and present some of those ideas to

> my faculty members to see if they knew individuals in that particular institute. – *Julia / Black, Ph.D., Genetics, HBEU*

HBEU students additionally learned to gracefully manage their relationships with faculty; part of effective self-advocacy was to go after what was needed while at the same time being aware of the hierarchical power dynamics wherein faculty had the upper hand. In speaking about their faculty advisors Issac and Morgan shared:

> [Relationships with faculty are] definitely, definitely dependent on the particular person you're dealing with... And the politics are very key. And being aware of those personalities is on some level what helps you navigate this experience. – *Issac / Black, Ph.D., Chemistry, HBEU*

> You have to build relationships with multiple professors in order to get what you really need. And that's just because I was straightforward. And people have to hone their own talents, and whatever their passion is... And I know people [who] always advise, don't tell them that you don't want to be a professor. But I did, because the other option is not to get the skills to do what I need to do when I get out of here. – *Morgan / Black and American Indian, Ph.D., Pharmacology, HBEU*

Likewise, LSU students had a variety of ways of handling an advisor who was unreasonably demanding or absent. In the next quote, Evan demonstrates how he gently set boundaries with respect to his time with his advisor – a tactic that likely wouldn't work with all advisors:

> I try to let [my advisor] understand that, 'Okay, I cannot do that like you want.' 'Why?' 'Because I'm taking classes and because I also want a life. I'm not staying here 24/7. I always have a break for lunch. I like to do some exercise and different activities that will allow me to have good performance at school… At least me, I'm not going to do the good things or be the best me if I only do one thing. So I explained that to him and he's like, 'Okay, okay, just try to do your best and I want to see some results next week.' Sometimes he forgets what I tell him and I tell him again. [Laughter] So yeah, I've been learning to how to handle him – how to talk to him. – *Evan / Latino, MS, Electrical Engineering, LSU*

On the other end of the spectrum was an advisor that did not demand much, forcing the student to take a great deal of initiative to be productive with research, as Brianna explains:

> Sometimes I just keep asking [my advisor] – I'm one of those people like… 'Let me know what we need to be doing. Where should I be at?' I could easily spend two years here and not do anything and nobody would do anything [about that]. I'd suddenly be like, 'Oh, I have to do research? What? How do you do that?'… You have to take the initiative in our department. – *Brianna / Latina, MS, Industrial Engineering, LSU*

LSU students also had to rely on their own initiative when their advisor wasn't aware of program requirements or when they simply weren't around enough to meet with students:

> My advisor didn't really know [what I needed to do], so I just had to figure it out on my own. No one really knew what was going on. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

With respect to an absent advisor, LSU students learned to rely on colleagues for feedback on research and advice:

> With respect to the quality of the research, I've got a ton of other colleagues all over the country I collaborate with and who help and give me advice. So the research is not suffering, but the relationships that we have definitely are. – *Steven / American Indian, Ph.D., Fisheries Ecology, LSU*

Steven was especially resourceful in that he was able to create relationships with 14 Ph.D.s on an external biology committee who were interested in working with graduate students. He explained, "They're actually professional biologists that are within federal and state agencies, private affiliations, private consultants." These colleagues, who were not related to any university, offered Steven "that perspective of what…[he] should do academically and what's really possible." Steven shared that he was in regular contact with these external individuals who both had a vested interest in his research and who didn't mind if he called on them to bounce off ideas.

Like Steven, Alexis relied on others, namely peers in her program at LSU, to look over her research when her advisor simply did not have time to do so. It was still frustrating, however, to have an unresponsive advisor:

> I had finished my journal article and I was going to submit it. [My advisor] hasn't looked at it once. I've been constantly bugging him. I've had other students in our group who have published in our research group but [with a] different advisor. We came up with questions. I sent him those questions. He never answered. I'm supposed to graduate. I keep pushing. I've even approached the department head… why he hasn't looked at it, I don't know. He still, to this day, has not looked at it. – *Alexis / Latina, MS, Physics, LSU*

In a response to a caring, but busy advisor, Maria also learned that she needed to be quite independent in maintaining progress with research and choosing classes:

> [My advisor is] very lenient. He's very flexible. So you have to be very independent… he tries to have like a lot of face time with the students in his lab but his lab is huge and everybody is usually consumed in their individual projects. So you have to be very independent and working on your projects. – *Maria / Black, Ph.D., Biomedical Engineering, MU*

Maria, who attended MU, also reported that she learned to seek advice from other people, including peers and faculty, for additional perspectives on challenges she encountered. One of her mentors was a faculty member with whom she took a course who "adopted" her; this particular faculty member belonged to the biomedical science department, which was closely affiliated with biomedical engineering. Maria also became more affiliated with professional groups and learned to ask around and inquire before pursuing any major decisions.

Like Maria, Cooper needed to expand the people he relied on for advice and mentorship. His narrative shows, however, that he was very aware of departmental politics at MU, wherein asking another faculty member for advice could potentially offend an advisor:

> If I wasn't that proactive in getting information from [my PI], I would never get it. She's been very helpful for me getting post-doc and getting other different opportunities, but as far as, "Hey, how did you do this?" and "What were you thinking about at this point in graduate school?" – those types of things – even if you ask her it's like pulling teeth to get the type of answer that you need. So that's when you have to realize there's other people you can talk to – other professors that are much more helpful. But you have to be very careful because everyone's friends in that department, so they might say, "Oh, Cooper came and talked to me about this" and it's going to get back to her and make her feel like crap. So understanding your departmental politics when you ask questions –

> and I feel like I shouldn't have to be in that type of position. – *Cooper / Black, Ph.D., Chemistry, MU*

Likewise, Jake was both learning how to best interact with his advisor and also building relationships with other faculty at MU in order to get the mentorship and feedback he needed:

> I'm also doing or starting projects with another faculty member and one of the reasons I came here was because the psychology department is really great about collaboration and doing interdisciplinary stuff. So this is another young faculty member who's been really supportive and helped me out and helped me streamline my ideas a lot. He's just been helpful. – *Jake / White and Latino, Ph.D., Cognitive Psychology, MU*

Colin relayed that his advisor was only in name and that he didn't have any meaningful mentorship at MU, which he attributed to his position as a master's student as opposed to a doctoral student. Although he was ultimately able to get the information or advice he needed, it was due to his proactive approach to asking questions until he found an answer and his resolve to find a mentor:

> I'm only going to speak to our program and recognizing that I've only been here for less than a year. A lot of the mentoring is really focused on Ph.D. students. I feel like if they know you're a Masters [student], they really don't care that much, whether they're providing the funding or not. And for me, I've had to find people that are doing what I'm interested in. If I just want to talk about a subject, I have to go find those people and talk to them. But it's really not a big deal to me. I know the people that I want to talk to and most of the time they make themselves available. But you're not going to get anyone who's going to come and tell you, "Hey, I could be your mentor." You have to look for them. – *Colin / Black, MS, Industrial & Operations Engineering, MU*

Jasmine knew when to call it quits with an advisor who simply was not providing the mentorship she needed:

> The advisor that I have now, I switched. So my relationship is very, very good with my current advisor. But the one before that, not so much. He was a great person but he was just entirely too busy to have grad students. So I recognized that and saw that I wasn't getting the mentoring that I needed, so I just made the switch. It was an amicable switch. – *Jasmine / Black, Ph.D., Computer Science, MU*

What the preceding narratives demonstrate is that as apprentices in the cultural norms of academia, students at all three institutions relied on advisors to step in when they could not help themselves due to lack of skill, savvy, information, or resources. Faculty who did not have time for students and therefore did not advise students in ways that helped them feel like they could overcome challenges they confronted in graduate school, made these students more vulnerable to making frustrating time-consuming mistakes. As Austin – a Black doctoral student in mechanical engineering – relayed, lack of faculty support perpetuated a feeling that he was "thrown into the ocean…with no life vest."

Power Dynamics in Students' Relationships with Peers

Another set of relationships that were additionally comprised of power dynamics was with peers as they also had the capacity to support or constrain students in ways that pushed them along in their degree programs – representative of a positive use of power and balanced power relationships – or in ways that dragged them down, which is representative of negative uses of power.

Peer Power to Facilitate Degree Progression

As noted previously, actions by peers that support the degree progression of students are representative of the absence of negative power dynamics among peers and of a more equal (and often times collaborative) peer environment. At HBEU, students went out of their way to ensure that their lab mates and classmates met academic goals (Audrey and David) and prospered (Hunter and David) by helping each other with class work and acting as free sharers of knowledge (Julia and Savannah). Like students at HBEU, students at LSU also pushed each other in supportive ways (Benjamin and Steven), relied on each other to elevate their work (Steven and Landon), and shared knowledge when it came to understanding disciplinary

material or procedural skills (Benjamin, Liam, Mason, and Lauren). Lauren and Avery, both at LSU, were grateful they could learn from their peers:

> I communicate with people if I don't know a certain [research] technique and I know there's a certain person in a different lab that knows more about it. I would go over there and ask them for their advice. – *Avery / American Indian, MS, Biology, LSU*

Furthermore, Landon relied on his peers to improve his research, Benjamin spoke to peers who took a class in a previous term for advice on how to survive, and Evan relied on teamwork to get class work done:

> I realize… you can help each other with homework. So… I have friends and sometimes we divide homework so we can finish everything quicker and at the end we can explain to each other what's going on with problems. I like how I interact with people over there in my department. – *Evan / Latino, MS, Electrical Engineering, LSU*

At MU – discounting stories regarding interactions with international students which will be shared under the next thematic heading – there were also many stories wherein students casted their programs as collaborative (Aaron, Austin, Hayden, Kate, Charlotte, Amelia, Sean, and Abby), which outnumbered stories that casted programs as competitive (Dominic, Chase, Brady, Cooper, and Jasmine). The manner in which programs were cast is indicative of the power dynamics among peers, with collaborative programs being suggestive of more balanced power dynamics among peers and competitive ones suggesting that some peers had more power than others and used that power to their advantage. For example, students in a number of MU programs didn't hesitate to help out one another partly because they were helped in the past and the help was instrumental to their success in their graduate programs; in short, they wanted to pay the favor forward. Further, if Austin's claim is true, – that as a doctoral student in mechanical engineering much of his learning of lab techniques came from peers – then

collaboration made progression through the graduate degree easier. Indeed, being able to rely on peers for help with lab work and completing coursework was beneficial:

> We just decided [to] get some of the other students involved [to study], so we formed a collective undergrad environment (i.e. we formed an environment similar to how we collectively studied when we were undergrads)…For some of our intro classes that everyone took that were very intensive… we would get together and have study groups with different people. So even if I didn't always interact with them socially, at least on an academic [level] we could get together and compare homework. So that was helpful for getting through some of the coursework. – *Sadie / Black, Ph.D., Biomedical Engineering, MU*

As a whole, supportive behaviors were empowering to students as they helped students get through their coursework more easily and made graduate school enjoyable or at least more tolerable. Indeed using peers to one's advantage was a great use of agency to get ahead, period – not simply as a response to an absent advisor.

Not coincidentally, students who were able to count on peers to fill gaps in information and worked collaboratively with peers within their program, also tended to feel appreciated and respected, and seemed to enjoy graduate school as demonstrated by the positive depictions of their experiences. At MU for example, Aaron noted that he "hadn't had any problems" in his program, Amelia shared that graduate school was "really good," and Hayden described his program as being "like a family." Furthermore, across the three institutions, meeting with peers for schoolwork served as a social outlet of sorts for students, with peers having the potential to serve as important sources of motivation and friendship (Audrey and Savannah from HBEU; Benjamin, John, Evan and Landon from LSU; Hayden and Amelia from MU). In recognizing that as a master's student he'd be spending a lot of time with those in his electrical engineering program, Evan, a student from LSU, decided the best thing to do was to create friendships with them. Friendship with other students in the program was a motivator "to help keep going [forward]" according to Benjamin who also went to LSU but was pursuing a Ph.D. in industrial engineering. With a few words, Benjamin demonstrates that the extension of friendship to

another person in one's program was a demonstration of power because it shaped how other students perceived life as a graduate student and influenced their progression through the degree program.

Peer Power to Make Degree Progression More Difficult

MU was the only institution, wherein students talked about peers in ways that suggested that peers behaved in a manner that made progression through their graduate programs more difficult, which is indicative of a negative use of power and an imbalanced, competitive peer environment. Students in competitive programs could not trust peers to care when they were struggling academically (Dominic), craving social relationships (Carson), or needed people with whom to study and complete class work (Jasmine). Not coincidentally, these students reported distancing themselves from the people in their programs. As Jasmine – a doctoral student in computer science – noted, "you won't catch me at a big department event or something." Similarly, Austin actively avoided social situations with people in his program because he reportedly realized that he really didn't have anything in common with them.

Furthermore, at MU, there was a rather large division between international students and underrepresented racial minority students. While not ascribing motives to the actions of international peers, in which they seemed to exclusively study together to the exclusion of URM students who had requested to join these groups, what is clear is that they amassed a great deal of power simply because they comprised a greater numerical proportion of many of the graduate programs. In some programs, international students seemed to only offer help if they were point blank asked to provide it *and* if they also saw that they stood to benefit from the knowledge processed by the asker of help. Asking for help and receiving help in essence became based entirely on the ability to exchange information as a commodity. It was the mentality of, 'I will help you only if I have something to gain from you.' Because of international

students' lack of warmth and reluctance to help, the URM students seeking the help knew they were not welcomed into those peer groups (Dominic, Chase, and Sean). By "politely" declining requests to join their study groups, international students were exclusive in a manner that also allowed them to save face in the eyes of the participants of this study. Indeed, many URM students casually shrugged off exclusion from international peers – and didn't view it as being a problem – because they chalked the exclusion up to cultural preferences for studying and therefore natural. Nonetheless, by not being inclusive in their informal study groups (and socials to a lesser extent), international students guarded knowledge that would have helped URM students be successful and created an environment where students felt unwelcomed by their peers (Dominic, Carson, and Brady).

Student Resilience as a Powerful Force to Overcome Peer Barriers to Degree Progression

In recognizing that peers were critical to being successful (and relatively happy) while in graduate school, some students made an intentional effort to build relationships with others in their department:

> If you can't tell I'm definitely outgoing. So I've been in classes where there may have been classmates that weren't necessarily as social as I am, but I can pull it out of them. It's just a matter of me opening up and talking to them. They open right up and share. – *Savannah / Black, Ph.D., Microbiology / HBEU*

Some students also made a point to seek friendships with students across campus, even if they were in a supportive graduate program. Charlotte made friends via informal channels:

> I came in through the genetics department even though that's probably not the department I'm going to go into. So I made friends with one of the genetic counseling students who take genetics classes with me. And then she went to undergrad here, so she knew a lot of people. So I made friends through her friends. So I have a whole lot of friends who are in economics [and] that are in business. I have a friend that emailed me that was like, "My friend is going to business school over there. You should contact him." So I was like, "Okay." So

> I contacted him. So like I'm friends with him now. – *Charlotte / Latina, Ph.D., Biomedical Sciences, MU*

Further, because students had different levels of success in cultivating relationships with peers within their programs, they used their agency to ensure that they had a supportive social group nonetheless. Chase, for example, sought friendships off campus:

> Interestingly the community or the people that I hang out with are not the people in my research group... It's a group of friends from a church community. I have a couple rec sports that I play on. There are a couple engineers in the bunch. But it's definitely not like I went to the people in school and the people that I relate to the most… tend to not be the community that I hang out with the most. – *Chase / Latino, Ph.D., Electrical Engineering, MU*

Issues of Gender and Power

Although topics of gender weren't specifically a line of inquiry in the original research questions, a critical lens recognizes that multiple identities (race, gender, etc) coalesce to inform a person's experience within a physical space. After the initial coding of the data, a theme emerged that indicated gender played some role in the way students' experienced graduate school (RQ1) and the power dynamics within their programs (RQ2). I therefore report students' narratives pertaining to gender here.

At each institution, several female students noted that they were underrepresented at intersections of race and gender in STEM as a discipline or in their specific programs:

> I can say [my different identities] probably enhance what I do in a sense. If you think of just solely genetics, and me being an African American and being a woman, then I am one of the few minorities in the field. – *Julia / Black, Ph.D., Genetics, HBEU*

> In my field, there are not a lot of female researchers, let alone African American female researchers. – *Audrey / Black, Ph.D., Genetics and Human Genetics, HBEU*

Brianna – a Latina masters student in industrial engineering LSU – felt "more like a minority being a woman than being Hispanic" when it came to the diversity within her program in

industrial engineering. In other words, from Brianna's perspective, there were fewer women in her program than Latinos. Similarly, for Amelia, gender trumped ethnicity with respect to how she experienced graduate school:

> I don't think that I feel a conflict with [being a Latina/Native American person in science]… I just think of myself as a person and really more as a woman in science rather than a certain ethnicity who's gotten this far. – *Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology, MU*

Lauren, who was in molecular biology, relayed that she was "the only female graduate student" her advisor had at the time of the interview. Interestingly, Maria, who was in the male-dominated field of engineering, felt fortunate to have a small group of other Black women start the program with her. Having these women to rely on for support was helpful:

> Actually from my cohort, [Laughter] I was very lucky because there was a good amount of African-American women to make me feel that I belong and I still know this cohort of women to this day and there was maybe four or five of us. There's also certain organizations [for graduate students… that the College of Engineering is very supportive of… and that sort of helps as well. So my experience has been supportive for the most part. – *Maria / Black, Ph.D., Biomedical Engineering, MU*

Charlotte recognized that although women were underrepresented in STEM as a whole, some disciplines did a better job at reaching gender parity:

> [Being a female minority student], it's more difficult if you were a woman in engineering or in physics or something where you're definitely the minority. In biology, in the biomedical sciences, you're not necessarily in the minority. There are a lot of women. There's women PIs, there's very successful women scientists. – *Charlotte / Latina, Ph.D., Biomedical Sciences, MU*

A few men also noted the gender disparity in STEM. Evan, for example, saw that women were underrepresented in STEM but the manner in which he phrased his observation made it seem as if it the lack of women in the field was a matter of coincidence and inconsequential:

> In my area, it's very, very weird to find women… I don't know why. It's not of their interest, but I don't feel apart (i.e. treated differently) or anything like that. – *Evan / Latino, MS, Electrical Engineering, LSU*

It's not surprising that Evan reported not feeling as if *he* was treated differently in his program due to his gender seeing as he belonged to the dominant gender group. Similarly, Tristan and Colin were aware that a strong presence of women was lacking in their disciplines within physics and engineering respectively. Both seemed to imply that there was a problem with the gender disparity, but the concern was presented as more of slight nuisance rather than an issue that deeply affected their graduate experience:

> Physics has been really bad with having enough women in it for a while. And so I think that having realized that, because even the young professors are able to sort of tell and nudge the older professors into realizing that. – *Tristan / Black and White, Ph.D., Physics, MU*

Colin, in noting that there were few females in his engineering program, wished there were more women to hang out with socially as he was tired of hanging out with a group of only men:

> One of the downsides is most of the people that I hang out with are the same people that I'm in classes with, the same people that I see all the time… It's all engineering [people], and sometimes we'll be sitting in a group with a bunch of guys who are like, "Isn't there any women in our programs that we could be hanging out with?" And then the same thing happened again the following week, and so you just get used to it. – *Colin / Black, MS, Industrial & Operations Engineering, MU*

Not surprising there was also very few female faculty in students' programs. Alexis indicated that there were no female faculty members in her department:

> The faculty, they're all male. We used to [have a female professor]. She was really easy to talk to, but she left because she got a position at [a more prestigious university]… So now it's back to all male. The only people that are female [in the department] are the secretaries. – *Alexis / Latina, MS, Physics, LSU*

Brianna was excited that with respect to an open faculty position in her department, two of the three candidates were women. She was hopeful that there would soon be a female faculty member from whom she could learn.

Female students at all three institutions also commented on the implications of the gender disparity to how they personally experienced STEM or their programs. Victoria had two important observations to share. First, she saw her calling to be a scientist as something reserved only for unique people who shared her gender and racial identities, something in which she seemed to take pride:

> To be a successful Black chemist and a woman on top of that, I think that that attracts people who can be like me or who are interested in being successful. – *Victoria / Black, Ph.D., Analytical Chemistry, HBEU*

Second, she noted how her unique positionality was associated with the general treatment of women in her field and later in her specific program:

> In general, we have a very hard time as women [especially in the hard sciences]. Absolutely. Throw [being] Black in that and that just makes it a hundred million times worse…The women [professors] are a little bit more protective [of the female students], but we don't have that many women in the chemistry department. So, I have a mentor who is a woman, but most of the men are really tough on the women. But it could be more how men communicate versus how women communicate, so I have to take that into consideration, as well. – *Victoria / Black, Ph.D., Analytical Chemistry, HBEU*

In Victoria' department, the fact that men were "really tough" on women is noteworthy since there were many men compared to women, and the cumulative effect could potentially result in great disadvantages for women. Instead, she attributed the treatment of women to gender differences in communication style, giving male professors the benefit of the doubt rather than attributing different treatment to actual power dynamics or intentional ways of holding women to a different standard.

With respect to how female minority students were treated within their STEM programs, Brianna offered an opposite perspective than that shared by Victoria, and indicated that she hadn't personally noticed any difference in treatment between the female and male students in engineering. She had overheard, however, male engineering students express the sentiment that "teachers favor[ed]" the women. Alexis was also asked whether the male faculty were supportive of the female students. Her response was as follows:

> I don't know. It was one of the [male] professors… that directed me to [my current research position] and that's how I got involved in research in the first place. But I sometimes wonder if some professors use it to their advantage when they work with [female students]. It's a good thing [for a PI] to say… that you have a woman working for you that's also a minority. – *Alexis / Latina, MS, Physics, LSU*

In other words, Alexis seemed to be of the opinion that women were provided favorable research opportunities not because the graduate program wanted to be fair in how students were treated and how research opportunities were allocated, but because the PIs were interested in gender diversity simply as a means to gain access to lucrative government grants. Alexis was the only student to suggest that there was some commodification of women in her department.

Jasmine was far more vocal about how having two identities that were in opposition to the norm (that of being female *and* Black instead of being a White male) affected her experiences as a doctoral student in computer science (Ginther and Kahn, 2012; Liefshitz et al., 2011). Often times, according to Jasmine, her requests for inclusive gendered language and recognition that women were even present were ignored, making Jasmine feel as if her program did not highly value female students:

> I'm in computer science [and] it's a very male-dominated field. Whenever there's hypothetical situations, students will always say, "He." People always say, "He." Talk about an advisor – well, now we have two women faculty. But we used to only talk about one. And whenever somebody would talk about an advisor,

> they'd say, "He." And that really gets on my nerves. And I always go, "He or she." And then as soon as I said that, the very next question someone answered, they went back to the "He" again. "Did you not just hear what I said?" It's not a very inclusive environment if you're someone who's not White or Asian or a typical race that dominates computer science. Or if you're a woman. And actually, this year for the prospective [students], there was one woman out of 55 students. There was exactly one woman. Exactly one. So I can only go by what I see. But I just feel like they don't want women in the department. I mean that may very well not be the case, but I don't know. – *Jasmine / Black, Ph.D., Computer Science, MU*

Jasmine shared another story of being completely overlooked by male colleagues at a social event. Being a female, particularly a female who was Black, meant that she was often times ignored or treated as invisible, which is further demonstrative of a culture of insensitivity towards minority women in her department and is indicative of the structure of control:

> We have department teas and stuff. And I was in there one day and I'm helping to set up the tea because the friend that I have is the graduate student group leader and he asked me to help set up. And so one of the guys goes, "There are no girls in here. Where are all the girls?" And I'm like, "Am I not standing here?" – *Jasmine / Black, Ph.D., Computer Science, MU*

Exclusionary practices, that initially seem inconsequential (e.g. saying "he" rather than "he or she"), conveyed the subtle and persistent message that women were not embraced in the department but perhaps merely tolerated. The fact that the administration or faculty were not willing to recognize the gender bias in their behaviors and the behaviors of other male students and were not willing to take appropriate action, marginalized and disempowered women even further. Men, as the dominant gender in Jasmine's department, seemed to hold the power to establish who would be recognized and accepted as having a legitimate presence in the graduate program.

Jasmine's narrative showed that when students did not see others like themselves across racial or gender lines in their department, they sometimes concluded it was because their department did not value diversity or did not care to include people from diverse

backgrounds within the academic community. After having less than enjoyable interactions with the male students in her department, Jasmine eventually joined professional organizations geared towards women in science.

Issues of Race and Power

The issues of race/ethnicity and racial diversity emerged as important themes as race informed the power dynamics in students' programs (or within the field generally) and was manifested in the training and educational experiences of students at LSU and MU specifically. In this next section I will first discuss how students spoke about diversity and the representation of minorities in STEM across the three institutional types. I will then discuss the treatment of students as being included or excluded within their programs at MU and LSU (HBEU students did not comment on this point). Since students at MU spoke far more extensively about race and ethnicity, I will next discuss three additional themes that only emerged at MU, the first being experiences with race-related conflict, the second being the ambiguous nature of discriminative experiences, and the third being positive aspects of the graduate context for racial minorities amidst an environment where it was widely known that at least some URM students felt marginalized.

Diversity and the Representation of Minorities in STEM

How students spoke about diversity and their views of the representation of minorities in STEM differed widely by institution. At HBEU, students simply commented on the phenomena of underrepresentation within their field generally, but understandably not with respect to their particular programs because the institution is quite diverse as a historically Black university. Students at MU also spoke about the phenomena of underrepresentation but within their programs specifically. Alternatively, students at LSU offered remarks regarding the abundance of compositional diversity in their programs and at the university overall. Because the students

at each institution spoke so differently about diversity and the representation of minorities in STEM, I present their narratives by institution beginning with HBEU, then with MU, and finishing with LSU.

The phenomenon of underrepresentation within the discipline as told by HBEU students. For the most part, graduate students at HBEU didn't talk about the racial diversity of the campus, perhaps because it wasn't perceived as a salient issue to their experiences since it was such a normal part of their graduate lives. Black students at HBEU were extremely aware, however, that STEM as an overall field was racially homogenous with few minorities:

> With regards to at least the physics community in which I can speak, I think the data are something like African American and Hispanic physicists constitute about less than two percent of the number of physicists currently out there. So it's interesting to me because I sometimes resist the label of a scientist because I recognize with that label comes a certain perspective, a certain worldview. – *Brody / Black, Ph.D., Physics, HBEU*

Brody wanted to add to the diversity in his field with his presence and with socially responsible research. In his view, science was not a precise field (although some believe it to be) and is based on the interpretation of data; thus, the racial background of scientists informs how people "do" science:

> [For many people, their] worldview is often very much associated with if I can't observe it, or even if my interpretation of the data leads me to realize that something doesn't exist, then it doesn't exist. Let me give you an example. If a physicist who isn't concerned with racial issues in America looks at the data, they might easily interpret, 'Oh, well African Americans and Hispanics can't cut it. They're not physicists because they just can't do it.' Because their interpretation of the data is limited to their worldview of what it means, then of course [only] the 'smart' people will become physicists. Then that, to them, leads to an interpretation. And so the problem with science is that it's only as good as the amount of information that you're taking in, which is always limited. – *Brody / Black, Ph.D., Physics, HBEU*

According to HBEU students, the lack of representation among minorities within STEM maintained larger societal notions of the roles Black individuals should or could play with

respect to science and academia. Although the examples students provided did not occur within the physical space of the university, David, Camryn, and Kaelyn all touched on how not fitting the mold of their discipline had affected them. First, according to David, there seemed to be a widespread perception among other U.S.-born Black folk that an interest in reptiles among African Americans was not only incompatible, but also somehow absurd:

> I'm a Black person and I'm working with snakes. And for some reason it seems that a lot of Black Americans in particular have an almost extreme aversion to snakes. I'm not going to say completely phobic but pretty much [they think], "Those things are bad, they're evil, kill them." So for instance, the first summer that I went to Arizona and I took a picture of the first rattlesnake that I had worked with and put it up on Facebook, "Look what I got to handle today." My wall lit up with comments of, "Have you lost your mind?" "Black people don't do that shit." And like, "Negro are you crazy?" And it was funny the first time. But when I got like 20 of them, [I was] like okay, this is really a problem. This is part of the reason I decided [that I eventually want] to put together a research training program…to introduce other minorities to fields like ecology. So there's a conflict… at least among Black Americans. – *David / Black, Ph.D., Animal Behavior & Ecology, HBEU*

Camryn and Kaelyn similarly spoke about the surprised reaction of former White students when students discovered that they, as Black women, were their science instructors:

> Before I decided to get my Ph.D. – when I was teaching, which was my most influential experience – a lot of the students would look at me. First of all, I'd walk into class, because I was their instructor. I was their professor. They would tell me, "Well are you just the TA?" They would ask me, because I don't look a certain way. I don't fit the mold of what a professor or an instructor should look like. I'm not a White male. I'm not middle-aged. So they were concerned and a bit confused as to what I could possibly be doing there. – *Camryn / Black, Ph.D., Pharmacology, HBEU*

> When I walk into the classroom, I don't fit that mold…I remember my first time ever teaching and it was in [a state in the Midwest that was] two percent Black. I walked in [the classroom]…and I go to the board. And I will never forget the look that these eyes were like, 'Are you serious? Are you the TA?' And I said, 'Yes, I am.' And I just started teaching. So you can actually have an impact on non-minority students, because they're like 'Wow!' They've never seen a Black woman teach at the collegiate level, because there were not a lot of Black professors there. –*Kaelyn / Black, Ph.D., Biology, HBEU*

From the reactions of others, Camryn and Kaelyn knew that they did not fit the mold of what it meant to be either a science person or a person who had the authority to speak on STEM-related issues. Because African Americans did not fit "the mold," it was easier for others to question the intellect of Black academics in science:

> My advisor, he's been among all these folks [in the discipline] – but for him, it's why he's at [HBEU]. He's at [HBEU] trying to do research at the cutting edge level, but when he goes to those places, he doesn't feel comfortable. And there's a presumption of ignorance until proven that you're competent. So that's the issue. – *Brody / Black, Ph.D., Physics, HBEU*

Audrey also felt like she was viewed in a slightly negative light at conferences in her field because of race. Although she says she was not concerned with the views of others, the fact that she only stayed around for what was necessary says otherwise:

> I can honestly say I don't pay attention to how they view me. I just go to conferences and get what I want and leave. When I go there's just a lot of Caucasians or Asians and there's little ol' me sitting in a corner…I'm really not paying attention to what they really think about me. I'm not observant enough that way. I just take what I need and go on my merry way. – *Audrey / Black, Ph.D., Genetics and Human Genetics, HBEU*

In all, students' narratives from HBEU demonstrate that larger societal forces impacted students (i.e. discrimination and the seemingly incompatibility of a Black person who also has considerable expertise in a STEM discipline). However, having a supportive and safe learning institutional environment insulated students somewhat from experiencing the negative impact of discriminatory perceptions.

