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**Campus Climate and the Underrepresented Minority Engineering Student
Experience: A Critical Race Study**

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Education

in

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by

Terrance Mayes

Committee in Charge:

University of California, San Diego

      Professor Carlos Coimbra
      Professor Frances Contreras
      Professor Mica Pollock

California State University, San Marcos

      Professor Jennifer Jeffries, Chair

The Dissertation of Terrance Mayes is approved, and is acceptable in quality and form for publication on microfilm and electronically:

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Chair

University of California, San Diego

California State University San Marcos

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Dedication

I dedicate this dissertation to my parents, grandparents and brothers, for you unconditional love and support. I could not have done this without you.

TABLE OF CONTENTS

List of Figures

List of Tables

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Vita

2002   Bachelor of Arts, Speech Communication, California State University, Fresno

2005   Master of Science, Organizational Leadership, National University

2014   Doctor of Education, Educational Leadership, University of California, San Diego
& California State University, San Marcos

ABSTRACT OF THE DISSERTATION

CAMPUS CLIMATE AND THE UNDERREPRESENTED MINORITY

ENGINEERING STUDENT EXPERIENCE: A CRITICAL RACE STUDY

by

Terrance Mayes

Doctor of Education in Educational Leadership

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Professor Jennifer Jeffries, Chair

In the current technological era, the number of minorities in science, technology, engineering, and mathematics (STEM) is a crucial factor in predetermining the economic growth of the United States. Since the minority population is growing at much faster rates than the non-minority population, the lack of proportionate production of minority engineers poses a threat to the United States' ability to remain a global competitor in technological innovation. Sixty-three per cent (63%) of undergraduate students who enter engineering majors continue on to graduate in that major. The graduation rate, however, for African-American, Hispanic, and Native-American students in engineering is significantly lower at 39%. As this group represents only a small fraction of the annual student enrollment, engineering programs are graduating these minority groups at rates that are greatly disproportionate to United States demographics. Therefore, researchers

are thoroughly investigating certain initiatives that promote academic success among underrepresented minority students in engineering.

Colleges and universities have attempted to address the growing achievement gap between underrepresented minority and non-minority engineering students, predominately through various deficit-based interventions, focusing on the student's flaws and problems. As the pipeline for minorities in engineering continues to narrow, it begs the question of whether institutions are focusing on the right solutions to the problem. Critical Race Theory scholars argue that colleges and universities must address institutional climate issues around students, such as racism, microaggressions, and marginalization, before members of oppressed groups can truly succeed. This dissertation explored the unique experiences of underrepresented minority engineering students in a predominately White and Asian campus.

Chapter 1

Introduction

Today, the United States serves as the world leader in science, technology, engineering and mathematics (STEM) advancements. However, that position stands in jeopardy. The economic growth of the United States is connected to its technological productivity and capacity, which creates a growing need for technically skilled labor (Ntiri, 2001). President Obama's Council of Advisors for Science and Technology, the House of Representatives in its National Science Policy Study, and the United States Commission on National Security have argued for an intensified focus on science and engineering across the country, in order to remain competitive with other nations (PCAST, 2010). This focus is imperative since the USA issues H1-B work visas to foreign STEM professionals to makeup for its own domestic shortfall (George Y., Neale D., Van Horne V., & Macolm S.M., 2001).

Responses to what has been characterized as a crisis in the economic and knowledge building future of the United States have taken many forms, one of which is the establishment of formalized K-16 initiatives known as "STEM" or Science, Technology, Engineering and Math programs. The intent of STEM programs are to ignite, excite and prepare students for majors and careers in the high-demand fields of Science (PCAST, 2010). The STEM initiative takes many forms. One form is the effort to increase the number of underrepresented minority students (URM) in higher education settings who pursue degrees in STEM disciplines. These programs address two of the larger educational issues of our time: increasing the number of STEM graduates who can

contribute to the national effort to generate knowledge and expertise in science, technology, engineering and math and increase the number of under-represented minority students who earn a college degree.

While many of these programs have demonstrated moderate success in increasing the participation and graduation of underrepresented minorities in STEM fields, a large disparity remains in the disciplines. Most STEM programs take a deficit approach by focusing on "improving" the individual student. This approach frames the student as the sole "problem" and relieves the institution from holding themselves accountable for the troubling outcomes described above. An alternative to the deficit approach of exploring these outcomes is to interrogate the institutional factors that, if skillfully explicated and addressed, could improve the campus climate in which these students find themselves.

Problem Statement

In 2000, minorities comprised about 30% of the United States population, however, the 2008 United States Census projects that current minority groups will represent the majority of citizens by mid-century (US Census). This growing minority-majority shift requires thoughtful and intentional consideration in terms of access to and success of URM students in STEM programs. To illustrate this point, currently, white males make up nearly 70% of the domestic STEM workforce (George et al, 2001).   As the effort to increase STEM graduates moves forward, we could easily create more white male engineers only. This would not be responsive to the demographic nor ethical imperative of increasing access to and success in STEM fields for URM students. Therefore, an emphasis must be placed on closing the Science, Technology, Engineering,

and Math (STEM) achievement gap and degree completion between historically underrepresented minority students (URM) and non-URM students.

Closing the gap between URM and non-URM students entering the field of engineering will be no easy feat as the retention of URM students in the STEM fields is a significant challenge. URM includes students of African-American, Hispanic or Latino American, and Native American backgrounds. In engineering, only 39% of URM students who enter as freshmen are retained to graduation in that major (Landis, 2005). This is compared to a 63% graduation rate, overall, of all students who enter engineering programs (PCAST, 2010). This problem is compounded when one considers that few URM students are initially enrolling in STEM programs. In 2000, URM students made up only 3% of students represented across all physical and life sciences (Jones, Barlow & Villarejo, 2010). Since African-Americans, Latino Americans, and Native Americans are seriously underrepresented in STEM majors, it deprives the nation of the benefits of their talent, creativity, and unique perspectives. It also limits the access of these groups to well-paid, high growth positions in technical fields.

Across the country, STEM initiatives such as Minority-Engineering Programs (MEPs)have placed an emphasis on empowering the student. Landis (2005) introduces evidence of effective action undertaken to increase retention rates at varying rates, however a great discrepancy still exists in engineering and other STEM fields. Landis suggests that the optimal solution is to reinforce the use of STEM initiatives such as MEPs and to create an optimal learning environment for minority students. The latter is the issue that STEM programs are ill equipped to handle and must be pursued at the institutional level. This study uses critical race theory to interrogate the gaps that current

university programs have failed to solve such as racist instructors, microaggressions of various forms, and acts of racism that are barriers to the success of URM students. This study reveals that colleges and universities must also focus on improving campus racial climate in order to create the conditions under which all students are able to excel.

Theory Overview

Three theoretical frameworks were used to analyze the data in this study. *Critical race theory*, *appreciative inquiry*, and *persistence theory* proved helpful in exploring the experiences of URM students in STEM programs and in creating recommendations for addressing campus climate.

Critical Race Theory. My study was conducted using a critical social research framework. Critical researchers seek insights into the social world in order to help people change oppressive conditions (Esterberg, 2002). Ultimately, the goal of social critical research is to work towards human emancipation. As I am particularly interested in understanding the experiences of ethnic minority students in engineering, I will be using a "critical-race" theoretical framework. Critical Race Theory (CRT) was developed out of legal scholarship. It provides a critical analysis of race and racism from a legal point of view. Since its inception within legal scholarship, CRT has spread to many disciplines. One such discipline is education at both the K-12 and higher education levels (Delgado Bernal & Villalpando, 2002).

Appreciative Inquiry. Appreciative Inquiry (AI) is both a philosophy and an approach for motivating change that focuses on exploring and amplifying organizational strengths. This approach to research is unique in a way that it focuses on identifying strengths as opposed to gaps and weaknesses. In other words, it seeks what is "right" in

an organization (Watkins & Cooperrinder, 2000). AI is an organizational change model, which can be used in forming higher education curriculum, polices, and procedures. It is one of several positive organizational scholarship approaches that embrace analytic tools and empirical research as a means to understand conditions that support excellence (Daly & Chrispeels, 2005). Within the framework of CRT, this study aims to unveil the affect campus climate has on the experiences of underrepresented minority students in engineering. The combination of critical race theory and appreciative inquiry is a seldom used approached in existing literature, perhaps because one approach requires a radical critique of institutions while the other explores their positive attributes. This study, however, seeks to understand all factors that contribute to the manner in which URM students experience the campus climate, whether those factors are positive, negative or neutral.

Persistence Theory. Tinto's theoretical model of persistence (1975) argues that student persistence is enabled when a student successfully integrates both academically and socially into an institution. He further argues that the longitudinal process of students persistence in college is made up of several distinct stages through which students must pass (Tinto, 1988). Other researchers have built upon the literature contributed by Tinto to examine the role of the institution in the social and academic integration of underrepresented minority students (Rendon et al, 2004; Nora, 2002; Cabrera, 1992). Tierney (2004) suggests that students should not need to leave their identities at home while pursuing their education. Tierney's model of persistence proposes that students must be provided with the cultural capital necessary to succeed in an educational system where barriers to persistence and integration exist for minority students.

Definition of Terms

The following terms are commonly used within critical race theory and persistence theory discussions and are used throughout this study.

Impostor Syndrome**:** An irrational fear of being discovered as intellectually inadequate or a "fraud" (Kolligian & Sternberg, 1991).

Microaggression: A subtle insults directed toward people of color, often unconsciously (Solorzano et al, 2000).

Racism: The belief in the inherent superiority of one race over – in particular White, over others (Lorde, 1995).

Self-Efficacy: An individual's self-evaluation on their ability to execute a course of action in order to reach a desired outcome in an effective manner (Zajacova et al, 2005).

Social and Cultural Capital: Academic and cultural advantages in the form of rudimentary knowledge required to be successful in a majority-dominated, academic environment (Shebab et al, 2007).

Stereotype Threat: Being at risk of confirming, as self-characteristic, a negative stereotype about one's group (Steele & Aronson, 1995).

Research Questions

Combining critical race theory, persistence theory, and an appreciative inquiry in a holistic approach, I explored the following questions:

1. Do underrepresented minority students encounter racialized experiences in engineering programs? If so, what are those experiences?

2. Do students perceive issues of race as impacting their academic experiences? If so what are those issues and experiences?

3. Have racial experiences impacted students' self-efficacy and motivation to complete their program? If so in what ways?

Summary of Methods. A qualitative study of URM students from the University's engineering program was conducted. Using a critical ethnographic research design, my study sought to understand whether there might be common racialized experiences or other unique experiences of an often-marginalized group. Three processes were employed to gather data. First, semi-structured one-on-one interviews were conducted with eleven participants. At the conclusion of the interview, each interviewee was asked if there was one question I could have asked to better understand their experiences. For the second component of the qualitative study, I compiled all responses to this question and sent it out to the group of interviewees as a questionnaire. The third process involved convening all of the study participants in a group discussion of the preliminary findings and suggested recommendations.

This report is organized in five chapters. Chapter one provides an overview of the problem of Black, Latino and Native American being underrepresented in STEM disciplines, as well as an overview of Critical Race Theory, Appreciative Inquiry, and Persistence Theory. Chapter two further discusses CRT and posits the framework as a better way to understand the challenges facing URM students in STEM disciplines. Chapter two also provides an overview of literature related to campus racial climate and the importance of mentoring and academic support for URM students. Chapter three provides an explanation of the research design, methods, data analysis, and data reporting. Chapter four discusses the major themes that emerged from the data, and

chapter five presents the findings that address the research questions and a set of

recommendations for engineering programs.

Chapter 2

Review of the Literature

The review of the literature addresses research findings related to critical race theory, racism as an institution, campus racial climate, contributing factors to URM success in STEM, academic barriers, and mentoring.

Critical Race Theory

The critical race theory (CRT) movement is supported by a group of activists and scholars interested in studying and transforming the relationship among race, racism, and power (Delgado & Stefancic, 2001). It is a frame used by researchers studying various topics. Author and educator, Gloria-Ladson Billings, discusses critical race theory within the context of education. In the groundbreaking article by Ladson-Billings and Tate (1995), the authors explain how CRT as a conceptual framework can be applied to our understanding of educational inequity. They describe CRT in education as a "radical critique of both the status quo and the purported reforms" (p.62). CRT also challenges the ways in which race-based power relationships are produced and perpetuated (Ladson-Billings, 2009).

Major tenets. Solorzano, Ceja and Yosso (2001) identify five major tenets that exist within the basic CRT framework.

(a) the centrality of race and racism and their intersectionality with other forms of subordination,

(b) the challenge to dominant ideology,

(c) the commitment to social justice,

(d)

(e) the centrality of experiential knowledge, and

(f) the transdisciplinary perspective.

The centrality of race and racism and their intersectionality with other forms of subordination. Critical Racial Theory explores not only racism, but also other forms of discrimination and subordination like those based on gender (Crenshaw, 1989). The aim of scholarship using a CRT lens is to empower those who feel marginalized through scholarly-based advocacy. Solorzano and Bernal (2001) argue that race and racism is permanent and central factor in explaining minorities' experiences with the legal system, but it does not always account for other intersecting factors and form of oppression. Other "marginal" factors might include realities such as sexual orientation, gender, class, and religion. Including gender, for example, in a CRT study about race helps an analyst differentiate between men and women in their treatment, from society, despite them being of the same race.

The challenge to the dominant ideology. CRT scholarship also aims to challenge the dominant ideology. Specifically, scholars challenge claims often used within the education systems of race neutrality, objectivity and color-blindness. This can be seen in the work of Ladson-Billings and Tate, (2000) who insist that racism still exists in the American society. She argues that the problems of race and racism should not be mute but acknowledged and discussed openly before we can derive real solutions. CRT scholars believe the use of many traditional educational paradigms serve as a camouflage for furthering the self-interests of the dominant groups in American society (Calmore, 1992). For example, the Scholastic Aptitude Test (SAT) administered to high-school students as a precursor to college admission is presented as a color-blind phenomenon but

according to CRT scholars serves to further advantage white students who score higher on the exams (Ladson-Billings, 1999).