The phenomenon of underrepresentation in one's program as told by MU students. Seeing as MU is a predominately White institution, it was no surprise that a number of MU students talked about there being few racial minority students in their programs specifically and at the institution overall:

> Here in [MU] there's not a lot of African American or Hispanics walking around. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

> I'm the only African American student [among] the current students in my graduate program. – *Brady / Black, MS, Electrical Engineering, MU*

> The majority of my program is international students – South Asian or East Asian. And so there are a few White American students and then there's myself. I don't think we have any Black or Latino people…So that's sort of the demographics of my program. – *Carson / White and American Indian, Ph.D., Bioinformatics, MU*

> Being part Native American it's really hard to find other people who are also Native American or the same background [in graduate school]. – *Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology, MU*

Being aware she was underrepresented and only one of a few people on campus mixed with Native American ancestry, Amelia would "just try to steer towards whoever [she] can identify with" instead of trying to find other Native Americans with which to interact. Overall Amelia said she really didn't "think about [her] race that much in general." In contrast, Charlotte purposefully sought out "friends that [were] Latin," which she said was personally important thing for her to do while she was in her program. Dominic was also aware of his underrepresentation:

> In my department, I don't think there were any minority students ever before. I think me and a friend were the first ones. – *Dominic / Black, Ph.D., Electrical Engineering, MU*

In Dominic's case, not only were there few URM students but also few URM faculty. With respect to his engineering department in particular, Dominic said:

> When I was in my undergrad, there was only one Black electrical engineering professor. For some reason, I just remember that vividly and then when I came here, I wasn't expecting much. I was like, "Okay, yeah, it's probably going to be the same." So far I've only known two African-American professors in electrical engineering, that's it. And I don't really interact with them that much because they are in a different field. But it's expected. I know that this is how it's probably going to be for a long period of time… I've never had a class with an African-American engineering professor before or an African-American science professor so… I don't know how it's going to be... I'm hoping it may be different. But I do

know there are a lot of non-African-American professors. – *Dominic / Black, Ph.D., Electrical Engineering, MU*

Maria, who was in the same focus group interview as Dominic, explained why having Black faculty was important to Black students in engineering: "The faculty members that are African-American, you make an effort to go out and seek them and find them and to at least speak with them or say, 'Hi, I'm here,' and they can serve as sort of a role model."

There were also a number of MU students who seemed to be relatively satisfied with the level of diversity present on campus and in their respective programs, although the definition of diversity was sometimes expanded to include more than simply race:

> I would say for me from a lab perspective…we're fairly actually diversified in terms of ethnicity, even sex as well. So it's interesting. – *Sean / Black, Ph.D., Mechanical Engineering, MU*
>
> In [my] physics [department] it's much more diverse. – *Tristan / Black and White, Ph.D., Physics, MU*
>
> [A student] told me about applied physics. And when I got to applied physics…I talked to the director… he put together a lunch of students of different backgrounds and right away I was surprised that I didn't feel like I was the only one. I felt like there were a few more people like me. And over the years, I have seen applied physics has been one of the best programs in the university when it comes to diversity, especially recruiting minorities and retention. – *Brandon / Black, Ph.D., Applied Physics, MU*
>
> The smartest guy in my department is from the Congo and then the second smartest guy is Jewish and the department head is Chinese. My advisor is a French woman. So there's a lot of diversity of cultural backgrounds. Everybody's really smart, though there's no [racial] diversity there. There's certainly diversity of culture. – *Hayden / Black, Ph.D., Aerospace Engineering, MU*
>
> Pharmacology's good [when it comes to diversity]. We usually have a lot of minority students entering the program and graduating from the program. Faculty-wise I think it's less diverse. – *Kate / Black, Ph.D., Pharmacology, MU*
>
> I never feel like a minority. In my lab, there are eight people and there's only two that were born here in America. [So it's very international.] My advisor's from Paraguay, so I speak Spanish with her. – *Jordan / Latino, Ph.D., Ecology and Evolutionary Biology, MU*

> Half of the students in my program are international, so it's quite diverse. – *Colin / Black, MS, Industrial & Operations Engineering, MU*

> In terms of how diverse the campus is…it's pretty multicultural. It's pretty open to different [people]. At least in our department, I have never felt a separation. We were accepted…. My lab is pretty diverse. We have people from India, me, from the US, from different places. – *Abby / Latina, Ph.D., Pharmacology & Cellular and Molecular Biology, MU*

Being that racial minorities are underrepresented in STEM, it was no surprise that students also talked about not fitting the mold of who a science person was, which coincides with the narratives of students at HBEU. Like their HBEU peers, students at MU spoke about not fitting in, in a general sense:

> When most people meet me, the first impression they get is that, 'Oh, I'm not in engineering or science... one of the reasons [for this is] because I'm African-American. So that's why they initially don't believe it. If I go to the bars down here and I start speaking to people they ask me what do I do. I'm like, "Oh, I'm in engineering." They're like, "Okay, really? What kind?" Electrical. And they're like, "Undergrad or grad?" Grad. And then they're like, "Oh, okay, so I'm assuming your master's." I'm like, "No, I'm not master's, I'm doctoral." So they seem more and more surprised about where I am. But I get this all the time so I'm used to it already. – *Dominic / Black, Ph.D., Electrical Engineering, MU*

> What's more interesting is the conversation I like to have with people is when you get the question of you're Black *and* you're getting a Ph.D. in physics. – *Brandon / Black, Ph.D., Applied Physics, MU*

Seeing as a number of students seemed to not fit the stereotypical notion of who a scientist could be, it was not surprising that several had experiences with others within the academy wherein their intellect, commitment to science, or the merits by which they were admitted was questioned:

> Race is a big one just because you just don't see a lot of African Americans in engineering… And it's a conflict because within the academy itself there's people who question your ability…It's probably in a general context [that people question my ability based on my race]. I can't think of any particular incidence where it's shown itself here… Like when I've been on my internships for example, it's like, 'Can he pick up on this or that?' And what might have helped is that I've been blessed to have an extremely high GPA when I was an undergrad, [so] it's hard

> to argue with something that's objective like that. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

Similarly Dominic, a Black doctoral student in electrical engineering, had peers that questioned his competency and knowledge in his discipline:

> In most of my classes when I try to ask somebody else for help, the first impression [they have] is that I don't know how to do this… [They think] I'm going to piggyback off of them. And until they hear me speaking, then their impression changes. But it's something I've become accustomed to, being the only African-American in the class. I'm just accustomed to it.

Austin and Cooper encountered individuals who *openly* stated that they did not believe they rightfully earned their awards for financial aid, despite their impressive skill set and previous accomplishments:

> People always say, "Well, you got this scholarship because you're Black." So you just always have to be prepared to answer those types of questions. – *Cooper / Black, Ph.D., Chemistry, MU*

> I've had someone look me in the face and basically say that the reason why I've gotten the fellowships I've gotten is because I'm Black. So I've had to deal with that. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

In sharing the quote above, Austin explained that he recognized that "racial undertones" existed at MU and that racial minorities confronted a "stigma" in the engineering department. With respect to this stigma, Austin coped by "downplay[ing] it in [his] mind."

Understandably, it was highly problematic and offensive that others would think they were not deserving of their place within a STEM program at a selective institution. As Isiah, a biracial student in biomedical engineering, commented: "I consider the path that I took here to be a series of choices that I made. So I don't want to give the impression that any of this was handed to me." This quote is a prime illustration of the differential treatment some students experienced in STEM academic spaces and also demonstrative of a form of stereotype threat in

which no underrepresented racial minority student is seen as deserving of being at the institution based on merit.

Few URMs in a department also meant that those present were hyper visible. As racial/ethnic minority students, Max, Sean, and Maria raised the notion that they felt they were in some ways representing their race at MU because they could feel people watching them. They therefore worked hard to not give peers or professors any reason to believe that they were not academically worthy:

> As an intellectual… [and] an underrepresented minority, there may be some added pressure there. You are representing a lot of people from past generations and current generations. So it's important to keep that in mind - that you're representing your people in a sense so there's pressures associated with that. – *Max / Latino, Ph.D., Biomedical Engineering, MU*
>
> I always feel the need to work harder and outperform other people because I'm aware of the fact that there are some people who question am I supposed to be here, can I really measure up. – *Sean / Black, Ph.D., Mechanical Engineering, MU*
>
> As far as being in class... sometimes I feel that as an African-American you have to do very well in the courses, perform very well because you're representing your race. You're trying to dismiss myths that other people have [of you]… So I feel a little bit of pressure that way. You really want to make it seem that you belong here and that you're qualified – *Maria / Black, Ph.D., Biomedical Engineering, MU*

By working hard to excel in their programs, students were not just trying to signal that they belonged within academic spaces, but were also trying to disprove negative stereotypes about students of color.

Finally, a single student suggested that being underrepresented racially within his department made it harder for him to receive adequate mentorship and guidance from upper level students in his program; this person was Dominic and he was a Black doctoral student in electrical engineering. After seeing more advanced international students mentor novice international students and White students help other White students, in which information "got

passed down from previous students to the current students," Dominic concluded that navigating graduate school would have been more manageable had he had access to advanced URM students in his department. Dominic, in other words, did not have access to advanced minority students in engineering to field questions or ask for advice, simply because there weren't any.

Overall a number of MU participants claimed they were accustomed to being the only underrepresented racial and/or ethnic minority student in their programs and tried to minimize the significance of chilly reactions from faculty and peers. Nonetheless, the narratives offered here and later that touch on exclusion and conflict across racial lines suggest that underrepresentation in a graduate program *does* matter.

Compositional diversity in the campus environment as told by LSU students. Student after student at LSU spoke about the great deal of diversity present both on campus and in their programs with respect to gender, nationality, ethnicity, and race:

> We have very diversified ethnicities and we have both genders – we have [people with] backgrounds from India, China, Japan, and Mexico. – *William / Latino, MS, Industrial Engineering, LSU*
>
> I think there's really good diversity here. I work with people from Nepal, Hispanics, Caucasians, and Asians. Definitely…there's a higher population of minorities here. – *Landon / Black and American Indian, MS, Molecular Biology, LSU*
>
> There's just a lot of international students here. You just get a different perspective. That's very good. – *Mason / Latino, MS, Environmental Science, LSU*
>
> I'd say the majority of students [here] are minorities. – *Cameron / Latino, MS, Mechanical Engineering, LSU*
>
> I know my department is very diverse. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

Diversity in the student body was seen as a positive aspect of students' graduate experience because it provided them with the opportunity to learn from the varied perspectives of others:

> We're pretty diverse and I like the fact that all the students come from different backgrounds. It helps with the interaction because you think differently and you do things differently. You come from a different education. So I know there's a person in my department and his knowledge of statistics is just way far beyond anything that we've ever had in my field. He just knows so much more it's encouraging me to take more statistics. I really think I need to strengthen that. So I like the fact that we're diverse because I'm learning how to work with other cultures and knowing their strengths and weaknesses so I can better myself. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

Curiously, unlike their peers at HBEU, LSU students did not share an awareness that the racial diversity they experienced in their STEM programs was highly unique and was not reflective of the larger STEM discipline in the United States.

Inclusion or Exclusion within Students' Programs at MU and LSU

Students at MU and LSU spoke about experiences with exclusion and/or inclusion at their respective institutions. A discussion of experiences with exclusion will be presented first, which is a point that only MU students shared. I will then discuss narratives shared by several students at both MU and LSU that indicated they perceived they were treated no differently than their majority peers.

Experiences with exclusion at MU. Being that they were typically just one of a few racial minorities in their programs, students at MU were very cognizant of how they were received by others. Austin, Brandon, and Dominic spoke about the general reception they encountered in their programs, which impressed on them that their presence was less than welcomed:

> Before coming here, I spent the summer in the physics department during one of those programs. I'd actually made up my mind I would not come to [MU] to graduate school because I felt really out of place in the physics department. It

> was one of the most well defined, 'We're glad you're here, but we don't really welcome you' thing. Of course no one will tell you that to your face. – *Brandon / Black, Ph.D., Applied Physics, MU*

> Whenever a minority enters the engineering department I feel as if there's already some, I don't want to say stigma, but there's always that, he has to prove himself deal. I wonder how he or she got here thing. Are they filling some quota? It's very subtle. I don't think the university flaunts it. But I definitely know it's there. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

Similarly, when describing his experience of first walking into a graduate classroom, Dominic made the following observation:

> So over here [in graduate school] I walk into a class and everybody just looks at me and they're like, "Oh, okay. This is random." – *Dominic / Black, Ph.D., Electrical Engineering, MU*

Not only did his classmates stare at him upon entering the classroom, but Dominic also noted, "I get this [response] all the time." He added:

> I could just sense that they (my classmates) are looking down on me… So they interact among themselves and they help each other... But for someone like me, I came in not knowing anybody. If I try to reach out to somebody else, I have to be careful.

By making an effort to "play [his] part" and show them that he was "not there to copy" from them, Dominic tried to signal to his peers that he was like everyone else – there to learn and possibly contribute to discussion. Further, Dominic didn't expect the negative reaction from peers to change in the near future as demonstrated by the statement, "I'm prepared to know that this is how it's probably going to be for a long period of time." He attributed the staring and lack of warmth from classmates to negative stereotypes about URM students. Dominic's narrative indicates that non-URM peers appeared to view his presence within STEM graduate spaces as unexpected and perhaps even somewhat threatening. Simply said, being underrepresented along race lines could be a lonely place to occupy within STEM academic spaces. Because he wasn't able to build meaningful relationships with peers in his program, Dominic stated that he

joined SMSG (a minority graduate student organization) because they provided him with some of the social support he desperately desired and needed.

MU students told stories of being excluded on two fronts: one by international student peers and the other by domestic student peers, although it is not always clear which of the two they were referencing (or perhaps both). With respect to international students, Sean recounted how his classmates did not permit him entry into an existing study group for the qualifying exam. At the time, the qualifying exam was comprised of several difficult tests:

> [The department] recommended that to prepare for exams, that you form a study group and work together. And I remember it was a Korean guy I asked, cause he said he had a study group and I didn't have one yet. And I was like, 'Well, could I join your group to study?' And he politely declined. And I was kind of like, "Oh, okay." And this was my first year so I really didn't know a lot of other students. So I was like, "Okay, I might be on my own here." That was a little bit frustrating… we were in the same class together too, so that's why I was thinking [we could study together]. And we had talked about other things. I had shared information with him, so I thought it was going to be an open forum. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

Chase spoke of Korean classmates who were repeatedly unresponsive to his inquiries to meet for research purposes and who were unwilling to collaborate with him despite studying with one another frequently:

> When I joined the [research] group I was the only American citizen in the group and that was maybe like six or seven people. And there was like a Korean clique and an Irish clique. My advisor came from Ireland, so he brought them over from where he used to teach there. And when he first assigned me to a project he said, "Okay, why don't you help so and so out with this project?" I tried. I emailed them a few times. Tried to set up a meeting. But I felt excluded from that. Like he didn't really want me to help on it. I didn't really directly feel like, "Oh it's a race thing" but you do notice that there's a clique of Koreans. They get together and they work on their projects with each other all the time and they collaborate. I feel like, "Well, I need some help too man." Then you ask a question and you get the one line answer. So sometimes you see a little bit of separation within the group like that. At least I've noticed it. And that's still true today. – *Chase / Latino, Ph.D., Electrical Engineering, MU*

Brady, a Black master's student in electrical engineering, had comparable experiences and held a similar sentiment about the role of race in these interactions: "I'm not too sure if it has anything to do with my racial background or the fact that I'm not an international student." Curiously, both Chase and Sean also attributed the rejection or unresponsiveness they encountered from international peers to cultural misunderstandings, instead of racial bias.

Maria echoed the sentiment that international students appeared to study and socialize primarily, and in some cases exclusively, with others of the same nationality to the exclusion of others. She had an alternative experience to offer however:

> [In] pharmaceutical engineering there was a huge influx of international students…[and] if you're very interested and if you try to perform well, they notice that – or maybe they just noticed my effort or my desire to do well, and a lot of times they want to help you to do well…but I haven't sensed direct competition [from them]. And [there will be] some people who are just going to study on their own and don't want to be associated, but then there are a lot of the students that I find are open to working with you. – *Maria / Black, Ph.D., Biomedical Engineering, MU*

Maria added that she found international students to be "pretty welcoming." She admitted, however, "Sometimes I force myself into those groups. [Laughter] And sometimes people will force you out." To enter these study groups, and maneuver around possible exclusion, Maria actively pursued personal relationships with international students before asking to be part of their study circles. Maria recognized that international students often times already had exposure to course material that they seemed to "remember… by heart" and that they "learn things in much more complex sense than we do at a younger age." She noted, "I see benefit in it." In other words international students represented rich sources of information and potential collaborators. Maria also figured that by interacting with the international students, she could identify areas of convergence and divergence in regards to their respective racial backgrounds and thus dispel mutually held racial stereotypes:

> And for me…I just take it as an opportunity to learn about their background and see how we're different and those sorts of things to maybe to dispel certain myths or whatnot that we might have about each other. So for me, I just take it as an opportunity to learn. – *Maria / Black, Ph.D., Biomedical Engineering, MU*

Perhaps more demoralizing than exclusion from international students were experiences of rejection by MU domestic peers. Dominic shared a particular experience partnering with a White male student for a lab project. Even after collecting data and closely working with his lab partner, the partner was still unwilling to discuss homework answers with Dominic. The fact that the partner was distrusting and closely guarded the knowledge he possessed was both surprising and upsetting:

> We take data together and we had answered the questions and all that stuff. So one day, I went up to him and [asked him], "Do you want to go over the homework?" And he's like, "Sure." So I brought out mine. So I'm like, "Okay, so is this how you did this?" He's like, "Yeah, yeah, yeah." So now I was like, "So is this the answer you got?" And he's like, "No. I can't tell you that. I'm not allowed to do that." And I'm like, "Okay." If I went to a random person and asked the person this question, I'd have understood, but this is someone who's in my lab group… we're trying to solve the same project together. We're meant to be in the same lab project. We're supposed to have some kind of bond. And then he said that [he wouldn't discuss the homework with me] and I was like, "Hmm, maybe I have to rethink working with this guy." If he's as individualistic as he is then [he's] probably not the kind of person I want on my team. – *Dominic / Black, Ph.D., Electrical Engineering, MU*

Dominic soon learned that to protect himself from future discomfort and disappointment, he had to be strategic and careful about whom to ask for help:

> Now when it comes to academics, I have to choose my friends wisely. I can't just go up to somebody, who's also in my lab and also taking the same class with me, and say, "Okay, I need help," because sometimes they won't be interested in helping you. And unless you choose your friends wisely, then you may end up just being on your own for like a long period of time.

Fortunately for Dominic, it was easier to reach out to non-minority students within the context of his lab "because as the years go by I tend to bond with them. So people who came in at the same year as me, it's easy for me to speak to them."

Jasmine also had experiences with classmates who were less than enthusiastic to work with her although it is unknown whether it was due to her racial identity, gender, or the intersection of the two identities. These classmates seemed perfectly fine working with each other so it wasn't a matter of a competitive spirit that was driving the non-collaboration:

> I really like learning in groups because you pick up on different things and everyone learns from each other. But my experience in my first semester I was very, very discouraged because I had two classes that had group projects. And then as soon as it was time to form our own groups, everyone just turned into little clusters of people who knew each other – they may have come from the same school. So it was me and then another girl and a guy who just ended up like, "Okay, we're all the leftovers. All right." – *Jasmine / Black, Ph.D., Computer Science, MU*

Indeed, at MU, exclusion from both international and U.S. born peers exacerbated feelings of being the only racial minority student. Although there are many problems associated with being excluded (or not completely included) from peers, a practical consideration is that exclusion made learning, completing class work, and passing qualifying exams more difficult.

To avoid rejection, some students noted they intentionally selected specific peers for the purpose of creating study groups, seeking out only those peers who they already knew to be collaborative and supportive. Jasmine learned not to take it personally when classmates did not care to study with her:

> I'll go out of my way to – if I know someone is really smart in the class and I'm having trouble, I'll introduce myself and say, "Hey, when are you going to study? We should meet up together." If they say no, I move on to the next person. – *Jasmine / Black, Ph.D., Computer Science, MU*

If students were not satisfied with their interpersonal relationships within their departments, one strategy utilized as previously mentioned was to branch out and participate in groups specifically tailored for underrepresented racial/ethnic minority students pursuing STEM graduate degrees. Involvement in campus groups that were welcoming to URM graduate students granted participants access to other students with whom they could study, gain

professional socialization, and cultivate friendships. Students noted that participation in these groups made them feel more comfortable in academia. When reflecting upon her involvement in these groups, Charlotte stressed, "I *need[ed]* this." Further by connecting with minority students from other STEM departments, participants warded off feelings of isolation and satisfied their needs for belonging.

Inclusion and perceiving treatment to be no different than majority peers as told by MU and LSU students. Not every student had experiences with exclusion or conflict in their programs. When speaking specifically about race, Hayden, Amelia, Abby, Charlotte, and Brady indicated that there were no differences in the way they were treated as URM students at MU opposed to everyone else. Referencing the university and its diversity, Abby chimed in and stated that MU was "pretty accepting." The others had more to say:

> In my department, it was rather indifference as far as backgrounds… I'm the only African American student in my program. As far as [treatment from] the professors… I don't necessarily get treated any differently… there's a lack of interest of anyone's particular background, at least in my experience. I don't necessarily get any different treatment than the other students would. And that's fine. I accept that for what it is… I can only speak for myself [but] there's a lack of interest in me as opposed to some of the other institutions I've been to. – *Brady / Black, MS, Electrical Engineering, MU*

> I suppose [my status as a minority] is acknowledged, but it's certainly not apparent. I haven't felt anything either way, which I suppose is nice. There's certainly diversity of culture, which maybe why it's not apparent or openly recognized. People, they see it, they understand how you speak and they understand your research or see your research and that's what they care about. – *Hayden / Black, Ph.D., Aerospace Engineering, MU*

> Being Latina it's different. You don't see [many Latinas in biology] as much…But I don't know that there's a conflict [being a Latina in science]. I don't feel that way personally as far as I know. – *Charlotte / Latina, Ph.D., Biomedical Sciences, MU*

> I feel like I've been pretty well accepted here. Coming from back home where most people are Hispanic, it's very different out here. There are definitely a lower percentage of people of our ethnicity. But I don't feel like I've been treated

> different in any way. – *Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology, MU*

The fact that Amelia felt accepted within her program may explain why in another part of the interview when talking about any possible tension between her race and her field of study, Amelia reported, “I don’t feel a conflict.”

Similarly at LSU, many students shared that they felt that they were treated no differently than their majority peers, an experience that may be due to the diversity present in both the student and faculty bodies:

> It’s nice to see [faculty] that are from different ethnicities doing things that they’re doing right now. It actually encourages you. Like they’re doing this, so I’m definitely able to do this. – *Avery / American Indian, MS, Biology, LSU*

> My biology and ecology and wildlife sciences [departments] in general are just filled with all kinds of people. So I don’t feel like I’m either set apart. Actually I feel I’m part of the flock. So I don’t see any difference [in the way I am treated]. – *John / Latino, MS, Wildlife Studies, LSU*

> I don’t feel any different [in the Chemistry department] because there’s maybe 80 percent Asians, Indians, people from India and so I don’t feel there are problems with race. – *Zachary / Latino, MS, Organic Chemistry, LSU*

Samuel indicated that he never felt that as a Latino male he had to prove himself differently. He went on to say, “I don’t feel any discrimination. Actually, in my department, the most recognized professor is from Mexico." Similarly from Benjamin’s perspective, the university as a whole and his department specifically intentionally strove to be diverse, was very welcoming of different local cultures, and seemed to “take pride in the diversities.” Not coincidentally, Benjamin reported not seeing any tension arising from his pursued field in engineering and his being a Latino man.

The fact that LSU students had experiences that felt so normalized may have contributed to the perspective that one’s work alone, and not race to any extent, was the sole basis by which a scientist was judged and treated by colleagues:

> My mentor, he's from Eastern Europe and I think that really has somewhat of a different perspective for me… [For] international audiences, we're all scientists... So you're either a good one or a bad one. From that perspective, there are really no differences there. – *Mason / Latino, MS, Environmental Science, LSU*

Similarly Liam, a Black doctoral student in mathematics, indicated that he didn't feel like he was discriminated because of his color. Accordingly, in the math department people only "view you differently if what you say is not interesting. So it depends on your work… I would say I don't have any issues with my color. Because in mathematics, we're very strict… [What someone says] is either true or false. We don't have anything in between." Landon had a similar perspective:

> I think inside you're either a good scientist or you're not. You're not a female scientist. You're not a male scientist. You're either a good scientist or you're not… It's more [a matter of] the human experience. So if you had somebody regardless of color that came from a similar background that you did, it definitely helps. They can relate to what you might be going through at that point in your life. They might picture the same thing when they're a graduate student. I really don't think it's color at all. – *Landon / Black and American Indian, MS, Molecular Biology, LSU*

Brianna was the only student at LSU that indicated that she was aware of how her identity as being Mexican affected how others perceived her within the field, but it wasn't because of her race per se but because of her status as a noncitizen:

> Throughout my undergrad I figured I'd graduate and go back to Mexico. So I never felt [my race] was a part of me that I had to struggle with here. I was just here getting my degree and then I'll go back home. Now that's changed because I'm considering staying here if I find a job or pursue my Ph.D... So now it's starting to creep in a little bit more. I'm starting to see myself being seen as Hispanic, especially now that I'm applying for jobs and 'not a U.S. citizen'…. I've never felt different or like a minority [before]. – *Brianna / Latina, MS, Industrial Engineering, LSU*

Experiences with Conflict on the Basis of Race at MU

Several students at MU relayed that they had faced experiences with conflict on the basis of race in their programs, which is a theme that was not reflected in students' narratives at

HBEU or LSU. For example, although lab mates were typically friendly on the surface, for a few MU students the collegiality ended abruptly there:

> On the face of it [my lab mates] were very nice, but when it came to if you did something wrong in the lab or whatever, they wanted to tell the PI (primary investigator) about it. And so that made you look stupid and then you had to go and defend yourself to the PI. It was a very bad situation. – *Cooper / Black, Ph.D., Chemistry, MU*

In other words, Cooper's lab mates used their positions as more senior students to undermine the PI's confidence in Cooper's competence and work ethic. To successfully manage passive-aggressive and unprofessional behavior in the lab, Cooper used "some common sense and professional and personal communication skills to deal with people who don't [have these skills]." It also helped to have same-raced peers that could offer a listening ear and to whom one could vent frustrations:

> My transition for the first year was pretty difficult. I was very lucky to have another lab mate who was African American as well, and she understood a lot of things I was going through, and that really helped and it's really good to identify those people... I think that was very important for me to survive because I think other people would have quit. And I knew I wasn't going to let some people who had their own issues [with me] stop me from getting my degree. – *Cooper / Black, Ph.D., Chemistry, MU*

Cooper reflected that he had more confidence to attend to problems that arose in the graduate school context and to deal with them in an appropriate manner, precisely because he knew his advisor supported him. Other students also reported consulting with peers or faculty to gain advice or perspective before reacting to negative interactions with individuals in their program. In this way, students were able to make more informed decisions when navigating conflict.

The challenges students described up to this point appear to be of a racialized nature simply because they are byproducts of students' severe underrepresentation *across racial lines* in their program. Whether such experiences are undoubtedly racist is less clear, although some level of racial bias within STEM graduate programs appears to be at play. Nonetheless MU

participants easily offered a number of discrimination experiences they faced that are more unequivocally on the basis of race. Austin, a Black doctoral student in mechanical engineering, for example noticed that racial discrimination occurred with "a very subtle undertone" at MU and offered an example with his advisor to demonstrate this point. Apparently one of his advisors (he was co-advised) told him to **"**maybe stay away from some classes because there are some Asians in there and they might bust up the curve for me… So I've had to deal with that." Understandably, Austin was offended by his advisor's assumption that he could not compete with peers who were presumably smarter because they were Asian and he was Black. Thankfully, Austin was also a self-described "fighter by nature" and so he didn't take "you can't do this" for an answer and instead tried to judge himself based on what he knew of himself and not on what people told him he could or could not do. He additionally tried to "overlook the ridiculous [racial] stuff" his advisor said and didn't interpret such incidents as serious points of racial conflict for the following reasons:

> The reason why I don't have a problem with [this advisor] is because I know he's naturally awkward. He's the guy who will just say whatever random thought on his mind. And I'll sit there and be like, "What the hell are you saying?" And I just got used to his – he's not socially correct. He just does weird things and I just got used to it. But he's a genuine guy. I know he's looking out for my best interest…. I know he has my best interest at heart so because of that I can overlook the ridiculous stuff he says sometimes. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

Other students had more volatile relationships with their advisors characterized by confrontation and distrust. Carson, a biracial student who strongly identified with his Native American Indian heritage, had a falling out with his advisor after she refused to recognize the importance of his engagement in culturally relevant activities during graduate school:

> My first advisor actually was pretty awful and wouldn't let me engage in extra-curricular activities. I was recruited by a minority recruitment person here, so when I got here the woman said it would be nice if you could help recruit more students. My advisor wouldn't let me, so I told the recruiter I can't do that. So the recruiter went to the director of my program and said, "What's going on?

> Carson's not helping out. We helped him get here." So that sort of put this tension between me and my program. – *Carson / White and American Indian, Ph.D., Bioinformatics, MU*

In the tensions that ensued, Carson explained that his previous advisor cut his funding and told another professor to cut his funding too. "It was a really ugly thing," he explained. Carson was understandably not able to brush off this point of racial contention and destructive use of faculty power. As he stated, the relationship simply did not "work out." Carson ultimately chose to have no advisor for "about a month or so" during his second year as a doctoral student rather than continue to be under the supervision of his former advisor.

Brandon and Jasmine also dealt with discrimination from professors with whom they took classes but who were not their assigned advisors. Their stories are similar and are indicative of more blatant experiences with racism:

> I was trying to talk to [a professor] about his research and his response was, "Well, I didn't think your kind would be interested in this research." And I stopped and asked myself do I really want to go into this or not? So, of course, me being the way I am, I just decided I'd challenge him. "What do you mean my kind?" And I think a lot of it comes from ignorance – and I don't even think he thought about what he said. – *Brandon / Black, Ph.D., Applied Physics, MU*

Jasmine recounts a similar experience:

> I had a [instructor] call me "one of you" before. He was like, "I've never taught one of you before." And I was like, "You've never taught a middle-class student before? Never taught a softball player?" Trying to figure out what he meant by one of you. And he finally came out and said, "I've never had a Black student before." It was just very, very uncomfortable. I know he didn't mean anything negative by it. But a lot of those little things, they add up and you're like, "Okay. Is this department exactly where I want to be?" – *Jasmine / Black, Ph.D., Computer Science, MU*

Brandon and Jasmine exercised agency (and courage) by challenging their professors and seeking clarification for the meaning of what they stated. Interestingly, despite challenging their professors, both reduced the blame they placed on the offending professors by reasoning that the professors were not intentionally trying to be malicious. Alternatively, Colin related that

although he never personally experienced racism in his graduate program or saw it in relation to another individual, he would challenge insensitive words directly if it occurred. The challenge was not so much to seek clarification for what was said, but to transform the incidence into a teachable moment:

> I'm one those people that if I see something [insensitive], I'm going to tell you. I'm going to call you on it, 'cause if you say something and I don't say anything, you might do it again. Because sometimes [people] say things without really thinking about them, and sometimes if we just educate them a little bit they may not do it again. – *Colin / Black, MS, Industrial & Operations Engineering, MU*

However, as both Brandon and Jasmine explained, instances of racism made students question whether they wanted to continue in their graduate programs.

The Ambiguous Nature of Discrimination Experiences at MU

At MU, the burden of being a member of a racial minority group was that students sometimes struggled with deciding whether it was fair to attribute negative experiences with others in their programs to racism or whether it was a reflection of something that had nothing to do with discrimination at all. Maria for example, a Black student in material science and engineering, described a situation wherein the question of whether her intellect was being doubted because "of race or lack of preparedness" was ambiguous. In essence, Maria wanted to take a class that her advisor counseled her not to take after he found out that she "didn't have a huge biology background" or "all the prerequisites." Maria took the class anyway because as she explained, "I really didn't take [his advice] to heart because I thought he was just talking to me casually." After finding herself doing poorly, she tried to drop the course retroactively but her professor would not allow her to do so. Maria was disappointed at the lack of concern and support she received from her advisor, especially since she was used to a high level of care from professors as an undergraduate:

> I know that I'm capable to do well but I probably did make a mistake by taking a course that I didn't have the background for but… usually when I take a course that I've never taken before or that I want to challenge myself, the professors would encourage me to take it and say, 'Well stay in here for a few months. If you don't do so well, then we can [tell you] if you should drop it or not'… For any other course that I've taken, if I voiced my concerns, the professors were very understanding… I don't know if [the way my advisor handled this situation was] particularly because I'm a minority or not. – *Maria / Black, Ph.D., Biomedical Engineering, MU*

This situation was complicated by the fact that Maria did not know whether her advisor's initial lack of encouragement to take the class was due to an assumption about her academic ability based on race or because he genuinely believed she was not prepared. The former would have qualified this case as an incident of racism whereas the latter would have demonstrated that the advisor was only looking out for her best interests. Jasmine also talked about how determining whether differential treatment was due to discrimination based on race or gender was difficult to disentangle:

> Well it's very hard if you know that you're different and you feel as though you've been treated differently. It's very hard to say, "Oh, I attribute [different treatment] to the fact that I'm a woman, or I attribute that to the fact that I'm Black."… it's just really hard to isolate the one specific reason that something might have happened. – *Jasmine / Black, Ph.D., Computer Science, MU*

Positive Aspects of the Graduate Context at MU

Several MU students, who did not personally feel marginalized on campus but who recognized that some of their URM peers did, intentionally shared positive aspects of graduate life for people of color at their institution. According to these students, positive aspects existed at multiple levels ranging from supportive advisors at the individual level, the university context at the next level, and the city in which the university was nestled at the broadest level. For example, a few advisors recognized some of the issues related to underrepresentation that their URM students faced:

> My advisor…he's not a minority. But he made it clear to me that he wants to increase the number of minority faculty members in academia…He's not being subliminal about it. He's just like, 'Yeah, man when are you going to start teaching?' So we'll see how that goes. I respect him in that regard because not many professors would ever make that statement openly or not many professors would acknowledge the issue and say that they want to help alleviate that situation. And teaching is always something I've been interested in. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

Like Austin, Carson's second advisor was supportive of his engagement in efforts that strove to improve issues important to minority communities:

> My program is really supportive of me and is always looking for new opportunities and encouraging me to apply for fellowships and honor societies. I think that's all because I have a minority advisor. And I have a good one that's invested in things that are important to me like teaching Indian students and going to these conferences to meet other Indian people and network so I can get a job teaching and working in science with Indians. – *Carson / White and American Indian, Ph.D., Bioinformatics, MU*

At a broader level, Colin thought the university was "really trying" and "doing pretty well" with respect to diversity as demonstrated by an event that sought to discuss the "minority crisis in graduate education." Colin noted that the dean of graduate students was at the event "to find out from students what's really happening with minorities in graduate school." He added:

> My undergrad [institution] had more [racial] issues than I could find here. Just, like, if you look at AGEP [Alliance for Graduate Education and Professoriate], they have an advocate for each [graduate] program… I never interacted with him, but he's supposed to be the person you can go and talk to about these issues. So I think [the university] is trying. I haven't seen anything. I've only been here for a few months, and half of the students in my program are international, so it's quite diverse. And I don't expect to see anything... But you never know. But nothing has happened so far. – *Colin / Black, MS, Industrial & Operations Engineering, MU*

Like Colin, Kate – who was a Black doctoral student in pharmacology – shared that "nothing has happened that has taken away from my experience here or to make me think of the school in a bad way," although she did lament the fact that many of her peers didn't "understand affirmative

action, so they think it's just based on your skin color." The fact that peers didn't "get it" was a bit "frustrating" to her.

Finally Abby was of the opinion that the city was welcoming of people from racially diverse backgrounds and reported that she "never felt any separation or rejection" other than one racist incident at the university hospital by some teenagers:

> [This city] it's pretty multicultural. It's pretty open to different [people] – and at least in our department, I have never felt a separation [due to race]. We were accepted. I think it's funny, 'cause they're like if … "You're a minority. We'll have more options for you." It's a cultural shock when you move, but I only had an issue here with some people being racist, but it was just when I moved here with some people at the hospital. But other than that I feel really comfortable, and I like [this city]. It's pretty diverse, it's pretty open, and they promote that. – *Abby / Latina, Ph.D., Pharmacology & Cellular and Molecular Biology, MU*

Being from the Caribbean, Abby was of the opinion that one of the biggest obstacles of adjusting to graduate school was **"**getting used to the different cultures and the way people interact." Other than the cultural adjustments she adamantly believed that "everyone's friendly."

Collectively students' narratives at MU reveal a split on how they were treated within their programs. It is telling however that when departments/programs received URM students with indifference, avoidance, negativity, or downright hostility, URM students were likely to feel like outsiders looking in and tolerated instead of truly embraced or welcomed. These students looked elsewhere for academic and social support because that was in the purview of their control. Alternatively, students who felt like they were not treated any differently compared to majority peers, seemed to love their programs and heavily relied on peers for both collaboration purposes and social engagement.

Motivation for the Graduate Degree as a Strategy for Resilience

Students' ability to successfully continue in their graduate programs despite the varied and numerous challenges they face as discussed above is not only a testament to their

resiliency, but is also a demonstration of resistance (Yosso, 2000) as students remembered why they were motivated to pursue an advanced degree in STEM and, in doing so, employ a survival strategy. Interestingly, the source of students' motivation can overwhelmingly be attributed to an intrinsic desire to improve conditions for racial minority communities. Thus, via the work students plan to do with an advanced degree, students stand to challenge a variety of social inequities. This next section reveals that intrinsic motivations – such as the desire to be a role model or mentor, to improve STEM education, to help future college students in STEM, and to give back to the broader minority community – are powerful precisely because they reinforce students' decisions to remain in their programs.

The Desire to be a Role Model or Mentor

Many students, mostly those from HBEU and MU, spoke of using the knowledge they gained from their degree to improve conditions for racial minorities. One important way students planned to give back to their communities was by becoming a role model/mentor that others could look up to for inspiration (Victoria, Aaliyah, and Savannah from HBEU; Sadie, Cooper, and Maria from MU). Victoria, for example, highly valued role modeling for Black students, especially women, so that they could be more attracted to chemistry:

> When I look at the youth… there are not a significant amount of role models. [People in my family] are my role models – they have shaped me into who I am today. And I feel like that is something that I have to do for the next generation. And so when I stand in front of a group of kids and I say, "Hi, I'm Victoria. I'm working on a Ph.D. in analytical chemistry, there's like a, 'Woo, you must be smart.' [And I'm like,] 'No, that's not always the case. It's how I'm wired, but you can do the same thing.' – *Victoria / Black, Ph.D., Analytical Chemistry, HBEU*

Similarly Aaliyah explained that as a Black woman growing up poor, a Ph.D. in psychology and becoming a researcher would allow her to "give back to other Black women" who also grew up under the same circumstances. Maria and Sadie, both from MU, also felt "a sense of responsibility" to be role models and act as mentors to other minorities in their communities:

> I have in a lot of ways tried to be a role-model, even for some of my dad's friends who have younger children; a young lady who's interested in doing science or engineering. Just talking to them about that, making sure in high school that they're doing some things so they can [do to] be prepared and competitive for the college realm once they get there. And even talking them through that once they start and saying, 'You can do it. These are some of the things that you need to do and resources that you need to look into.' – *Sadie / Black, Ph.D., Biomedical Engineering, MU*

Like Sadie, Cooper also served as a role model for others, namely same-aged peers, and championed them to reach new heights with respect to education:

> My friends from high school… I keep motivating them like, 'You can do [graduate school]. Make sure you find funding, but once you do that everything is really cool.' And a lot of them have started to get their masters and are thinking about doing their Ph.D. I always said, 'If I can do it, [you can] and I don't think I'm a rocket scientist. If I can do it and get a Ph.D. in chemistry, you can do anything. Because everyone has something that they're good at and passionate about.' – *Cooper / Black, Ph.D., Chemistry, MU*

Being underrepresented in the field and wanting to add to the diversity present was another part of role modeling. Issac recognized that "there aren't many Black men with Ph.D.s" in Chemistry and explained "[that is] the reason I choose the professoriate instead of sort of leaving it and doing business - there's a level of exposure there to students and there's a level of visibility which I think is good." Like Issac, Kaelyn recognized the severe underrepresentation of Black individuals in biology coupled with the lack of role models for them. She, therefore, wanted to "stand for the young girls out here, these undergraduates." She explained that her presence as a TA increased the visibility of Black women pursuing Ph.D.s in STEM and communicated a message to her students that they could do it, too. She also added that she wanted to inspire "those who might not even know about a career path that they didn't hear about." Camryn also saw the power her position as a TA had, and wanted to pique the minds of her young female students and turn them on to science:

> The more and more class goes on, the more and more the students, the young women, would come up to me [and ask], 'How do you do what you do? Why do

> so much? You're so young. How old are you?' They would ask questions. And I would tell them, 'Look, I'm doing this. This is how I got to where I am.' Before that, I never, ever thought to be anybody's mentor, or – for God's sake, anybody's role model. I just wanted to do what I thought was right. And in pursuing what I think is right, I realized that other [young Black women] should know that they have this other path, that there's this possibility. – *Camryn / Black, Ph.D., Pharmacology, HBEU*

Finally, part of being a role model for students was redefining the definition of who could be a scientist. Indeed, Kaelyn saw her position as a Black instructor in the sciences as being equally beneficial for her non-minority undergraduate students, in that they learned that Black people were also knowledgeable and qualified to teach on STEM issues. Morgan adamantly agreed "breaking the mold is definitely a key portion of a Black woman getting a Ph.D."

The Desire to Improve STEM Education at the Secondary Level

Another great source of inspiration for the graduate students at HBEU and MU (LSU students never commented on this point) was that they wanted to use their degrees to improve STEM education and get children and adolescents excited about STEM. For example Morgan, a doctoral student in pharmacology at HBEU, wanted to in some way work with secondary schools because she felt that it was her responsibility to transfer what she learned to the next generation. Since she had teachers in the past who "made research fun…[and] made it come alive," as an educator she wanted "to stimulate intellect and to make sure [students know] it's okay to learn." The mentoring aspect was important to Morgan because in her opinion it made learning "more dynamic" and showed students that someone could be "down to earth, but [also] really smart." Similarly, Brooke wanted to travel around to different elementary schools and conduct indoor science experiments to expose children to science at a younger age.

Aaliyah, a doctoral student in developmental psychology, also wanted to teach students and noted that she wanted to investigate "why students got interested in STEM fields, and persisted in STEM." As part of her career, she wanted to conduct program evaluations and

create “a nonprofit that helps figure out what helps motivate students to learn.” Although David didn’t say he wanted to become a teacher per se, he had plans to create a research training program in the future that would introduce minority students in high school to ecology related fields via varied research experiences and ultimately increase their presence in the workforce. He wanted to partner with researchers around the country to mentor the students on an independent project or perhaps as part of their own projects. He added:

> Introducing students on that level and seeing what affect that has on the student's direction in terms of where they see themselves going, what options they see available to them in terms of a career and where they actually end up. Do they actually get into these fields?" – *David / Black, Ph.D., Animal Behavior & Ecology, HBEU*

In short, the program David wanted to create would expose minority students to fields other than medicine that existed in the workforce for which a science degree would be useful, and “broaden their perspectives at an earlier age where they can still make a decision."

The Desire to Help Future College Students in STEM

Many students shared plans to enter the professoriate (David, Savannah, and Camryn from HBEU, Cameron and Lauren from LSU; and Brady, Carson, Maria, and Tristan from MU) and cited reasons for wanting to do so that all deal with helping future students, especially those that are URM, succeed in STEM during college. Mentoring future generations of students was important to those interested in a future professorship role, especially those who didn’t feel properly mentored during college. Savannah, a Black doctoral student in microbiology at HBEU, shared, “that’s definitely a reason why I want to be a professor, be a mentor, is because I really wish that I had someone.” Similarly Brady, a Black MU student in electrical engineering, shared that he wanted to guide his students “as opposed to just letting them flounder around and fritter not knowing what they want to do. Because I can relate to that. That’s where I was. I don’t

really think I ever received that interest and guidance [from a professor]." Issac, from HBEU, also wanted to enter the professoriate as a career choice because he thought a greater visibility of Black STEM professors was a good thing for students.

Others "loved" to teach (i.e. Camryn and Issac from HBEU; Liam and Benjamin from LSU; Brady and Carson from MU), and wanted to improve STEM education for all students but especially students who shared their racial backgrounds by making complex scientific concepts more understandable and by connecting STEM work with issues mattering to URM students. The intention was to get undergraduates more excited about STEM learning and to attract more students into the field:

> The two years that I taught at the community, and I taught anatomy and physiology, I just fell in love with it. I never thought I would love to teach… [so] being a professor would be a wonderful other option for me… there's so many matters that need attention. – *Camryn / Black, Ph.D., Pharmacology, HBEU*
>
> [When it comes to] teaching undergrad students, [I want to find] a way of taking things that may have been abstract and putting them into something that's more digestible to further spark their curiosity. – *Brady / Black, MS, Electrical Engineering, MU*
>
> One of my goals in getting a Ph.D. is to develop a language that I can talk to the people that don't understand science. I want science to be more accessible so that people aren't afraid of it. So it's difficult sometimes, but I really make a concerted effort. It's important to me that I can talk to regular people versus [only] science people. – *Carson / White and American Indian, Ph.D., Bioinformatics, MU*

Finally, although Kaelyn did not explicitly say she wanted to enter the professoriate she wanted to help "Black girls just like [her], who didn't know what they want to do." As someone who used to be heavily involved with programs aimed at advancing underrepresented groups in science, she wanted to introduce undergraduates to research so that they could determine if graduate school would be more interesting to them than medical school. She did not elaborate on how she would meet this goal if she were not in a professorial role, however.

The Desire to Give Back to the Broader Community

Finally, a number of students had ambitions to give back to the broader community either in the United States or more globally. Aaliyah, an HBEU student, simply wanted to use her degree in developmental psychology to generally "help other people." Julia more specifically explained how she saw the eventual application of her Ph.D.:

> I knew that I wanted to enter a profession, which… [would] have an impact on the lives of people…[and] an influence on the lives of children… At the same time, I'd like to use my Ph.D. just to make sure that I'm educating particularly the minority populations about the genetic resources that are available. It's something that some communities never talk about just because they're not informed. So I really would like to use my Ph.D. to provide them with the information that's available and let them know about some of the life-saving technologies that are coming out, to which they may not be aware. – *Julia / Black, Ph.D., Genetics, HBEU*

She added:

> I also see myself going into the ethical side of genetics, just to make sure that we don't have a repeat of the Tuskegee experiments…because I am aware of unethical experiments that have been performed on minority populations… So I want to make sure I do what I can to ensure that those same situations don't occur again. – *Julia / Black, Ph.D., Genetics, HBEU*

Audrey was also in genetics, and like Julia wanted to be a positive influence in the Black community. In her case, she wanted to use her work to improve the overall health of Black people because it upset her that African Americans had a "greater susceptibility toward [a number of] diseases." Camryn wanted to be part of a more global impact:

> I would like to work in the development of policy for the World Health Organization or the UN in the realm of developing policies or being on the front line of the research that develops policies that will get medications and particular drugs to places in Africa that are very much in desperate need of some of these drugs. The retroviral for HIV… developing research to try and combat the prevalence of malaria, because it's very, very debilitating in a lot of the countries. And it's very easy to combat the spreading of a lot of diseases on the continent…but nobody cares enough to try and deal with it. So that's what I want to do. – *Camryn / Black, Ph.D., Pharmacology, HBEU*

Several students at LSU also spoke about using their degrees to give back, but the giving back was more with respect to their local communities. Mason, for example, wanted to use the knowledge he gained from his environmental microbiology degree partially to ensure decision making on the family farm had "a strong background in the sciences." He also wanted to bridge his specialization in soil microbiology with agriculture. In this way his degree would be going "full circle to [his] past experiences in agriculture." Like Mason, Steven wanted to use what he learned in his ecology program to improve farming and ranching in general. Landon's personal experiences growing up on an Indian reservation and wanting to address the problems he was witnessing there was a strong motivating factor:

> I grew up on an Indian reservation so I saw a lot of death and a lot of disease and things like that going on… my interest was to understand my environment and try to get a feel for the underlying causes of the things I was seeing. [So] I wanted to study viruses. – *Landon / Black and American Indian, MS, Molecular Biology, LSU*

Finally, Lauren had the broadest goal for her degree in molecular biology, which was ultimately "to improve plants so there's more food to feed more people."

Moving on to MU students, Charlotte, Austin, Carson, Brandon, Amelia, and Isiah also had broad goals for their degrees that as Isiah put it, made an important "contribution to society." Charlotte was interested in "promoting scientific literacy in the public." To meet this end she was considering pursuing a science and technology public policy certificate so that she could work in government or policy in positions that had a hand in shaping science education. Austin and Carson reported wanting to go into non-profits. Carson specifically stated:

> When I'm done [with my degree] I'll continue my work in non-profits. I'm on the board of directors for an Indian center here and I think my wife and I are interested in either helping out with another non-profit here in town or maybe starting our own involving the use of technology for the advancement of Indian people. – *Carson / White and American Indian, Ph.D., Bioinformatics, MU*

Amelia – in microbiology and immunology – hoped to "one day have [her] own research lab and try to come up with a cure" for an illness. Similarly, with his Ph.D. in biomedical engineering, Max wanted to "find treatment for those ailments" associated with mental illness. His personal motivation stemmed from having had been diagnosed with clinical depression twelve years ago. Brandon was also interested in using science to have a positive impact on society:

> I think it's quite interesting that I identify myself as a scientist… and I have an opportunity now to actually work with people and look at poverty reduction and issues of electricity... So I get to actually do something I feel that's meaningful in everyday [life]…which is why I got interested in [my field of study] – *Brandon / Black, Ph.D., Applied Physics, MU*

In sum, many students across the three institutions felt that there was a great social responsibility to give back to their communities as earners of a graduate degree. Issac explains this sentiment perfectly:

> I think that it's a great deal of social responsibility that [us graduate students] feel, just in general. I think that is sort of a common thread. And so to sort of go through this process without having that be a motivating factor would [be a shame]…and the thing that you said about society, is that the Ph.D. is just so substantive. It carries the greatest currency for our [minority] community. So I think it would be extremely remiss if we weren't considering those things. – *Issac / Black, Ph.D., Chemistry, HBEU*

CHAPTER 6

PROGRAM AND INSTITUTIONAL STRUCTURES THAT SHAPE STUDENTS' EXPERIENCES

The third research question in this study seeks to identify the program or institutional structures, contexts, and/or processes that shape students' experiences. Before discussing these structures, however, it is important to note that several students at the historically Black institution had experiences attending predominantly White institutions. These students therefore naturally drew comparisons between their current experiences and the previous institutions they had attended; these comparisons are included where relevant. Further, unlike HBEU where students shared similar stories and referenced similar processes with few exceptions, many structures at LSU and MU did not cut across several graduate disciplines but seemed to be more idiosyncratic to the program or department in which students enrolled. With these differences in mind, I first discuss important structures of students' graduate programs, followed by a discussion of institutional resources and their affect on students. I end with a very brief commentary on the racial climate and students' sense of feeling welcomed, since many issues pertaining to race were already covered in Chapter 5. Under each thematic heading are subthemes, within which I identify similarities in structures that cut across institutions and those that appear to be unique to specific contexts.

Important Structures within Students' Graduate Programs

In identifying important structures with students' graduate programs, four critical areas emerged. I first discuss the pedagogical practices and philosophies towards learning within students' programs followed by a discussion of how programs structured classes, research, and student teaching. These two areas, of the four identified, are the most important to students' experiences within their program. Still important but much less so was the level of exposure students received to industry within their program, which I discuss third. The fourth area of

importance is the responsiveness of students' programs to requests for information and to student recommendations for changes, which I discuss fourth.

Pedagogical Practices and Philosophies towards Learning

Students across all three institutions shared both positive and negative comments about the quality of teaching, how talent was cultivated, and how instructors taught science material. Starting with HBEU, students spoke about teaching in ways that suggested a high level of satisfaction in this area. HBEU faculty were described as "top notch" professionals in their field and generally effective teachers. Indeed, despite "the difficultly of a lot of the subject matter," the quality of teaching at HBEU seemed to be consistently strong:

> I can definitely say that there's a priority on teaching here…at the institution. So that's actually helped to shape my experience here at [HBEU], just because I've been fortunate enough to meet a number of people – and wonderful people at that. So I'm very grateful. [Graduate school] is a lot of work. But I wouldn't trade it for anything. – *Julia / Black, Ph.D., Genetics, HBEU*

When comparing HBEU to other institutions they attended, students thought it was important to emphasize that the schooling they received at HBEU was not inferior:

> I don't want anybody to think that because we're at a HBCU we don't learn. We definitely learn. [The faculty] hold you at a different magnitude, because they are like, 'You're going to learn, and we're going to send you out the best way.' – *Morgan / Black and American Indian, Ph.D., Pharmacology, HBEU*

Camryn confirmed that the "the education here (at HBEU) very easily rivaled" the standards for educational quality she had grown accustomed to while previously attending a PWI. It wasn't until she attended HBEU that she realized that "all HBCUs aren't what [she] had assumed." She added:

> The pace of the information at my predominantly White [undergraduate] institution… prepared me greatly for [the HBCU I went to for my master's]. Now when I went to [my master's HBCU], I was like, 'This is baby stuff. What you guys doing?' But then I came here [for my Ph.D.], and then I said, 'Now this is not like [my masters institution where] the pace was much, much slower. They baby

> their students there… Here,…these people are teaching you things that you may not have learned in your predominantly White institution.' And when I went to [the PWI], I had this perception of Black schools, which was facilitated by my parents' understanding of what a Black school is. So I wanted to go to Spellman… And my mother said, absolutely not. You will not dare go to Spellman. Because she said, "If anybody sees Spellman on your resume, they're going to think, 'she went to a Black school. She took the easy way out.'" – *Camryn / Black, Ph.D., Pharmacology, HBEU*

One aspect of good teaching was that the classroom instruction allowed everyone an opportunity to learn, irrespective of the variability of students' knowledge on the subject. Issac shared that "the presentation of the [course] material" at HBEU was at a slower pace than what he was used to, but ultimately he was grateful for this because it ensured that he had a deeper understanding of the basics:

> I was thankful to [the slower pace of instruction], because it gave me an opportunity to catch up. It gave me an opportunity to really sort of stretch my skills and to solidify my foundation. And so I think that on sort of a large scale level, what's great about [HBEU] is that both undergraduate and graduate alike, it admits students from a wide spectrum of [academic] levels. – *Issac / Black, Ph.D., Chemistry, HBEU*

Teaching professors at HBEU seemed to meet students where they were with respect to mastery of the disciplinary content and developed them from there. This meant that unlike other institutions, HBEU professors didn't just define students in terms of the grades students received in their courses; although high grades were still valued, the difference was that the professors didn't give up on those who struggled academically, but instead tried to lift them up so that they could meet expectations for high academic performance:

> Professors try to cultivate whatever talents and skills you have, not based off of, oh, your GPA is this, so that means you're worthless, or we can't do anything with you. But they look for whatever skills and talents you do have and try to cultivate that, and affirm you as a person. And I think that just helps achievement in itself… They see more in you than a [grade] on a paper. – *Aaliyah / Black, Ph.D., Developmental Psychology, HBEU*

Aaliyah also noted that HBEU was distinctive in the sense that there was a large emphasis on learning:

> [Here at HBEU], it's not just you read a book, you have an assessment, and then you go on. There are many [more] components to it. When you come here, there's a level [of achievement] and you've got to keep jumping [towards it] until you get up to this level. And they're not going to lower it. So they are hard on you. Whereas if you are at a different institution, whether it be a PWI you might not get that. They'll give you the material, but there's not necessarily a drive to get you to where you need to go. – *Aaliyah / Black, Ph.D., Developmental Psychology, HBEU*

HBEU faculty appeared to take special care to make sure students learned the material, even working with students on the weekends. Good teaching required a level of patience that not many students were accustomed to previously. Aaliyah describes the effort faculty put forth when teaching:

> If you're not getting [the course material], then you can go and you can ask [the faculty] questions, and most will explain it to you inside and out, until you understand. – *Aaliyah / Black, Ph.D., Developmental Psychology, HBEU*

There were some exceptions, however, to this helping behavior as Morgan explained:

> Some [faculty] are very hands on, and they don't mind taking the extra hour out of their day, or finding time to help you figure out how to do this assignment, or pull you aside and say, 'Hey, that test, we're going to work on this' type-of-thing. Where other [faculty] they'll give you that lovely low digit [grade] and a nice big old red mark, and just hand it back to you. 'Figure it out for next time.' So it really just depends on the individual [professor], and I'm assuming the department as well. – *Morgan / Black and American Indian, Ph.D., Pharmacology, HBEU*

Morgan also added that she had "learned from both of them," referring to professors who went the extra mile and those who did not. "Regardless, you will learn," she noted but "the personality and the technique of teaching by that professor is what's going to make the difference."

A second aspect of good teaching at HBEU was that professors connected science to students' personal lives in meaningful ways. Indeed a unique aspect of HBEU (that was not mentioned at LSU or MU) was that the education students received was commonly linked to Black history and Black communities. Camryn and Aaliyah were "pleasantly surprised" at this educational practice since it was not present at the PWI institutions they had attended prior. For example, in Camryn's biochemistry class at HBEU, the professor informed students of sickle cell's origins in Africa and told students "you have to know this…You're African-Americans." Camryn went on to say:

> The funny thing is, I've heard about malaria and sickle cell before [but] it's never been taught with that perspective. I had no idea – I didn't realize there were certain aspects of [sickle cell and malaria] that related to Africans in particular…And [once I learned this stuff] I thought it was amazing. – *Camryn / Black, Ph.D., Pharmacology, HBEU*

Issac opined that this sort of education was preparing students "to do research" and "to go out into the world and be Black scientists." Therefore not connecting scientific research to Black history in the classroom would "be a great injustice." He added:

> We are prepared with race consciousness because we are Black. So we have to be better, we have to do more, or we have to work harder… What an HBCU does for you that you wouldn't see at a predominantly White institution is that you're allowed to do research that has social responsibility... So I wouldn't necessarily have that opportunity at a predominantly White institution. That may not be their focus. They may have a plethora of other [research agendas] that may not deal with [people like] me. I may not even like the perspective from which they are approaching the issue that may have something to do with my community. So I think that coming here avails that opportunity for you to have research that deals with social responsibility. – *Issac / Black, Ph.D., Chemistry, HBEU*

Isaac went on to explain why he thought pursuing a graduate degree at an HBCU was so unique:

> That's what being at an HBCU allows you to do very well, is have [race-related] conversations without actually saying those words. You get to know people's backgrounds… Whereas if you were at a larger predominantly White institution, it

> might be harder for us to connect… And so I think all of those things, and sort of being at an HBCU, have tremendous value. – *Issac / Black, Ph.D., Chemistry, HBEU*

Kaelyn made the observation that HBEU, like the HBCU institution she attended for her master's degree, employed a diverse faculty that included non-Black professors. These professors, although not African American, were successfully able to link the curriculum with relevance for responsibility to the Black community:

> People get the perception that if you go to a HBCU, you're taught by all Black faculty. No, not at all… even though we weren't taught by Black faculty members, we still were able to get that responsibility part within our lectures. – *Kaelyn / Black, Ph.D., Biology, HBEU*

Kaelyn seemed to be making the point that a professor's race as non-Black did not impede his or her ability to deliver a culturally relevant curriculum. In contrast, Kaelyn had to insist that professors at her undergraduate PWI discuss the details surrounding certain scientific discoveries and not gloss over Black contributions to science:

> When I went to [my undergraduate institution], I would tell the professors why they're called HeLa cells… Henrietta Lacks… she had cervical cancer, and so they took her cells back in the fifties. And a researcher wanted some cells that they could keep and culture over and over again, that they would just keep replicating... And they're still using her cells in research… I like Black history… I talked to my professors about these things. But it's so amazing how [connecting the curriculum to Black history] is an institutional type thing, but it can be on an individual basis too [dependent on the professor]. – *Kaelyn / Black, Ph.D., Biology, HBEU*

Similarly, at her previous institutions, Camryn learned science in ways that glorified White scientists even if these scientists had used science to oppress minority communities. For example, it wasn't until she attended an HBEU that Camryn learned that "Charles Darwin was an individual who was trying to develop a reason for racial classification, a genetic reason for racially classifying people. And he was saying that Black people have smaller brains." She compares this education to the undergraduate education she received attending a PWI where

she learned that “Charles Darwin… is this cool guy. He was doing all these good things for science.”

LSU students also described some of their professors positively and provided statements indicating that instructors were competent or “smart” (Evan – Electrical Engineering), “open to sharing their knowledge” (Benjamin - *Industrial Engineering Operations Research*), “know their science” (John – Wildlife Studies) and/or “interested in what they do and… in teaching” (Mason – Environmental Science). Brianna, an industrial engineering student, stated “one of the things why [she] likes [her] department so much” was precisely because faculty “were very approachable, very willing to help, and always very willing to mentor or give advice.” Indeed good teachers at LSU, like those at HBEU, explained concepts in a different way when they saw that their students were not understanding, pushed their students to connect disparate concepts, gave them time in class to pause and think, and gave personalized thoughtful feedback to both personal and group assignments.