The commitment to social justice. A major concern for CRT scholars is social justice. A social justice framework asks authors to speak against racism and oppression and to demonstrate that it still exists in America. This tenet aims to establish a liberating reaction towards the oppressions based on gender, race, or class disparities. Scholars have lauded the accomplishments of people of color in an effort to eradicate poverty, sexism and racism.

Centrality of experiential knowledge. CRT has led to studies that have shown that students who have experienced racial discrimination can be an important source of knowledge and expertise in many areas of education based on their experiences. Bernal (2002) argues that these students have the potential to create new knowledge if given the opportunity. More so, they have the potential to provide key information to education related research. CRT scholars thus often draw on the experiences of the racially discriminated by using methods such as biographies, storytelling, chronicles, parables and narratives. The results of such methods typically suggest reasons for the existing gaps in the education system.

Transdisciplinary perspective. Through a transdisciplinary perspective, CRT scholars are able to demonstrate the strength and applicability of their methods of research concerning race. As mentioned, however, CRT goes beyond studying issues of race and expounds on other contemporary perspectives including: women's studies and feminism, history, law, among other fields. CRT is an integrated theory that is holistic in

the effort to promote pluralism within society while diving deeply into the study of race (Bernal & Solorzano, 2001).

Recognizing that racism is endemic in the U.S. society, CRT academic scholars reject the question of how racial discrimination can be eradicated while maintaining the interests of the status quo and traditional dominant societal values. They instead inquire into how these traditional interests, values and cultural norms serve as vehicles to impede the educational opportunities of students on color (Tate, 1997).

Interest Convergence. Interest convergence serves as a primary component of CRT. CRT scholars maintain that motives behind civil rights and other societal advances for people of color are rarely altruistic. Delgado and Stefancic (2001) discuss landmark civil rights that emerged out of the converging interests of African-Americans and the United States government, acting in the interests of whites. One such instance is the 1954 U.S. Supreme Court case, Brown v. Board of Education , in which the school segregation policy "separate but equal" was outlawed. At the time of the historical case, the United States was in the middle of fighting the Cold War. Derrick Bell, former NAACP legal counsel and the first African-American tenured professor at Harvard Law, has argued that the optics of oppressing people of color would have reflected poorly on the United States and hindered it's ability to secure the alliances of Third World countries, much of which were populated by people of color (Bell, 1980). Therefore, out of its self interest, the U.S. government merged its interests with that of the civil rights movement resulting in interest convergence.

Of course, interest convergence in the educational sector is not a thing of the past. Bell (1980) describes it as a "dilemma" and it is still very prevalent today. Take for

instance when a University compromises its admissions "standards" to accommodate a promising African-American athlete. Another scenario of interest convergence occurs when a university seeks to increase its ethnic diversity making it eligible for special government funding or avoid negative public relations. Research faculty commonly draft "diversity plans" in order to comply with federal funding guidelines. Some scholars argue that it is important to recognize and take advantage of these points of converging interests (Harper, 2009). All are examples of institutionalized interest convergence.

Counter-storytelling. Counter-storytelling, another common component of CRT, is a framework that legitimizes the racial and subordinate experiences of marginalized groups (DeCuir & Dixson, 2004; Ladson-Billings, 2009; Parker & Villalpando, 2007). Counter-stories are personal, composite stories or narratives of people of color (Delgado Bernal & Villalpando, 2002). DeCuir and Dixson stated that counter-stories are a resource that both expose and critique the dominant (male, White, heterosexual) ideology, which perpetuates racial stereotypes. Delgado (1989) warns that the recipient of an unfamiliar counter-story may initially reject it, as well as the storyteller, because it makes them feel a higher level of discomfort. According to some researchers, however, experiencing the discomfort is the only way to deal with the reality of race and racism in an honest and forthright way (Singleton & Linton, 2006).

The use of counter-stories in analyzing higher education's climate provides faculty, staff, and students of color a voice to tell their narratives involving marginalized experiences. Counter-stories can assist in analyzing the climate of a college campus and provide opportunities for further research on the ways in which an institution can become inclusive and not simply superficially diverse (Hiraldo, 2010). The goal of 'inclusion' is

important to keep in mind when institutions work toward creating a diverse educational

community by simply increasing diversity of the student population but do not

simultaneously ensure an inclusive and supportive campus climate. Specific to this study,

counter-stories of underrepresented minority students in undergraduate engineering

majors will be used to offer their personal narratives on their academic experiences

Institutional Racism

Racism can be defined as a complex ideology composed of beliefs in racial

superiority and inferiority and is enacted through individual behaviors and institutional

and societal policies and practices (Jones, 1997). Lorde (1995) offers a more concise

definition: "The belief in the inherent superiority of one race over – in particular White,

over others". America has a long history of legislatively supported racism including black

slavery and the Jim Crow "separate but equal" laws both of which served to engrain in

the minds of whites and blacks alike, that blacks were the inferior race (Fredickson,

2009).

Racial hierarchy and supremacy in the United States dates back to the founding of

the Country. Hudson (1999) provides a fitting summary of racism in America's origin.

> Many of the founders of American democracy were dedicated proponents
> of this Anglo-Saxon myth. Thomas Jefferson, for example, held the
> conviction that U.S. independence would allow for the full and
> unencumbered expression of the Anglo-Saxon gift for sound, democratic
> government….it is important to re-member that only racially pure Anglo-
> Saxons were presumed to possess this "gift" and only Anglo-Saxons were
> considered fit to share in the bounty of the new nation. Racism evolved as
> American culture evolved and, very early in American history, being
> white became synonymous with being "American"(p.15)

Racism can be subtle or blatant. It can also be conscious or unconscious, personal

or institutionalized. An example of personal unconscious bias in an educational setting is

when an instructor has low expectations of students of color and gives more personal attention and development to white students.

Since racism is the "systematic" mistreatment of groups of people, it is difficult to argue that white people can be victims of racism as they serve as the dominant group in society. A person of color, however, can hurt a white person because of prejudice. The difference is that in this country, people of color face on-going personal and institutionalized forms of biases (Weisglass, 2001). These forms of bias can be expressed through campus climate conditions.

Campus Racial Climate

Researchers indicate the importance of campus climate on the success rates of underrepresented minority students. In a study by Rankin and Reason (2005), they utilized a specific assessment tool in order to explore whether students having different racial backgrounds experience their campus climates in a different manner. Undergraduate students of color encounter different experiences of college campuses compared to White students. A substantial number of students of color (approximately one third of the sample) reported experiences of harassment. Such harassment undertakes different negative forms mainly expressed through highly inappropriate comments about race or gender. Students of color are more likely to indicate that the respective campus climate is dominated by racist and hostile elements.

Helm, Sedlacek, and Prieto (1998) administered surveys to first- and third-year university students regarding aspects of campus climate and major cultural attitudes. Numerous factors were identified to have a persistent effect on the success of underrepresented minority students such as extensive racial tension, comfort of URM

students establishing cross-cultural relationships, awareness of diversity, racial pressures, fair treatment, and racism demonstrated by faculty . In addition, respect and tolerance of all students for other cultures, lack of support, and overall satisfaction were found to play a key role in forming certain attitudes toward campus climate. It is important to note that student perceptions of diversity issues were correlated to their overall satisfaction with the respective educational institution. Nevertheless, the degree of this relationship tends to differ across racial groups. The study thoroughly discussed the level of comfort experienced by Whites and Asians with their own culture and the way in which this reflected in their academic performance.

It has been argued that the ability of students to "negotiate a complex and diverse system is a correlate of academic success for all students, including Whites" (Helm, Sedlacek, & Prieto, 1998, p. 4). Yet Asian Americans are more likely to perceive themselves as possessing similar characteristics to majority groups, and thus they tend to identify themselves with White students to a significant extent. At the same time, African Americans seem extremely conscious of race, as the perception of racial discrimination turns out quite problematic for this racial group (Cabrera et al., 1999). The lack of support is seen by all racial groups to be associated with a high level of dissatisfaction, which further reflects in low academic results.

The process of assessing campus climate relates to important implications for diversity in terms of race, as it is demonstrated in the research literature. Undoubtedly, the ongoing academic journey of students is associated with the dimensions of race, gender, and ethnicity. Edgert (1994) initiated a four-year study of the feasibility of evaluating campus climate. The researcher presented significant advantages of using the

approach of institutional self-assessment of campus climate in order to provide a better understanding of its impact on the achievement of racially diverse groups. The study identified the major effect of campus climate is reflected in retention and graduation rates. Locks, Hurtado, Bowman, Oseguera (2008) also explored campus climate and its impact on the educational experience of Latino students. They found positive interactions among a diverse group of peers result in a greater sense of belonging for all student on the campus.

The educational and social experience of students turns out to be affected by elements of culture, diversity, and race. Edgert (1994) found that URM students demonstrate a relevant understanding of the common obstacles they face on campus, including challenges related to orientation, adjustment to campus life, and inadequate institutional support. Cabrera et al. (1999) indicate faculty representatives sometimes fail to ensure an appropriate level of transparency and accountability in their interactions with culturally diverse students, and this negatively reflects in student academic success rates.

In a study conducted by Hurtado and Ponjuan (2005), the researchers aimed to provide a relevant explanation of the factors affecting educational outcomes for Latino students. Hurtado and Ponjuan (2005) used four dependent variables to determine the effect of campus climate on academic performance: sense of belonging, climate that lacks tolerance for diversity, analytical skills that are self reported, and demonstrating a pluralistic orientation. Minority Engineering Programs and similar programs may be effective in building confidence in students of color, who then feel more reassured about their capacities to deal with racial tensions on campus.

In 1999, one of the earliest campus climate studies in relationship to racialized issues found that Black students appeared the least satisfied with the racial climates present on their campuses (Cabrera et al., 1999). In 2008, Museus, Nichols, and Lambert found the development of a welcoming campus racial climate is critical to a positive URM student experience. This implies that a higher level of satisfaction with campus racial climate predetermines the impact on social involvement of students and ultimately, degree completion.

Nora and Cabrera (1996) observed that underrepresented minority students face persistent challenges in racist campus climates. In order to address this condition, they recommend campuses should focus educational efforts on race relations to improve the the negative aspects of this climate . Rankin and Reason, (2005) note the presence of a negative racial climate on campus deteriorates academic performance, which implies that educational interventions should thoroughly address campus climate issues. They go on to suggest a relevant strategy to remediating a negative racial climate is providing adequate educational sessions for students that were the perpetrators of harassment acts. Researchers also discuss the important role of faculty in this context, as they can serve as enhancing socializing agents on campus Cabrera et al. (1999) note that a shift of basic assumptions regarding race is mandatory in order to solve the challenges faced by underrepresented minority students. The implementation of new, creative approaches to learning, decision-making, and teaching is recommended in the literature on the subject. It is important to ensure a holistic strategy in dealing with similar problems so that racially diverse students can feel confident, self-determined to succeed, and comfortable on campus.

Contributing Factors to URM Success in STEM

  Self-efficacy. Self-efficacy refers to self-evaluation on the ability of a student to execute a course of action in order to reach a desired outcome in an effective manner. In recent years, the phenomenon of self-efficacy has received considerable attention among post secondary institutions in the U.S. despite the steady rise in enrollment rates. Zajacova, Lynch and Espenshade (2005) suggest self-efficacy is a cognitive factor that significantly affects academic retention and performance among college students, especially in minorities, in technology, sciences, and engineering fields.

  Within academic settings, it is impossible for one to consider self-efficacy without understanding the institutional factors that contribute to a minority student's level of self-efficacy. One factor which can have an institutional origin is stress. Stress has a negative correlation with self-efficacy, which is an important social cognitive ability (Gigliotti and Huff, 1995; Hackett et al., 1992; Solberg, Hale, Villarreal, and Kavanagh, 1993; Solberg and Villarreal, 1997; Torres and Solberg, 2001). Stress can affect the ability of a student to retain information or execute specific tasks. While literature shows that minorities are more likely to experience stress in the academic setting (Zajacova, Lynch & Espenshade, 2005), additional research is needed on the societal and institutional factors that contribute to these higher levels.

  Stereotype Threat. Another psychological factor that affects URM persistence in STEM programs is stereotype threat. Stereotype threat is the state of fearing one will confirm a negative stereotype about one's group (Steele & Aronson, 1995). Stereotype threat has had a considerable effect on academic performance for minorities enrolled in degree programs. Stereotype threat and a lack of self-efficacy pose a negative effect on

the URM student's ability to retain academic information. Extensive research confirms that both factors are crucial elements that affect college success in minorities particularly those in engineering, sciences, and technology (Bandura, 1977).

Stereotypes have been defined as "cognitive structures that contain the perceiver's knowledge, beliefs, and expectations about human groups" (Hamilton and Trolier 1986, p. 133). White Americans continue to negatively stereotype African-Americans and other minorities as "lazy" and/or "violent" (Peffley, Hurwitz & Sniderman, 1997). When one is regarded "lowly" in a society because of his or her social status, there is a significant possibility that such individual may not perform successfully because the negative stereotyping signals that "such people" are not fit or capable of doing certain things, including performing well in higher academic settings.

According to Steele's (1995) hypothesis on stereotyping, victims are stigmatized to the extent of suffering serious consequences. URM's suffer the effects of stereotyping because they are associated with certain predetermined labels that make them feel discriminated against in a manner that places them in an unfair position of fear. According to Steele, an African-American engineering student might be less likely to visit his or her instructor's office hours for homework assistance for fear of being perceived as "lazy" or "dumb", thus confirming the negative stereotypes.

Finally, studies have shown that stereotype threat has a negative impact on self-efficacy which in turn impacts negatively on the student's ability to execute specific tasks (Zajacova, Lynch & Espenshade, 2005). Research confirms that stereotype threat contributes significantly towards under achievement in execution of academic tasks. According to Steele (1997) , stereotype threat evokes one to identify with a particular

social group. If the social group is one with negative stereotypes associated with academic endeavors, the impact can be to reduce the students' sense of self-efficacy. This feeling is compounded when other social groups have been instilled with positive stereotypes associated with academic endeavors (Osbornea & Walkerb, 2006). The individual impacted by negative stereotypes can fall into the trap of believing that special groups of "genius students" are able to handle courses better than the group with which they associate themselves. This double impact of feeling "less than" and viewing others as "more than" often contributes towards failure. These prevalent perceptions have developed over centuries as a result of historical racism and white privilege.

Microaggression. Prominent researchers have used critical race theory to examine microaggressions and their effects on minority student achievement. A "microaggression" has been defined as a subtle insult directed toward people of color, often unconsciously (Solorzano et al, 2000). According to Pierce (1995), a microaggression in and of itself may seem harmless, but the cumulative burden of instances of microaggression proves to be extremely harmful to one's confidence. Microaggressions can be both verbal and non-verbal and, although they are subtle, they are also pervasive and often uninvestigated (Solorzano et al, 2000).

Microinsults. One form of microaggression, commonly experienced in academic settings, is that of microinsults. These have been described as "behavioral and verbal expressions that convey rudeness and insensitivity and demean an individual's racial heritage or identity" (Sue, Capdilupo & Holder, 2008, p.329). These insults are often subtle, hence the "micro" and perhaps expressed unconsciously by the perpetuator but are, nevertheless, demeaning to the person of color on the receiving end. A professor who

conveys a tone of surprise to a student of color who excelled on an assignment, spoke articulately in a debate, or solved a challenging problem would serve as a microaggressor. An individual who "encourages" a student of color to pursue athletics as opposed to academia might be guilty of the same.

Microinvalidations. According to Sue et al. (2008), microinvalidations serve to "invalidate, negate, or diminish psychological thoughts, and racial reality of Black Americans". Gifted and high-achieving black students might be exceptionally prone to this form of microaggression. They often hear comments that are perhaps intended as praise but actually work to invalidate their heritage and experiences. Such comments include: "You are not like the rest of them", "You're different" "I don't think of you [a Black person] as Black" (Solorazano et al., 2000). Other comment such as "we are all the same" or "we are all human-beings" are perhaps well intentioned and meant to suggest "color-blindness", but also trivializes the unique experiences of a person of color.

Social and Cultural Capital. Shebab et al. (2007) found that URM students experience an absence of social and cultural capital, which the authors define as academic and cultural advantages in the form of rudimentary knowledge required to be successful in a majority-dominated, academic environment. Put simply, students raised in the "dominant" culture (white and Asian in the case of engineering) are more likely to have the preconceived expectations that they can succeed in a rigorous science or technology-based discipline. They also have a higher probability of having attended a high school with rigorous academic preparation, critical to the success of an undergraduate engineering student.

Since African-American, Latino, and Native American students are significantly underrepresented in STEM majors, they are often left feeling isolated or excluded. They find it difficult to find and connect to fellow students with whom they share common cultural and life experiences. The absence of "cultural and social capital" can lead to both academic disadvantage and a sense of isolation (Shebab, Murphy, Davidson, Rhoads, Trytten & Walden, 2007).

Academic Barriers

According to the 2014 National Assessment of Educational Progress, African-American and Hispanic high school students perform well below their white and Asian peers in mathematics and science. This is of significant concern since math and science are the primary foundation of an engineering curriculum. Additionally, while black and Latino students comprise over 30% of the national population, they were only 15% of AP (advanced placement) test-takers in computer science, calculus, physics, chemistry and biology (National Science Foundation, 2014).

There are a variety of reasons for the pre-college achievement gap in mathematics and science. A significant factor is a large proportion of African-American and Hispanic students attend high school in the inner-city. These schools are often predominantly minority and have a grievous lack of resources relative to schools in higher socio-economic neighborhoods (National Center for Educational Statistics, 2013). As a result of inadequate resources, secondary schools with high URM enrollments offer less extensive and rigorous science and mathematics programs. For these reasons, URM students are often, through no fault of their own, disadvantaged academically, when they enter STEM disciplines in college.

Although social and academic integration are perceived as a persistent factors for success of URM students, these conditions, alone, are not sufficient for attaining positive academic achievements in engineering (May & Chubin, 2003). Academic-based intervention programs are of significant importance because they provide extensive academic support that facilitates a highly productive educational environment. The constant provision of an academic support program can facilitate academic success over time (Good et al., 2001-2002). Extensive program involvement affects retention rates, which implies that minority programs have a longitudinal impact. Results of the study conducted by Good et al. (2001-2002), as well as the outcomes presented by Palmer, Davis and Thompson (2010), indicate that the direct effects of engaging in minority programs remain of persistent interest to researchers and program administrators.

Mentoring

It is critical that URM students in STEM identify a role model, early on in their college education. Mentors can help to mitigate effects of poor campus racial climate. A longitudinal study conducted by Grandy (1998), found that "enthusiasm" for engineering and science builds within the first two years of one's college education, if it does at all. The study argues that having a mentor or role model is an important part of building this "enthusiasm". Faculty and older peers serve as role models and as examples of individuals who have successfully navigated a rigorous engineering curriculum (Hernandez & Lopez, 2004). Hezlett and Gibson (2007) define mentoring as "an intense, dyadic relationship in which a more senior, experienced person, called a mentor, provides support and assistance to a more junior, less experienced colleague, referred to as a protégé or mentee" (p. 385).

Peer mentoring. Researchers argue that the upper-division (junior and senior) students of MEPs ensure important support to younger students (Ohland, & Zhang, 2002). This type of peer-mentoring program also helps individuals fulfill their social needs within their specific academic environment (Moore, 2005). For first-year students, peer-mentoring programs can help to remove anxieties about college and significantly increase motivation and persistence in the major. This result is stronger when students are paired with mentors of the same major and ethnicity (Good et al., 2000). Matching by ethnicity is of particular importance since there are a lack of African-American, Latino, and Native American role models on many campuses. The peer-mentors serve as the support systems for the URM freshman, thus improving the campus climate (Henriksen, 1995)

Faculty mentoring. Morales (2009) examined whether mentoring relationships with faculty are effective in facilitating student achievement. In this qualitative study, Morales interviewed 15 Hispanic students that indicated that they had a faculty or administrator mentor. In reviewing the data, he found three common themes that mentees derived from their relationship with their mentor: *mentors as suppliers of inside information, mentors as approvers,* and *mentoring the American Dream.* He further explained that students benefitted from learning what they considered to be "insider's information" from their mentor. They also received validation that they were on the right-track academically, positioning the mentor as the "approver". Finally, Morales details that students benefitted from seeing the "American Dream". In other words, the students, some of whom were first-generation Americans, saw in their mentor who they could be someday. Morales explains:

>Recruiting and supporting college faculty and administrators willing and able to mentor at-risk Hispanic students in the ways described above can enhance the students' academic engagement. Additionally, by then sharing these implications with current or potential mentors through formal or informal training, colleges and universities can not only facilitate these students' success, but in the process help them achieve their versions of the American Dream. (p. 400)

Another program that has been found effective in the process of retaining minorities in STEM fields is University of Maryland, Baltimore County's Meyerhoff Scholars Program. Meyerhoff scholars are more likely to achieve higher grade point averages and gain admittance to graduate schools at higher rates than students at the same institution who do not participate in the program. The Meyerhoff Program includes several components, but perhaps none as critical as matching the students with a faculty mentor to conduct hands-on research (Maton, Hrawbowski & Schmitt, 2000). These are common aims of successful mentoring programs (Ohland et al., 2002; Morales, 2009; Winters, 2008). An important parameter of the identified program is the willingness of project directors and faculty to take personal responsibility for guaranteeing the success of each student. Such persistent focus on individuality and academic performance is introduced in other studies as well (Moore, 2005; Ohland, & Zhang, 2002; Reichert, & Absher, 1997). The fact that project directors are encouraged to meet regularly with each student separately is indicative of the immense focus on facilitating individuality, equity, and transparency as constituting basic principles of the program (Moore, 2005; Morning, & Fleming, 1994). From this perspective, students are more likely to perceive faculty as a positive aspect of college.

Summary

In the current postindustrial period marked by extensive technological progress, the number of minorities in science, technology, engineering, and mathematics (STEM) is a crucial factor in predetermining the global competitiveness of the United States. The problem of retaining minority students has recently intensified, which prompts researchers and educators to find reasonable and sustainable solutions that can improve the functions of educational institutions in relation to minority students. Critical Race Theory plays a vital role in the effort to recognize, disrupt and repair the existing marginalization within education.

The retention gap in STEM disciplines continues to widen, even with intervention programs in place that aim to minimize minority attrition to non-science majors. While there is an abundance of literature on the effectiveness of minority engineering programs, little research exists on how these programs can be tailored to meet the needs of individual students of color and, more importantly, how institution of higher education can be more inclusive and supportive of all students.

Chapter 3

Methods

This study uses qualitative inquiry to explicate and explore the experiences of underrepresented minority students in an engineering program on a campus with predominately White and Asian students. As discussed below, qualitative inquiry is the appropriate methodology to respond to the following research questions:

1. Do underrepresented minority students encounter racialized experiences in engineering programs? If so, what are those experiences?

2. Do students perceive issues of race as impacting their academic experiences? If so what are those issues and experiences?

3. Have racial experiences impacted students' self-efficacy and motivation to complete their program? If so in what ways?

Qualitative research is a type of scientific research which seeks to understand a given research topic from the perspective of the participants (Mack, Woodsong, MacQueen, Guest & Namey, 2005). Qualitative researchers look to reveal meanings people ascribe to particular events or activities. It aids the researcher in understanding complicated social processes in context (Esterberg, 2002). Qualitative research is an effective method of understanding social phenomena. Qualitative researchers pay close attention to the subjective nature of both those being researched and the researcher. This subjectivity is embraced and, oftentimes, included in the research as the researchers theoretical framework of lens (Esterberg, 2002). Qualitative research therefore acknowledges that researchers own point of view can impact and influence their work.

Many qualitative researchers argue the strength of their chosen method is its ability to provide written descriptions of how people experience a given phenomenon. Qualitative methods are effective in identifying intangible yet significant social factors such as gender roles, socioeconomic status, ethnicity and religion (Mack et al., 2005). My own research encompasses many of these social issues, which makes qualitative methods an appropriate design choice.

Research Design

Critical ethnographic design. My study sought to explicate the racialized experiences of underrepresented minority students in engineering programs as a means of challenging the dominant narrative about the population. To accomplish this a form of qualitative inquiry known as *critical ethnographic design* (CED) was used. This research design is used when the researcher is interested in advocating for the "emancipation" of groups marginalized in our society (Creswell, 2008). Emancipation, in this context, refers to the "process of separation from constraining modes of thinking or acting that limit perception of and action toward realizing alternative possibilities" (Thomas, 1993 p.4). Unlike traditional ethnography in which the researcher seeks primarily to understand the experiences and conditions of the population being studied, CED assumes a stance in which the researcher becomes a "change agent" who is developing structures with the intent to critique and support the transformation of the communities being studied (Barab, Thomas, Dodge, Squire, & Newell, 2004).

CED requires that "commonsense" assumptions be questioned. The CED approach offers a direct style of thinking about the relationships between knowledge,

society, and political action. The primary premise behind CED is that powerful research can be both scientific and critical (Thomas, 1993). Critical ethnography researchers often collaborate with their participants in the design, analysis and dissemination of their study. This is done to empower groups who are marginalized by society and challenge the status quo dictated by dominant groups (Creswell, 2008).

Participant Selection

Sampling technique. A purposeful sampling technique was used to identify and select study participants. Purposeful sampling occurs when researchers intentionally select individuals and sites to learn or understand the central phenomenon (Creswell, 2008). There are various approaches to purposeful sampling including "homogeneous sampling", which is the specific technique used in this study. Homogeneous sampling occurs when the researcher intentionally selects individuals based on membership in a "sub-group" that has defining characteristics (Creswell, 2008). This is an appropriate sampling technique for this study since it examined a sub-group of engineering students at a large research institution, all of whom share in the fact that they are racially underrepresented.

Recruitment. As a former administrator at the identified university and former founder and director of the minority engineering program of which I selected participants, I had direct access to the students via e-mail, phone or in-person. I also had direct knowledge about their abilities to narrate their experiences in an academic settings. As I studied a vulnerable population, I took appropriate precautions during the recruitment stage all the way through analyzing and publishing my data. To start, I sought permission to conduct my study from the Institutional Review Board (IRB) at California

State University, San Marcos and applied for reciprocity with the IRB at the campus where I conducted my study.

Once granted permission from IRB to conduct my study, I proceeded with recruiting participants. I initially sent an e-mail recruitment message to fifteen students who were lower-division engineering majors (years 1-2) and fifteen who were upper-division (years 3+) with the goal of interviewing six each. Those interested in the study were asked to complete a short survey that asked for their contact information, availability, and their reason for wanting to participate in the study. I offered a $25 gift card for those selected to participate in the study.

I received responses from nine lower-division students and twelve upper-division students, all expressing interest in participating in the study. After reviewing the participant applications, I decided to focus my study on upper-division students, as I felt they would have more to say about their experiences as an engineering student on the campus due to time in the program. I invited all twelve upper-division engineering students who indicated an interest to participate in the study. Eleven of the participants confirmed and were later interviewed.

Participant Demographics

All eleven participants entered the university as freshman engineering majors. Of the eleven students, six were male and five, female. Nine of the participants identified as Latino/a and two as African American. The eleven participants were all upper-division (3rd year or higher) and represented seven different engineering or computer science majors. Two of the participants were in the process of changing their major out of

engineering at the time of the interview. Pseudonyms have been assigned to each of the

participants.