Patience was especially important for graduate students who came in not having strong foundational knowledge in their discipline, as Alexis explained:

> As far as the level of teaching, I think they’re all very good professors. Even the classes I had trouble with – unfortunately, the advisors did not see [some of] us coming in with the math deficiency. But they all teach really well and they went out of their way to help me pass. They would sit there with me even if it took a long time; even if I could tell they were getting a little frustrated that I didn’t understand something. They showed a lot of patience. – *Alexis / Latina, MS, Physics, LSU*

As can be surmised, LSU students provided far fewer positive statements regarding the teaching of faculty compared to students at HBEU. MU students also had few positive comments to share regarding the teaching of their instructors, but the qualities that made a good teacher were essentially the same across the three institutions. For example, one

characteristic of well-liked professors at MU was that they were excited about what they were teaching:

> Sometimes you can even tell when they're really talking about the specific subjects that they actually do research on. They get really excited and you can tell when they're teaching. – *Colin / Black, MS, Industrial & Operations Engineering, MU*

Beyond the effort teachers put into their teaching, *how* content was taught was also important in determining who were the good teachers. For example, the way a professor approached difficult course content mattered:

> I actually had one [instructor] that was just really good… the way he broke down things was just very fundamental. I was like, 'Wow! I haven't had too many professors pretty much ever do that, especially not at a graduate level.' And it was very helpful. And his tests, he still pushed us with the tests and challenged us. But I felt like I came away from those courses with a very solid understanding of what the material was that he taught. So, I mean he was probably one of the better professors I've had. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

The biomedical science program at MU apparently started course lessons at a foundational level and built on knowledge from there. As we learn from LSU, this teaching approach is especially helpful for students who needed the extra exposure to the course material:

> Some people [in the class] felt like, "Oh, I already did this in undergrad." But at least for me it was very helpful. Because like I said, my background is different. So, it's essential to get everyone on the same page and make sure we have this core [knowledge] of biochemistry, genetics and cell biology. – *Charlotte / Latina, Ph.D., Biomedical Sciences, MU*

Classes in the biomedical science program also tended to be co-taught by a team of professors from different fields each teaching on matters pertaining to their different specialty. Charlotte seemed to like this set-up and found classes in her program to be "pretty good." Amelia's

program in microbiology and immunology was similar to the biomedical sciences in that the pace of the classes allowed students to catch up with regard to content knowledge:

> I hadn't had a lot of those classes in a while. So I thought it was really, really important for me to catch up on that. And as far as the instructors go… they're definitely willing to help. I think the way the classes are structured are really good. We go through a lot of primary literature and like, critical analysis, which I think is really important if you're going to be working in a lab. – *Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology, MU*

Jake explained that entering graduate students were "still confused about a lot of stuff and trying to figure out" how to approach learning in order to fill conceptual gaps. Students therefore found that "the small [classes] especially have been very helpful", perhaps because they were more conducive to individualized attention from an instructor. It was also helpful when programs took student's inquiries for academic help seriously. Kate's program in pharmacology provided her with tutors after she realized that she was struggling in difficult classes and sought help. Kate explains that after she "asked for the help, it was fine afterwards."

Up to this point, graduate school does seem wonderful, at least in respect to faculty teaching. However across the institutions included in this study, students also had several complaints to share about the teaching practices of faculty, with the number of complaints students shared varying vastly by institution. Indeed students at HBEU had the fewest and most innocuous complaints to share, with the number increasing with LSU students, and being most prolific with MU students. Starting with the grievances coming from HBEU, although students expressed the sentiment that the university valued teaching and therefore had few or "no complaints" (Brody), one student still shared the sentiment that teaching wasn't always the priority:

> I think they do feel that instruction is important, but in the mathematical sciences I think that there is more importance placed on research and original material than instruction. – *Hunter / Black, Ph.D., Physics, HBEU*

Another complaint regarding the teaching at HBEU was that older faculty refused to learn how to use more current technology to help make their teaching enticing and more effective. Victoria especially was vocal on this point:

> When you walk through this building, you see smart boards, which can offer a lot of capabilities… But if you don't want to learn how to use [the technological resources here]…[For example there is the] webcam…I think it's a wonderful idea to be able to communicate with different people in different areas, but if you're not open to learning how to use that, then you don't expose your students to that. And, so, I don't think resources are a problem here… [I] think it's enough professors who are willing to take the time to learn something outside of writing on the stupid chalk board. – *Victoria / Black, Ph.D., Analytical Chemistry*, *HBEU*

As a whole, however, the ratio of positive to negative comments regarding the teaching practices of faculty were two to 11 at HBEU; clearly HBEU students were far more satisfied with the quality of teaching they experienced than dissatisfied.

Compared to HBEU where teachers were, for the most part, spoken about positively, the teaching quality at LSU and MU on the other hand seemed to be far more variable with students having many experiences with poor teaching practices. An MU student illustrates this point:

> I've been in a couple of departments here, and I've got to say that the quality of the teaching varies greatly depending on the department that you're in. The previous department I was in, despite its golden reputation, had some absolutely dreadful teachers, honestly… The department I'm in now, biomedical engineering, is a little better. Maybe it's just I'm more interested in the subject matter, so there's a little bit of a bias there… I can't really honestly say that there's been a huge difference in the quality of instruction between a large and a small class of the classes that I've taken. – *Isiah / White and Latino, Ph.D., Biomedical Engineering, MU*

Teaching quality may have been in some ways shaped by department rewards for teaching – recognizing professors for good teaching practices at minimum demonstrated that good work was noticed. For example, although none of the students in the physics department at MU commented on the teaching ability of their professors, Tristan was impressed that his department at least gave recognition to good teachers where recognition was due:

> It's not strongly rewarded to be able to teach well. But at least in physics it's rewarded a little bit more than what I've seen in other places. There's a departmental award for teaching, and since there are so many students taking physics, the professors actually have to do the recitation sections. – *Tristan / Black and White, Ph.D., Physics, MU*

Because of the variability in teaching quality at LSU and MU, when asked about their experiences in the classroom, students at both institutions offered numerous stories that would constitute prime examples of poor teaching. Interestingly, every single student who had a complaint about teaching at LSU came from engineering. In electrical engineering, for example, students were not to ask questions in class, but instead expected to save questions for office hours, which limited student engagement in the classroom:

> What I don't like here in my department is that it's not very common that students ask questions. You have to go in office hours to ask them and I don't like that. I'm not used to that. For example, in [undergrad] I always participated. I always had a question. That's the way things stick in my mind. Maybe later I hesitate going during office hours – that's something I don't like. [But here in graduate school asking questions] it's not encouraged… I don't think that's appropriate. – *Samuel / Latino, MS, Electrical Engineering, LSU*

Furthermore, some LSU professors were disorganized or simply had no experience in industry and so were unable, according to students, to explain how what they were teaching could be applied in real life. Further, in contrast to HBEU faculty, some LSU instructors taught with the assumption that students already knew a bulk of the material to the detriment of those who did not (Evan – Electrical Engineering) or were "too easy "(Benjamin - *Industrial Engineering Operations Research*). Students explained that neither approach adequately prepared them, making their lives harder in the long run. Benjamin offered an explanation for why he avoided easy faculty instructors:

> If I had to do my orals tomorrow I wouldn't be prepared. I'd have to do more work outside. I could have just read the textbook and been further than taking [this professor's] course. – *Benjamin / Latino, Ph.D., Industrial Engineering Operations Research, LSU*

Professors who were known to be absent were also to be avoided. Benjamin recounted an incident wherein a professor disappeared in the middle of the term with numerous emails by students going unanswered:

> The last time I took the class with [this particular professor], we didn't hear from him for a month. That was the issue I had to grasp. We had to play catch up at the end where he gave us like seven assignments with a week left to go [in the term] and a project. – *Benjamin / Latino, Ph.D., Industrial Engineering Operations Research, LSU*

In essence, students expected classes to adequately prepare them for the next steps in their academic journey as graduate students and wanted to know the material well enough so that they didn't have to do much outside research in order to be well versed in the material and to be able to adequately explain it to someone else. A demanding class on the other hand meant that students could be confident they were learning what they needed to know. Benjamin further explained:

> [A demanding class] would prepare me as a student and individual to relay that information later without adding the extra effort that I would have to make to go learn the material from other sources or from other people and do so much more work outside of class to learn. I'd really rather start and have the chunk of it here [in the classroom] with a little bit more time on my own just to further my own understanding and have that interaction with [the professor]. Like, 'Hey, I was curious about this…' Now, I don't even know where to go to look for more information. – *Benjamin / Latino, Ph.D., Industrial Engineering Operations Research, LSU*

Steven had his own opinion to offer on why so many professors at LSU were what he considered poor teachers:

> I might add one other thing, too, that's relative to the university because this is a research university. So your professor is only teaching one or two classes a semester, if that. So they're not passionate about teaching or they wouldn't be here. They're passionate about research. So it's relative to the university as well, I'd say. If you went to [the nearby teaching college], instructors are going to have higher teaching loads. They're going to be more passionate about teaching because that's why they got a job there. – *Steven / American Indian, Ph.D., Fisheries Ecology, LSU*

As a whole students at LSU shared roughly the same number of positive and negative comments about the teaching they experienced. Like LSU students, MU students also offered many stories of characteristically bad teaching. The difference is that the negative comments (there were eleven) far outweighed the positive (there were six). Although there is only one mentioned case of this, Colin implied that one of his professors did not know the material he was teaching:

> I've had a professor in public health who would put stuff on the PowerPoint and couldn't answer the questions [that students asked] that came out of there, and he didn't acknowledge that he didn't have the answer. – *Colin / Black, MS, Industrial & Operations Engineering, MU*

Other than the aforementioned example, students thought poor teaching was often the result of brilliant professors who just simply did not know how to transfer their knowledge so that students could learn:

> Some of these [professors] are really, really smart. And I think that can work against them. I don't know if they just can't sympathize with grad students. Like they're so far removed from that level of their life that they just can't remember what it was like. I had this one professor, he would just come in and talk. He had his slides and he just talked. He didn't write on the board. He was just so smart he could look at a slide and talk about it for 20 minutes. I mean he'd ramble. And you'd be like, "Dude, what is this?" There's no direction. But he was a smart guy. – A*ustin / Black, Ph.D., Mechanical Engineering, MU*

> Most [instructors] are… so smart, but when they have to teach a class… it just gets hard because they want to give so much knowledge and teach everyone, and it just becomes really hard for them to communicate efficiently. – *Abby / Latina, Ph.D., Pharmacology & Cellular and Molecular Biology, MU*

Kate, a student in pharmacology, added, "generally speaking [the faculty teachers] are good. I think the ones that are bad don't know how to communicate large amounts of information, because it's just a lot of material to get across in so much time." Professors who didn't put much thought or effort into their teaching were another contributing factor to bad experiences in the classroom. Students felt short-changed in these cases:

> We had one professor specifically who I did not think was a good professor and I ended up getting two classes with him. And it ended up being the same class. One was special topics and one was an actual normal class that's been offered for a few years. But he used the same material back – or he used the same material almost for both classes. And so I felt I got ripped off in the class selection because of that. – *Chase / Latino, Ph.D., Electrical Engineering, MU*

And then there was the professor who was too busy to invest enough time into the classes he taught:

> I had one professor who was busy – up for tenure that semester, so he was not really there that often. And then people could not get the help they needed. – *Aaron / Black, Ph.D., Biological Chemistry, MU*

Finally, a few teachers were indicated to be "so-so." In describing his experience with a core class, Jake, a cognitive psychology student, explained that one of his professors was "an interesting guy" who facilitated "some good discussions," but often went off on tangents wherein he "engaged in storytelling."

Like LSU students, MU students did not appreciate the approach of teaching to the most knowledgeable students, which was typically only a small subsection of the class, and expecting everyone else to catch up:

> The teacher will gloss over things like, "Oh, you've seen this before. You've seen this." And I'm like, "No, actually that's the first time I've seen it. So can we go more in depth into it?" And I don't know if it's because they're trying to teach to the entire class. But maybe 10 percent of the class has had [the content] before and 90 percent who hasn't… That's the sort of feeling that I get for the instruction dynamic in our department. – *Jasmine / Black, Ph.D., Computer Science, MU*

Maria and Dominic – both engineering students – seemed to have numerous experiences with bad teaching and chalked it up to the discipline being characteristically "notorious for having not good professors or professors that teach that well." Dominic additionally described experiences with instructors in electrical engineering that didn't "try to make [classes] interesting or try to engage the students."

Because of the wide variability of teaching quality at MU, students, especially those in engineering, learned to adjust to the teaching methods of each professor. As Maria, a biomedical engineering student, explained, "you just sort of have to adapt on a case-by-case basis how much you're going to have to study on your own, how much you're going to actually learn in the course." If a professor didn't teach well, it was up to the student to supplement the gaps in learning with a great deal of independent study. Sean talks about the self-teaching he had to do in a class with one particular professor:

> I wouldn't say that he was bad per say. He just didn't really explain things that well. And so basically I had to do more of the digging on my own, teach myself kind of thing. Some people will say, 'It's grad school, that's what you're supposed to do.' – *Sean / Black, Ph.D., Mechanical Engineering, MU*

Teaching was so bad in some departments that students lightly joked that confronting dreadful teaching practices in required foundational classes was "more like a rite of passage" in graduate school than an exception to the norm.

The Structure of Classes, Research and Student Teaching at LSU and MU

Compared to HBEU, there were far more identifiable ways in which programs varied in structure at LSU and MU. This may be an artifact of slight differences in the way in which students were recruited for participation in this study at each campus. It is also possible that since LSU and MU students are disproportionately represented in the sample of students participating in this study (16 LSU students and 23 MU students participated out of a total of 53), there was a greater possibility of detecting variation between programs; or it may be that programs at MU and LSU actually are more variable than those at HBEU. In a similar vein, HBEU contributed the fewest number of students to the sample (14 out of 53), which may account for why there are so few narratives from HBEU students on structural components of their programs. In any case, there were three areas important to the structure of students' graduate programs: the structure of classes, research, and student teaching. In short, students

at LSU and MU were concerned with how well structured their learning experiences were with respect to classes. (HBEU students did not speak on this point.) MU students, however, were the only students within the sample that expressed additional concerns regarding the structure of research experiences and opportunities for student teaching.

At LSU students who commented specifically on their degree programs seemed to talk about the loose structure of classes. In industrial engineering, for example, students were allowed to simply pick whatever classes in the graduate catalog that interested them to fulfill class requirements for the degree:

> One of the things that surprised me is there seems to be no structure at all…. [No one tells you] which [classes] you should have or you shouldn't have. How to link [classes] to future research. Sometimes you don't know if you're doing a thesis or not. You're given a choice of whether you even want to do a thesis or a project or nothing at all. So it's like everybody can get their own experience, but at the same time you can graduate or not graduate because of something that you didn't take or you took something you shouldn't have. You learn that you have to be chasing people around and that's not easy. – *Brianna / Latina, MS, Industrial Engineering, LSU*

Brianna contrasted her current program at LSU to the industrial engineering program she had in Mexico, which she says was clear on which classes students need to take each semester and in what sequence. Ultimately, Brianna liked that in the Mexican educational system, students "have fewer options, but more structure." Brianna's statements imply that completing a graduate degree in industrial engineering was a straightforward process in Mexico, but not at LSU. Some LSU students, however, liked the freedom that their degree program offered:

> You have the freedom to choose any classes that you want. You are not [obligated] to take [any particular] classes…in grad school. You only take the classes that you are more interested in or that will help in your research. – *William / Latino, MS, Industrial Engineering, LSU*

Like LSU, programs were also very loosely structured in terms of classes at MU. The physics department there, for example, gave students the option to build their own degrees based on the work they wanted to do after their graduate programs were completed:

> You can make up your own degree now. I don't know how long you've been able to do this, but I just found out that somebody in astronomy… created her own degree, which has to do with teaching and informing the public about astronomy. It's like a joint [degree] thing. So I think if that was advertised more, people would be much happier. – *Tristan / Black and White, Ph.D., Physics, MU*

Students especially liked when their programs offered an option to take a class that would equip them with relevant skills beneficial either in the workplace or later during students' academic careers. Charlotte's program in the biomedical sciences for example offered "practical" classes – like grant writing - that students could take if interested, and Jake's program in cognitive psychology offered a "main core class" that prepared students for the preliminary exams. Jasmine's program in computer sciences offered "a few classes that [were] research based." In these classes students "might do a project based on some finding in a paper or extend some papers' findings" with the findings from their own research. Class research projects "might turn into a paper or a project of its own." Furthermore, the seminar classes in Aaron's biological chemistry program explicitly trained students on how to critically read and analyze primary articles, call to question "every single figure," and determine whether authors "used the right experiment" or "asked the right questions." In these classes Aaron shared, "you discuss everything, like, down to the minute detail… you get better training at actually being critical."

Only two students, both in engineering, were dissatisfied with the courses offered by their programs. Austin, for example, couldn't find a class that specifically catered to his interest in orthopedics:

> There are really no orthopedics classes here. I'm taking courses that are not really related to what I'm doing. So I'm in a position where I'm just sitting in

> classes and doing stuff because I have to meet these ridiculous requirements. So it's more like I'm constantly self-motivating myself… Here at grad school my ultimate goal is to write my dissertation, do my research, [and] become a better researcher. In my mind I don't see anything [useful] about classes. Classes don't resonate with me. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

Like Austin, Chase was "disappointed with the course selection" in the electrical engineering program and reported that there were "the same five classes or four that everyone takes. So there's not very much diversity."

Some programs at MU were very lenient with the type of classes they allowed students to take from other departments. Physics, for example, allowed students to take classes from different departments as long as students completed the required core classes:

> You really can do what you want to do [in my applied physics program]. So for example, if you look at my transcripts, half my classes are taken over at the business school. And I still get credit for them for my program. So essentially I took the three "required classes" and because I knew my background was never going to be purely science or theoretical physics, I took everything over in engineering, which…made it a lot easier for me. – *Brandon / Black, Ph.D., Applied Physics, MU*

The flexibility to choose only those classes that were personally interesting was favorable to students, but only when this flexibility was paired with guidance on course selection. Simply knowing that a minimal amount of credits were needed for the degree was not sufficient. Colin, an engineering student, was unimpressed by the way his program oriented new students to the program and its expectations:

> For anybody who's doing a Masters, and maybe it might be just my program, it's like, you're here. They do orientation. You need 30 units to get out of here. That's it. You're on your own. You're a grad student… So in a way it's good, because now I don't start with having to take classes that I don't really want to, because I take half of my classes from public health and I'm in engineering. So in a way that flexibility for me works, but for a lot of people that I hear, a lot of people who come from other countries, especially in the engineering grad school, they're used to structure. But when they come here, these people are like, "You need 30 units to graduate. Go." That's about it. That pretty much was the orientation. – *Colin / Black, MS, Industrial & Operations Engineering, MU*

Chase, also an engineering student, was similarly unimpressed with the lack of effort his program made to orient him to graduate school:

> When I first came here I started in the winter term in January. And there was pretty much nothing in terms of orientation or anything to get me going. Part of it was, yeah I started in the middle of the school year. But when I came in… I was disorganized actually in terms of finding my way around the campus and getting registered and all that. – *Chase / Latino, Ph.D., Electrical Engineering, MU*

Programs at MU also differed in how they structured research experiences. (Students at HBEU and LSU did not speak on this point). For example, Charlotte's biomedical science program structured research experiences so that students did rotations among different PIs and their respective labs. At the time of the focus group interviews, Charlotte had already completed three rotations with three different PIs. Alternatively, research experiences were unstructured in Chase's (electrical engineering), Austin's (mechanical engineering), and Sean's (mechanical engineering) respective programs. For Sean, the freedom his program afforded with respect to research caused a bit of stress:

> The one thing that was a challenge for me was trying to just do research… I would have liked to [better] understand what [research] is and how to approach things like that. And it was really a challenge for me my first year or so, trying to balance [learning how to do research] with coursework… the research, it's more long term…no one's standing over your back necessarily to make sure that you get it done. But yet it's probably the most important thing. It definitely is the most important thing in graduate school as opposed to like classes. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

Although Chase recognized that "there's a lot of opportunity for individualizing yourself" with research, it was still difficult making the transition to being an independent researcher:

> The biggest transitional adjustment problem was when I started doing research full time, when I finished taking classes and I became a Ph.D. candidate. And then it's like, okay that's it. Now you're just doing research full time. I really struggled at first with how to handle well, everything. Time management, doing research, reading articles. Figuring out what my problem was. Setting deadlines.

> That [sort of] thing. I really struggled with that for the first semester. And so knowing more of how to treat it as a job would have probably been helpful…[Doing research is] a lot less structured and much more autonomous. – *Chase / Latino, Ph.D., Electrical Engineering, MU*

Another way programs at MU differed was with respect to the emphasis they put on providing students with teaching experiences. (Again, students at HBEU and LSU did not speak on this point). Carson (bioinformatics), Maria (biomedical engineering), and Sean's (mechanical engineering) programs did not expect them to teach at all. Even though Carson wasn't required to teach, he did so because he was interested in gaining teaching experience, which pleased his department a great deal:

> My department has really helped me. They've given me opportunities to get teaching experience because they knew that I was interested in teaching – normally no one else wants to do teaching in my department so they come to me first. So I get first pick and so I've been teaching this last year. – *Carson / White and American Indian, Ph.D., Bioinformatics, MU*

Maria would have liked to teach, but time did not permit her to do so:

> I wanted to [TA] but I just didn't get around to it. I didn't really find a suitable course and I was really consumed in my coursework and research so I really didn't have time and it wasn't necessary because I didn't need it for funding. – *Maria / Black, Ph.D., Biomedical Engineering, MU*

Sean hadn't taught either, and wasn't completely sure if he would, although he knew it would be in his best interest if he were seriously considering entering the professoriate:

> I haven't taught…if we do any of the teaching [my advisor] encourages it more towards the end of our studies. So right now would be a good time for me because I'm in my fourth year. I'm about to wind down next year. So [my advisor] might encourage that more now since I'm done with classes… but my advisor's philosophy is more focused on research… the teaching stuff, obviously that's an interest especially if you're trying to become a professor… Maybe do that, in your later years when you have a little bit more flexibility in your schedule. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

Cooper added that it was beneficial to teach in graduate school because TA'ing is typically the only "teaching experience you're going to have" and "nine times out of 10…applications for…institutions are going to ask for a teaching statement."

Sean explained that those who were not funded sometimes taught not necessarily out of an intrinsic desire to do so, but out of necessity for a paycheck. In other words, they taught in order to get the funding they needed to finance their educations:

> Basically it comes down to money…there were some people in my lab that are actually younger students that have been TAs. But that was because [of] their funding situation where they didn't have the fellowships and [my advisor] didn't have as much resources to provide the research assistantships. So [those students] had to [be a TA] for a term or two. – *Sean, MU*

Cooper added that those who didn't teach typically didn't have to because they were "paid through other types of funding." Cooper added:

> We see in our department people who win teaching awards. It's really awesome and looks great on their resume, but they're either in a discipline where they can publish more easily or they just don't get a lot of stuff published research-wise. And so their Ph.D. ends up taking five years or six or seven, which for synthetic chemistry, someone's going to look at your application and say, 'Why did it take you seven years? Oh, you got this nice teaching award, but what was your research?' – *Cooper / Black, Ph.D., Chemistry, MU*

Cooper came from the mindset that teaching simply "got in the way of getting publications out" because it took up "several mornings and several days a week" and didn't leave "much time to do research." Cooper and the chemistry department seemed to be very aware of the large time commitment teaching took. The department, therefore, adopted a very loose definition of teaching as explained by Cooper: "Every time you mentor a younger graduate student or you do tutoring, it counts as teaching experience because you have to explain what to do and how to do it," Cooper noted. To calm students fears about not having had taught in a formal classroom, the department had former alumni who taught at different levels share that they didn't have any teaching experience at the point that they were hired for their current teaching position.

A few students, Dominic (electrical engineering), Amelia (microbiology and immunology), and Aaron (biological chemistry), were in programs that required them to teach at least one term before they graduated. Dominic hadn't yet served at a TA at the time of this study. Aaron reflected that the biochemistry department wanted students to do one semester of teaching "to give you experience" and better position students for the job market. "So in that sense [my program in biological chemistry will] try their best to help you out," Aaron noted. Amelia's program offered a teaching certificate for students who were interested:

> [TAing] is a requirement in the micro immunology department. So last semester I was a TA for a bacterial pathogenesis class. And I was hoping it would have been more of a lab class where I could have actually gotten a little bit more personal with the students. But basically I just had office hours and the students would come to me if they had questions about the material. And I would grade their exams. So it was hands off. But I really liked working with the students a lot. So that's why I wish I could teach a lab class now because I feel like I would have a lot of fun actually teaching rather than just answering questions. But [teaching is] definitely encouraged [in my program]. They actually have like a teaching certificate program that you can take along with your Ph.D. So that's something that [my program] also encourages us to do. – *Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology, MU*

Understandably, it was frustrating to students who wanted to develop their teaching skills when they received little instruction on effective teaching techniques or dealing with hot topic issues that arose in the classroom:

> There isn't any instruction on teaching. There's one requirement, which is because of an interaction between the department and [grad division]. The requirement is that if you're going to [be a TA] then you have to go to some training course, which is either through [grad division] or it's through your department. And it took a couple of us [TAs] saying, "Hey, we don't want to have to deal with students being really pissed during our labs, so you're going to train us better. – *Tristan / Black and White, Ph.D., Physics, MU*

Students' Exposure to Industry within their Programs

Across each of the three institutions, students spoke about the extent to which they were provided exposure to industry in their programs and how safe they felt sharing their interest in

pursuing a career in industry. At HBEU, Hunter indicated that there were opportunities in physics to prepare for whatever path students wanted to pursue. It was common for his department to "bring in a lot of guest speakers" from different professional backgrounds with whom the department "encourage[d] the graduate students to interact…and network." The faculty in chemistry on the other hand didn't seem to have the rich connections to industry that Hunter's program had. As a result, Victoria didn't feel as well positioned for the job market:

> The faculty members [in my department] don't have [a network] or [they] have been destroyed over the years. And, so, when I think about when it's time for me to graduate, I have to leave here with a job… we don't have companies come to our department to interview us and that is a very valuable resource. So that's a problem for my department. So I have to do [things on] my own, [like] conferences that I go to. I really have to network and find people that I can slide a card to and [say] "Hey, remember me because next year, I'm going to be putting my application out because I need a job." So that's a conversation piece that lacks in my department… to be able to get a job with the Department of Defense? Yeah. The network is not there for that. – *Victoria / Black, Ph.D., Analytical Chemistry, HBEU*

Interestingly, a few HBEU students were hesitant to share with others in their department the type of career path they were genuinely interested in pursuing because of department politics. Camryn, a pharmacology student, indicated a desire to go into industry during the focus group interview. She then suddenly paused and added, "I should probably think before I start blabbing. I always [have] to be careful. Always careful."

Another major consideration HBEU students had to keep in mind was the idiosyncratic personalities of faculty and learning how to best approach them. This task was, according to Issac, "key" to successfully navigate one's graduate program. Thus, the personality of a professor and how they viewed the professorship dictated the level of transparency a student could have with their advisors regarding their career plans for the future:

> Depending on what you think of the professor lifestyle choice and…your professor, definitely [determines] what you tell them. Because it's a highly

> politicized process. And if you aren't aware of that, it can be a huge difference between sort of sinking or swimming. – *Issac / Black, Ph.D., Chemistry, HBEU*

How programs at LSU structured exposure to different career paths also vastly differed by degree program. The programs to which Lauren (molecular biology), Zachary (organic chemistry), and Alexis (physics) belonged seemed to give students little to no exposure to career options in industry. In Lauren's case, the department simply didn't "talk much about going into industry... it's not really discouraged to go into industry but it's not really encouraged either." Similarly, Zachary reported that his program didn't let people know of their options:

> You find out what you want to do as you take each type of chemistry so you get a little taste of each kind… and then you figure out which one you like best and just go in that direction. Then as you go through you start worrying 'Well, I'm about to graduate. What can I do?' Then you have to do your own personal research so they don't really have a big list, [that says] 'Hey this is all the things that you can do [with your degree]'. – *Zachary / Latino, MS, Organic Chemistry, LSU*

Zachary was hoping that he would gain more exposure to multiple career pathways in science via outside programming offered through the graduate school – unfortunately this was not the case. Zachary was especially in need of this type of exposure since he wasn't "too sure" on what he wanted to do with his degree and didn't "even know where to find that education" to come closer to a decision. Alexis, a physics student, tried to seek out career related information, since her program didn't readily offer it, but the people she asked were unknowledgeable and unhelpful:

> As far as making recommendations [regarding] industry or career-wise, I've gone up to one of the other advisors and asked, "What can I do with a master's in physics industry-wise?" And they're like "I don't know." They don't really know because they've been in academia for so long. They know opportunities are out there and they'll tell you that, but they don't know what you could be doing. [The professor] may have a few friends that went and did something else. Maybe it's just their focus on the research that they don't know what can be done – like with my advisor, [he works on] fuel cells, so of course that's more industry-oriented. But I would say he's the only one [knowledgable about jobs in industry]. – *Alexis / Latina, MS, Physics, LSU*

Finally, the extent to which MU students were exposed to information pertaining to industry and the comfort they had in sharing their true career plans also varied by department. For example, Amelia, a student in microbiology and immunology, indicated that when she talked to faculty members or even other students in the program, she was comfortable expressing what she eventually wanted to do career wise and that people were supportive of her career plans. Likewise, Aaron's program in biological chemistry seemed to be very supportive of student aspirations to enter the professoriate. Seeing as Aaron "might go into academia," he took advantage of opportunities for professional development offered by his program, including teaching for two semesters and giving talks to the department to gain practice doing a professional talk. His program also allowed students to serve on special committees. Aaron shared that last year he "was on the admissions committee and this year I'm on the communications committee, and then there's a retreat committee, so you get a sense of what it's like being on a committee, which is pretty much what all faculty do." Further the candidacy exam in his program made students complete an application for a post-doc position and grant. Aaron explains the utility of this exam, "That's what you're going to do when you graduate. You're going to apply for some grants, so they have you do it your second year so that by the time you get to your fifth year you know how to do it." Finally, as students progressed through the Ph.D. in Aaron's program, "the older students help[ed] out the younger students [because] that's what you do when you get your own lab." By helping out the younger students, Aaron shared that he was able to get a taste of what it would be like to mentor advisees if he were to become a faculty member. Although Aaron spoke extensively on the training he and others in his program received to enter academia, he did not mention whether students were trained to enter the workforce in terms of industry.