Participant	Name	Gender	Ethnicity	Year	Major
1	Luke	M	Black	3	EE
2	Sean	M	Black	3	CE
3	Jesus	M	Hispanic	3	CE
4	Sandra	F	Hispanic	5	BE
5	Lupe	F	Hispanic	3	ME
6	Ashley	F	Hispanic	4	ChemE
7	Roberto	M	Hispanic	3	ME
8	Joseph	M	Hispanic	3	ME
9	Mary	F	Hispanic	3	AE
10	Jonathan	M	Hispanic	4	ME
11	Rachel	F	Hispanic	3	CS

Table 1 Demographics

Participant Backgrounds

Luke, an African-American male in his 3rd year as an electrical engineering major

grew up as an adopted and only child in an all-White family with many uncles, aunts, and

cousins. He describes himself during his childhood as the "Black sheep". He faced

significant hardship growing up in a neighborhood he described as "country" and "cow-

boyish" area. Entering high school he was able to enroll into higher learning classes

where he focused on grades and sports before entering college.

Sean, an African-American male in his 3rd year as a computer engineering major

grew up in a small town in the high desert as the youngest child with three brothers and 2

sisters. He and his siblings attended schools in the 5th quintile however he excelled with

through participation in the GATE program. While his parents were low-income, his

grandparents were affluent and took he and his sibling on vacations out of the state and country which, he remarks "was rare for anyone in my area".

Jesus, a Hispanic male in his 3rd year as a computer engineering major grew up in Pico Rivera, a suburb of Los Angeles. The town is predominantly Latino, as were the all the schools in the city. His mother was born in El Salvador and father in Mexico. He remarks that he grew up in a very traditional Latino family. "My mom would stay at home and do housework, while my dad was the breadwinner" he remarked.

Sandra, a Hispanic female in her 5th year as a bioengineering major grew up with a single mother and a younger brother in an apartment complex in a middle class neighborhood. Her mother sent her via bus to middle and high school outside of her designated region because the schools in her area had a reputation for gang violence and drugs. Her grandmother and aunt who lived closeby were an integral part of her family unit.

Lupe, A Hispanic female in her 3rd year as a mechanical engineering major grew up with both parents and 2 brothers. Her family was low-income and utilized welfare. She moved often as a child and her parents divorced when she was nine-years old. She is the first in her family to attend college.

Ashley, a Hispanic female in her 4th year as a chemical engineering major grew up as an only child. She grew up in a primarily Latino community in Southern California. Neither of her parents attended college and while in high school, she received college advice from older friend who had attended college. Her parents are proud of her accomplishments and supportive of her academic pursuits, although they don't completely understand what it means to work towards an engineering degree.

Roberto, a Hispanic male in his 3rd year as a mechanical engineering major. He is the first-person in his immediate family to attend college, although he has an uncle who is a computer engineer that he looks up to. Roberto went into engineering because he wanted to work with machines and had an interest in alternative energy. His family is from a low socio-economic background, so he had to work during his first year of college. Working and attending school became unmanageable so he has since decided to take out loans instead.

Joseph, a Hispanic male in his 3rd year as a mechanical engineering major grew up in a large Mexican Family. He describes his family as conservative and Catholic. He attended private schools from kindergarten through high school. He is the oldest of three and feels a responsibility to be a successful role model for his younger siblings.

Mary, a Hispanic female in her 3rd year as an aerospace engineer has parents who immigrated to the United States from Toluca, Mexico. The majority of families in her neighborhood were also immigrants. As a result, her native language is Spanish and she did not learn English until the age of seven. Over 90% of the students in her elementary school were in English as a Second Language classes. She was once told that she would never amount to much because she spoke "broken English".

Jonathan, a Hispanic male in his 4th year as a mechanical engineering major has parents who immigrated from Mexico to give their children a better life. His father has a high school education and his mother received a two-year degree in computer science while in Mexico. Jonathan's high school was about 95-98% Hispanic. According to Jonathan, state rankings were low for his high school and many students dropped out. Also, he was surrounded by drugs and significant gang activity. Still, Jonathan

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persevered by participating in the Gifted and Talented Education (GATE) Program, which only admitted the top academic students in the district. He credits this program with his ability to be admitted to a prestigious higher-education institution.

Rachel, a Hispanic female in her 3rd year as a computer science major grew up in a home in a middle class area. Neither of her parents attended college and she is the oldest of three children. As a child she was encouraged by her parents to participate in extra-curricular activities and, as the first born, she was always told that she was the role model for her younger siblings. Her parents always stressed to her the importance of a college education.

Data Collection

I collected data for this study in three phases. The first phase involved semi-structured interviews. The second phase involved a co-constructed questionnaire containing items generated with input from the participants. The third phase of data collection was unexpected, and came from a discussion of recommendations between the myself and the participants. I analyzed the data from all three phases with consideration of my research questions and the final recommendations.

Semi-structured interviews. In phase one, I employed semi-structured interviews to collect data from participants who are underrepresented minorities and who are current students or alumni of the engineering program on the identified campus. Interviewing is a popular method of collecting qualitative data, which traditionally involves engaging an informant in a formal or informal discussion (Esterberg, 2002). According to Creswell (2008), "a qualitative interview occurs when researches ask one or more participants general, open-ended questions and records their answers" (p. 225).

Creswell further posits that there are advantages and disadvantages to using interviews as a qualitative research method. The advantages of interviews are they can provide useful information about the interviewee and his or her experiences in the absence of observations. An interview also allows the participants to describe detailed personal information and the interviewer options to probe. The disadvantage of using this method is that data will always be "filtered" through the lens of the interviewee. This is less problematic in this study as CRT depends upon the voice of the person of color in its unedited form. The interview protocol can be found in Appendix B.

According to Creswell (2008), data collection in a critical ethnography is less focused on time in the field or on the extent of data and more on the relationship and collaboration between the researcher and their participants. The research questions in this study are deeply personal and potentially complicated. Semi-structured interviews allowed the researcher to probe the interviewee for detailed narrative that informed his research questions. Importantly, it allowed the participants to tell their stories in their own words. This is a necessary requirement in using a CRT approach. I interviewed each participant using a teleconference format, supported by Skype software. The eleven interview sessions were audio-recorded using the Apple Software "AudioNote" which allowed for simultaneous audio recording and note-taking. The software was installed on a personal password-protected and encrypted iPad owned by myself. No one other than myself has knowledge of the password and encryption protecting this equipment.

Qualitative questionnaire. As CED calls for "participatory research", participants were asked to contribute to the development of the questionnaire which was used in phase two. At the end of each semi-structured interview, I asked the

participant the following, "Understanding that I seek to understand, interrupt and repair social constructs that oppress underrepresented minority students in engineering, what question would you have asked if you were me?".   Ten of the participants responded to this question with a question of their own. These questions, as well as items from the researcher, were placed in a questionnaire . Nine of the participants responded to the questionnaire. The questionnaire can be found in Addenda A.

        Participant Discussion of Recommendations. After I collected and analyzed the data from phases one and two, I invited the research participants to an in-person group meeting at the University to discuss a set of recommendations for engineering programs that responded to the study's findings. Six of the eleven participants were involved with this phase of the study. During the course of the discussion, participants offered new data about their experiences as URM students, and while unexpected, this data helped to shape the study's findings and final recommendations.

Data Analysis

      The interviews were professionally transcribed. In order to protect the confidentiality of participants, pseudonyms were assigned at this stage. The transcriptions were transferred to HyperResearch, a qualitative data software program, for an initial coding of the data. Based on the coding, I identified and labeled broad themes. I then reviewed the data provided from the collaboratively created questionnaire. I coded this data using HyperResearch and developed broad themes. The themes from both data banks were integrated and used in the analysis of the interview data.

     I systematically applied the themes to the research questions, assigning relevant themes to each question. Once the themes were developed, I met with the study

participants as a group to discuss recommendations. Additional data was provided by the participants at this stage. This data was summarized as results in chapter four. This process became the basis for determining the findings and recommendations of this study, as well as the foundation for the content of the "call to action."

Social Context

A large public university in California, referred to by using the pseudonym "The University," is a premier research institution set apart by its entrepreneurial culture and integrative academic disciplines approach. It is one of the youngest and fastest rising among the nation's top public universities, and has one of the largest engineering schools, to be referred to as "the engineering program," in the State of California. While the engineering program maintains a comfortable position among the elite engineering schools in the country, it lacks ethnic diversity. Specifically, the School enrolls and graduates African American, Chicano/Latino, and Native American students at rates drastically lower than the statewide demographic percentages. As of Fall 2011, the School enrolled 4,424 undergraduate engineering majors of which 54 (1.2%) were African American, 570 (12.9%) Chicano/Latino, and 20 (0.5%) Native American. The majority groups were Asian American (49%) and White (35%). Degree attainment in engineering data from the University shows that URM students are 21% less likely to graduate with a degree in engineering than their non-URM peers.

In the context of this study, these figures illustrate an institutional weakness shared by many programs and which needs urgent and intentional attention and action.

Ethical Consideration

The participants in this study were underrepresented in their major, most at-risk for not graduating, and often times first-generation to attend college. As a vulnerable population, the highest degree of research protection was afforded to them. During the interactions with the participants, the researcher paid particular attention to extending the upmost respect and confidentiality, while working to avoid feelings of exploitation. All participants signed an informed consent (see appendices E, F) form prior to commencing the interview. I assured the participants that their comments would not be attributed to them in any identifiable way and pseudonyms would be assigned to each participant. Lastly, in my recruitment e-mail, I will assured the students that their participation was strictly voluntary.

Study Limitations

As with most research, this study has certain limitations. First, the findings and recommendations are based on data obtained from a small and select number of students at one university, so they are not representative of all university and college students. The study therefore has limited generalizability. Second, the participants were studied at one point in time, as opposed to a longitudinal examination. This limits the amount of data I received but is acceptable in a critical ethnographic design. Due to the limited number of participants it is unlikely that the data captured all of the variables that might influence campus racial climate. Lastly, the my prior involvement with the University as a former administrator and his familiarity with the participants posed a proximity issue. The potential for bias existed.

Chapter 4
Results

The purpose of this study was to better understand the unique experiences of traditionally underrepresented minority (URM) students in engineering majors. Participants consisted of eleven URM students from six different engineering majors. The overarching questions that guided this study were:

3. Do underrepresented minority students encounter racialized experiences in engineering programs? If so, what are those experiences?

4. Do students perceive issues of race as impacting their academic experiences? If so what are those issues and experiences?

5. Have racial experiences impacted students' self-efficacy and motivation to complete their program? If so in what ways?

At the University, most engineering students do not enroll in engineering courses until their 2nd year. Upper-division students were selected as they could provide more substantive accounts of their experiences as a URM student in their major than their undergraduate counterparts. Therefore, all participants were upper-division, having three or more years in the program.

In the following discussion, the data is presented in terms of four broad themes related to the study. After the primary data collection and analysis, the researcher convened the participants to create a set of recommendations for engineering programs based on the researcher's findings. Unexpected new data was presented during this phase of the study. This data was explicated by the researcher and a summary is included in this chapter, using verbatim participant remarks, and integrated with the recommendations in chapter five.

Analysis of Themes Based on Interviews and Questionnaires

The analysis of the interview and questionnaire data revealed an overall theme of

"Campus Climate" supported by three sub-themes:

- Racialized experiences

- Sense of belonging

- Mentoring and Advising

The individual experiences of the participants relative to these themes are described

below.

   Campus Climate. All participants discussed their perceptions of the campus'

racial climate from the lens of their lived-experiences. Overall, participants had neither

an overly positive nor an overly negative view of the campus' racial climate. Campus

racial climate can be described as real and perceived institutional attitudes and

behaviors related to race. There was a nearly equal occurrence of positive and negative

comments related to the campus climate. There were 17 comments in total because

several participants made more than one comment. Of the 17 comments, six were

positive, eight were negative, and three were neutral.

   Roberto's overall perception of the campus climate was shared by three of the

participants. He remarked, "I feel like I've been excluded from things, but not

academically ever. I feel like the University helps everyone out no matter what race".

He goes on to say,

> But as a whole [campus] climate, I feel like there's a lot of racial
> ignorance. Like even myself, I see other Asians and I see white people
> and I see Indians and I mean I judge them with things that I think I know
> Indians, and stuff like that. But I mean they're just people. I feel like
> that's how people look at me. They look at me sometimes and they're
> like, "Oh, this guy looks like a cholo. He looks like the regular gangster

kind of guy." But I mean, they meet me and I'm one of the nicest people
they've ever met. I feel like there's a lot of racial ignorance. There's
people who all their lives have been in a bubble that feels very true to
me and it's something the University needs to deal with. (personal
communication, September 16, 2013).

Sandra remarked, "I feel there are programs and people trying to make an effort
[to promote a healthy campus climate]" (personal communication, September 13,
2013). Luke agrees with this statement as he pointed cultural and community centers
that have made a positive impact on the campus and on himself. He feels that his non-
minority friends fail, however, to understand the need for such centers, "they just felt
like it was unnecessary, it doesn't need to be like a black only place on campus – they
said they were segregating themselves by forming this [Black community center] and
that it was unnecessary" (personal communication, September 13, 2013).

Lupe described the campus racial climate as "timid" with a misguided "color-
blind" operation. She states,

Yeah, because I feel like they're out there (racial issues). Like, after the
80s, 70s, since the civil rights movement, this is the aftermath. Racial
issues are real and I feel like people just sweep them under the rug. We
all like to say, we're all human, we're all equal. But no. It's too late for
that. We need to start dealing with things, with issues in a different way
(personal communication, September 13, 2013).

Jonathan seems to agree with this sentiment, remarking, "people always pretend there
aren't issues, but it's obvious" (personal communication, September 19, 2013). Sean
feels the campus is mute to issues of race, stating, "to avoid any conflict, don't bring up
conflict". While Luke said, "I feel the campus compared to the city is very non-diverse
and narrow-minded when it comes to race" (personal communication, September 13,
2013). He also offered, "I believe this campus is majorly lacking by protecting from

hate crime, there is no real source on campus that is specialized to handle those situations" (written communication, September 29, 2013).

Racialized Experiences. Racialized experiences, in this study, refer to situations in which the participants perceived their race or ethnicity was a factor in a personal experience, regardless of whether it led to a positive, negative or neutral outcome. The data suggests that engineering students from underrepresented minority backgrounds encounter racialized experiences during their undergraduate academic careers. All except for Lupe were able to point to multiple racialized experiences during their interviews. These experiences can be summarized across three common constructs: *racism or racial discrimination, microaggression (manifesting as micro-insults or micro-invalidations)* and *tokenism*. In Table 2, the frequency of four racialized experiences is expressed

Racialized Experience	Number of Occurrences Discussed
Racism or Racial Discrimination	7
Micro-insult	24
Micro-invalidation	8
Tokenism	5

Table 2 Racialized Experiences - Frequency Count

Racism or racial discrimination. Some participants used the term 'racism' as an umbrella word to describe any racialized experience. For instance, Sean, a black 3rd year computer engineering student described a situation in which a white-female engineering student told him, "you're one of those smart black guys" (personal communication, September 13, 2013). Sean identified this as an act of racism as opposed to a 'microaggression', which will be discussed subsequently. Some participants discussed racism within the context of the traditional definition of believing

that one race of people is superior or inferior to another and/or treating them as such.

For instance, Jesus, a Latino 3rd Year computer engineering student recalled a time

when he was walking on campus with a male friend of Asian descent, and they walked

past a group of predominantly Latino high school students who were touring the

campus. Jesus' friend commented, "I hope a lot of them get in here because that would

be less competition for me" (personal communication, September 13, 2013). Jesus said

this comment made him feel that his friend believed Latino's were intellectually

inferior to him.

Luke described an ignorance towards racism on the part of teaching assistants at

the University.

> In one of my classes a TA brought up a generalization that rap is a way
> to show how Black men degrade women, immediately all the female
> students in class turned to look at me [the only black one in class]. I
> actually didn't really resolve this struggle, I finished the class a week
> later but it really showed me that TAs being students can be ignorant to
> racism and its stereotypes (written communication, September 29,
> 2013).

Sandra, a fifth year Latina bioengineering major described a series of incidents

that happened at the University during her sophomore year, which she perceived to be

framed by racism:

> Two members of a mostly white fraternity went to the University news
> network and just went on a rant using racial slurs against minorities, and
> all of that, and then they just left like they just took off…and then
> afterwards there were some people who didn't really understand what
> was going on and there are some people who did. The people who did
> they would make nooses and hang it on the statues and in the library.
> And then other people there would kind of ignore it and say, "It's a rope,
> who cares?" There were some who were making minorities feel like they
> should be scared and then people who just kind of going along to make
> jokes about it further increasing that fear (personal communication,
> September 13, 2013).

Blatant racism or racial discrimination was the least cited form or racialized

experiences. In total, seven of the eleven participants described incidents they perceived

as racism.

Microaggressions. The term *microaggression* was explained to participants as

brief verbal or non-verbal insults, whether intentional or unintentional, which

communicate negative racial slights towards people of color or serve to invalidate their

experiences. This definition was provided to the participants prior to the interviews

along with the set of expected interview questions. Micro-insults can be defined as a

verbal or non-verbal action, whether conscious or unconscious, that demeans ones

heritage. A micro-invalidation demeans by ignoring or dismissing ones heritage

(Solorzano et al, 2000). The data reveals microaggressions are common among the

participants. Since there was a planned question regarding microaggressions for the

interviews, participants were provided with this definition in advance of the interview.

All participants described personal instances of microaggression, which came in the

form of insults or invalidations of their experiences. It is important to note that while

most participants recalled one or two specific-examples of microaggression, the

majority commented that they encounter these situations on a regular and frequent

basis. Some of these experiences are described below, and categorized by "micro-

insults" or "micro-invalidations". In Chapter 5 the long-term negative effects frequent

microaggressions can have on a student's academic performance and psychological

well-being are discussed.

Micro-insults. During her interview, Rachel, a 3rd year Latina, recalled an

instance in which she and her mother visited the university's financial aid office and the

staff-person gave her the impression that they expected her to translate for her mother. Her mother, she notes, is a registered nurse and an English-speaking U.S. citizen. She further adds, "…when I'm with her, I do feel as though they look to me to, you know, dumb it down for her" (personal communication, September 22, 2013). Rachel's experience of micro-insults related to language are shared by other participants in the study. Jonathan, a 4th year Latino mechanical engineering major, was perplexed when he walked into a professor's office for the first time, and the professor remarked, "Wow, you're Hispanic?". Jonathan replied, "Yes, why do you ask?", to which the professor offered, "On the phone, I didn't hear your accent. I thought you were…". Jonathan indicated that the professor trailed off without finishing the sentence (personal communication, September 19, 2013). Luke, a black male 3rd year electrical engineering major, also described experiences in which he perceived to be microaggressions from faculty:

> I definitely feel I have experienced microagressions. I can't name a specific one, because I mean it just happens. Because usually with a lot of classes, I'll not hesitate at all to wear a suit to class. Especially on Fridays like I'll wear a dress shirt and tie and I'll go up and if there's any Friday project I'll stand up in front of the class, I will speak like fluently about my subject and a lot of professors the first time I do this or they are surprised and are like "wow"! Well, yeah this is just kind of how I am, you know. I don't really think about it and then from then on I usually like try to develop a relationship with the professor so that way, I can communicate with them on a much more casual basis while still maintained that professionalism. So, I get that surprise thing in a lot, because I'm very passionate about a lot of classes that these professors are teaching and I don't know if they're just not expecting passion from a student or they just not expecting that like whatever from a black student (personal communication, September 12, 2013).

Sean recalls being called an 'oreo', a term he described as being "black on the outside, but acting like a white-person on the inside". He rejects the term, stating he is

simply 'black'. He also recalled an instance when a white female student admitted that

she was attracted to him although she wasn't normally attracted to black guys. The

classmate referred to Sean as the "exception", another term Sean rejects. "I'm not for

being an exception, in that way" he remarked. Sean explained that these individual

instances don't disturb him as much as when he is walking around campus and he

observes people or an individual staring at him, which gives him the feeling that he

doesn't belong. He described a similar incident with another one of his peers:

> Yeah. She said I was one of those smart black guys and I was like, "Well
> that's not very nice." She's insane. Every time I tell other people with
> my major, they're like very surprised (personal communication,
> September 13, 2013).

Roberto, a 3rd year Latino mechanical engineering major, described a microaggression

that occurred when he felt uncomfortable when his peers seemingly censored their

discussion in his presence:

> I feel like how people interact, I mean, that's definitely a big factor. I
> feel like a lot of people ...when you are just around with friends and
> everyone is just joking and stuff and someone's scared to say a joke
> because you're there… But it's like, I don't know, you know when
> people are trying not to be awkward and trying to be nice? The fact that
> they're just being nice like that, like I read your question on micro-
> aggression, like I get that all the time, all the time (personal
> communication, September 16, 2013).

Micro-invalidations. According to the data, micro-invalidations occur less

frequently than micro-insults, or they are less noticed. Two participants, however

recalled occurrences where they were made to feel as if their unique and lived-

experiences as a person of color were invalid. Luke, a black male, 3rd year, electrical

engineering student recalls a white male classmate during an ethnic studies course

lecture raise his hand and ask "Why are we learning about black people, why isn't there

any white history?". He recalled another student who he overheard asking a friend "why is there a center just for black students on campus…isn't that segregation". Sean commented generally that many individuals from non-URM backgrounds say "people are complaining and making it [racial occurrences] more than what it is". Luke recalled a specific related instance in which a roommate who dismissed claims of racist incidents that occurred on campus, telling him "fucking people and your whiny bullshit" (personal communication, September 13, 2013).

Tokenism. Five participants discussed the underrepresentation of their racial group resulting in perceptions of tokenism when they are in certain settings. In most cases, participants discussed this perception as belonging to others, not themselves. For instance, Sandra, a 5th-year Latina student in Bioengineering, described her peers reaction to her receiving a prestigious scholarship. She recalled one of her peers saying, "Oh, you got in, because you're Mexican, so there's at least one Mexican in the group" (personal communication, September 13, 2013). Luke shared a similar experience, "I'm in a fraternity, and so I am the only black guy. But they know that I wouldn't appreciate it if they called me the token. But people who see me from the outside, like in the fraternity, they're like "Oh you're the only black guy, you're the token. I'm like…I'm not a token. They understand my feelings, but they'll just say I'm a token" (personal communication, September 13, 2013).

Sense of Belonging. Sense of belonging in the campus setting refers to a student perceiving or believing that they are a respected member of the campus community. It might also be described as a sense of ownership. While none of the participants felt like they "belonged" when they first joined the campus, most of them

developed a sense of belonging over time. The participants' experiences with sense of

belonging is discussed below and includes study groups and finding community.

Joseph, a 3rd Year Latino mechanical engineering major, discussed his

experience going from a predominantly Latino high school to a university where

Latino's are a minority. In his interview he commented, "…I mean it's a whole

different feeling walking into a room full of Mexicans and then walking into a room

full of Asian and white students". He continued on to say, "just by chance I live in a

triple and both other students are Mexican and, it is just a lot more easy to relate to

them…and then...not having that in class was definitely – it's a lot different" (personal

communication, September 16, 2013). Roberto, also a 3rd year Latino mechanical

engineering major described a similar experience. He shared:

> I still don't feel like I belong that much. I feel like a lot of people see me
> and they've never seen anyone like me. They come from places that
> they've never seen anyone like me.   Like me and my two other friends,
> we talk a lot of slang and we come from places where it's like, "Hey,
> what's up dog?" A lot of people aren't used to stuff like that and I feel
> personally, like they see us. Suddenly just give us the look. It was hard
> [to find friends to relate to]. It was really hard (personal communication,
> September 16, 2013).

Roberto admits that while he felt it took some time for his peers to accept him, it also

took some time before he was comfortable interacting with his peers from the majority

groups. He stated, "I never had a white friend. I never had an Asian friend…every other

race was a shocker for me" (personal communication, September 16, 2013).

Ashley, a 4th year Latina chemical engineering major recalled the way she felt

sitting in classes soon after she joined the university, "…being there with other people

in my major, I did notice quite a big difference. They were females but there weren't

Hispanic females. Socially, I felt like I might have liked to see more, so I could have

maybe made some friends early on and then we would have stuck together" (personal communication, September 13, 2013). Ashley elaborated on this point stating that she did not only feel hyper-visible in her major due to her ethnicity but also because of her gender. Cindy described similar challenges:

> Being a female Aerospace engineer is definitely tasking; not just in academics, but because I do not see many individuals that I can relate to. I struggled tremendously because I was always felt discouraged to continue; forms of microaggressions that I encountered at UCSD led me to believe that I was not fit for college and that I could not succeed in such a rigorous career. The skepticism that a woman coming from my background could be so intelligent was something that I had to learn to avoid because I should be the only person deciding how to live my educational journey, not anyone else. It was due to the acknowledgement that I am one of the few people from my barrio who overcame institutional racism and blessed enough to attend a prestigious university, that I could not forgo my career path (written communication, September 29, 2013).

Other participants spoke primarily of their race or ethnicity when describing feelings of isolationism or hyper-visibility. For instance, Jesus remarked, "I don't know. It's just something natural. I would like kind of look around my classes and see if there are other like Latino students or not. I saw a lot of Asian and white people. I didn't really see that many Latinos" (personal communication, September 13, 2013). Luke remarked, "I definitely stood out, the tall guy with an afro" (personal communication, September 13, 2013).

A common experience that may have affected participants' lack of a sense of belonging at the beginning of their college careers can be described as *hyper-visibility* or *isolation*; a direct result of being racially underrepresented on the campus and in their engineering programs. All eleven participants described feeling isolated or hyper-visible as students in their major and/or on the campus.

Study Groups. Joseph discussed past difficulty in joining or forming study groups. He remarked, "Yes, it still is a challenge [to be invited to join study groups], I actually like studying in groups better, but it is just harder to do" (personal communication, September 16, 2013). Sean mentioned that he sometimes studies with friends from high-school who also attend the university or friends he met during the campus' minority-focused overnight admissions program (personal communication, September 13, 2013). Mary, a 3rd year Latina aerospace engineering major, explained the difficulty of forming study groups with peers in the MEChA student organization as few members were engineering majors. She said:

> I have about two engineering friends I can consider very close, as friends.
> So when it comes to like, finals or midterms and I want to form my study
> groups, I can't. Because everyone - well, they have to take like the
> calculus - like the physics/calculus portion of it. I can't study with anyone
> in MEChA, so I would have to go out on my own, go the to the library by
> myself, or go see the teachers, or professors by myself (personal
> communication, September 17, 2013).

Mary continued on to say that she had never been approached to join a study group in her three years in the major and on the campus. She also expressed form of microaggression, "I've never been asked to help anyone on a problem. I've never been asked to answer a question. If I do, they're like, "Oh, I didn't know you knew that," kind of thing" (personal communication, September 17, 2013). Ten participants suggested that studying in groups lead to better success as an engineering major than studying independently, however all of the participants suggested they study independently more than they study in groups.

Finding community. As mentioned, most participants suggested that they developed a sense of belonging to the campus and to their major, over time. Central to

reaching this experience appears to be making friends within and outside of the participants' major. Participants identified a few common steps that they've taken to build friendships, including joining student organizations, interacting with peers within their on-campus housing, and through campus cultural centers including connections with peers they met in summer-bridge programs. Each of these avenues led to the participants connecting with peers from similar racial and/or ethnic backgrounds.