Kate (pharmacology) and Jordan (ecology and evolutionary biology) were the only two students who indicated that their programs at MU didn't provide much exposure to industry-

related information; essentially in these programs it was up to the individual person to educate themselves about how to enter job markets in industry and to seek networking opportunities. They added:

> In my program, [professors] are only oriented towards research so they expect you to get a post-doc. We don't have any application in industry right now – maybe in the future. So if you don't want to continue with that path, you have to be very conscious to try to find other ways [and] network. – *Jordan / Latino, Ph.D., Ecology and Evolutionary Biology, MU*

> It's still very individualistic in terms of seeking the information. But I think the school is good about at least having the information. Because they have the certificate programs; you can get certified in policy and teaching, and I think there's an industry one. And then there's the career development office – I haven't used them yet but I've seen their e-mails. – *Kate / Black, Ph.D., Pharmacology, MU*

Abby, another pharmacology student, who was also in the focus group with Kate, agreed that information about workforce opportunities was not readily available and dependent on whether the student sought out such information or "if your mentor talks to you about it." Hayden's program in aerospace engineering had a clear preference for students to enter academia rather than industry, although they didn't exactly push students to one path over the other:

> There's definitely pressure from some in the department for you to want to be a professor…In listening to others and myself, when [people] come in they have this sort of academia attitude, at least in my department, that's favored. That attitude is favored. If you want to be a professor, they're much more likely to want you in the department and to want to keep you around. But as for being pushed one way or the other, no I don't think so. – *Hayden / Black, Ph.D., Aerospace Engineering, MU*

Other MU programs were much more encouraging of their students to enter non-academic jobs. In the physics department, the department put on monthly presentations for students called 'Life after Graduate School.' Tristan reflected that this monthly presentation started as the program's response to frustrated students who did not have an idea of what they wanted to do occupationally once they completed their degrees:

> Word must've gotten to the rest of the department, there must've been other people who were like, "Oh geez, what am I going to do with this degree? I'm not sure why I'm here," and so they started the whole program. – *Tristan / Black and White, Ph.D., Physics, MU*

Some programming was offered college wide:

> At the college of engineering, at their career center, they do workshops for non-traditional careers for Ph.D.s… And they're also offering a class on how to teach for Ph.D.s, so that is probably helpful for people graduating with their Ph.D.s… I'm part of the Human Factors in Ergonomics Society, and the professors and advisors for that program, they have a lot of connections, so now and then they'll forward an e-mail from somebody looking [to hire] for a certain position. – *Colin / Black, MS, Industrial & Operations Engineering, MU*

Sadie, a biomedical engineering student, admitted that although she preferred industry to academia, she thought she would "be adequately prepared to do either" due to the "professional development" to which she had exposure. Similarly, in Aaron's biochemistry program, some students went into academia and others to industry with everyone doing fine. He further explained that students were "prepared to go either way":

> They always [have] workshops and…forward the e-mails to us. And we have seminars every Tuesday from invited speakers and you're required to go to these. And we have speakers from both academia and industry so you see what it's like out there. – *Aaron / Black, Ph.D., Biological Chemistry, MU*

Program Responsiveness to Requests for Information and Recommendations for Change

The final area where programs differed was on program responsiveness to requests for information (an issue raised only by LSU students) and recommendations for change (an issue raised only by MU students). At LSU, a few students were vocal on the difficulty in their programs involved in gaining information on practical (but nonetheless very significant) administrative procedures. For example, when a professor was away on sabbatical at LSU, it was unclear to whom students should go for advice or signatures on important documents. Further, the individuals that students went to were sometimes unknowledgeable about important

department processes. Alexis and Lauren described their frustration with the seemingly simple task of filling out formal forms:

> I was wondering about that myself earlier today. And that's the problem with those forms and stuff. You probably already filled out your program of study. Nobody in the physics department, not my advisor or the general graduate advisor for students who don't have a professor to work with, knew the process of graduating and getting all your forms. I'd ask them and they'd be like, "Oh, go ask the grad school." So I go ask the grad school and they're like, "Your professor should have told you this." [And I'm like, 'my professor] told me to come to you.' – *Alexis / Latina, MS, Physics, LSU*

> I had a similar thing happen to me. My advisor didn't really know, so I just had to figure it out on my own. No one really knew what was going on. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

Beyond not having the proper information needed to file her thesis, Alexis was still unclear of the format and order of the contents her thesis should follow, despite asking numerous people in her department.

At MU, the noteworthy issue raised was a program's responsive to students' needs and recommendations for change. Among students' narratives, only Tristan and Brandon (both in the physics department) shared accounts, which cast their programs as being at the frontier of supporting students. According to Tristan, "many people, professors and students [in the program] are acknowledging the multidisciplinary aspects of [their] future work," which was good for students who liked to collaborate and learn about the research endeavors of their colleagues. The program also "started an annual progress report that [students] have to fill out with [their] advisor." In this way students, knew what they were doing well and what areas remained prime opportunities for improvement. Finally, Tristan reported that the physics department was moderately flexible in the way it operated to better meet the needs of students. Tristan explains:

> I've noticed at least one or two changes every year for the years that I've been here to help students do something more – to help move along more smoothly.

> The first thing I saw was that they started an annual program so that one week during February the professors would have to be in their office for a certain period of time so that first year [students] could come and say, 'Hey, what's your research about?' – *Tristan / Black and White, Ph.D., Physics, MU*

According to Tristan, scheduled introductory meetings with different professors in the program were necessary because a formal arrangement wherein students rotated from lab to lab did not exist in the physics department. Therefore, students needed a structured avenue whereby they could arrive at a conclusion about which lab best fit their interests. In physics, once students found an appealing lab, they could ask to join it. Tristan added, "Very few students leave (i.e. drop out) the math and physics departments. The mean [time to finish the doctoral degree] is around five to five and a half years."

Brandon, who was not in the same focus group as Tristan, shared a narrative regarding the physics department that was similarly very positive. According to Brandon, the applied physics program did whatever they could to "just to make sure that you, as a student, feel comfortable." He gave an example of a suggestion he made to the department for the curriculum; in response, the department looked into making the change. Although the implementation of the change "never really worked out," Brandon seemed to be both impressed and content that his program took his suggestion seriously. He added:

> One of the things I love about [my program] is their openness to try different things…. I can go suggest something and there's always openness, which I think is a rare thing to find in a lot of departments. – *Brandon / Black, Ph.D., Applied Physics, MU*

It is interesting, however, that not all programs housed under the physics department were structured to be equally supportive of students, especially those who were underrepresented racial minorities:

> Applied physics has, in fact, been one of the best programs in the university when it comes to diversity, especially recruiting minorities and retention. [My program is] producing – we're ranked high in producing African American

> Ph.D.'s… but it's interesting that the department that shares the same building and everything [with my program] is completely the opposite [in its willingness to support students]. – *Brandon / Black, Ph.D., Applied Physics, MU*

Institutional Resources and the Affect on Students

In identifying important structures that affect students' experiences in their graduate programs, institutional resources emerged as being rather important. Specifically the ability for students to finance their graduate degrees and the number of resources available varied by institution. I will discuss these two points first. I will then discuss notable campus programs at each institution that seemed to help students progress through their degrees while in graduate school.

Financing a Graduate Degree

Funding was an important issue for students as was the ability or willingness of their programs to support students financially through degree completion. Many students attending HBEU were not fully funded (in stark contrast to students at MU) which required them to seek funding opportunities elsewhere:

> [During] my first year after I got accepted, as far as funding and stuff like that, I was like, 'What do I do?' …So for funding, I have to go seek opportunities… – *Savannah / Black, Ph.D., Microbiology, HBEU*

> When I decided to come to [HBEU], one of the first things I inquired about was funding. What scholarships are available, what fellowships are available?... I refused to give up on coming to [HBEU] just because I was informed that funding was not available. So when I got here, I inquired once again about funding opportunities. – *Julia / Black, Ph.D., Genetics, HBEU*

Julia especially spoke extensively of the funding available at HBEU, which in her opinion was severely lacking. She recounted her search for funding opportunities during her first year. To Julia's misfortune many of the deadlines for funding had already passed by the time she heard about them at the beginning of the school year. Her situation was especially frustrating because as an undergraduate McNair scholar, she constantly heard that "graduate students,

and especially minority graduate students, don't pay for graduate school." Julia noted that had she pursued graduate work at "a number of other institutions [funding] wouldn't have been a problem." Hunter (physics) and Victoria (analytical chemistry), both well-supported in the physical sciences, were the only acceptations to the funding issue and relayed that funding had not been an issue for them.

At LSU, there seemed to be more of a mix in the number of students who were receiving financial support and those who were not. Three students (Liam, Lauren, and Landon) seemed to have funding covered via teaching assistantships, while two students (Avery and Alexis) had more precarious funding circumstances. For example, Liam's program in the math department awarded him a 50% TA appointment, which covered the cost of "everything" including tuition. He had already taught five classes, which he seemed to take seriously seeing as how he used the feedback from evaluation forms to determine whether his teaching skills were "on the right track." He went on to add:

> In my department at the graduate level, the department pushes you to complete your degree on time…you have to pass your competency exams within two or three years. If you don't get them done by then, you get kicked out… Then if after five years you're not able to graduate, they will terminate your [financial] support. So that really pushes you to complete the program…They have to make sure you're not wasting time. – *Liam / Black, Ph.D., Mathematics applied to Biology, LSU*

In molecular biology, everyone who was accepted was apparently guaranteed a teaching assistant position. This funding practice seemed to be in place more to ensure all students had experiences teaching before they graduated, rather than a practice to ensure that everyone was funded:

> I know in my department, as long as you got accepted into the department, they guarantee you a teaching assistant position. So they do it in the form of gaining experience, you're going to learn how to teach and you're going to really enjoy it. So they push that you'll eventually go into teaching. I personally do like it – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

Landon, who was also in molecular biology, confirmed that everyone in his program taught, even though it wasn't required, because teaching was a paid position. He hinted, however, that the stipend allotted was still not enough:

> Getting into a program is not difficult, but just being able to finance stuff is a problem. In our program, we're applying for fellowships and learning about different ways to fund [our degrees]. So hopefully that will also benefit us in the future. – *Landon / Black and American Indian, MS, Molecular Biology, LSU*

Not everyone, however, belonged to programs that provided as much financial security. Avery (biology) was concerned with finances and "mak[ing] sure [she was] able to afford the tuition and cost of living. Alexis was in a similar boat and hinted that funding would likely become an issue for her:

> The money's gone. [My advisor is] still not paying me because he no longer has money for the [research] projects. The money that he has left is for a grad student that was already on the project. But to get additional funds, he probably hasn't had time to apply for any different grants. I've been supported half by the department and half the research with astronomy. – *Alexis / Latina, MS, Physics, LSU*

Thankfully, a major perk associated with attending LSU was that the tuition was quite affordable. Benjamin chose to go to LSU primarily because of its low cost:

> I think cost would probably be the number one factor [I decided to attend this institution]. It's extremely cheap. I don't even know what the [cost of a] credit is anymore. But for two thousand two hundred dollars a semester I've been told that's extremely cheap. – *Benjamin / Latino, Ph.D., Industrial Engineering Operations Research, LSU*

In direct contrast to HBEU and LSU, almost all the MU students were fully funded, although the source of the funding varied. Chase and Austin secured graduate fellowships in engineering as seniors in college; without these fellowships both questioned whether they would have attended graduate school:

> My junior year of undergrad I applied for some graduate fellowships. I was fortunate enough to secure one, my senior year. So if I didn't have that funding I

> don't know what my path to grad school would have looked like or if it would have happened really at all. – *Chase / Latino, Ph.D., Electrical Engineering, MU*
>
> I worked hard to secure some fellowships my senior year. So I knew I wanted to go to grad school, but I knew that I wasn't going to pay for grad school period. So if I didn't get any funding I just wasn't going to go. Because I just heard that it was way too expensive and there was just no point in paying for a Ph.D. So that was my bottom line decision. If I didn't get funding I wasn't going to go. But getting the funding pretty much made me comfortable in knowing that I could go to grad school. So after that, there wasn't anything really stopping me from going. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

Brady (electrical engineering) shared the same sentiment; he explained, "It wasn't until I received the opportunity for funding, which I currently have, that I even considered graduate school on a full-time basis." For most students at MU, having sufficient funding was not an issue at all:

> If you were accepted as a doctoral student, you were guaranteed funding. But when we get here, I think they fund you for two years and then they try to get your department or your advisor to take up the funding. But by the two years, I applied and obtained a fellowship. So it wasn't a huge issue for me. – *Maria / Black, Ph.D., Biomedical Engineering, MU*

Tristan (physics), Max (biomedical engineering), Cooper (chemistry), Hayden (aerospace engineering), Brandon (applied physics), Isiah (biomedical engineering), Aaron (biological chemistry), Sadie (biomedical engineering), Amelia (microbiology and immunology), Charlotte (biomedical sciences), and Colin (industrial and operations engineering) were fully funded either from their department or from their advisors' research grants. The preceding compilation of quotes demonstrates the funding situation of these students:

> In a lot of the sciences, they do a pretty good job of just making sure that you're not destitute. So [being a graduate student] is actually a pretty good lifestyle. I can't complain. – *Isiah / White and Latino, Ph.D., Biomedical Engineering, MU*
>
> I wasn't really concerned about finances, because I knew for Ph.D.s, especially engineering, they give you money, so I wasn't overly concerned about the financial part. As long as you're accepted, you should be fine as far as that's concerned. – *Sadie / Black, Ph.D., Biomedical Engineering, MU*

> Having funding pretty much for your whole time [in graduate school] – a guaranteed five-year fellowship, you couldn't have gone wrong. I couldn't have picked anything better than that. So…I still have a lifestyle that I can lead with what I earn as a graduate student. – *Brandon / Black, Ph.D., Applied Physics, MU*

> As far as finances, that wasn't really an issue as far as coming to graduate school because that's paid for us… So I think we're very, very fortunate where we're actually paid to study and do research and to actually live here. They do take pretty good care of us as far as that goes. – *Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology, MU*

> Obviously, finances were not an issue because we are taken care of. It's very rare that you'll apply to a Ph.D. program in the sciences and they won't help you. So, knowing that also made it more appealing. – *Charlotte / Latina, Ph.D., Biomedical Sciences, MU*

> I was fortunate to get funding, and I walked into the funding office and they're like, "Each month you get a stipend and they will pay for your school fees." And I'm like, "That's it? What's the catch?" [And they said,]"Just take the classes you need to take." And I'm like, "Are you sure?" And I'm still waiting for the catch. (Laughter) – *Colin / Black, MS, Industrial & Operations Engineering, MU*

Colin added that in his department, "once they bring you here for a Ph.D., you're good when it comes to funding" because the department has to "make sure they have the money [to support students] before they bring you in."

Recruiters at MU let prospective students know that they didn't "really offer funding for masters students," which persuaded people like Isiah (biomedical engineering) to get a Ph.D. although he was originally interested in a master's degree. "Oh, we'll fund you for that," the recruiters told him. Indeed, "funding was never an issue" for many students and was "guaranteed for the entire Ph.D." for many of the participants wherein students got "a stipend… full healthcare" and were only required to teach for one semester. Although Colin was already fully funded, his department still sent him and everyone else in his program e-mails about additional fellowships for which they could apply. Colin explains how lucky he was to receive funding as a masters student in engineering: "I was fortunate to get funding [for this masters], … I don't have to apply for all these fellowships… I have it easier than most." Sean had a similar

observation with respect to funding across different levels; those who struggled with funding were often STEM students pursuing master's degrees as opposed to the Ph.D.

> It's harder to find [funding], if you're a master's student I think it's harder to find funding in general for graduate school. I mean there are some fellowships or monies available, but you run probably more risk, at least that's been what I've heard, that you might have to take out loans and stuff like that. – *Sean / Black, Ph.D., Mechanical Engineering, MU*

Not one participant from MU shared any complaints about their funding situation. In fact, several students were acutely aware of the fact that students in non-STEM fields were poorly taken care of financially:

> [Looking at] students from different departments, you see how easy we have it… You shouldn't be worrying about money…you see people from the social sciences and they don't get any funding. They have to work and teach. They don't get health insurance. And I was like, 'I'm not complaining ever again.'... Biological sciences, it's way different than social sciences and yeah we're spoiled [with funding]… That's what they tell you. If they don't offer you money for the whole time you're going to be there, don't go to that school…I met people from the social sciences who had it rough, so I tend not to complain about it anymore. – *Abby / Latina, Ph.D., Pharmacology & Cellular and Molecular Biology, MU*

Abby added that because of her current funding situation, she had the luxury of opting to "delay graduation" if she couldn't find a job or post-doc before graduation.

Implications of Limited Institutional Resources to Students' Experiences

Of the three institutions, HBEU and LSU, were the two wherein students seemed to be directly impacted by a scarcity of institutional resources. At HBEU, students repeatedly referenced how poor resources influenced teaching and administrative services. For example, one consequence of poor resources was poorly resourced departments. Julia's department curiously functioned on the good will of professors from the medical school:

> My department is actually housed in the medical school, so all of my department [faculty] members are paid by the medical school. They're not paid by the graduate school. So they really help graduate students on a volunteer basis. And we're very grateful. So my reasoning for saying that is that [the professors] are overworked and underpaid. And I know that they're overwhelmed, so they can only help us so much. – *Julia / Black, Ph.D., Genetics, HBEU*

David similarly commented that "the faculty are really strained and they have a heavy class load as well as being expected to do research and maintain a lab and publish… [but] the teachers are doing their part as best they can." Both students felt they were "definitely" getting enough encouragement and support. But because HBEU was limited in some of the resources that it could provide, students had to go off campus to get the training that they needed that would make them a bit more marketable as a Ph.D. student or as a researcher. Julia described one of the resources that she had to go off campus to find because it wasn't offered at HBEU:

> With my program, we have clinical rotations. And although [HBEU] is a teaching hospital, there's not a cancer rotation for us here or a pediatric rotation. So we may have to travel to [the nearby major city] to get those other rotational experiences that we need. Also, my department is limited in faculty members. And a number of them are actually retired, but they come back to help us on a volunteer basis. So you're just limited if you have a particular interest in an area, and there's not a faculty member here that specializes in the area, then you may have to seek resources elsewhere. – *Julia / Black, Ph.D., Genetics, HBEU*

According to Julia, "[HBEU] realizes that it's limited" and so "they encourage us to go outside." Since HBEU was part of the consortium on the East coast, students were able to take classes at other institutions. Another area that HBEU seemed to be lacking was in facilities. As Julia explained:

> We don't have a graduate student space, per se – like we don't have a graduate student lounge. We don't have a graduate student computer lab, where the students are able to come together in one particular setting and interact. So when we do interact, it's because you remember the informational event is going to be today at 5pm… But I think the lack of space, and just the fact that we're not seeing each other on a daily basis may hinder [the graduate] experience. – Julia

Victoria and Evelyn also talked about outdated facilities and classrooms that were apparently equipped with only a chalkboard and overhead machine. According to these women, however, programs differed by the amount of resources to which they had access. Victoria was of the opinion that not all of the problems they encountered could be attributed to limited resources. As an example she explained that the institution had new technological equipment that could improve the delivery of teaching – but sometimes older faculty refused to take advantage of these resources. Interestingly, Victoria and Evelyn asserted that there was "a generational gap" wherein they described the faculty at HBEU to generally be very "old" and looking to retire. In the conversation that ensued, the women agreed that the university as a whole did not "use their young persons" well.

Another student shared the observation that the administrative services were poor at HBEU and that this was not the case at the PWI she had previously attended. Navigating registration, financial aid services, and completing other fundamental tasks that were not specific to a student's home department was extremely difficult. For example, students apparently had to physically show up to financial services to hand in paperwork in order to make sure they received their aid; a simple phone call would not suffice. To add or drop a class, students had to fill out paperwork and physically turn it in to the appropriate office instead of logging onto a computer system remotely. Again students were of the opinion that these administrative difficulties did not exist at PWIs, which presumably had more resources. Victoria stated that she experienced the same things when she went to a different HBCU. "[It's] just unacceptable… [the administrative staff is] so stretched thin here, which is unfortunate, so, a lot of people wear different caps at this school. And it's just really unfortunate. It's sad. It makes me sad."

Similarly, at LSU students had two overarching complaints that they attributed to the limited fiscal resources of their institution. The first complaint was that many graduate classes were also cross-listed as undergraduate classes:

> The classes that I'm taking, there's undergrads in there, too. So it's a mix of both undergrad and graduate. – *Avery / American Indian, MS, Biology, LSU*

> In my department I think we only offered two courses that were just pure 500-level graduate courses. Everything else is listed with undergrad. You do a little side project or something. So no, I'm not happy with graduate courses in our department. But that's been a huge issue for a long time. But as far as the courses that I took, they were good courses. I learned from them. That's the important thing. – *Steven / American Indian, Ph.D., Fisheries Ecology, LSU*

The second complaint was with respect to the limited variety of courses offered by the departments, which can be indicative of a lack of full-time faculty, a lack of faculty time, or a lack of faculty expertise. Landon and Alexis expounded on this matter:

> I'd definitely change the curriculum just to include more infectious disease classes because that's what I'm interested in, but this is a really big agriculture college so that's not likely. – *Landon / Black and American Indian, MS, Molecular Biology, LSU*

> The thing that I don't like is I'm supposed to be a geophysicist. There's no geophysics class. There's geophysics classes for the undergrads, but at grad level there aren't any. So even my qualifying exam was supposed to have been different because I was going into geophysics... Going along with that, the required courses are offered every other year. So if you miss one, you wait two years to take it. – *Alexis / Latina, MS, Physics, LSU*

Cameron (mechanical engineering) and Lauren (molecular biology) had alternative viewpoints, however. Cameron shared that "the class offering is good" and Lauren seemed pleased with both the quantity of course offerings and the student makeup of the classes in her program:

> In my department, there are very few classes that we take with undergrads. Most of them are just graduate courses. But like I said, we have a very big range in microbiology; if you're working with plants or bacteria – there are so many fields that they offer a range of classes. So depending on what your specific

> research subject is, we get to choose from a range of classes for that particular credit. So they're mostly graduate courses. There's a few of them… [that] we have to share with undergrads, but we have a separate project. We have to write another paper or our grading scale is different or something like that. – *Lauren / Latina, Ph.D., Molecular Biology, LSU*

Overall students were pleased with the number of students in their classes, which Anna (mathematics) and Samuel (electrical engineering) say ranged between eight and 30 students. Students especially appreciated small class sizes in courses with a reputation for being difficult, perhaps because student questions were more easily managed with fewer students. Students may have liked small classes for the same reason that they liked small departments; it lent itself to greater intimacy between people. Bigger departments didn't seem to bother students as long as there was a sense of community and intimacy among those in the program.

Interestingly, the lack of institutional resources did not stop Benjamin's program from taping classes and posting them online, which permitted students to have more flexibility to juggle a work schedule and school responsibilities. In fact, Benjamin shared that he "never [had] to step foot on campus if [he] didn't want to."

> The distance ed that industrial engineering [has for] a lot of the courses has really, really helped 'cause I travel a lot during my work. So I'm gone for 2 ½ weeks, but I can usually just have the lectures at hand and e-mail the professors at any time. So that was nice. *Benjamin / Latino, Ph.D., Industrial Engineering Operations Research, LSU*

Notable Campus Programs that Help Graduate Students

In describing their experiences, students at each of the three institutions mentioned several programs that were strong sources of support as they pursued their graduate degrees. At HBEU, one of the most helpful structures in place that reached students the minute they stepped foot on campus was a thorough half-day orientation for all graduate students that provided crucial information from the onset. During the orientation students had the opportunity to ask all the questions they had and the administrators seemed very open to answering

questions from students. The orientation also had current graduate students (including those about to graduate) on panels to speak to the incoming students. Both faculty and administrators attended.

The second supportive structure at HBEU was the counseling services available to students. Hunter shared that when he first started his graduate program he immediately began to use the counseling center for students and that helped ease the transition. The third highly supportive structure at HBEU was "student groups for graduate students," as Hunter noted. Julia for example was the vice president for the Graduate Student Council, which provided opportunities for students to network with people from other disciplines. Julia and her Council colleagues strove to put together more events that would build community among students across the graduate school:

> We're constantly coming up with events to meet the needs of the graduate students. So I really know the time, blood, sweat, and tears that go into planning the events, and just trying to get our colleagues to interact and meet one another just because we're trying to overcome the sentiment that there is no graduate student experience. – *Julia / Black, Ph.D., Genetics, HBEU*

The fourth major support structure HBEU students commonly referenced was the Alliance for Graduate Education Professoriate (AGEP). A Google search of the AGEP program revealed that AGEP is a National Science Foundation program aimed at enhancing the preparation of underrepresented minority graduate students for faculty positions in academia. Participants are to participate in monthly student organized meetings to share knowledge and can receive mentoring from more advanced AGEP graduate students to better navigate graduate school. Persons qualified to serve as a Principal Investigator (PI) at an institution can apply for the federal grant that would finance an AGEP project at their local campus. At the time of this study, 108 institutions had AGEP programs.

According to David, AGEP provided HBEU students with additional funding as long as they fulfilled certain expectations such as attending monthly meetings. At these meetings, students shared and exchanged ideas and information. In this way, AGEP scholars were made aware of a variety of opportunities that would soon become available to them. Julia added:

> I've been fortunate enough to be an AGEP scholar. And a lot of the mentors in the AGEP program, [are] always forwarding us e-mails about summer opportunities and different things. And I'm grateful to receive that information, even though I know I already have a summer opportunity in place. But had I never... been fortunate enough to be an AGEP scholar, I know that would have been information I never would have been privy to… [Further] this year, I have not had to pay a single penny or take out a single loan for my education. That wasn't the case in years past. So AGEP has been very helpful in that aspect. We also have workshops every now and then that are very helpful. And as an AGEP scholar, we're also required to participate in the Preparing Future Faculty Program here at [HBEU]. So we're exposed to a number of professors on campus, and they're instilling in us knowledge that you'll need as a future professor and sharing opportunities as well. – Julia

Issac used an interesting metaphor to describe AGEP and how it had helped him:

> AGEP is like your mom when you were in high school. It asks you to do way too many things than you really don't want to do, but I think it's creating a standard. At least that's the way I choose to believe it. That's the way I choose to look at it, is that on some level they're trying to create a standard as a sort of top-notch scholar fellow program. And so on one level I appreciate it… But I think AGEP has been great. I think it avails a window for mentoring and retention. A lot of schools don't have that. – *Issac / Black, Ph.D., Chemistry, HBEU*

Being an AGEP fellow was particularly important for David to be successful in graduate school, particularly when it came to finances:

> I cannot see myself working and commuting to [school from the nearby large city]. That's just not happening. And I know a lot of students who are working and doing decent commutes and they're pretty stressed out – so I don't have to worry about [the financial] aspect of [graduate school] and that helps a hell of a lot. We hear about a lot of opportunities before the other students do. So that helps a lot as well….the major thing is going to be the finances… some of the requirements of the program… they're helpful in the long run because we have to apply for funding. We have to put in an application for…an external funding source like NSF or NIH. And that helps to make us competitive when we

> graduate because then you can say, "I've successfully applied for funding. I know how to put together a proposal." – *David / Black, Ph.D., Animal Behavior & Ecology, HBEU*

AGEP was also useful in that it offered students a number of beneficial workshops to attend. Some workshops were created specifically to address pressing needs of AGEP scholars:

> Sometimes if there's a particular subject that a lot of the students are taking, like I think a lot of the students were taking Biochem one semester and people were really having trouble with it so they set up tutoring…I wasn't taking Biochem so it didn't directly affect me, but that stuff is useful and it's nice to know that you have some people that you can ask when you have questions." – *David*

AGEP also connected students to helpful resources on campus:

> I forgot to mention there is one other thing that AGEP did that was really helpful. We were introduced to [the Center for Learning and Teaching in higher education] and I took a lot of courses there that I think really helped prepare me for the professoriate. And a lot of them, just in general, are a good preparation in dealing with working in teams and things of that nature, working with groups of people. So that's one thing that really helped from that program. – *David*

According to David, some of the requirements of the program however "add[ed] a little bit of stress at times" to students' lives. Issac elaborated on this point:

> [AGEP] does not look into specific situations. It sort of makes a sweeping rule and doesn't take into account that TA-ing and taking biochemistry the way it's offered in the med school is tough. That's really, really tough. And if they expect students on some level to meet the standards that they would like, they have to have some level of flexibility on an individual case or at least individual departments. – *Issac / Black, Ph.D., Chemistry, HBEU*

To be a participant in the program for example and receive the substantial stipend that program participants were given, students *had* to say they aspired to eventually become a professor. However, the reality was that entering the academy did not always remain students' career of choice:

> Because I'm an AGEP fellow, when I graduate, I'm going to have this teaching portfolio that allows me to be able to be a professor. Thank you for paying tuition

> –that little stipend that I get every month – but I don't want to be a professor. Not right now. So, if I were to go tell the person who oversees my program that, "By the way, I really don't want to be a professor," they'll snatch my funding right from under me. But in the long-run… I want to work for the government…That is not supported right now. It is all about being a faculty member." – *Victoria / Black, Ph.D., Analytical Chemistry, HBEU*

Indeed students who remained in AGEP for the training experiences and funding, but who eventually figured out they did not want to join the professoriate took great care before speaking to others in the program about their career aspirations:

> When you finish your Ph.D., in general, [it is expected that] you're going to be a professor… [that's] why you're in AGEP. Doing anything other than becoming a professor is deviating from the norm. *Kaelyn / Black, Ph.D., Biology, HBEU*

Victoria had similar comments:

> People talk. So if someone says, "Oh, I met this great person for Victoria in the government." [Their response will be,] 'She's in AGEP. How's she going to be a professor in the government?' So, people talk... People talk so much – *Victoria / Black, Ph.D., Analytical Chemistry, HBEU*

The second drawback to being an AGEP fellow was that to get the scholarship monies associated with participation in the program, students were required to TA. According to Aaliyah, TA'ing made the transition to graduate school much "more difficult." Camryn provided a much more thorough explanation of why this was so. In her case, Camryn was made to TA during her first semester as a graduate student in addition to conducting research and taking classes, which was overwhelming. She shared, "I don't advise any first year student to TA. That's absolutely ridiculous… It was way too much for me. Thank God I squeaked out the way I did."

Although there were many structures at HBEU that seemed to be supportive of URM graduate students in STEM in their journey towards degree completion, at LSU, there were only two such references, and both structures were helpful indirectly as they were offered at the undergraduate level. For example, one bridge program set students up for becoming interested

in research during their pursuit of a bachelor's degree and thereby served as a pipeline to graduate school:

> There are some programs that actually help support students. So, for example, there's a bridge program here that recruits students from community colleges and they bring them down here and give them some experience in science. They allow them to work for the summer in a lab and actually get a feel of it, and to help them transition from a community college to a four-year university and provide support for them, too. I think that's what really drives a lot of students who participate in this bridge program to come to this university because they already have the experience in the lab. They have their mentor. They have a way of supporting [themselves] financially. It really eases the transition for them and plus when they come down here they have housing over here set up. So they already pretty much have everything if they want to transfer. We have the RISE program (Research, Innovation, Service and Entrepreneurship Program) here, too, which is another program that helps students work in the lab and pay them to work in the lab. So that really helps people. – *Avery / American Indian, MS, Biology, LSU*

Seeing as a number of students went to LSU for their undergraduate studies (e.g. Avery, Evan, Mason, Brianna, Benjamin, Anna, Cameron, Lauren, Alexis, and Landon), continued on at the same institution for their masters' degree (or Ph.D. in some cases), and worked with the very same faculty they had worked with during their undergraduate years, it is reasonable to conclude that this pipeline was in part made possible by undergraduate research programs like the RISE program mentioned above. A quick search of LSU's website shows that as part of the RISE, engineering students worked alongside faculty on projects that had a real impact on society. Students could be RISE scholars for as long as they wished during their undergraduate career.

The second institutional-wide resource offered to students at LSU were federally funded programs, which inherently pushed students to go for the Ph.D. – even if a doctoral degree wasn't in alignment with students' interests:

> There's certainly no encouragement for anything other than a Ph.D. within [federally]-funded programs – for academic prosperity. Absolutely not. They're

> almost difficult to work with when you want to explore other [career] options. I think it's a major problem… [for] most of their funding grants and their fellowships you make an agreement before you go in that you're going to do your Ph.D.… It's the same deal with probably most of us here that have fellowships from various organizations. They want a commitment to what you're doing… Unfortunately I know more than a few people that are doing Ph.D.'s right now because they felt committed to it and they don't want to be there at all. That's a problem… But as far as my experience with NSF goes, they're pretty relentless as far as what you commit to… Depending on your organizational funding, [determines] the type of pressure you have to follow a certain [career] direction. – *Steven / American Indian, Ph.D., Fisheries Ecology, LSU*

Beyond the two programs above, three students referenced involvement in organizations specific to their departments that made graduate school more enjoyable. For example, in the electrical engineering program to which Evan belonged, students had the option of serving as student ambassadors. As part of their duties, ambassadors were in charge of speaking to prospective students and explaining to them why they should seriously consider attending LSU. The Wildlife Science program to which John belonged had a graduate student organization that met once a month. Members went to conferences together and also gathered socially for beers. Similarly, according to Brianna, in the industrial engineering program there was a professional chapter for engineers. Going to chapter meetings, social dinners, and study groups allowed Brianna "to know more people" within her program and across her department.

At MU, students in the interviews mentioned several programs aimed at improving the number of underrepresented individuals in STEM disciplines, although not all of the mentioned programs targeted graduate students. For example, MU offered summer research programs to undergrads from different institutions and bridge programs for incoming graduate students. MU students shared their experience participating in these programs:

> I did an [NSF-sponsored] REU (Research Experience for Undergraduates) internship, here at [MU] in the fall, summer 2007. [More specifically], I did the summer SROP (Summer Research Opportunity Program) program here at [MU]. So that's really what confirmed that I wanted to not only come to [MU], but go to grad school. I was in a summer program here before so I made friends that way.

> And even if they're not in the field, being grad students, they understand the framework of research and you can communicate on that level. Doing the summer program before my first year definitely helped me establish a good support network of friends and stuff. – *Austin / Black, Ph.D., Mechanical Engineering, MU*

The Summer Research Program (SROP), according to MU's website, was for undergraduates underrepresented in their field and allowed participants to conduct intensive research across a variety of disciplines. Participants also engaged in a series of academic, professional, and personal development seminars. The program's goal was to prepare students for advanced studies in a Ph.D. program at MU. The Research Experience for Undergraduates (REU), sponsored by the National Science Foundation was similar to SROP in that it targeted undergraduate students and allowed them to do research over the summer for ten weeks at MU. The Summer Institute was another program offered over the summer to MU students entering graduate programs:

> I came to a visitation program here one semester and [came another year for a different program] my senior year of undergrad. Those programs were geared towards underrepresented students. So those were very helpful. I became friends with someone who ended up being my roommate my first two years here, and like I said I did the summer program called Summer Institute… [Participants were] incoming Ph.D. students or master's [students] if their program only offered master's [degrees]… and [participants were] in different fields so it was good to have that diverse support group to start out my first summer here. – *Max / Latino, Ph.D., Biomedical Engineering, MU*

> When I got into [MU], I got into the Summer Institute program, which bridges the transition between undergrad and grad school. So basically what you do is you come in June – so I graduated in May, came in June, and spent eight weeks, and they give you seven thousand dollars or so. And then you have seminars, you get to do research with a faculty member, get advice on pretty much how to do anything. And then it's the summer and there are 70 people, so you get to make friends right away. And it's not just biomedical researchers, it's pretty much everybody, so I still have friends that I met in [the Summer Institute] and that's really cool because before you start taking any classes, you're getting used to the place, making friends. – *Aaron / Black, Ph.D., Biological Chemistry, MU*

In addition to the campus wide programs, there were three STEM student groups that students specifically cited as providing extra academic and social support during their graduate study at MU: the Movement of Underrepresented Sisters in Engineering and the Sciences (MUSES), the Society of Minority Engineering Students - Graduate Component (SMES-G), and the graduate version of the Society of Women Engineers (SWE). A quick review of the organizations' websites populated by the search engine available on MU's main page reveals that these programs were created precisely to uplift, empower, and affirm underrepresented students of color (or women) in graduate spaces. MUSES worked to address issues of retention for women in engineering and science and the multidimensional struggles they face. It also served as a mentoring vehicle and an avenue by which to build community among URM women. SMES–G had similar goals but targeted students in engineering and science disciplines and was also open to men. This program also focused on outreach and advocacy, encouraged community and skill building, and strove to provide its members a welcoming and nurturing environment. SWE targeted women in general (not just URM women) and served as a social outlet, put on professional development events for members, and provided opportunities to network professionally. SWE also offered large career fairs, charity events, and community outreach opportunities to its members.

Charlotte reflected that the programs outlined above offered a support system wherein "no one was competing or trying to knock anyone down." Jasmine indicated that these programs helped her connect to pockets of students across the campus:

> There's a group when I came in… SMESG, and they headed up the activities. So I'm very active in SMES-G. I was the president and the vice president there. There's another group called MUSES and it's the Movement of Underrepresented Sisters in Engineering and Science. And I was their vice president one year. So throughout SMESGE and MUSES I've sort of been able to click with other people who may be the only one in their department [that is a racial minority] or the only one of three. So we all come together. And that's

> once a week where I'm like, 'Ah, okay. They get me.' – *Jasmine / Black, Ph.D., Computer Science, MU*

Similarly Kate appreciated student groups geared toward scientists as a social outlet:

> I gravitate more towards the [student groups] that have more scientists in them, just because you're naturally going to go where you feel comfortable and welcome and you can have stuff in common with people. – *Kate / Black, Ph.D., Pharmacology, MU*

Dominic joined STEM-related student groups more as a source of social support and as a way to give back to his community via service, than for the professional development these programs provided:

> I'm a member of a lot of [the STEM-related graduate student groups] but my reasons for joining most of these organizations are different… the main reason why I'm normally part of them is one, for the food. And then, two, it's the easiest way for me to give a certain minimum amount of hours back to the community. So by joining this organization, it's easy for me to perform community service. Like for example, when I was in [one organization] they made us mentor middle school kids. And if I joined some other organization, I probably would not have the chance to do that. – *Dominic / Black, Ph.D., Electrical Engineering, MU*

Maria reported that she "tried to be affiliated with all of" the professional student groups cited above and even served in leadership positions for two of them. These programs helped contribute to the sentiment that her graduate "experience has been supportive for the most part." Maria was pleased to add that the College of Engineering and its Dean were "very supportive" of the student groups identified above.

Another noteworthy program was the Program in Biomedical Science (PIBS), which was an interdisciplinary gateway program that coordinated admissions and first-year graduate studies for 14 doctoral programs at MU. The program allowed participants to rotate in the labs of more than 500 faculty and choose a permanent program by the end of their first year. According to Kate PIBS, was "committed to diversity and bringing in people" to the university. Students enrolled through the PIBS program, were guaranteed full funding and benefits for their entire

Ph.D. and connected to resources in the graduate school that would support their success. Further the program provided students with roundtables to discuss topics such as how to have a successful lab rotation, how to choose a thesis advisor, and which classes were best suited based on one's interests. Amelia and Aaron offered their perspectives regarding this program:

> PIBS is great because there are so many people that come in [through] that and so many people to talk to that are all going through the same thing. So I think that you make friends pretty quickly and it's a big support group in itself. Most of the friends that I have, they either were in PIBS originally and they've gone off into their different departments… But I think for the most part, they're all PIBS students that I tend to hang out with. I'm not really in any other groups besides that. *– Amelia / Latina and American Indian, Ph.D., Microbiology and Immunology, MU*

> The PIBS program, they have all these social events. It's a very big program, so you get to meet a lot of people, a lot of faculty. And the way they have the classes set up – it doesn't matter what department you're going to eventually end up in. You all take the same core classes. So my first class was not basic, but just stuff to get everybody on the same page. So it wasn't that difficult. And they have all the social events and retreats and coming from [another country] and coming to [MU] where I knew nobody, it didn't take me long to really get going. – *Aaron / Black, Ph.D., Biological Chemistry, MU*

PIBS also offered a student club for underrepresented students called the Association of Multicultural Sciences (AMS). AMS provided students with community service opportunities, speakers' series, socials, and was involved with recruitment activities. Charlotte commented on who participated in this club:

> There are quite a few Puerto Rican students in there [and] African Americans, Native Americans – a very diverse group, which I like. So I need this [student group]. It just made me feel comfortable. So there's that. I don't get to go to as many meetings as I'd like to because of scheduling conflicts. But when they have events, I do like to go. *–Charlotte / Latina, Ph.D., Biomedical Sciences, MU*

From Kate's perspective, firm support for diversity improvement programs like PIBS seemed to have waned in the few years before the interview took place:

> Since [legislation was passed that prohibits affirmative action] the wording has to be changed in terms of what they can call certain things, and I feel like that's

> made more people be more [vocal] about, 'Well, why do we need such scholarships and diversity programs?' and 'Isn't that separating things?' – which just makes me think they just don't get it, as to why there is still a need for such a program for people like me. – *Kate / Black, Ph.D., Pharmacology, MU*

The final program mentioned by MU students was the Alliance for Grad Education and Professoriate (AGEP) and it was much like the AGEP program at HBEU.

In addition to major programs that support diverse graduate students, the graduate school offered a lot of programming, some specific to minority groups and others that were not, that offered support for pressing concerns that were typical of graduate students. Some events offered included yoga; talks with titles like "Beyond the Academy," "The Imposter Syndrome," and "Life after Grad School"; and workshops on tasks like dissertation writing. Many students saw the Graduate Division as a great resource:

> I think there's a lot of help that's available. If you don't get [into] the academic programs, they have a lot of different workshops that can help you with anything that you might be struggling with. Whatever program you're in might not have that particular help, but if you just look out there, open your eyes a little bit, there's a lot of help here that can make your life easier. At the college of engineering, at their career center, they do workshops for non-traditional careers for Ph.D.s. I'm not a Ph.D. so I don't go to them, but I've seen those. And they're also offering a class on how to teach for Ph.D.s, so that is probably helpful for people graduating with their Ph.D.s. – *Colin / Black, MS, Industrial & Operations Engineering, MU*

There was also programming offered via the graduate school that provided students information that could help them prepare for the professoriate:

> Actually there is a program, it's through [the graduate school] and one of my advisors is trying to help out with it. It's [called] something like, 'Your Academic Future.' And so they try to display the various avenues that you could have within academia and maybe talk a little bit about outside of it, but it's a lot about teaching, a lot about how you get tenure. This [programming] is totally new. – *Tristan / Black and White, Ph.D., Physics, MU*

Interestingly, students noted several tensions existing between the graduate school and their particular department. Namely, when students complained about a particular issue enough,

the graduate school pressured the department to improve the situation in question, yet the department might resist making any actual changes. As one student put it, “departments do not necessarily follow the initiatives created by [the graduate school] by engaging in action.” In other words, the decrees professed by the graduate school were limited in that they did not necessarily translate to changes made at the department level. Another point students made was that departments sometimes used the graduate school as “a crutch” for not offering needed services to students within their programs. Finally, the most substantial critique of the graduate school was that it changed certain rules pertaining to graduate students in response to some departments (including non-STEM departments) that were “out of control.” For example, a new continuous enrollment policy was established whereby students had a total of seven years to finish their degrees after which point they would be kicked out of the program.

The Racial Climate and Feeling Welcomed

Students at each of the three institutions commented on how their institution or program ‘felt.’ At HBEU several students spoke of the overall differences of warmth they experienced in other campus environments compared to HBEU, which they found to be far more welcoming. Claire, for example, originally went to HBEU for her undergraduate institution, left for her masters to a nearby PWI, and came back to the HBEU for doctoral studies. Prior to starting her doctoral degree, some of her undergraduate professors at HBEU remembered her during a campus visit, which pleased her a great deal: “I was like see? This is why I came back. And that was one of the main reasons why from [my master’s institution] I came back [to HBEU] when I was applying for grad school.” Claire went on to say that she didn’t apply to her master’s institution at all and explained why:

> My first semester at [my master’s institution] – meeting with the advisor I did not have a very pleasant experience at all. And so it just made me long for the nurturing environment of [HBEU]. And so that was the main difference. The environments were different. [HBEU] was so welcoming from the first moment

> that I stepped foot on this campus…The person that took me around the campus…was just so nice and so inviting. – *Claire / Black, Ph.D., Microbiology, HBEU*

Julia also wasn't a fan of the institution she had attended prior to HBEU:

> I wasn't really happy at my undergraduate campus. But here, definitely, if I compare the two, I'm supported here. I feel as though if I have a question, that I can go to that professor's office, whereas I would not have done that in undergrad. They're just a little more welcoming here. You feel as though they really have your best interest at heart, and they want to see you succeed, whereas I didn't feel that was the case in undergrad. – *Julia / Black, Ph.D., Genetics, HBEU*

Another reason students felt more welcomed at HBEU was because of the warm cultural environment for Black students. For example, Camryn shared a story about how matters of race played out differently at a PWI in the Midwest that she had previously attended and recounted that although she got a great education there, she "hated" going to that institution. As an example of the racial discrimination Black students faced at her previous institution, Camryn shared:

> [The students at my previous institution] had things like 'The Old South Day,' when they would rent little Black children from [the nearby city] and [the children] would stay on the lawn of these big White [frat] houses. And… it's supposed to be something funny. There were a lot of situations that happened like that when I was at [this PWI]. So I realized that this [place] is not me. I cannot live like this. There was the first time ever a Black student ran for president. She was mugged, and they told her, 'That should teach you. You should never, ever again run for president. Now you'll see.' And it was all over the news. [The PWI] sent letters home to all the students' parents, saying, 'Don't worry. We're not racists.' It was ridiculous. And so it taught me a lot. – *Camryn / Black, Ph.D., Pharmacology, HBEU*

At LSU, when students spoke about the feel of the institution it was also with respect to race and feeling welcomed. Langdon, Avery, and Mason, all from the same focus group, agreed that the institution provided a good climate for diversity wherein they felt welcomed by the campus and both supported and welcomed by their home departments. Benjamin agreed that the institution as a whole treated the different local cultures warmly and "took pride in the

diversities." He added, "I think they even advertise that, being just a diverse university. I think they try for that." When asked to name the specific ways that attending a university with a great deal of Latinos and other underrepresented minority populations influenced how he felt as a graduate student in STEM Benjamin responded accordingly:

> I just would say I felt normal. I don't know how else – I never really thought a lot about race or ethnicity so much. I just felt like growing up here for the majority of my life and then going on campus and just looking around and I just see it's just a diverse [campus]. You look around and there's just a huge mix. – *Benjamin / Latino, Ph.D., Industrial Engineering Operations Research, LSU*

In recognizing that not all institutions were welcoming to Latino students, Benjamin offered a story of a Latino friend who was also pursuing a STEM graduate degree. This friend, who initially went to a different institution, "could not stand going there" and "ended up transferring here and he said he loves it here. It's just a whole different culture. He feels like he's accepted [at LSU]. His professors are different." Evan noted that not only was there a "good environment right here [at LSU]," but that the institution was "well recognized… especially if you compare it to the [other] southern universities" and offered graduate programs that were "pretty good."

At MU, when students spoke about the feel of the institution or their programs it was also with respect to race and feeling welcomed. Comparing the information MU students shared in Chapters 4 and 5, there seems to be interrelationships between the normative culture within a program (i.e. whether it was reported as collaborative or competitive), students' experiences with racial issues within their program (or on campus more generally), and whether or not students created friendships with peers and their perception of their programs. For example, graduate programs that seemed to be overly competitive turned off students. Brady, an electrical engineering student, indicated that he perceived his peers to be more competitive rather than collaborative, with people constantly trying to prove themselves. It is understandable then that although Brady's interactions were "cordial" with others in his program, he "never spent any time with anyone" outside of the academic context. Similarly, Jasmine, a student in

the male-dominated field of computer sciences, had peers who didn't seem very enthusiastic to work with her in the classroom context, although these same peers seemed to have no hesitation to work with each other. Not surprisingly, although Jasmine's interaction with peers was "not negative" per se, her interactions with them were "minimal" as demonstrated by the fact that she reportedly didn't attend department socials often and that she didn't go out of her way to make friends.

Dominic is another prime example of how a competitive and subtly racist peer environment affects students. A look at the narratives he shared shows that he perceived classmates in his electrical engineering program to be "individualistic" rather than collaborative, and much more so than students at his undergraduate institution. Classmates in his graduate program signaled to Dominic that they were "not interested in helping" him although they worked together, stared when he walked into a classroom, and expressed an overall lack of warmth in their interactions with him. Dominic reflected that he felt that at least some of this treatment could be attributed to his being African American and one of very few racial minorities in the department. Not surprising, Dominic didn't have the best social relationships with peers in his program and sought academic and social support elsewhere on campus.

Alternatively students who described their programs to be collaborative and/or perceived there to be no racial issues in the program were those who tended to view peers as friends and who viewed their program in a positive light. Tristan (in physics), explained that "being able to hook up with other students has been the most useful way of getting ideas about what I actually want to do" and limiting the "feeling of isolation." Similarly, the pharmacology program to which Kate belonged had a collaborative spirit. She reportedly felt like she could "talk to anyone" if she needed help or simply wanted to do so. Further as a Black student, when speaking on the subject of racial issues, Kate shared, "nothing has happened that has taken away from my experience here or to make me think of the school in a bad way." Not surprisingly, Kate often

met peers for social interactions at bars and admitted, “Yeah, I love my department.” Abby was in Kate’s program and also explained that within her department people worked together on schoolwork and research. Further with respect to race, Abby who identified as being Latina, shared that she thought MU was “a really good university if you’re looking for a multicultural environment” and felt that the university was “pretty diverse” and “pretty open.” She seemed to be pleased that there were “tons of student groups that are for multicultural students to integrate everyone” and that the university was “working on” issues it had with race and diversity. She too shared that she often socialized with peers at the local bars for happy hour and in four words summed up her graduate experiences with, “I’m pretty happy here.” Like Abby, Colin (Black student in industrial and operations engineering) reported that the university was “really trying here” and “doing pretty well” when it came to matters dealing with race and diversity and reflected that his undergraduate institution had more racial issues than he could find at MU. Seeing as Colin didn’t personally experience racial tension during his graduate studies, it isn’t surprising that his classmates comprised a majority if his circle of friends.

Hayden decided to go to MU precisely because during his campus visit, everyone in aerospace engineering was “very warm” which was in stark contrast with the people at another institution he was previously interested in attending for his graduate work. Hayden “didn’t have a good feeling about [the other institution]” since they were not “very cooperative with [his] visiting.” In talking about his program at MU, Hayden described those in his department as “good people” and his advisor as a “very welcoming [and] a very exciting person.” Once at MU, Hayden often collaborated with lab peers on research projects and reportedly had especially positive and close bonds with the people in his lab. Peers were not just friends to Hayden, but more “like family.” In sum, Hayden stated, “I’ve been here for two years and enjoy it.”

Amelia, a microbiology and immunology student, reported not feeling competition in a negative sense “at all” and added, “I feel like you can walk down the hall and ask someone for

advice on how to do a certain technique or whatever it may be. And everyone's really, really willing to help and share what they know with you." It wasn't surprising then that she reported that her biggest sources of support and friendship came from people with whom she had classes, which was nice since she spent "way too much time in [the] lab." It therefore had been "pretty difficult for [her] to meet a lot of other people" outside of her department. Jordan's department in ecology and evolutionary biology also had a collaborative spirit and intentionally organized socials and parties that helped keep students engaged with each other. He also reportedly would meet peers socially for informal activities like happy hour. Finally, Aaron also belonged to a program that had a collaborative and supportive climate. When talking about his program in biomedical sciences he shared:

> If you need anything advice, time on some piece of equipment, or help with anything – you just send an e-mail, and within five minutes somebody will reply to you. So it's very open, very accessible. I have replied to many e-mails where people need help. So if you need anything, you'll get it. Somebody's going to help you, so I really like that about the med school. So I haven't had any problems. I haven't seen any problems where some faculty will deny somebody something or anything like that. So I'm spoiled, but that's what I've observed. – *Aaron / Black, Ph.D., Biological Chemistry, MU*

Given the norms within his program, it is no surprise that Aaron reported that he had "an excellent relationship with [his] advisor," who was also "very accessible."

As mentioned before, there is evidence that a program shapes the interactional dynamics between peers. For example, Sean (mechanical engineering) shared that under "the old system [students] had to take these battery of tests" and that these tests seemed to serve "a weeding out" function because there wasn't enough funding to go around for everyone. This reality, wherein the success of one student could mean that another student would not be funded, may partially explain why peers denied Sean inclusion when he had asked to join their established student study group. Although Sean didn't altogether feel like his peers behaved in a "cutthroat," manner he did admit

that there was a competitive sentiment in his program. Austin, who was also in mechanical engineering explained that the reason the qualifying exam used to serve a "weed out" function, was because the department used to "just accept a bunch of people" and so funding was scarce. By using the qualifying exam as a tool to narrow down the number of people who needed funding, the program was inadvertently pitting students against each other and contributing to a competitive learning environment. This dynamic may also explain why, according to Austin, the few times students in his program got together socially there was "tension" and a "clash of personalities." As a result Austin explained, "so for me that just kind of made me retreat, you know socially and just say, well, instead of just constantly butting heads with these people let me just avoid them completely." Austin eventually made a set of friends outside of his department with whom he was reportedly very comfortable.

Alternatively, welcoming, cohort-based programs seemed to facilitate the establishment of friendships among people in the same program:

> The applied physics program prides itself on bringing people together as a family. So usually your first year of being in the program, you come in, you all share an office together or it's a big class. And they usually don't take maybe eight students a year at the most. So most of you are taking the same classes your first year so you're usually together and relationships form and you get closer. As long as alcohol is involved somewhere you find people getting together a lot more. But what happens usually after your first year is people get into their research thesis. There are some people in my year I haven't seen in two or three years, especially if they're off-campus [but] it's usually there at the very beginning when I feel – when it's probably the most needed. I know people who still brew beer up until now, every other weekend, because that's what they started doing [together during] their first year. – *Brandon / Black, Ph.D., Applied Physics, MU*

As a collective, students' narratives above suggest that structures at the program or institutional level can influence their experiences as they provided financial support, shaped social interactions, provided help with coursework, impacted the number of classes and training experiences to which students had access, helped create an environment that felt more

welcoming for diverse students, and assisted in students' learning. As illustrated above, many of these structures are under the institutions' purview of control so that even though institutions cannot possibly control the behavior of every individual person on its campus, it most certainly can create interventions that make progression to degree completion at the graduate level more attainable and enjoyable for URM students.

CHAPTER 7 CONCLUSION

"THE LITTLE THINGS ADD UP"

Considering the importance of a highly educated and diverse pool of science, technology, engineering, and math (STEM) researchers for our country's future, it is troubling that many students start advanced STEM programs but do not persist to degree completion. Indeed, only about half of those who start doctoral degrees (Council of Graduate School [CGS], 2008) and roughly 40% who start master's degrees in STEM (Kent, 2013) finish within 10 and two years respectively. Further, there are wide racial differences in graduate degree completion within institutions of the same type with Black, Latino, and American Indian students least likely to complete their graduate degrees (CGS, 2008). There are also large differences in advanced degree completion between institutions. Taken together, these facts indicate that there are systematic barriers affecting students and certain institutional contexts that better position URM graduate students for degree completion (Charmaz, 2006). Uncovering the facilitators and barriers to success in graduate school is therefore a necessary line of scholarly inquiry, especially since barriers often affect students from racially marginalized groups "first and most severely" (George & Malcolm, 2011, p. 10). Further, increasing the number of minority persons who persist and attain advanced degrees in STEM is needed for technological and innovative advancement in industry and business, the efficient use of scarce resources, the diversification of the STEM workforce and faculty ranks in academia, and for more aggressive research on disparities and living conditions specific to minority communities. Moreover, non-completion at the graduate level wastes talent and resources.

For these compelling reasons, universities are tasked with making changes that will better support diverse graduate students as they progress to degree completion in their respective STEM programs. Not much is known, however, about the particular experiences of this unique group of students or the environmental factors that contribute to such experiences

(Flynn, Sanchez, & Harper, 2011). Consequently, the purpose of this study was to uncover the academic and social experiences URM students have within their graduate STEM programs that support and hinder degree progress. The research questions guiding this study are as follows:

1. What are URM students' social and academic, both formal and informal, experiences at the graduate level in STEM disciplines?
2. What power dynamics are at play in URM students' graduate programs in STEM and how does race and ethnicity influence students' training and educational experiences?
3. What institutional structures, contexts, and/or processes can explain the difference and/or similarities in experiences of URM students?

The evidence provided by this study demonstrates that the interactions students have with peers, advisors, and faculty; the power relations present within those relationships both generally and with respect to gender and race specifically; and the programmatic or institutional structures in place, work in combination to make graduate socialization experiences enjoyable, manageable, and rewarding – or these factors can "add up" as obstacles along the pathway to a graduate degree. Further, although there are clear differences in the experiences of graduate students at the three types of institutions (HBEU, LSU, and MU), there is also common experiences and examples of URM students enacting agency in order to enhance their outcomes.

In investigating the educational, training, and social experiences of URM students in STEM graduate programs, I merged three distinct theoretical perspectives to place issues of race and power at the center of analysis: the first critiques American institutions and notes how race and power normalize and reinforce racial inequity and social hierarchy (Bonilla-Silva, 2001; Omi & Winant, 1994); the second focuses on inequities and demonstrates that seemingly trivial institutional practices and unconscious individual behaviors can collectively result in great opportunities and benefits for some people and great disadvantages for others (Brennan, 2013;

Rowe, 2008; Sandler, 1986; Wylie et al., 2007); and the last theory explains how graduate students are socialized and trained in the educational context (Antony, 2002; Weidman et al., 2001). By merging the three theoretical frameworks into what I term, a critical application of socialization theory, I identify ways that URM students face discrimination and oppression in their educational trajectories and demonstrate that URMs are not simply socialized into their STEM domain of study.

In this concluding chapter, I provide an overview of the unique contributions this study makes to the literature in graduate higher education by revisiting key findings with respect to the main three original research questions. Findings are tied back to existing literature and critical socialization throughout to highlight several of the contributions of this study. In closing this chapter, I provide theoretical contributions of this study, implications for practice, followed by recommendations for future research.

Key Findings Related to Students' Academic and Social Experiences in their Graduate Programs

Students' Relationships with their Advisors or PIs

Looking at students' experiences at different institutions, it seems that good advising and mentoring was highly variable. Good advising is conceptualized to encompass the combination of faculty actions that empower students in ways that help them achieve success (Dowd, Sawatzky, Rall, & Bensimon, 2013). Good advising therefore also includes helping students with the different dimensions of socialization (e.g. gaining content knowledge, interpreting and navigating the educational environment, and learning the unspoken social and cultural practices of the field) so that they move towards professional maturity as a successful independent research/scholar and a full participant of the discipline (Chao, O'Leary, Wolf, Klein, & Gardner, 1994; Gerholm, 1990; Lave & Wenger, 1991; Lovitts, 2001; Weidman et al., 2001;). If

institutions had to be ordered by way of the accessibility and approachability of faculty (which are antecedents to socialization opportunities provided by faculty), HBEU would be ranked first as faculty were reportedly both extremely approachable *and* accessible. This coincides with previous research showing that compared to faculty at PWIs, faculty at HBCUs tend to demonstrate greater dedication to teaching and cultivating relationships with students (Fries-Britt, Burt, & Franklin, 2012). Indeed, at HBEU many faculty advisors were extremely invested in students – a prime example being the professor who took his students' failures as a reflection of his own shortcomings as an advisor. The faculty at HBEU also seemed to actively cultivate relationships with their students and to value both honesty and openness. As a result of these seemingly healthy faculty/student relationships, students reported that they felt comfortable talking to their advisors about challenges they faced and having frank discussions with their advisors, which wasn't always the case at LSU or MU. The overwhelming number of positive stories regarding advisors at HBEU may be indicative of an institutional expectation of high quality mentorship of students. Indeed, only one HBEU student offered a story of having an absent or inaccessible advisor.

Compared to students at HBEU, students at LSU and MU readily shared that they were frustrated with poor advising stemming from an absent advisor, an advisor who had little interest in the student's research, or an advisor who did not take the time to teach students tasks before assigning them. Looking at LSU specifically, faculty seemed to be approachable (much like HBEU faculty), but much less accessible as demonstrated by numerous instances of unresponsiveness to student requests for meetings. Like HBEU faculty, LSU faculty seemed to place a high value on the development of students' skills and interests. Faculty, therefore, intentionally collaborated with students on research and did a good job giving credit to students' contributions. However, precisely because of the hierarchical nature of the faculty student relationship, some faculty at LSU needed to better check their demands for student work

productivity, which by a few students' accounts were sometimes unfair given time constraints and uncontrollable barriers to productivity. In other words, unlike faculty at HBEU, faculty at LSU were sometimes a bit unsympathetic to students' concerns and the challenges they faced.

At MU, although there was much variability in how students described their faculty advisors and PIs across discipline and programs, students shared more stories of MU faculty being inaccessible and/or inapproachable – at least compared to faculty at the other two institutions in this study. This is in part likely reflective of department and faculty priorities wherein high research productivity and published work in indexed journals is expected and, therefore, an enormous consideration in the judging of faculty for tenure and other promotions. Unfortunately, the pressure for high research productivity may come at the cost of the adequate mentoring and socialization of students throughout their graduate programs. Further, only at MU was there evidence of students having real instances of conflict with an advisor or feeling pressure specifically from an advisor to follow a specific career trajectory.

Supporting students and productively socializing them into their respective fields of practice wasn't simply about faculty being available or nice to students. It was about supporting students and encouraging development in instrumental ways. For example, faculty productively supported their students when they set high expectations for their students but did so in a scaffolding manner so that students felt in control of their ability to accomplish a task. Indeed, students were appreciative of high faculty expectations (and eager to meet them!) as long as these expectations were realistic, faculty were caring in their interactions with students, and as long as the extra training needed to complete the given task was provided. Supportive advisors also integrated students into professional networks so that they were set up for success and favorably positioned for the job market post-graduation.

Productive advisor/advisee relationships were also about achieving balance: balance between allowing students to make their own decisions with respect to research and learning so that they learned to figure out problems independently, on the one hand; and on the other hand, checking in with students regularly to make sure they were progressing and to address their concerns. Students seemed to be able to handle challenges when, based on previous experiences, they believed faculty would be sympathetic to their plight, felt that faculty respected them and their decisions, and when faculty gave them room to make their own independent choices but firmly supported them as needed. Fortunately across institutions were numerous examples of advisors who were heavily invested in students' success and seized the role as champions for their students, even when these activities took more time out of the faculty advisors' day. Where these dynamics existed were students whose narratives suggested that they felt incorporated into their field of practice, were confident in their identities as emerging scholars and researchers, and who seemed to be happy in graduate school. Previous research demonstrates that when faculty are consistently involved with all stages of the doctoral socialization process, students tend to have shorter time to degree and higher persistence rates in programs (Gardner, 2007, 2008, 2010).

Alternatively, when students' relationships with faculty advisors were characterized by some level of benign neglect, students consequently felt lost; wasted precious time and energy making avoidable mistakes; had less positive views of their program and their experiences; and had more difficulty progressing through classes or research – all of which could delay time to degree or cause the student to leave with a master's degree instead of a doctoral degree. Previous research confirms that neglect at the hand of meaningful others in science stunts the academic growth and social involvement of URM students (Cabrera, Colbeck, & Terenzini, 2001).

A critical application of socialization frameworks recognizes that students have social agency as they learn how to be successful in graduate school and beyond. Indeed, students who did not receive the level of support they needed tended to seek it from outside sources, even from faculty outside of their discipline or institution. Students who knew they could rely on multiple people in their programs or within their field for support were in the best position for adapting to the graduate environment. It is problematic, however, that the act of seeking outside help could potentially turn into a political minefield that students were forced to navigate. In effect, students could find themselves between the proverbial 'rock and a hard place' as they desired guidance over and above the amount their advisor provided, but faced potential negative consequences from their advisor for seeking help elsewhere. This tightrope act is an unnecessary stressor. Students had to also learn how to handle advisors' numerous demands and courageously communicate their needs in the face of those demands.