Summer bridge and "overnight" programs including those offered by the central university and by the school of engineering were discussed as having a positive impact on participants' sense of belonging. Jesus remarked, "when I did the overnight program, I met the people who are the mentors, like the first years and second years. I met a lot of Hispanic-Latino students from there. When I got to campus, they kind of introduced me to their friends which are also predominately Hispanic or Latino" (personal communication, September 13, 2013). Sandra also discussed overnight programs, "[my college] had an orientation where you slept there overnight so it was like two days and I got a roommate and everything and I'm still friends with those people from orientation. So that's really cool. I got to know them and then those people ended up being in my classes" (personal communication, September 13, 2013). Joseph discussed the benefits he received from participating in the engineering school's summer bridge program, which he said reminded him of a similar program he participated in before high school. In his narrative, race was not the only bond that contributed to his sense of belonging.

> You know 100 kids before you even start, and then you know all their
> friends as well. So then, you come to high school knowing at least half
> your class. And so, I looked at that as sort of, I mean, it wasn't as many but
> it was the same mentality. And I knew all those people and so I knew their

friends too, and so coming into it, it was a lot. I mean, it was just as equal, but probably better, because, unlike with orientation, I actually had stuff in common with people, like diversity…they weren't all one race, kind of deal, but there were majors you could relate to (personal communication, September 16, 2013).

Joseph is still friends with many of the students he met during the summer program, as are all of the participants who did summer bridge.

The summer bridge and overnight programs were hosted by various campus cultural or community centers. Ten of the participants identified cultural centers within the campus and in the engineering schools as primary environments that they were able to find community. Ashley articulated this point by saying:

If it wasn't for the engineering diversity center and the academic enrichment program, there is a lot that I just would not know. A lot of times I've heard emails from them of things that I think, "Oh, that's so awesome like I had no idea." A lot of times I would say, "Oh, I'm going to do the research and to see how I can get this scholarship or get into this lab or whatever. We're so busy with all the other things, but these programs and places help you by giving that information to you and just being there also for people to talk to, because a lot of times your department advisors or your college advisors, they can help you with some things, but maybe not talk about personal issues. It's something added that is needed, at least for minority students…just to help the students who might feel like they need to have a little bit of that push or feel overwhelmed because there aren't people that look like you and stuff like that. I feel like if both places weren't there it will be hard (personal communication, September 13, 2013).

The most discussed form of finding community was through student organizations. Some of the student organizations discussed were social or profession organizations with a cultural mission, others had more of an academic mission.

The majority of participants who discussed their experiences with student organizations mentioned that they favored academic-related cultural organizations, such as the 'Society of Hispanic Professional Engineers (SHPE)' over social-related cultural organizations such as Movimiento Estudiantil Chican@ de Aztlán (MEChA), often

citing a closer tie to their engineering major. Sean discussed this by saying, "I actually

joined NSBE (National Society of Black Engineers) spring of my freshman year. I

wanted to join BSU (Black Student Union) and I had been to BSU overnight program,

but I just saw that there was a National Society of Black Engineers. So it seemed more

fitting than the black student union because no one there was from my major and it

didn't make sense to me" (personal communication, September 13, 2013). Jesus

remarked, "I've really wanted to connect with MEChA but I haven't really because I

feel like my workload doesn't kind of allow me to and that's just a totally different

thing from my major" (personal communication, September 13, 2013). Ashley offered,

"I remember my freshman year looking through the catalogue of student orgs info, and

I knew I wanted to join stuff that would help me, so it wouldn't be too social, rather it

would help me academic-wise or program-wise" (personal communication, September

13, 2013). Roberto remarked, "I feel like it just emphasizes Latino the stereotypes. Not

all Latinos are all like sweet bread with milk. (laughs). It's not like that. It's not like that

anymore. Like that stereotype has stayed in MEChA for such a long time and they need

to change their view on how to attract Latinos" (personal communication, September

16, 2013). Rachel expressed different reason for being attracted to other organizations,

> "I do have friends within that club [MEChA] and within the Mexican
> sororities or the Mexican fraternities, but at times I do meet people that
> have the mentality "Oh, you know we have to stick together, don't hang
> out with and don't study with other types of people. We have to stick
> together." You know, I never really liked that thinking so that's why I'm
> not really involved with any cultural clubs or fraternities or sororities like
> that" (personal communication, September 22, 2013).

A question submitted by one of the participants for the questionnaire (addendum

A) asked, "Are you drawn to cultural-focused student organizations? Why or why not".

Most participants responded that while they understood the value of such organiztions, they were not, themselves, drawn to cultural organizations. For example, Jesus wrote:

> I am not drawn to these types of student organizations because I feel that they can not really help me in my career. I feel myself drawn to engineering organizations more. But I still feel it would be nice to be involved with a cultural organization that represents my culture (written communication, September 29, 2013).

Rachel expressed a different reason for not participating in cultural organizations:

> No. I am typically not drawn to cultural focused student organizations because I have found that several students have the mentality that they should "stick with their own kind and help each other out." I was not raised in a strong cultural house growing up, so even though I do love and know my culture, I will not be putting others down or stressing its importance to others (written communication, September 29, 2013).

Luke wrote, "I was drawn but now I have tried to branch out to professional organizations in order to find a more business centered group of people" (written communication, September 2013).

Mary is a member of MEChA and described positive experiences and views of the organization, stating,

> MECha is an organization which looks for empowerment in communities for giving back to the communities for, I guess, wanting to empower minority students to continue going off to college and I feel a lot more comfortable because even though I like people in SWE (Society for Women Engineers), I feel like I can't really connect to them". As mentioned, she also stated that she isn't able to study with anyone in MEChA and studies alone instead (personal communication, September 17, 2013).

Universally participants felt that their participation in student organizations positively affected their sense of belonging and community. Jonathan said, "At first, I felt kind of lonely because there were no Hispanics…especially in my suite, but I reached out to other clubs who would help me have that family kind of thing again, any other

Hispanics" (personal communication, September 19, 2013). Ashley elaborated on her discussion of SHPE by saying,

> SHPE has definitely made me grow. Socially, professionally and academically, it has helped but more on the social and professional-wise. I remember being really shy and not wanting to talk to anyone, but SHPE has kind of forced me to step out of that boundary and talk in front of crowds, talk to professionals. Even when I go to career fairs now, because of additional SHPE career fairs and a couple of professional events, I am not at all afraid to talk to people and selling myself and presenting myself (personal communication, September 13, 2013).

Sandra pointed to cultural benefits of being a member of SHPE, "…most of the students are Latino so you get to hear the jokes that you grew up with, and the same languages, they're just so fun. I think they're so fun" (personal communication, September 13, 2013). Mary also discussed the cultural benefits she derived from her participation in student organizations, stating, "…because, like I said, I sometimes have a hard time communicating myself in English. I can slip into Spanish in that one and it'll be fine in MEChA" (personal communication, September 17, 2013). Rachel's inability to identify a student organization she was drawn to early on, negatively impacted her sense of belonging. She wrote, "I struggled a bit my first year. I didn't seem to find a club I could fit in to and as a result I didn't participate in any extra-curricular activities. Eventually, by my second year, I found a few activities I enjoyed and I am still a member of those organizations today" (written communication, September 29, 2013).

Mentoring and Advising. Participants described their experiences of receiving mentorship and advising from faculty, staff advisors, and peers. Some participants also described relationships with mentors outside of the campus. In most cases, participants' experiences with staff and faculty advisors were transactional in nature in that they

were focused on supporting the participants with a specific-issue, usually

administrative. Many of these interactions were adversarial in nature, as is detailed

below. Only a small few participants reported positive and transformational experiences

with formal advisors on the campus. Jesus mentions,

> I feel like the Professors don't really connect with students on that kind of level. I didn't get that experience with any of my professors because it was really just, "Oh, I have a couple of questions." It wasn't really like ... He was like kind a just teaching me and focusing on me sort of that kind. So it didn't really feel like a one-on-one connection (personal communication, September 13, 2013).

Five participants reported similar experiences with staff academic advisors. Participants

visited the advisors office for a specific issue, and only that specific issue was

addressed. Mary described an experience of when she approached an academic advisor

in her college to discuss possibly changing her major since she was overwhelmed with

coursework:

> Well, I remember when I was contemplating on changing my major, I went to go ask and while I was explaining how I felt really behind in my studies…how I didn't feel encouraged; I didn't feel any support. They were just saying, "Well, if that's how you feel, maybe you should change your major." Like, they didn't even try to say, "Well, let me offer you some resources. Let me direct you to some clubs you can join" I found everything on my own. My counselor, all he did was tell me, "Maybe you should switch your major (personal communication, September 17, 2013).

When Mary later went to speak with her aerospace engineering advisor, she was told

"…if you don't have a specific question regarding your major, I can't help you".

Sandra also reported instances with advisors in which she was discouraged to persist in

the major. She commented:

> Yeah, just because those counselors kept making the same, like "You can't do it," I would think about it, like "Should I change it? Should I just do bio or something like that?" So sometimes when people try to knock you down, either that builds your fire, you want to prove them wrong, or it

just makes you really question your ability. It just depends on the day. I felt like it really just fueled my fire. There were times when I thought maybe I'm just not smart enough or something, but then I just let go of it (personal communication, September 17, 2013).

In her questionnaire response, Sandra adds:

There were multiple times when I spoke to the academic counselors where they made me feel like I was not intelligent and that I did not have a bright future ahead of me. I overcame this struggle because I used it as fuel to keep me going and to prove the counselors wrong. Now that I am going into my last year they have lightened up a little and are slightly nicer than when I was a freshman and sophomore student.

While most of the reported experiences with formal advisors were transactional, many of them were positive. For example, when Jonathan went to speak to his department advisor about feeling stressed and overwhelmed with coursework, the advisor helped him to create a more manageable four-year graduation plan. He noted, however, the advisor did not refer him to other on-campus resources. Sean reported a positive experience with a counselor in the engineering diversity center:

They are very beneficial for everything. I notice how it's always busy, but I'll just go in there. One of my friends almost got disqualified. He is an under-represented minority. He's Mexican. He's from Fresno. He was almost getting disqualified and I e-mailed them and I said "I don't want my friend to get disqualified. Can you help him?" and she was like "Well yes, send him to my office and I'll help him," and then he wasn't disqualified (personal communication, September 13, 2013).

Mary reported a positive relationship with a graduate student mentor assigned to her through the engineering diversity center. While advisors, from her perception, encouraged her to switch out of her engineering major, her graduate student advisor encouraged her to persist. Her account is as follows:

I was telling Daniel how I was contemplating changing my major, because I felt that I just couldn't handle it, like all the pressures, since I had been, I guess, like facing a lot microaggression…and I was telling him that it was

getting to be too much, that I was having panic attacks every time I had to take a test, because I had all this stress going on at school and then my parents don't really understand. I was like, why am I going to stress throughout college for a major that, even though I like it, it's really hard for me, if I can just switch into something that will guarantee a degree and I get BA. He told me I could do that by wouldn't enjoy my classes or my future career. So, I stuck it out and I told Daniel, I was like, I'm really glad I did because I would've been so bored as a political science major, but I'm doing well. I'm doing a lot better in my classes (personal communication, September 17, 2013).

Some participants discussed difficulty in identifying faculty mentors who could relate to their culture and heritage. Joseph mentioned the fact that the University's engineering school has a small number of Hispanic faculty, but noted the following:

There is a difference when you have someone teaching you that came from like the slums of L.A. versus like the rich parts of Argentina," you know? There's a difference between the person's character and just how they are, and if you saw someone that came from what you came from it's just like you see more of an example of what you could be (personal communication, September 16, 2013).

Ashley echoed this sentiment by stating, "I feel like it would be nicer to see more Hispanic faculty members. I feel like I would be a little bit more entitled to actually approach them if there were". When asked why she felt this way, she responded, "you know, it shouldn't be that way, but it's just kind of like a mental thing. I don't know" (personal communication, September 13, 2013).

Improving Campus Climate for URM Engineering Students

A participant submitted question for the written questionnaire asked, "What can [the University] do to improve campus climate towards race and diversity?" Participant responses to this question are summarized below.

Several participants discussed the need for increased diversity and cultural awareness among the campus community. For example, Sean wrote, "[the campus

should] make students aware of the different backgrounds people come from, especially those students of affluent backgrounds, and solidify the idea that the horrible conditions people live in, in movies, is real, and those children do truly need our help" (written communication, September 29, 2013). Rachel wrote, "the University should hold workshops or large scale service projects for people to learn more about other cultures" (written communication, September 29, 2013).

Jonathan also discussed the need for education on these issues, stating:

> Instead of boring town hall meetings where the administration tries to persuade the student body of being more diverse, there should be more fun events. Only holding 5 de Mayo for Hispanics is not enough. Hispanic Heritage Month should be celebrated more and even have Hispanic leaders come to school and tell students on how to overcome the struggles that he/she has faced (written communication, September 29, 2013).

Some participants pointed to a need to increase the ethnic diversity of the student body as a means of improving the campus climate. Jesus suggested this begins with the University supporting underrepresented students at the K-12 level, stating, "the University can actually start sponsoring programs that benefit underrepresented students in underrepresented schools. I feel that they leave this type of work to the students who actually care about race and diversity on campus" (written communication, September 29, 2013). Luke wrote, "I believe having a more diverse campus would be very beneficial as it would mirror real world surrounding on campus" (written communication, September 29, 2013).

Analysis Of Themes Based on Discussion Group Process

As outlined in chapter three, the researcher invited all research participants to participate in a discussion group that would aid the researcher in preparing a comprehensive set of recommendations intended for engineering programs interested in

supporting the unique needs of URM engineering students. It was not expected that this process would generate new data that would further illuminate the content of the recommendations. In fact, the discussion did generate such data which is presented below.

Six participants took part in this phase of the study. The overarching theme and sub-themes were used as the framework for generating recommendations which are presented in chapter 5. This multi-participant exchange is summarized below.