Why Faculty Ethic of Care Is Important

Faculty advisors can act more as mentors when they go beyond the official duties of an advisor and offer friendship in addition to other forms of psychosocial support to students, (Johnson et al., 2007; Palmer & Gasman, 2008; Smith, 2007; Sweitzer, 2009), all of which positively contribute to the development of students and their sense of worth (Cole & Griffin, 2013). Advisors showed they cared by being interested in students' futures beyond graduate school, by being accessible and approachable, and by expressing a genuine concern for students' academic and personal well-being. Students at all three institutions took comfort in knowing that advisors were concerned and would intervene if problems arose. Psychosocial and emotional support from a faculty member has been shown to go a long way in terms of student development (Johnson et al., 2007), success, and persistence (Antony & Taylor, 2004).

At each institution were advisors that students found to be extremely supportive and caring, many of which were not racial/ethnic minorities themselves. A related point is that at HBEU, Black students were very comfortable approaching non-Black faculty, so long as those professors demonstrated care in their interactions with students. This is an important point as URM STEM graduate students often find themselves with an advisor who has a racial background that is unlike their own due to a dearth of URM faculty in STEM (Patton & Harper, 2003; Nettles & Millet, 2006). Recognizing the need for proper advising and mentoring of graduate students, the National Institutes of Health has recently sponsored the National Research Mentoring Network to begin "coaching" faculty on how to mentor a more diverse cadre of researchers in biomedical fields over the next decade, and to study its impact on increasing the number of URM research scientists (NIH, 2015).

Furthermore, the numerous stories students offered about faculty, some of which dated back several years prior to the focus group interviews, demonstrates that students have a long memory of positive recognition and words of encouragement, which students recalled and clung to in the face of difficulty. Positive recognition from faculty can draw students further into their domain of study (Carlone & Johnson, 2007) and help reinforce students' belief in their ability to become a professional in their field (Coldbeck, Cabrera, & Terenzini, 2001). Students were also acutely attuned to subtle faculty words and behaviors that they interpreted as being tantamount to receiving the message: 'I don't care about you or cultivating your talents.'

What differed between institutions was the ethic of care experienced by master's students. Although there were no master's students participating in this study at HBEU, master's students at LSU had advisors who urged them to pursue the Ph.D., collaborated with them on research, and provided a great deal of mentoring. Alternatively, the only two master's students from MU that participated were both openly disappointed with the scant attention they received.

This is not surprising given that many masters bring enrollment dollars, but are not central to faculty work at research intensive institutions

Students' Relationships with their Peers

Previous research has highlighted the important contribution peers make to the academic development and skill acquisition of STEM graduate students via collaborative work on assignments, study groups for classes and qualifying exams, and the sharing of academic resources (Mwenda, 2010). Indeed social interactions with peers affect both academic achievement and emotional wellbeing (Hurtado, 1994). What previous research does not demonstrate, however, is that peer group dynamics are often times (negatively) shaped by international students. Although there was no mention of international students at HBEU (perhaps due to a much smaller proportion of international students at this institution compared to the others), at MU and LSU international students often times inadvertently excluded domestic students both socially and academically. Specifically, international students were perceived as keeping to themselves and not inclined to spend time with domestic students. This explained why participants at both institutions reported having superficial and exclusionary interactions with the international students.

The preceding finding is both surprising and expected. It is surprising because international students, at least at the institutions included in this study, were often non-White individuals and critical perspectives usually delineate White individuals as having the power to exclude. So although it was expected that URMs would likely be marginalized and possess an "other" or outsider status within the STEM environments into which they are invited (Howard-Hamilton, 2003), I did not expect URMS to be ignored in these environments at the hand of other people of color (i.e. of Asian ancestry) – even if these people were not underrepresented within the STEM context. However, as international students comprise an increasing proportion

of incoming cohorts of STEM graduate students in many programs, they change the demographics of the STEM environments they occupy so that they are no longer White-dominated.

Interestingly, there was a difference in the affective manner in which students at LSU and MU students spoke about international peers. LSU students seemed to have more of a neutral viewpoint of international students; not one LSU participant reported having substantially negative experiences with international students nor were they actively excluded by international peers when it came to research or class work. The divide between domestic students and international students therefore seemed to exist exclusively at a personal/social level, with foreign students largely keeping to themselves. Although LSU students seemed to be very aware of the separation between domestic and international students, their narratives on this point suggest that they were not cognitively aware of the implications of this separation to their academic lives nor were they aware of the racial politics that potentially played a role in perpetuating the separation. Exclusionary practices, however, even those that seem very inconsequential, send a message that the "others" are different, do not belong, and create a larger pattern of oppression for excluded groups (Abrams, 1993; Guzman, Trevino, Lubugin, & Aryan, 2010).

Alternatively, at MU, multiple participants noted that international students almost exclusively worked with each other on school related work to the active exclusion of others. International peers, perhaps as products of their competitive learning environments, seemed to guard information and offered inclusion into their study groups to outsiders, only if the outsider had something to offer. In this way, helping behavior seemed to be a commodity rather than what students simply did as a culture of the program. The MU students who spoke on this topic seemed to be very aware of how exclusion from informal social networks impacted them and, therefore, the topic of international students was of high saliency to their academic lives. MU

participants were also far more reflective of how they were perceived by international peers and hinted that the seemingly chilly reception from international students may have been due to cultural differences. It is interesting that neither LSU students nor MU students wanted to attribute discrimination or negative stereotypes of URMs as a reason for the fact that international students did not care to work with them. Other research explains that many racial minorities consider all other possible explanations to their experiences before attributing ambiguous incidences to racism (Carter & Forsyth, 2009). However, considering that peers play a critical role in the socialization processes and developmental experiences of students (Barnes & Austin, 2009; Gardener & Barnes, 2007), by being excluded from these informal study groups, the richness and number of opportunities for socialization, learning, and skill development was limited for URM students.

Students also painted vivid pictures of their interactions with peers as a whole. With respect to interpersonal relationships with peers, the proportion of students expressing discontent varied largely by institution. At HBEU only one student was unhappy with her peer relationships. All other HBEU students, when they spoke about the sources of their social and emotional support, referenced people *within* their programs. Indeed, students at HBEU seemed to get along rather harmoniously and work collaboratively. At LSU, students for the most part reported having rather collegial relationships with peers, although there was a number who would have liked to have more personal/social relationships with their international student peers. In contrast to students at HBEU and LSU, there are numerous instances of MU participants not having harmonious relationships with their peers or simply not liking their peers on a personal basis. Few MU students explicitly attributed race (or gender) as playing a role in their discontent with peers, although in many cases it is implied. Other research finds that when students do not feel supported or feel disconnected from others within their academic context (Ferrer de Valero, 2001), socialization will be more difficult, and can lead to feelings of isolation,

perceptions of inadequacy, and increase the likelihood that students contemplate leaving their programs (Austin, 2002; Gasman, Hirschfled, & Vultaggio, 2008; Gay, 2004; Golde, 1998; Graham, 2013).

So why was there a greater proportion of students who did not like their peers at MU? The act of liking one's peers or not, may have been somewhat a product of the competition or collaboration built into the graduate programs or department. Students in competitive environments (which among the sample were almost exclusively voiced by MU students) described clashing with peers on an interpersonal level and saw tension in the overall atmosphere. As a result, some students actively and intentionally limited the time they spent in the academic context with peers, which is a strong indicator of how they felt comfort-wise within their programs. Indicative of their agency, several students at MU (especially those who did not get along well with peers) sought support from discipline-specific student groups targeting URM students that were available across the graduate school. Every single student who spoke about these targeted groups attached positive feelings to them as the groups provided a safe place for URM students to be themselves on the MU campus. Previous research shows that, although having positive relationships with all peers irrespective of race is helpful, relationships with other URM students provide a unique sense of comfort and support due to a shared understanding of challenges associated with racial isolation (Morelon-Quainoo et al., 2009).

The likelihood that students characterized their home department as collaborative or competitive varied vastly depending on the institution. Students at HBEU were very likely, like students at LSU, to report that they motivated each other a great deal. This helping sentiment was so powerful at HBEU that it is suggestive of a peer culture wherein students felt personably responsible for the success of their peers. LSU students also reported a great deal of motivation and collaboration with peers to get work done. Because study groups often had a social component to them, program peers were a large source of friendship at both HBEU and LSU.

The I-am-my-bother's-keeper sentiment present at HBEU however was not present at LSU. Nonetheless LSU students, like those at HBEU, spoke about peers in ways that revealed a great deal of satisfaction.

The overwhelming number of stories by students at HBEU and LSU that described a free sharing of information indicates that a collaborative spirit was part of the overall ethos of the graduate schools at those two institutions. At MU, however, the culture varied largely from program to program, with students in engineering programs being the most disgruntled with the competitive and individualistic behaviors of peers. Indeed, there seemed to be a much higher level of competition among peers at MU and far more negative peer-related sentiments. Further at MU, students didn't seem to work with other students much to complete homework or to study, but did collaborate a great deal on conducting research, which may be indicative of larger research labs/teams and perhaps a different context of collaboration at MU compared to LSU and HBEU.

As expected, advanced student peers played an important role in the socialization of URM students across all three institutions and demonstrated a real concern for making sure that those coming in the program after them prospered. Helping behavior included answering general questions, offering advice, and providing instructions on how to conduct lab techniques. Traditional socialization frameworks do not account for the fact that students from the same stage in a graduate program can learn a great deal from one another and therefore represent important agents of socialization. Socialization perspectives alone also fail to take into account how issues of race and underrepresentation shape the relationships between people of color and others in educational contexts. Findings show, however. that since majority advanced peers have a tendency to work with people who are racially similar to them, URM students may be adversely affected by the unavailability of advanced students who are also URMs who can potentially serve as mentors. Previous research confirms that the commonalities shared

between people on a number of social characteristics - such as race, ethnicity, or gender – can impact with whom individuals seek interactions (McPherson, Smith-Lovin, & Cook, 2001). More study is needed to determine if this represents another barrier to full participation in graduate school and socialization into the discipline.

Key Findings Related to How Power Affects Students' Experiences

The Power of Faculty to Shape Peer Culture

Any discussion about faculty as they relate to students' socialization experiences in their graduate programs necessitates a discussion about power, as faculty's positional power places them at the top of the hierarchy in the proverbial ivory tower and affords them the capital necessary to make changes in the culture of the department and its structures. Examining students' educational experiences and outcomes via discourse about faculty power is necessary as it counteracts the tendency to attribute student failure to deficits and identifies how faculty practices can be empowering or oppressive. Several issues transcended all three institutions and directly relate to the socialization of students into their field of practice.

First, STEM as a discipline usually has a narrow ideal of what is considered acceptable practice, which does not recognize the different needs of diverse students. For example, White male norms common in STEM culture prioritizes the individual interests above the group, and promotes competition over collaboration (Epstein, 2006; Seymour & Hewitt, 1997). From students' accounts, however, some faculty are using their power to positively shape the overall mood, interactional culture, and helping behavior in the classroom and lab, and thereby moving away from competition and individualism in the learning context. For example, collaboration was likely in situations where faculty expected students to work together, with students going out of their way to help each other in contexts where their advisor exhibited the same helping behavior. Collaboration between peers in turn made it more likely that URM students indicated

that they felt appreciated and respected. By setting a culture of collaboration faculty avoided the treatment of URMs as an "other" and ensured that rather than being held at a distance, that URMs were fully incorporated into peer life (Abrams, 1993). Similarly, the concern and care faculty showed for students was mirrored in students' interactions with each other. A student at LSU, for example shared that he learned what it meant to be a good mentor from his advisor. Similar stories were shared at HBEU and MU. Finally, positive demeanors from faculty were contagious and students' seemed to exhibit the same positivity when describing their overall experiences. Apparently faculty are powerful shapers of how students treat each other inclusive of URMs, which from a critical standpoint, represent the subordinate group in STEM.

Second, some advisors are also redefining how students ought to be trained and socialized. One way of deviating from traditional STEM norms is by taking a flexible, tailored approach to mentoring and not giving up on students that do not fit a particular mold or that take longer to understand disciplinary concepts or lab techniques. By taking a flexible approach to mentoring, faculty recognized the varying needs of students from racially underserved and underrepresented backgrounds who did not come from families with long histories of educational attainment and may need additional guidance (Carlone & Johnson, 2007). Productive mentoring was also about practicing constructive coaching to problem-solve around mistakes and to strengthen weaknesses versus using blunt criticism, which could be destructive to a student that lacked confidence. By not taking a one-size-fits-all approach to advising, faculty ensured that URM students were socialized into their respective fields in ways that worked for them, instead of simply expecting students to assimilate into the dominant norm without question, which traditional socialization perspectives typically assume.

Issues of Race and Underrepresentation in Demonstrations of Power

Racial issues are common topics of concern for some URM students in STEM graduate programs despite prevailing conceptions that race is not a significant factor in the socialization experiences of students in disciplines like STEM, which are thought to be neutral and objective spaces (Cobb, 2004; Johnson, 2007). The extent to which race seemed to influence students' experiences varied, however: For some it was undeniably powerful as they were repeatedly treated in ways that seemed as if others' avoided them or merely tolerated their existence in their respective graduate programs. For several other students, alternatively, issues of race seemed to have more of a subtle, yet persistent influence – interestingly, students could be affected by racial issues while being completely unaware of its presence or its implications on socialization experiences. And yet for others, like students at HBEU, issues of race seemed to affect them indirectly as negative racial stereotypes existing at the larger societal level still had an impact on them while in graduate school, despite the fact that they were learning and being trained in spaces that felt welcoming and culturally respectful.

It is interesting that how students at MU and especially LSU talked about race was sometimes addressed indirectly via a discussion about diversity. LSU students, for example, used the word 'diversity' to not only include race and ethnicity, but also to denote any identity that was simply different from them, whether that be by gender, nationality, or culture. This was not too surprising as a search of the LSU website demonstrates that the university took great pride in the fact that it celebrated diversity. However, a key part of celebrating diversity includes an awareness and education of the ways in which different social identities have been oppressed historically and continue to face discrimination today. Further, social justice, empowerment, and respect are espoused values in LSU's mission statement. In light of these values, it was expected that LSU students would be more critical about the institution's STEM environment for underrepresented graduate students and be able to identify areas for improvement. It was also expected that LSU students would speak about how race was enacted

both on campus and in the larger society in more critical ways and to connect that discussion to their work in STEM – neither occurred. Perhaps students at LSU were taught to celebrate diversity, without much attention paid to critiquing or noting how racism, discrimination, or opportunity structures have had differential effects for different racial groups.

Indeed, students at LSU spoke about being scientists in ways that indicated that they were void of a deeper awareness of how larger negative stereotypes of URM people or inequitable institutional or societal structures adversely impacted the schooling and professional trajectories of racial minorities in STEM. A specific example is that several LSU students were of the opinion that race and other social identities were not contributing factors to how their work in their respective STEM disciplines was conducted or would be reviewed by outsiders. Discussions of race at LSU, therefore, contrasted vastly with the opinions of HBEU students who were of the opinion that racial background most certainly affected how people did science and interpreted data. It may be that without a culturally relevant or critical pedagogy in place (as was in place at HBEU), since racial minorities comprised the majority at LSU, race was no longer a salient issue for students within that educational context; being non-White was simply the dominant profile of a student and therefore normative. Indeed, at the time of the interviews in 2010, LSU had been "minority majority" for almost a decade, had been designated as an HSI for more than 20 years, and had a long history of enrolling and graduating Black and Latino students.

In stark contrast to LSU, HBEU students openly recognized that social structures continued to oppress them as a racialized group and spoke more critically about the treatment of Black people in society today and the great responsibility having an advanced degree entailed, especially when it came to giving back to Black communities. Perhaps this reflection is a function of their critical consciousness in regard to issues of power and oppression, to which they seemed to gain exposure in their classes wherein STEM professors reportedly discussed

how science was connected to their communities both historically and in current times. A culturally relevant curricula exposed students to how STEM perpetuated racial inequities and harm to minority communities, and seemed to have developed students' sense of social responsibility. This finding is exciting from a critical socialization standpoint because it demonstrates that URM graduate students can learn the norms of a discipline in STEM and at the same time maintain a critical stance about practices or values that reproduce inequity, and uphold a desire to avert further inequalities.

The findings emerging from HBEU coincide with the institution's mission statement, which states that the institution strives to develop historically aware and compassionate graduates who will be committed to the discovery of solutions to human problems plaguing the country. Being that the institution is an HBCU, the mission statement also places particular emphasis upon creating educational experiences of exceptional quality for *Black* students specifically. It is not surprising then that all but one student from HBEU construed the learning and training climate as highly welcoming for students, likely due to the fact that HBCUs intentionally build an atmosphere conducive to the success of African-African students (Nelson Laird et al., 2007). HBEU students also described socialization experiences as being, for the most part, harmonious, but were still able to identify aspects that could be improved.

It is also interesting that at HBEU, students spoke about race as it connected to being a STEM student on a more theoretical and abstract level (compared to students at MU) perhaps because the negative or uncomfortable racial issues they confronted happened in spaces that did not include the university setting itself. Several touched on not fitting the mold racially of who a science person was for their discipline; they therefore perceived that others, at conferences and in other institutional contexts, viewed them as not having the authority to speak on STEM related issues. This awareness is demonstrative of the damaging power larger societal forces

can have on graduate students even when they are educated within a safe, non-racist learning environment.

It is undeniable that the environmental context in which an institution is situated affects students. MU, the third institution in this study, is located in a state that has banned affirmative actions in college admission practices and race-targeted benefits (e.g. financial aid, special programs). According to one student, as a result of the ban, programs supporting graduate students have to talk about diversity in race neutral language and in terms that are inclusive of all groups. Race neutral language is also evident in MU's mission statement, which in sum says that the institution strives to serve the people and espouses a commitment to diversity. What is meant by the term 'diversity' is unclear, which means that it can encompass almost any human characteristic.

Rather than naming racism as a social structure that continued to perpetuate marginalization in the institution, MU students identified ignorance or cultural misunderstandings to explain racist comments or exclusionary peer practices. Previous research explains that exclusion is easily overlooked as a gender or racial inequity due to its ambiguous nature (Brennan, 2013). This study demonstrates however that exclusion curtails the socialization of students since it complicates the acquisition of increased knowledge and competence in a students' field and the learning of normative ways of participation. Exclusionary practices also send a message that the excluded persons are different and do not belong, create a larger pattern of oppression for excluded groups (Abrams, 1993), and is detrimental to the persistence of students (Lovitts, 1996; Antony, 2002)

In contrast to their peers at HBEU and LSU, MU students have far more personal stories of how not fitting the racial mold of who a STEM person was affected them *within* the space of the classroom and campus, and what it felt like to be severely underrepresented racially in their

programs. Indeed, the narratives of MU students demonstrate that subtle forms of institutional racism exist, including the lack of URM faculty (specifically Black faculty) and negative views of minority students. Some MU students reflected that within the space of their institution, people unjustly and openly questioned their intellect, commitment to science, or the merits by which they were admitted (although affirmative action was banned), all of which represent powerful microinequities and small acts of disrespect and devaluation (Brennan, 2013). These experiences also represent microagressions, since they are expressions of racism (although difficult-to-detect) in the form of insulting comments, behaviors, or indignities within the environmental context (Sue et al., 2007). The preceding finding confirms other research that finds that where there are few URMs in a given space, there is a greater likelihood that they are subject to negative stereotypes about their ability and qualifications (Gay, 2004; Johnson-Bailey et al., 2009). Others spoke about being hyper visible within the context of their graduate program and therefore felt like their performance was on display – they were in essence a representation of their race and had to work harder to prove their place in the program. Unfortunately, negative stereotypes about people of color appear to be a universal experience in higher education (Taylor & Antony, 2000) and may contribute to URM students' perception that they have to be more academically successful than their peers to show they belong (Gasman et al., 2004). Evidently, MU is far from being a post racial institution and has further work to do in addressing microinequities/microaggressions, respect for diverse students, and inclusion.

MU students especially show that STEM educational environments are in reality environments whereby power and how it is exercised bestows systematic disadvantages for certain student groups while advantaging others. As indicated previously, faculty and more highly represented student groups occasionally used their power in inequitable ways at LSU and MU, irrespective of intention. Enactments of power by fellow students and faculty appeared to

have racialized undertones at best, and at worst seemed to occasionally be motivated by more overt forms of discrimination. These findings are sadly unsurprising considering the exclusionary and racial historical legacies of many PWIs (Stanley, 2006).

Participants at MU enacted multiple forms of agency in response to the challenges arising from underrepresentation, inequity, and discrimination: by directly or indirectly challenging unambiguous racist acts, acting in ways that reduced the likelihood of being the target of racial bias, not acknowledging differential treatment, believing that most people they encountered were not intentionally malicious, and/or by focusing on productive ways of coping like seeking validation outside of the departmental community. These responses helped students struggle against inequity and resist internalizing the external judgment of others as the value they place on their own academic worthiness. These responses are also a testament to the resilience of URM students at PWIs as they continue to persevere in graduate school and achieve academically despite being subject to seemingly differential treatment at times. Although participants successfully managed and defended themselves against the inequities (and at times racism) they encountered in graduate school, it is important to note the act of doing so likely requires a tremendous amount of psychological energy that could have been directed elsewhere (Pierce, 1998).

This study also reveals that the attitudes people have regarding multiculturalism and the importance they place on irradicating inequities also matters. For example, for URM STEM students to feel welcomed by their program was to also know that faculty cared about the diversity present within the program and made an effort to improve it, and found ways to link the implications of course concepts and STEM research to the needs of racial/ethnic minority communities. These actions signaled to URM STEM students that they were respected and included in their programs.

Finally, analysis of issues of underrepresentation and power across the three institutions demonstrate that an additional salient issue for a few students was gender. Seeing as so few men commented on issues of gender and the ones that did, did so flippantly, suggests that many men in STEM are not aware of or genuinely concerned with gender disparities in their respective disciplines. The perfect example is from MU, wherein staff and faculty allegedly could not be counted on to challenge behavior and language that was offensive or that excluded women, even after a female student brought it to their attention numerous times. Non-action sent a subtle yet powerful message that discriminative or biased behavior was acceptable behavior in graduate education. Other work on STEM doctoral students, also found that females faced a disciplinary climate that was unwelcoming, with those deciding to leave experiencing steep losses in confidence while in their programs coupled with little or no encouragement to persist (Rohlfing et al., 2010). Unfortunately, it is not uncommon for URM women to struggle with being recognized as full and legitimate members of the STEM community (Hurtado & Figueroa, 2013; Ong et al., 2011).

Key Findings Related to the Programmatic and Institutional Structures Affecting Students' Experiences

Structures within the Degree Program

In examining structures within students' degree programs, three general points call for attention with the first point – students' learning needs and teaching quality – having several notable trends. The first structure important to students' ability to be properly socialized in their field was with respect to teaching quality. When it came to teaching, the qualities that made a good teacher were the same across all three institutions: someone who cared about student learning, had patience, showed excited about what they taught, was willing to help when students were struggling, and who took students' inquiries for help seriously. Teaching

philosophies that were divorced from an application to real life frustrated students. Listening to students' experiences within the classroom, it was clear that students were hungry to learn. However, at every institution were examples of students who did not have sufficient previous exposure to foundational material in their discipline. For some, this was due to switching areas of study between undergraduate to graduate school, or not taking all the prerequisite courses during their undergraduate programs. As such, some students had a lot of catching up to do and therefore highly valued patience from teachers when it came to learning. Indeed, the first year of graduate school seemed especially important in getting students caught up and clearing up confusion. Unfortunately, instructors at LSU and MU, often did not recognize the need to give an academic refresher to foundational disciplinary content.

Professors seemed to be the most dedicated teachers at HBEU as demonstrated by the fact that many eagerly provided one-on-one help to students who requested it and even sometimes worked on the weekends with students. At HBEU professors were consistently described as good teachers and caring, which is indicative of the priority the institution placed on teaching. Further HBEU was rather unique in that teachers connected science to students' lives in meaningful ways by relating disciplinary concepts back to the Black community both historically and in present times. The race of professors did not affect their ability or desire to deliver a culturally relevant STEM curriculum. Other research shows that in addition to the instructor's social identities, approaches to teaching are influenced by institutional support, department norms, campus climate, and institutional mission, suggesting that institutions can support and come to expect this sort of instruction from professors (Chesler et al., 2005). As a result of a culturally relevant curriculum, students at HBEU were prepared to conduct quality research as Black STEM professionals and to have a strong sense of social responsibility. In comparison, not one student from LSU had a similar comment to share and only two advisors at

MU were specifically mentioned as supportive of students using STEM knowledge to work with minority communities.

Students offered far more examples of characteristically bad teaching than good at LSU and MU due to lack of effort, lack of knowledge on effective teaching pedagogy, and/or being inaccessible when questions arose. At both institutions were examples of professors who taught with the assumption that students knew the bulk of the material, which contrasted with the teaching approach taken at HBCU. Engineering students were disproportionately represented among those who complained about bad teaching at both institutions; these engineering students seemed to accept bad teaching as a rite of passage during graduate school.

Teaching quality in graduate school most certainly influences students' ability to transition to graduate school and does not simply deal with whether the instructor knows the material. (All instructors seem to be highly knowledgeable). Indeed teaching has more to do with the delivery of course content, the pedagogical approaches instructors take, the enthusiasm they have for teaching, whether they care that students are mastering the content, and the level of relevancy the course content has to the future career plans of students. Good instructors know how to keep students engaged, demonstrate a high level of care in making sure that everyone understands what is going on, and can connect why the content imparted in the classroom has relevancy for real world problems and how students might use this information once they enter the workplace. Previous research has already established a link between the curriculum students encounter in their graduate programs and satisfaction (Golde, 1996; Herzig, 2002).

Turning to the second structure in students' programs that impacted how they experienced graduate school, it is clear that many graduate programs are not sufficiently structured. Indeed, at LSU and MU, students had many classes and labs from which to choose

and much difficulty accessing necessary program-specific information. A lack of structure could stem from the expectation that as doctoral students, students came in already being self-directed learners and researchers. Students' accounts show that, in general, this was not the case. Indeed students began graduate school with the expectation that they would be properly trained, not that they would train themselves. Further many novice URM STEM graduate students were not aware of the questions they should be asking or to whom, which made them feel that they were in a constant state of "being lost." Likewise, there seemed to be many instances by which students lacked a sufficient amount of guidance from faculty advisors, which only exacerbated feelings of being lost. Without sufficient guidance, previous research shows that students are forced to have an extremely high-level of self-direction just to keep up (Gardner & Holley, 2011; Holley & Gardner, 2012).

The third structure important to socialization into students' field or practice was exposure to career options in industry during graduate school, which appeared to vary vastly depending on the emphasis students' graduate programs placed on continuing one's education with the Ph.D. (for master's students) or entering academia professionally (for Ph.D. students). Little or no exposure to industry was frustrating to students who were not interested in academia and denies a reality wherein there are few annual listings for faculty positions in an already oversaturated pool of qualified individuals. Interestingly, of the three institutions, there were far more examples at MU of professors having a concurrent hand in industry, which was beneficial to students thinking about entering industry after degree completion. Professors at LSU seemed to have many connections with those in industry too, but there was only one mention of a professor having a concurrent hand in industry *and* academia. Conversely, one HBEU student opined that HBEU faculty's networks in industry, at least in her department, either never existed or had been destroyed over the years. Taken together, it seems like more faculty were connected to industry at MU and that those ties were stronger compared to faculty at the other

two institutions. This is important because it suggests that students at minority serving institutions may have differential access to professional networks in the workforce and therefore may have fewer socialization opportunities than their peers at predominately White institutions. Further although it was rather rare, there were a few students who reported that they were "adequately prepared to do either" meaning go into industry or become academics, showing that programs *can* be committed to empowering their students with the broadest array of post-graduate career paths for scientific research.

Structures within the Institution

Students commented on several structural elements that seemed to affect students across several disciplines suggesting that these structures might be in place institution-wide. The first structural element that was referenced was the availability of resources. Specifically, students at the minority serving institutions conveyed an opinion that their universities were under-resourced and commented on the ways that this negatively affected them. From a critical perspective, this finding is unsurprising as the present social order is characterized by inequitable distribution of resources along racial lines (Bonilla-Silva, 2001; Omi & Winant, 1994); indeed, HBCUs typically have fewer resources than PWIs (Harmon, 2012). At HBEU a lack of resources meant that some departments functioned on the good will of volunteer professors from other departments. It also meant that students had no choice but to be resourceful and savvy to get the training and socialization experiences they needed to become experts in their field. To not do so would put students at a large disadvantage in the job market when compared to peers at better-resourced schools. Poor resources at HBEU additionally meant that the administrative services were often disjointed and non-functional making the completion of simple tasks, like registering for classes or getting financial aid, both time consuming and frustrating. Students at LSU were also of the opinion that the institution was poorly resourced seeing as graduate classes were often cross-listed as undergraduate classes. Although there

can be benefits of classes with students who are at different program levels (i.e. undergraduates and graduate students), it likely takes a skilled professor to capitalize on the benefits associated with a hybrid class. At both HBEU and LSU faculty tried to make up for what their department or the larger institution could not offer students by connecting students to resources, networks, and training experiences existing *outside* of the institution – all of which represent socialization opportunities to which the student likely would not have had exposure otherwise.

Alternatively, MU students never suggested that there was a lack of resources at their institution. A related issue to institutional resources were concerns over student funding – a concern which was not present at MU either, not even among the master's students. HBEU students conversely were well aware that other, better resourced, institutions could have provided them with much more funding. Fewer students at LSU expressed concerns over funding compared to HBEU, with there being a seemingly even split between those who were financially stable and those who were concerned about their funding. Although this study is only comprised of three institutions, it is notable that the two minority-serving institutions were far less richly resourced compared to the PWI, both with respect to facilities and what they could offer student experientially and financially.

The second structural element important to students, at least those at both minority-serving institutions, was federally funded programs. At HBEU, for example, students spoke at length about the Alliance for Graduate Education and the Professoriate Program (AGEP), which was a college-wide intervention funded by NSF. AGEP empowered students with the latest information on where they could seek rich socialization opportunities, provided additional mentoring and professional development experiences that they would likely not have gotten in their individual programs, and awarded participants with full tuition plus a stipend. This extra funding was a selling point and tremendous source of relief for many participants, who would have reportedly had to take out loans to finance their education without it. A drawback of AGEP,

however, was that it had requirements (e.g. a teaching requirement) that, at times, overwhelmed students considering their already full plate of responsibilities and the fact that many were transitioning back into student life. Some overburdened first-year students reported diminished motivations to continue in their programs because they were struggling to balance all the responsibilities of being a graduate student *and* an AGEP scholar. Another drawback was that as a condition of being accepted into the program, AGEP scholars had to profess a commitment to entering academia since the program was aimed at increasing the number of faculty of color in STEM. Students who changed their minds about academia felt locked into a career path that they no longer wanted to pursue; others pretended the professoriate was something they wanted even though in reality their plans were different. Similarly, at LSU the most referenced type of institutional wide interventions to which students referred were federally funded programs. Like AGEP, many of these programs required students to commit to a Ph.D., which students did even if their heart was no longer in it.

Unlike the minority serving institutions, the two notable programs at MU that students repeatedly talked about seemed to be initiated by the institution (but also may have been grant-funded). The first was a bridge program for entering doctoral students; of the functions it served, one of the most impactful was simply connecting students to diverse peers and faculty early. Students appreciated having a diverse support group upon officially starting their graduate programs on a predominately White campus. The second commonly referenced intervention that MU offered was the Program in Biomedical Science, which structured transitional experiences for incoming students, guaranteed students full funding and benefits for the entire length of their Ph.D.s, and exposed them to numerous roundtable discussions. This program did not commit students to one career path over another and sponsored numerous social activities for participants, which students noted were effective in making them feel welcomed and comfortable.

The third structural element important to students, at least those attending LSU or MU, was student organizations specific to STEM that catered largely to the social side of graduate life. The discipline-orientated student social groups at MU had explicit missions to uplift, empower, and affirm URM students and cater to their sense of belonging and acceptance. MU students confirmed that these organizations served those purposes for them, which was extremely important since they were a visible minority. Students across all three institutions were interested in gaining additional exposure to professional development opportunities in these programs.

Theoretical Contributions

In addition to the contributions the key findings outlined above make to the literature, this study offers deeper insight into how a critical application of socialization theoretical frameworks is both needed and necessary when examining URM students' experiences in their STEM graduate programs. First, a critical application of socialization theoretical frameworks notes the realities of academia whereby disciplinary peer cultures and socialization norms can confer privileges to students belonging to the dominant social group, while disadvantaging URM students as members of the minority social group. Specifically, this lens takes issues of race and inequality and the climate of the graduate program into account when attempting to understand students' socialization experiences. For example, as a discipline dominated by men of White (and now Asian ancestry), it expects that STEM graduate programs will reflect dominant norms that subtly send a message that women and URMs are deviations from the norm and not entirely welcomed (Seymour & Hewitt, 1997; Young, 1990). As a result, there are likely to be numerous inconsequential practices that are disproportionately harmful to the socialization and satisfaction of URM students within STEM graduate education.

Second, this lens considers how power and its manifestations in relationships play a role in how students are treated or perceived, their opportunities for professional developmental and skill development, and their overall experiences in their graduate program. A perception that URM students are deviant coupled with asymmetric power relations that exist within graduate departments influences the interactions URM students have with others in their program, whether they feel empowered or disempowered as STEM emergent scholars, and their subsequent enthusiasm to progress through their graduate school. Third, it recognizes that students have social agency or may enact modes of resistance as they learn how to be successful in graduate school. In this way students are perceived as not simply repositories of socialization from faculty but self-advocators and enactors of change in their programs, even if this change is of a small magnitude, via their contributions to the research enterprise and ways of negotiating disciplinary norms. Finally, the application of socialization frameworks in a critical manner places an even greater onus of responsibility on the institution for enhancing retention among URM graduate students and creating inclusive environments, and its faculty, instead of viewing students as somehow deficient. It also allows for the reexamination of deeply held assumptions and embedded practices in STEM education.

In short, by viewing students' experiences via a critical application of socialization frameworks, researchers redefine challenges URM students face in STEM graduate education as being in part symptomatic of a) issues of race and unexamined inequalities, b) differential power dynamics, and c) a persistently rigid socialization process that has a narrow ideal of what is considered acceptable practice when training students. In other words, this lens demonstrates that URM students confront a host of challenges as they are socialized into graduate education that have little do with a lack of academic ability, individual student responsibility, or talent. Encouragingly, a critical socialization framework allows room for imagining innovative, alternative ways of socializing diverse students in STEM disciplines that recognize the different

needs of diverse students. For example, as this study shows, enactments of faculty power can redefine how students "ought" to be taught and trained and can also powerfully shape peer culture. All of these factors impact the socialization experiences students have with others in their disciplinary environment, their development, and students' subsequent ability (and desire) to navigate discipline-specific expectations and the various challenges that arise in graduate school.

Recommendations for Practice and Implications

As surmised from the three institutions, STEM graduate programs that seek to increase retention and persistence must not place all the responsibility of success as measured by degree progress and eventual degree completion in students' hands alone. Some students can and do simply hit the ground running, but many do not and need help negotiating graduate academic culture. As emerging from this study, four quite salient issues URM graduate students face while pursuing STEM degrees are 1) intergroup and interpersonal dynamics wherein underrepresentation, power imbalances, and preferences for interaction among different student groups can exclude URMs and make them feel unwelcomed; 2) competitive and unstructured learning environments that are set up seemingly to ensure that some people (presumably the most weak and least savvy) fail; 3) negative assumptions about the abilities of URM students and who has talent; and 4) the availability of institutional resources. As such, there are a number of recommendations for practice resulting from this study that can help STEM graduate programs make steps towards transforming graduate education and by doing so create environments that are more socially and academically supportive of URM students.

First, with respect to intergroup relations, one of the best changes graduate programs can make to improve URM students' experiences in STEM graduate education is to improve the relationships students have with faculty and peers. Asymmetric power relations between faculty

and students mean that students are essentially at the mercy of their faculty advisors for guidance, encouragement, exposure to much needed resources, networks, and knowledge bases, and protection from harmful experiences. Asymmetric power relations also mean that the words and actions of faculty are of high saliency to students, with students ascribing a great deal of meaning to what faculty say and do. Even within the context of balanced faculty-student relationships, students are well aware of the hierarchical nature of their relationships with advisors. Faculty should, therefore, take care in not only *what* they say to students, but also *how* they communicate those messages. Furthermore department retreats can serve as one additional avenue wherein faculty are encouraged to think more critically about their role as advisors and identify ways that demonstrate their commitment to students and ways they fall short of serving students.

In addressing intergroup relations, programs must also acknowledge that URMs, especially ones who have developed a strong sense of racial consciousness, often feel like an outsider within STEM environments due to their severe underrepresentation, which is confirmed when they are repeatedly ignored or treated as invisible in their programs. In order to ensure that student diversity is an asset, programs must therefore be more attentive to how intergroup dynamics play out and identify ways of better connecting majority and minority students so that everyone can capitalize on opportunities for acquiring skill proficiency, professional socialization, and content knowledge in collaboration with peers. To merge the divide between international students and domestic students, for example, departments may consider formally sponsoring academic and social activities that would be conducive to cultivating positive interpersonal relationships. There would have to be many opportunities for interaction and these activities would have to occur early on in order to establish trust, familiarity, and positive relationships.

Departments can also better include URM students in academic spaces by intentionally connecting students to one another via small structured study groups offered to students in their first and second year. Purposeful peer mentorship programs by which older students (especially those from URM backgrounds) mentor and provide timely practical advice to newer URM students would also be beneficial. Facilitated peer social support can be structured either by more advanced students who volunteer to take on a mentee, or the department in which advisors assign their newer students to more advanced students working under their supervision. In this way, programs can provide a greater guarantee that everyone feels supported.

A related point is that although STEM departments cannot feasibly control the behavior of every individual, they can certainly encourage positive interactions and work towards creating an environment whereby individuals from less-dominant groups are affirmed and welcomed. To do so, STEM departments and programs can instruct their faculty and staff on ways they can more intentionally and equitably distribute micro-affirmations. Micro-affirmations are “tiny acts of opening doors to opportunity, gestures of inclusion and caring, and graceful acts of listening” (Rowe, 2008, p.46). Faculty and staff can also make the academic environment more welcoming by stifling destructive peer behavior by being trained to become what Scully and Rowe (2009) call “proactive bystanders.” A proactive bystander is a person who witnesses or becomes aware of a positive or negative event and responds/reacts to it, even if they are not personally impacted by the event. In this way, the bystander highlights positive events (commending students’ achievements for example) and addresses socially undesirable behavior or negative events (peers undermining each other, excluding others, etc). Alternatively faculty reinforce negative interactions and stereotypes of URM students when they engage in silent nonintervention.

Second, to improve the circumstances of URM students pursuing graduate STEM degrees, programs ought to address peer learning environments that are unstructured and/or competitive because these characteristics ensure that some people (presumably the most weak and least savvy) fail. With respect to program structure, STEM educators must recognize that there is a great learning curve to transitioning to graduate life and reaching balance. Since those initial transitional experiences have enduring implications for students as they continue to progress through their programs, programs can help students by easing them into the full responsibilities of a graduate student. This can be accomplished by recommending that students only take foundational classes their first year; during this initial year of graduate school programs should reduce their expectations of research to a manageable number of hours. Limiting research in that first year would also provide protected time for students to better understand the disciplinary material in their classes and focus on learning. Programs may also consider delaying teaching requirements until the second year.

Another way programs can help novice students become acclimated to graduate life is by providing more structure in a graduate program at the onset. For example, an orientation before classes begin that clearly outlines class sequences and expectations for research productivity, at least in the first two years of graduate school, could help reduce the uncertainty and doubt incoming graduate students experience and make them feel more in control of their ability to succeed. An additional area that lacked structure in students' programs was the process of changing advisors, especially in cases where the student felt wronged and the faculty-student relationship was emotionally charged and characterized by conflict and distrust. Programs coordinators and department chairs must think about the outlets students have to remedy this sort of situation. In some cases a mediator might help. More often than not, however, students will need a formal structure in place so that they can be released from their faculty advisor while not having any gaps in advising. A possible plan could be that students

who want to switch advisors due to conflict are automatically placed under the mentorship of the department chair until a more permanent advisor can be identified. Since faculty advising is needed at every step of the graduate process, any delay in finding a replacement faculty advisor can be detrimental to progression through the program and the student's morale.

With respect to competitive peer environments, it is encouraging to find that faculty indeed have the power to shape peer interactional dynamics in labs, classrooms, and department culture – in part due to the great deal of authority inherent in their positions, For example, many students articulated that it was within the context of their labs where many of their friendships sprouted because they spent a substantial amount of time there. Therefore, PIs can also foster positive affect between international students and domestic students by offering the students within their labs numerous opportunities for collaboration as well as opportunities for socializing informally perhaps via dinners or small celebrations of special occasions. Similarly, it is clear that where there is collaboration and collegiality in the learning environment, there are students who seem to be performing well, have positive attitudes about their ability to meet expectations, and enjoy their graduate experiences. Although this may be ideal, departments may achieve improved retention rates if faculty start prioritizing collaboration and the success of all students (i.e. the group) over individual interests.

Since faculty represent vehicles of change when they model appropriate behavior between members of the academic community, departments looking to transform destructive peer cultures where they exist should also look introspectively and reflect on how the faculty interact with each other. Are there rivalries that affect student life? Are students expected to be loyal to their advisor at the expense of cultivating rich relationships with other faculty? Are faculty kind to each other? Do faculty model research collaborations? Are faculty willing and quick to assist their students? In short, faculty and administrators can shape students' experiences via what they establish as acceptable practices for interaction.

Third, a concern for justice and fairness requires that graduate departments and programs address the fact that important others (i.e. peers and faculty) often have negative assumptions about the abilities of URM students. With respect to the cultivation of talent, this study demonstrates that students are academically successful when they are educated in programs that take an incremental or scaffolding approach to training students, that engender a culture of cooperation and minimize the competition built into training experiences (a point addressed above), and that have supports readily available to students in the environment (for example having access to advanced students to learn procedural skills or an instructor willing to meet the student outside of class to go over content material). STEM programs therefore ought to try to mimic the approach to teaching taken by instructors at HBEU wherein teaching was enacted in ways that met students' skills where they were and then steps were taken to develop them from that point. Revisiting the pace of instruction allows everyone an opportunity to learn. This approach to teaching also moves away from relying on a survival-of-the fittest-mentality typical in STEM disciplines and alternatively assumes that all URM students can be researchers with the proper training (Epstein, 2006; Seymour & Hewitt, 1997). In short, instructors should continue to set high expectations for students, but should also support students in ways that help them reach those academic expectations.

If programs cannot change the behavior of tenured professors in classes and labs so that they intentionally build the foundational knowledge of students and pay more attention to diverse students, perhaps programs can create a supplementary foundational knowledge course taught by advanced students for a stipend. Structurally this foundational course would be run much in the same way as supplemental instruction at the undergraduate level, wherein students review topics covered in foundational courses and tackle problem sets. In this way advanced students benefit from facilitating teaching experiences for more novice students, and novice students benefit from learning from peers wherein everyone is both the student and

teacher. Learning within an intentionally structured noncompetitive and nonthreatening environment can also spark interpersonal relationships among students. A supplemental course such as this would support students in that it would scaffold learning, help students build relationships together via regular interaction, facilitate collaboration via working together in small groups, and represent an additional form of formal support available in the learning environment. Supplemental courses also runs in direct contrast to Darwinian assumptions about survival of the fittest - that those who drop out simply can't hack it and accordingly, are unqualified, unfit, or too weak. One must only point to the success of supplemental instruction at the undergraduate level in bolstering student achievement to demonstrate that students' talents *can* be cultivated (Armstrong, Power, Coady, & Dormer, 2011; Blat & Nunnally, 2004; Hands, Reid & Younger, 1997; Malm, Bryngfors, & Mörner, 2010).

Further it is known, at least anecdotally, that faculty tend to reproduce environments and cultures in which they were trained (wherein sometimes, the tougher their graduate studies, the more they wear it as a badge of honor—classic hazing dynamics—to be earned by their students). Because of this tendency, programs should make a point to begin faculty meetings with a short active learning exercise facilitated by either the chair or someone from the office on campus in charge of teaching instructors how to teach. Moreover, faculty can share techniques for active learning as some disciplinary associations are encouraging. The focus on teaching should help faculty understand the benefits of collaboration within the classroom and lab, of scaffolding learning, and of being supportive to students in ways that are personally meaningful to students. In this way faculty can apply this understanding to how they approach student learning. Hopefully this curbs the sentiment some faculty may have of "I-went-through-a-difficult-time-in-graduate-school-and-so-should-you."

With respect to negative assumptions about the abilities of URM students, programs can also create activities that help students and faculty alike recognize their own racial biases

(Morales, 2006) and reflect on how these biases may unintentionally create distrustful and unwelcoming learning environments (Bensimon, 2005). Engaging in these practices is an important first step in enabling faculty to become more critically conscious agents of socialization. Since faculty serve diverse students, faculty also need training on how to become more culturally responsive both in the pedagogy they use and the way they mentor students. Multicultural mentoring, in which the mentor and protégé celebrate differences and in which both parties respect the cultural background and experiences of the other, optimizes learning and development; this type of mentoring also keeps hierarchy to a minimum and maximizes collaboration (Williams & Schwiebert, 2000). Institutions can improve teaching by offering STEM professors – especially those in departments that are notorious for bad teaching – opportunities to learn about culturally relevant, non-racist pedagogies that meaningfully incorporate issues of race into the curriculum. Indeed, one way to challenge bias and discriminatory structures is by training those who work at the institutions to be more sensitive and proactive in serving students of color (Chesler et al., 2005). Programs should also substantially scrutinize practices for their potential in perpetuating inequalities however small so that URMs are no longer recognized and treated as different or unequal members of their academic community (Abrams, 1993).

From this study it is also clear that some programs are making inroads in the recruitment and retention of URM students. The most innovative graduate program at MU reportedly gave students numerous opportunities to voice concerns. This program then seriously looked into ways to meet these concerns and made changes where feasible and appropriate. As a result, graduate students in this department felt heard, appreciated, and that their opinions and presence were valued. Many other programs could follow this example. By merely showing a willingness to try new or modified practices, programs can signal to students that they matter and are interested in making their graduate experience satisfying and productive. In the spirit of being responsive to students, departments may consider surveying

their students to get an accurate pulse of the climate and to determine if any practices seem to be disproportionately harmful to members of specific groups. The department then can use this information to inform next actionable steps. Surveying students and then not acting on the information collected would undermine the trust students have in their departments.

The fourth and final set of recommendations is with respect to the availability of institutional resources. Examining students' experiences across the three institutional types demonstrate that URM students can have positive enriching experiences and thrive in many different settings. The ability to do so however is hampered by poor institutional resources, at least among minority serving institutions. In other words at a national level, this research supports the need for additional partnerships directed at supporting HBCUs and HSIs given the apparent enduring resource disparity between institutions. One telling example is that students attending the minority serving institutions in this study had differential access to professional networks and gaining real-world experience in industrial markets compared to their peers at the predominately White institution. Here lies a great opportunity for companies relying on STEM professionals to intervene by way of creating partnerships with MSIs so that students have access to coveted workforce and professional development opportunities both locally and nationally. Companies may utilize partnerships with graduate schools as a prime way to socialize a future cadre of STEM professionals with the particular skill set needed to thrive within their specific organizational context. In this way, the STEM professionals companies hire to work for them can hit the ground running immediately after being hired. The federal government can also create outreach programs for students at MSIs who wish to use their STEM degrees to enter government careers. A related point is that although current federally funded programs at the graduate level (e.g.. AGEP) provide URM students attending MSIs with rich socialization experiences and additional funding for which they were grateful, the requirement that students commit to a certain educational or career path is misdirected. Indeed,

many students are simply unready to make such a decision or later become unenthusiastic about their professed path. This demonstrates a need to rethink federal program requirements so that they are more flexible and reflect the fact that students may change their minds about what they want to do with their advanced degree once confronted with the realities of STEM job markets.

Also, since institutions rely greatly on resources from the federal government, they are likely to respond to policy pressures at the national level and enact change to certain aspects of the educational process to meet federal priorities. The government should therefore require that institutions receiving federal funds contact students who leave their graduate programs before degree completion and, if the student is willing, perform an exit interview. Institutions ought to know why their students leave before degree completion so that they can learn from students' stories, reflect to determine the extent to which the department practices/structures equitably serve students, and identify specific areas that they have control over improving. Changing a program so that students have more positive socialization experiences can help graduate schools build loyalty among its alumni and can amplify the desire of alumni to later participate in matters concerning the university; URM alumni can also become ambassadors of the program from which they graduated and attract younger generations of minority students to attend the institution for their graduate work (Johnson-Bailey et al., 2009). During the accreditation process, individual departments should be required to report what they learned from exit interviews and how they plan to address problems to demonstrate due diligence in creating an environment more conducive to academic success.

Recommendations for Future Research

Although this study was comprehensive in that it examined many aspects of URM students' experiences in STEM graduate programs, many questions remain unanswered. Thus

future research would benefit from addressing the following three areas: First, future inquiry should investigate how URM graduate students in STEM programs are supported at an organizational level, which would require the interviewing of deans, provosts, graduate program directors, the president, and most importantly STEM faculty. Using organization theory to frame issues of retention and persistence and putting race at the center of analysis will allow for robust findings that focus on how the institutions fares with respect to equity, diversity and social justice. One interesting question to pursue is whether STEM program faculty can be coached to become culturally competent with respect to curriculum and delivery of mentoring. Evaluation of the NIH-sponsored National Research Mentoring Network will be in the position to answer this question in the next five years, as many institutions seek federal funding to improve mentoring at all levels of research training.

Second, future studies should research STEM programs situated in predominately White campuses that are at the frontier of supporting their URM graduate students, as demonstrated by better than average rates of persistence to degree completion. This type of research would help other programs get a better sense of what they can do to achieve similar results. Future research should also examine the effect mentoring has on students' self-confidence and stress levels, the indirect effects of climate issues, and how intersections of different social identities affect students transitional experiences within their graduate programs. Further it would be interesting to determine how 'frontier' programs support master's students, since the pursuit of a master's degree as a whole is more prevalent than the pursuit of a doctoral degree, perhaps due to the fact that the master's require less of a time commitment than doctoral programs. Investigating the experiences of STEM master's students exclusively and across different institutional types would yield robust findings and implications for practice that strengthen the pipeline to doctoral degree attainment.

Third, it is important to note that participants in this study are comprised of only those who persisted to face another year of graduate school. The story that remains untold is what occurs when challenges in graduate school become overwhelming for URM students, and they are no longer part of the STEM academic community because they decided to leave rather than stay. Indeed, maintaining the energy needed to continue in a program that does not take much interest in mentoring or encouraging its students must not be easy. Thus, researchers should understand the ways STEM graduate programs do not provide the necessary support for degree completion and what can be done to reverse these trends since they contribute to disparities in career attainment. By doing so, these researchers will also challenge the dominant narrative wherein it is believed that URM students simply drop out of their STEM programs. Likewise, future inquiry can benefit from using longitudinal data collection procedures to better connect student experiences to outcomes and demonstrate how challenges in graduate school evolve.

Positive experiences and stories of resilience in this study demonstrate that URM persistence in STEM graduate programs is already occurring in many programs; therefore, increasing the numbers of diverse STEM researchers *is* within reach! However, experiences with multifaceted challenges connected to lack of caring mentorship, underrepresentation, differential power dynamics, and varying levels of racial bias undermine academic success and indicate that the institution must keep working towards serving its diverse graduate students. As one student noted, “the little things add up and make me question whether this department is where I want to be.” STEM programs, therefore, have a responsibility to not only ensure degree attainment, but also to provide academic learning environments that are supportive and inclusive of all students. Until graduate programs exemplify such support, URM students will remain a marginalized group in academia and underrepresented among STEM graduate degree holders. Moreover, without intentional educational practices of support, URM students will

continue to be an underutilized source of talent in a nation that is rapidly losing its position as a leader in technological and scientific innovation.

Appendix A.

CONSENT TO PARTICIPATE IN RESEARCH

National Science Foundation (NSF) / Higher Education Research Institute (HERI) Study

Post-Baccalaureate Experiences, Success, & Transition (BEST)

You were invited to participate in a study examining the post-baccalaureate experiences of recent undergraduate alums. This study is being conducted by Sylvia Hurtado, Ph.D. and Mitchell J. Chang, Ph.D., who are faculty members in UCLA's Department of Education. Please read this form and ask any questions you may have before agreeing to participate in this study.

PURPOSE OF THE STUDY
The purpose of the study is to better understand the post-baccalaureate pathways and transitional experiences of recent undergraduate alums.

PROCEDURES
If you volunteer to participate in this study, you will be asked to complete a brief questionnaire and participate in a 90 minute focus group. During the session, we will be asking you questions about your own educational experiences. The focus group will be audio recorded and later transcribed.

POTENTIAL RISKS AND BENEFITS
The study poses minimal risks. This study seeks to understand your overall experiences after college. In reflecting on your experiences it is possible that you might become uncomfortable with difficult or challenging experiences you have had. This may be somewhat emotionally distressing. You may elect to not answer any of the questions with which you feel uncomfortable and still remain a participant in the study.

You may not benefit personally from your participation in this study. However, this research addresses issues important to recent undergraduate alumni and may help inform institutional and classroom practices, which better prepares students for post-baccalaureate education and careers. Furthermore, you may derive benefit in reflecting on your own experiences.

PAYMENT FOR PARTICIPATION

You will receive a $20 gift card for your participation in this study. You may choose to participate in the focus group at whatever level is comfortable for you.

CONFIDENTIALITY

In any report we publish, we will not include any information that will make it possible to identify a participant. We will use pseudonyms for students in all transcripts and reports. Research records will be kept in a locked file; only the researchers will have access to the records. The recordings will be erased or destroyed once this research study is completed and the audio recordings have been transcribed and proofed. **Please note:** All participants are asked to keep what is said during the group discussion between the participants only. However, complete confidentiality cannot be guaranteed.

PARTICIPATION AND WITHDRAWAL

Your participation in this study is strictly voluntary and will not affect your current or future relations with your institution. You are under no obligation whatsoever to answer any questions or discuss anything that you are not inclined to answer or discuss. If you choose not to answer specific questions, you may still remain in the study. You are free to withdraw at any time.

CONTACTS AND QUESTIONS

The researchers conducting this study are Sylvia Hurtado, Ph.D. and Mitchell J. Chang, Ph.D. If you have any questions or concerns about the research, you may contact the Co-Primary Investigators at shurtado@gseis.ucla.edu or mjchang@gseis.ucla.edu .

RIGHTS OF RESEARSH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact the Office for Protection of Research Subjects, 11000 Kinross Avenue, Suite 102, Box 951694, Los Angeles, CA 90095-1694, (310) 825-8714.

STATEMENT OF CONSENT:

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

_____

Name of Subject

_____ _____

Signature of Subject Date

SIGNATURE OF INVESTIGATOR OR DESIGNEE

In my judgment the subject is voluntarily and knowingly giving informed consent and possesses the legal capacity to give informed consent to participate in this research study.

_____

Name of Investigator or Designee

_____ _____

Signature of Investigator or Designee Date

Appendix B.
National Science Foundation (NSF) / Higher Education Research Institute (HERI) Study

Post-Baccalaureate Experiences, Success, & Transition (BEST)
Student Information Form

All responses will be kept confidential, and your identity will remain private. Your responses to these questions are optional, but will be extremely helpful in our research. Thank you!

Please print all of your responses.

1. Name:_____

2. E-mail address:_____

3. Birth date: _____/_____/_____
   mm dd yyyy

4. Sex: *(Please check one.)*: ▢ Male ▢ Female

5. Current Marital Status: ▢ Single ▢ Married ▢ Divorced/Separated

6. How many children do you have? ▢ 0 ▢ 1-2 ▢ 3-4 ▢ 5 or more

7. How do you identify racially/ethnically? *(Please check all that apply.)*

▢ Native American/Alaskan Native ▢ Arab American/Middle Eastern ▢ Asian American/Pacific Islander

▢ African American/Black ▢ Hispanic/Latino/Chicano ▢ White/Caucasian
▢ Other _____

8. What is the highest level of formal education obtained by your parents?
   *(Please check **one** in each column.)*

	Father	**Mother**
Grammar school or less……	▢	▢
Some high school…….	▢	▢
High school graduate……	▢	▢
Postsecondary school other than college……..	▢	▢
Some college……	▢	▢
College degree……..	▢	▢
Some graduate school……..	▢	▢
Graduate degree……	▢	▢

9. How many miles is your average daily commute *(round trip)*? _____

10. From what institution did you receive your bachelor degree? _____

    a. Major: _____

    b. GPA: _____

    c. Graduation year: _____

11. Where are you currently attending graduate school? _____

    a. Program of study *(if applicable)*: _____

    b. GPA *(if applicable)*: _____

12. Please list any undergraduate research programs or internships that you were involved in during your undergraduate career: _____

    _____

Appendix C.
Focus Group Interview Protocol

Welcoming Comments
Thank you for coming today.

My name is _____. I went to undergrad at_____, then I _____ and ____. Now I am at UCLA completing my doctorate in Higher Education & Organizational Change. **(Describe your own pathway to the Ph.D. program.)**

Here's the history of what we're doing. In 2004, we surveyed a cohort of freshmen regarding their views on STEM, now we are gearing up to survey them again in our Post-Bac survey. However, we don't want to randomly choose what to ask them about, we want to have informed questions. That's why we invited you here. We need your insights into what your experience in STEM has been and how you have navigated your educational journey. We will use your responses to inform the development of our new protocol.

You can share whatever you wish with the group and you are free to choose not to participate in all or any part of our study. If you would rather not respond to a particular question, simply say "I pass." At any time you can excuse yourself without any consequences to your standing as a student.

We also ask for your permission to audio record the focus group and for my colleagues to take notes during our dialogue. In order to protect your real names and identification, we will assign a pseudonym for each of you when we review the transcription.

We ask that you all keep what is said during the group discussion confidential. **Please note:** However, we cannot guarantee complete confidentiality.

Are there any questions before we start?

Appendix C.
Focus Group Interview Protocol

Pathways

1. Can you please tell us your name, your program of study, how far along are you in your graduate program, and what your path here has looked like? Just as we described our own paths to graduate school, we are asking you to do the same. For example, did you come directly from undergrad to grad school, did you work for a while, etc?

Identity

2. Did you have any pre-college experiences at home or in school that influenced your decision to pursue studies in STEM?
    a. Was there someone in particular (e.g. family member, mentor) that had an influence on your decision?
3. Does being a scientist shape your identity?
    a. Can you think of the ways in which your identity as a scientist has an influence on your life? For instance, how does your identity as a scientist affect your relationships with family, friends, and community?
    b. Do you present yourself and your work differently to non-scientists? If so why, and in what ways?
    c. Can you talk about ways in which your identity as a scientist intersects with your gender, religion, ethnicity or sexual identity?
    d. Do you consider yourself a critical thinker? Do you think that you were this way prior to entering STEM or has being in STEM made you more of a critical thinker? Does this set you apart in any way?

Graduate Experience

4. What influenced your decision to attend or delay attending graduate school (e.g., financial concerns, time to degree, etc.)?
5. How would you describe your transition when you initially entered graduate school?
    a. In what ways was your undergraduate environment similar or different from what you encountered in graduate school?
    b. What were the key factors in your undergraduate experience that helped you feel prepared? (e.g., undergraduate research)
    c. Can you think of anything that was missing in your undergraduate experience that may have better prepared you for graduate school?
6. How would you describe your interaction with faculty members, your PI or committee members now?
    a. Do they provide adequate mentoring? Advising? Feedback and encouragement? Please give an example.
7. How would you describe the quality of instruction and curriculum in the courses you have taken so far?
    a. Is the quality of instructor important to you?
    b. Do you feel your instructors are strong teachers?
    c. Are you given any opportunities to teach? Encouraged? Discouraged?

8. How would you describe your interaction with peers in your department and the broader campus community?
    a. How easy or difficult is it to find support from your peers? Please give an example.
    b. Would you say the environment is competitive or collaborative? Please explain.

c. Where does most of your out-of-class peer interaction occur (e.g., student organizations, group projects, study sessions)? Please give an example.

Career Planning

9. What are your educational and career goal(s) both immediate and long term?
    a. Are you given exposure to or support in pursuing multiple career paths?
    b. Do you feel that you are receiving adequate professional development?
    c. What are the obstacles or barriers, if any, that might affect your immediate and long term career goals (e.g., family concerns, time to degree, financial rewards, etc.)?

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PHONE: (310) 825-1925

Dear <Name>,

You were referred to us by Dr. Alec Gallimore, Associate Dean for Academic Programs and Initiatives, as a potential participant in a research study being conducted by the Higher Education Research Institute (HERI) at UCLA, the National Science Foundation (NSF), and National Institutes of Health (NIH).

The purpose of the study is to understand the experiences of graduate students in STEM fields. Conditions are ripe for understanding what factors affect student preparation for Science, Technology, Engineering, and Mathematics (STEM) careers, and more importantly, how educational experiences create barriers and accelerators to these career goals. Your participation in this research study (or decision not to participate) will not affect your relationship with the University of Michigan, UCLA or any other academic institution.

Your participation will involve a 60-90 minute face-to-face focus group session with 5-6 of your peers. There is also a brief questionnaire to complete (~5 minutes) before the focus group. Participants will receive a $20 Borders gift card, food and refreshments.

We are planning to travel to Ann Arbor during the week of April 5th - 10th. We have yet to determine the exact time for the focus groups, but we will base our schedule upon participants' availability.

Please email mctran@ucla.edu if you are interested in participating, or if you have questions. For more information on the study and its benefits for participants, please go to: http://heri.ucla.edu/nih/

Thank you for your time,
Minh Tran (Michigan Alum, BA'00)
Research Analyst

UCLA IRB# G04-06-037-12B
Expiration Date: 1/4/2011

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