Campus climate. As mentioned earlier in this chapter, participants described the campus climate towards race and diversity as 'timid'. During the recommendations discussion, participants elaborated on this point by stating the University and the engineering school has many diversity programs and groups but lacks significant conversations around what diversity means and why it is important. Some participants expressed a lack of confidence that their reported concerns of racialized mistreatment might go unaddressed or unresolved. Others pointed out that they were unsure who or where to report concerns to within the engineering school. The participants offered several suggestions for improving campus climate, and these are integrated into the set of recommendations in chapter five.

Racialized experiences. During the discussion on suggestions for institutions interested in interrupting negative racialized experiences, participant's posited that a "lack of training" on issues surrounding diversity and culture contributed to an environment where these experiences were allowed to fester at the University and in the engineering program. Further, they argued that the underrepresentation of African-American, Latino, and Native American students contributed to negative racialized

experiences as it difficult to connect with peers who shared similar cultures and backgrounds. Some participants argued that the engineering program had effective K-12 outreach and recruitment programs and suggested that they should be sustained and become institutionalized as a means of increasing diversity in the engineering program. The participants offered additional suggestions for addressing negative or harmful racialized incidents.

Sense of belonging. During this discussion, several of the participants reiterated that they did feel a strong sense of belonging to the campus, however they did not experience this early on in their college career. One participant commented that, being the first to attend college in his family, he wasn't sure that he belonged in college at all. Participants discussed student organizations, particularly the Society for Hispanic Professional Engineers, the National Society of Black Engineers, and the Society for Women Engineers, as being critical to their process of developing a sense of community and belonging. They also pointed to valuable programs and services offered by the engineering school including: an engineering diversity center, an orientation to engineering course, and a tutoring and study group for students. The participants offered additional suggestions for improving URM students' early sense of belonging, and these are integrated into the set of recommendations in chapter five.

Mentoring and advising. During this discussion, participant reiterated much of what was reported during the data collection stage of the study, including difficulty with; obtaining faculty mentors, identifying role models who could relate to their experiences and, interactions with staff academic advisors. Several students discussed a structured mentoring program offered by the engineering program, that is multi-tiered

and provides participants with an opportunity to engage with and receive mentoring from higher year undergraduate students, graduate students, faculty and alumni. Participants discussed this program as having a positive impact on their motivation to persist in engineering and their sense of self-efficacy.

Summary

The purpose of this study was to gain a better understanding of the unique experiences of underrepresented minority students who are pursuing undergraduate degrees in engineering or computer science. Semi-structured interviews and a questionnaire, created by the 11 participants, were the methods of collecting data. The analysis of interview and questionnaire data revealed four common themes: racialized experiences, sense of belonging, campus climate, and mentoring and advising.

Analysis of the data indicates that engineering students from underrepresented backgrounds encounter racialized experiences during their undergraduate academic careers. Participants described racialized experiences, which included *racism*, *microaggression* and *tokenism*. Another dominant theme which emerged from the data analysis was the notion of a "sense of belonging". None of the participants felt like they "belonged" to the campus early in their college experience. Participants started to develop a stronger sense of belonging once they found a community in which they felt comfortable and where they could relate with others.

The data also revealed a picture of the participants' views and feelings towards the racial climate on campus. Overall participants felt the climate was "chilly" in discussing issues around race and culture, but supportive of all students. Finally, "mentoring" emerged as another prevalent theme from the data analysis. Overall,

participants' experiences with staff and faculty advisors were transactional in nature, and at times adversarial. Only a small few participants reported positive experiences with formal advisors on the campus.

In Chapter 5, each research question is addressed. The chapter concludes with a set of recommendations for addressing the barriers experienced by URM in engineering programs is presented. These recommendations were developed by the study participants, in collaboration with the researcher. They are intended to serve as a resource guide for those interested in increasing the success of URM students in engineering schools and universities. This includes students, faculty, and administrators.

Chapter 5

Discussion and Recommendations

This chapter provides an overview of the study and a discussion of the findings in relation to existing literature. The chapter also presents a set of recommendations, informed by the study participants, for supporting engineering students from underrepresented minority backgrounds. These recommendations intended for college or schools of engineering and central campus administrations.

The purpose of this study was to explore the social and academic experiences of underrepresented minority students in an engineering program. Eleven participants from across seven engineering or computer science programs were selected for the study using purposive sampling. Nine of the students were Hispanic/Latino and two were African-American. All participants were in their 3rd year or later, an intentional sampling effort as upper-division students are likely to have more to discuss, relevant to their experiences as an engineering student, than lower-division students.

Participants were engaged in four processes during the study, beginning with individual semi-structured interviews. At the end of interview sessions, the participants were asked to provide a question unasked by the researcher that would contribute to a better understanding of their experiences on campus. These questions were compiled into a questionnaire, which each participant responded to. I analyzed and coded data from the questionnaire and the interviews and discovered an overaching theme of *campus climate* as well as three sub-themes of *racialized experiences, sense of belonging,* and *mentoring/advising*. I provided the participants a summary of the data, which comprised

the identified themes, and convened them as a group, in-person, in order to create the set of recommendations. The themes address the questions presented in this study, which are:

1. Do underrepresented minority students encounter racialized experiences in engineering programs? If so, what are those experiences?

2. Do students perceive issues of race as impacting their academic experiences? If so what are those issues and experiences?

3. Have racial experiences impacted students' self-efficacy and motivation to complete their program? If so, in what ways?

The following section provides a summary of the findings which responds to the research questions.

Findings for Research Question One

The main research question asks, "Do underrepresented minority students encounter racialized experiences in engineering programs? If so, what are those experiences?"

Analysis of the data reveals that all eleven participants had on-campus experiences that they perceived to be either motivated or framed by their race. In total, 44 racialized experiences were discussed by the participants, 32 of these encounters were perceived by the participants to be "unconscious" or "implicit" behaviors or comments, signaling a lack of mal-intent. Only two students discussed experiences they perceived to be intentionally harmful. It is worth noting that both of these participants were African-American, they were the only African-American participants in the study.

All eleven participants described experiences of being exposed to microaggression. Microaggression has been defined as subtle insults directed toward people of color, often unconsciously (Solorzano et al, 2000). None of the participants in the study described these experiences as having a detrimental effect on their well-being or academic performance. However, according to Pierce (1995), a microaggression alone may seem harmless, but the cumulative burden of instances of microaggression proves to be extremely harmful to one's confidence. Several researchers have used critical race theory to examine microaggression and its' effect on minority student achievement (Ladson-Billings & Tate, 1995; Delgado & Stefancic, 1994; Solorzano & Bernal, 2001). Based on this literature, it is reasonable to assume that, even thought the participants did not report negative impacts specifically attributed to microaggressions, microaggressions need to be addressed in any campus climate initiative relative to URM student success.

All eleven participants indicated that they immediately noticed they were ethnically underrepresented among their peers when they began their engineering program. Participants described feelings of "isolation" and a lack of a sense of belonging, resulting from the realization they were underrepresented. Researchers have argued that achieving a "critical mass" of students from various racial groups positively impacts the chance for academic success, sense of belonging, and persistence in STEM majors (Landis, 1985, 2005). Further, research suggests that failure to develop a sense of belonging and community during a students' first year correlates with a higher chance of attrition from STEM majors and departure from college (Tinto, 1985, May & Chubin, 2003; Landis 1985; Inkelas et al, 2007).

The 44 reported experiences of on-campus racialized experiences reveal that participants encountered racialized comments, microaggressions, and isolation as on-campus experiences. The literature indicates that any one of these conditions can significantly impede the progress of URM students. Multiple and accumulated experiences such as these magnify the barriers encountered by URM students leading to reduced student achievement and lowered rates of degree completion.

Findings for Research Question Two

Research question two asks, "Do students perceive issues of race as impacting their academic experiences? If so, what are those issues and experiences?"

Several participants discussed issues of race as impacting their academic experience. For instance, seven participants reported difficulty joining study groups. They each reported that they were rarely or never asked to join study groups and they perceived this to be a result of their race. The participants felt that they were excluded from these groups because of the race or ethnicity they did not belong to, as opposed to the groups they did belong to. Joseph, for example, said "Most study groups are either all-Asian or all-white; you don't have that many all-Mexican study groups (personal communication, September 16, 2013). Non-participation in study groups is problematic as research shows studying in groups is more effective than studying alone for engineering and other STEM majors (Landis, 1985; Adair et al, 2001).

Exclusion from study groups deprives URM students hinders their ability to develop a "sense of belonging" and their ability to attain knowledge clarification and acquisition. The literature indicates that this mode of supplemental learning is a

significant source of social and intellectual capital. Therefore, study groups and similar structures should be part of initiatives intended to increase URM student success.

Participants also discussed difficulty in identifying and obtaining role models and mentors who could relate to their cultural background. During his interview Jonathan remarked, "I would love to have more Hispanic professors…it does feel like we are underrepresented in the faculty positions (personal communication, September 19, 2013). Of the eleven participants, six commented on the lack of representative minority faculty in the engineering school. Joseph remarked, "[We should] have someone representing each kind of community- obviously that would be hard but we need someone that's willing to not only teach and do the research, but someone who is also willing to mentor (personal communication, September 16, 2013)."

Morales (2009). examined the outcomes of a mentoring relationship between a student and a professor of the same or similar ethnicity The study explains that in this situation, students benefit from learning what they considered to be "insider's information" from their mentor. They also receive validation that they are on the "right-track" academically, thus increasing their self-efficacy. Finally, the study argues that students benefit from seeing the "American Dream". In other words, the students see in their mentor of a similar background who they could be someday. During her interview, Ashley made the following thought-provoking statement, "I feel like it would be nicer to see more Hispanic faculty members. I feel like I would be a little bit more *entitled* to actually approach them if there were (personal communication, September 13, 2013). The statement implies that Ashley does not feel "entitled" to approach faculty from different

backgrounds, a sentiment important to the "sense of belonging" and "campus climate" discussions presented in chapter four.

Lack of a diverse faculty is a chronic condition in institutes of higher education. The reasons for this condition are well documented, including recruitment and hiring practices as well as lack of ongoing mentoring for minority faculty. Increasing minority faculty will need attention in initiatives intended to increase URM student success.

Findings for Research Question Three

Research question three asks, have racial experiences impacted students' self-efficacy and motivation to complete their program? If so, in what ways?

Upper division engineering students were selected to participate in this study as a means of examining factors that contributed to their persistence and resilience. It is important to note, however, that all participants indicated that they, at some point, seriously considered departing from their engineering or computer science major. Two participants were still considering changing to non-engineering majors at the time of the study. Participants cited multiple reasons for their lack of motivation to complete their program, some of which were related to racialized experiences, however there was not enough data to confidently answer research question three. The data did reveal, however, another phenomenon of URM engineering students considering departing from their major due to stronger connections to peers and mentors in other majors, and developed interests in social justice and social science related careers.

Luke, one of the participants who at the time of the study was considering departing from the major remarked:

> I feel like that's something I could relate to more [communications major],
> because in engineering I couldn't get on board or find role models or find

anyone that I could really connect to and see that's what I want to be...Like I said, my friend that I've known since 5th grade, his father, who was a communications major, went into detective work. I talked to a lot of administrative people, and always involved in the judicial court and they have integrity now, and so I just feel like I'm meeting a lot more people who are more accepting of me. At the same time they're not more engineering, they're more like peer-to-peer, so like working with people, all that sort of thing. So I feel like the role models that I was able to find on campus, it's what really strived me towards going into communications, which is what I'm thinking about now (personal communications, September 13, 2013).

Luke's experience was common among the study participants, the majority of

whom indicated that they had stronger social connections with peers and role models

outside of engineering. Previous research indicates that science and engineering students

from minority backgrounds, including women, are more likely to be interested in the

social implications of their studies (Good & Halpin, 2001). Data available for the

university revealed that undergraduate students who belonged to Bethune College

(academic home within the University for lower-division coursework) were most likely

to switch out of an engineering major. While no data exists on the cause of this

discrepancy, it is worth noting that Bethune college, is the only of six colleges that has a

central social justice mission. It provides students with an opportunity to engage in social

activism and participate in discussions around diversity and equity. It could be

hypothesized that underrepresented engineering students perceive there are greater

opportunities to have an impact on problems they care about in majors that have similar

missions to Bethune College.

While many of the factors contributing to participants' consideration of departing

from the major were environmental, in some instances, they were academic-related.

Participants remarked that the engineering and pre-engineering courses were "too

difficult" and "a lot of pressure". Some of the participants were either unaware of

academic support resources offered by the engineering school and the university or were aware but did not take advantage of them. The participants who failed to take advantage of academic resources did not do so out of a lack of motivation. Each described a fear of being perceived as inadequate, a condition described in existing research as the "impostor syndrome", an irrational fear that they are a "fraud" and will be discovered at any moment. Studies reveal that students from marginalized backgrounds, including underrepresented minorities, are more likely to experience impostor syndrome (Kolligian & Sternberg, 1991). Similarly students from these backgrounds, particularly at high-achieving institutions, are most likely to experience "stereotype threat", which researchers describe as an psychological anxiety one experiences when they perceive they are at risk for confirming a negative stereotype about their group (Steele & Aronson, 1995). In this case, anxieties about under-preparation compound any *actual* under-preparation because URM students cannot or do not seek support.

Recommendations: A Guide for Supporting Underrepresented Minority Students in Engineering

The guide below was developed by the researcher in conjunction with the study's participants. The suggestions are informed and framed by the participants' experiences, all of whom persisted through at least three years in an engineering or computer science major. The guide responds to the findings presented in chapter four of this study by providing concrete actions . The guide is intended to advise engineering programs on supporting students from underrepresented backgrounds, including their personal, academic and professional development. It is also intended to serve as a guide for

engineering programs who are interested in developing or advancing a welcoming, and respectful climate for the ever-broadening communities they serve.

The importance of this study and its findings are difficult to be overstated. The problem of retaining minority students in engineering programs, and seeing them through degree completion, has intensified, which should prompt researchers and educators to understand the challenges that underrepresented minority students face. According to data collected in this study, many of these challenges include subtle and blatant forms of racism. Importantly, data suggests that higher education institutions may be looking for answers in the wrong places. Moving off the student as the *sole* unit of analysis in retention and degree completion efforts and moving to exploring the racial climate on campuses and within STEM degree programs is imperative.

At the heart of the guide is advancing diversity in engineering programs. The guide is structured within three areas: 1) Recruitment and Enrollment 2) Student Retention and Success and 3) Fostering a Culture of Awareness and Tolerance.
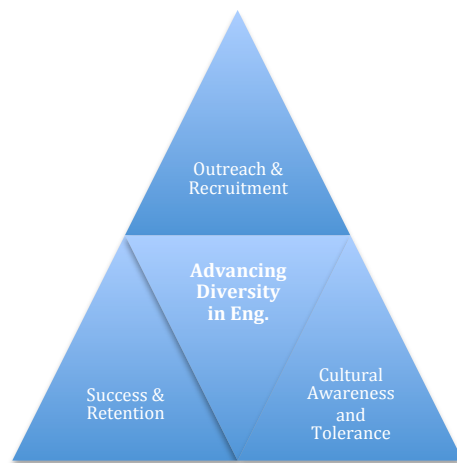

Figure 1 Key Areas of Focus for Advancing Diversity in Engineering

Outreach and recruitment. Study participants felt that achieving "critical mass" of URM students is essential for an engineering program that aims to promote and sustain a welcoming environmental and cultural climate for underrepresented minority students. Suggestions for increasing the enrollment of URM undergraduate engineering students are outlined below.

K-8 Outreach. Engineering outreach programs should engage students as early as elementary/primary school to secondary school students. Effective outreach programs provide hands-on activities and real-world experiences that promote increased knowledge, interest in and excitement about science, technology, engineering and math. Outreach programs may be most effective if they are *transformational* in nature, such as summer camps, versus *transactional* activities such as one-day campus tours. The entire engineering program community can participate in outreach activities, including faculty, students and staff. URM engineering students, in particular, may benefit from being engaged in outreach activities as they are often keenly interested in the societal impact of their work.

High School Outreach and Recruitment. Engagement of students at the high-school level should focus on college and engineering program preparation. Engineering programs can explore Academic Performance Index (API) data or their state's department of education website to identify target or priority high schools for recruitment. Selected high-schools should have the highest percentage of students that would contribute to the diversity of the engineering program. Recruitment activities might include:

- Admissions and application guidance

- Financial aid and scholarships guidance

- Overview of engineering and computer science majors

- Workshop on engineering and technology careers

- Campus and lab tours

- Academic Mentoring and/or Tutoring

- Summer internships or research experiences

AISES, NSBE and SHPE Jr. chapters. The American Indian Science and Engineering Society (AISES), the National Society of Black Engineers (NSBE), and the Society for Hispanic Professional Engineers (SHPE) are the three most prominent collegiate engineering associations for minority students. These organizations have a mission to advance participation of underrepresented minorities in engineering and technology careers and have a well-established presence on college and university campuses across the country. All three organizations also have structured pre-college, or "Jr." chapters. While there are fewer pre-college chapters of these organizations, engineering programs can easily support area high schools in developing chapters. In most cases, AISES, NSBE and SHPE Jr. chapters include established curriculum and built-in mentoring. Importantly, pre-college members are able to participate in regional and national conferences where they would encounter role-models and individuals in and pursuing engineering careers that share ethnic backgrounds.

Yield Recruitment. Engineering programs interested in increasing the enrollment of minority students should be sure not to neglect "yield recruitment" in which focused efforts are geared towards increasing the number or percentage of

students from target groups who accept their offer of admission. A simple but potentially effective strategy is an organized phone-calling campaign in which students, faculty, alumni and/or staff call admitted students from underrepresented backgrounds to congratulate them on their admission, discuss unique aspects of the school or institution, and offer to answer any questions. This "personal touch" could make the difference in the degree to which the student feels welcome on the campusA more involved effort that could positively impact yield is an overnight-stay program in which admitted students from diverse backgrounds are invited to stay overnight on campus or with student hosts, providing them with a first-hand experience of the campus culture, activities, and opportunities.

Student Success and Retention. As discussed in earlier chapters of this study, URM students are more likely than their non-URM peers to be pushed-out of their engineering major before graduation. Several factors contributing to URM lack of motivation to persist in their engineering majors have been outlined in chapter four, and include; isolation and lack of a sense of community, poor self-efficacy, varying levels of academic experiences and preparation, and a lack of mentors or role models. To positively impact the retention of URM engineering students, programs must directly address each of these challenges. Suggestions for addressing these are outlined below.

Engineering Diversity Center. Since the early 1980's engineering programs across the country have developed engineering diversity centers, most commonly referred to as "Minority (or Multicultural) Engineering Centers. While the missions of these centers vary, they general aim to promote the recruitment, enrollment and

retention of underrepresented minority students and women in engineering. For many URM students, these centers serve as a "home away from home" contributing to their sense of belonging and community. The center can serve as the administrative home for the engineering programs pre-college programs, URM retention efforts, and diversity education and awareness programming. As Mary states, "we need a program that would help bridge the educational gap between people like me and students in the same major who had the privilege to attend programs such as space camp or enroll in honors/AP courses".

It is recommended that Engineering Diversity Centers support, at minimum, the following programs or services:

Orientation to Engineering Course*. This course series should be designed to help both incoming freshmen and new transfer students, from disadvantaged backgrounds or historically underrepresented groups, transition successfully into their engineering majors. The course might introduce students to the various fields of engineering, and help them learn to navigate and manage their academic program. Engineering programs might also consider providing course participants with exposure to and contacts with representatives from industry as well as with officers of engineering student organizations, specifically, the Society of Hispanic Professional Engineers (SHPE), the National Society of Black Engineers (NSBE), and the Society of Women Engineers (SWE).

Academic Tutoring and Study Lab*. As discussed in chapter four, students from underrepresented minority backgrounds are less likely to be invited to join study groups or seek out academic help due to the perceived risk of being

discovered as an "impostor". It is critical for engineering diversity centers to

facilitate a "safe place" for URM students to study together and receive free

academic tutoring. Programs might consider making it a requirement for

participants to attend the study lab a certain number of hours per week. This may

help de-stigmatize the idea of receiving tutoring assistance.

Structured Mentoring Program. A successful minority engineering

mentoring programs will provide opportunities for URM students to obtain

personal, academic and professional mentoring from older students, faculty and/or

alumni. These mentoring relationships should grow organically but be initiated and

facilitated by the center. Mentoring is a critical aspect of URM success in engineering

and, as revealed in chapter four, URM engineering students often have a difficult

time identifying and obtaining mentors on their own.

Cohort Model. One of the most important aspects of an engineering diversity

center is its ability to promote a culture of inclusion and a sense of community for

its participants. It is recommended that centers recruit URM engineering students

into their programs before arrival, admitting them as "scholars". The scholars

would enter the university or the engineering major as a cohort and participate in

joint programming that facilitates community-building and a sense of belonging.

The scholars should be encouraged or required to take engineering and other

technical or science courses in clusters, minimizing the effects of isolation in their

courses.

Fostering a Culture of Awareness and Tolerance.

Bias and Cultural Competency training for faculty, staff and students. As revealed in chapter four of this study, engineering students from URM backgrounds often have negative experiences they perceive to be related to their race. These experiences come in the form of microaggression, racism, and tokenism among others. Often these actions are unconscious or unintentional on the part of the perpetuator and could possibly be remedied if they were aware of how their words or actions were being received by the URM student. Study participants suggested that, in order to promote a welcoming and productive environmental climate for the entire engineering community, engineering programs should institute training and discussions on implicit or unconscious bias and cultural competency. While difficult to require the entire engineering community (faculty, staff and students) to participate in training, this could be one of the most effective methods of promoting a positive climate. At minimum, individuals in leadership roles, such as department chairs and deans, should obtain this training as they often set the tone for their departments. It would also be particularly useful for staff academic advisors within the engineering programs to have the opportunity to participate in this training.

Publicized whistleblower protocol for students. As revealed in chapter four of this study, the majority or harmful racialized experiences in engineering go unreported by the victim. This makes it difficult for engineering programs to directly address racial concerns or issues. There are several feasible possibilities for victims of harmful racialized experiences not reporting these instances to authorities including:

- Uncertainty on whom or where to report violations

- Fear of retaliation or that their report will not remain confidential

- Fears or concerns that their report will be dismissed or not investigated

It is critical that engineering programs have a "whistle blower" protocol in place that addresses each of the points above. The policy and process should be well publicized and the submitted reports, anonymous. If the campus has a whistleblower policy and set of procedures, this should be shared with and communicated to engineering students on a regular basis.

Climate Surveys. It is difficult to improve the cultural and racial climate within an engineering school without comprehensive data from the broad community on institutional strengths and challenges. An effective way of gathering this data is through periodic cultural climate surveys. Validated survey instruments are available through several education research centers throughout the country. Engineering programs should survey students, faculty, staff and alumni, using the results to customize their diversity programming and shape their standard operating procedures.
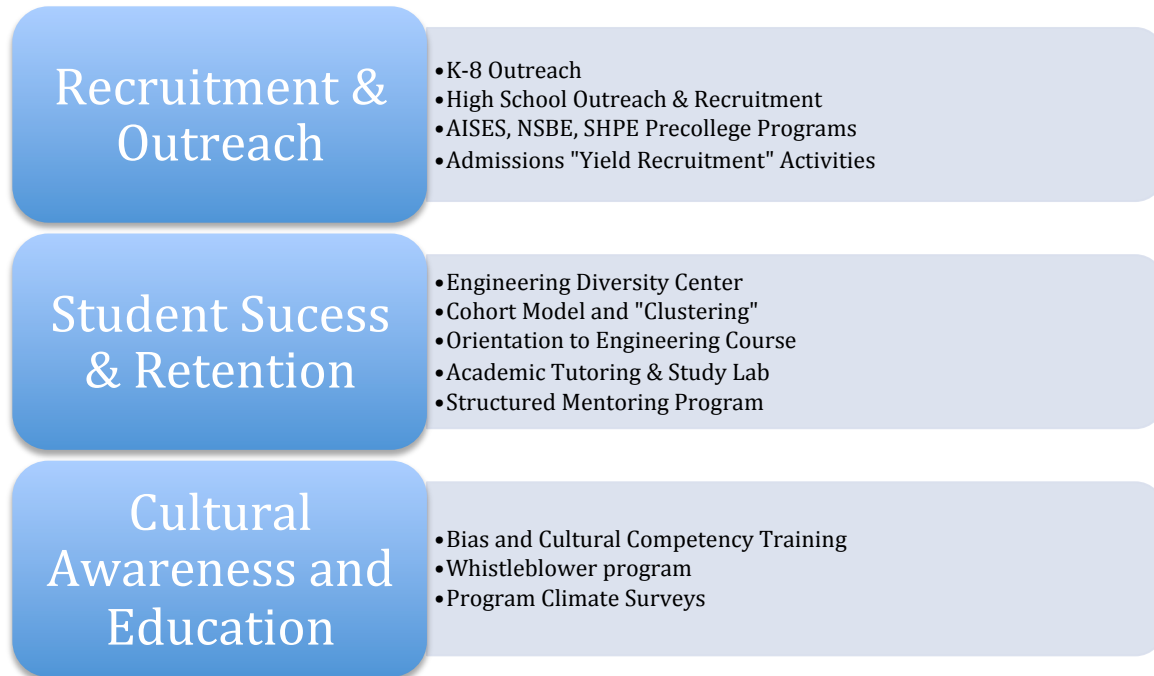
Recruitment & Outreach	•K-8 Outreach •High School Outreach & Recruitment •AISES, NSBE, SHPE Precollege Programs •Admissions "Yield Recruitment" Activities
Student Sucess & Retention	•Engineering Diversity Center •Cohort Model and "Clustering" •Orientation to Engineering Course •Academic Tutoring & Study Lab •Structured Mentoring Program
Cultural Awareness and Education	•Bias and Cultural Competency Training •Whistleblower program •Program Climate Surveys

Figure 2 Model for Successful Engineering Diversity Programs

Recommendations for Future Research

This study set out to explicate the experiences of underrepresented minority engineering students using a critical race theory framework. Analysis of the data resulted in deepening the understanding of these experiences and also generated several new questions that should be investigated in future research. Each of these questions were prompted by qualitative data generated from the current study. The design of the current study, however, did not allow for some related questions to be responded to.

First, existing literature demonstrates a disparity in the aspiration and persistence rates of underrepresented minority students across all STEM disciplines (Grandy, 1998; Barlow & Villarejo, 2010; Palmer et al, 2010). While this study explored the experiences of URM students in engineering and computer science disciplines, further research might

focus on other STEM disciplines including the life sciences, physical sciences and math. Specifically, future research should examine the unique factors within various STEM disciplines that contribute to URM persistence or attrition from the discipline.

Second, during interviews for this study, there was significant discussion pertaining to family expectations and pressures and the impact on academic performance and motivation to persist in the major. Several of the participants, particularly those from Latino/a backgrounds discussed expectations that they needed to travel home during the weekends, if they lived within driving distance. Others discussed expectations that after graduating they were responsible for financially providing for their immediate, and sometimes extended, families. Future research should further examine this phenomenon to gain a deeper understanding of the impact a URM engineering students' family and their spoken or unspoken expectations has on the students' academic experience.

Lastly, future research should focus on the intersection of race and gender, and its implications for the motivation to pursue and persist in STEM disciplines and careers. This research should further examine the unique experiences of female URM students, a "double-minority" in engineering. In the current study, several of the female participants described instances of bias that they were unsure as to whether they were related to their gender, their race, or both. Female participants also discussed feelings of isolation in their engineering courses both because of their race and their gender. They also discussed difficulty in identifying female mentors and role models in engineering.

Appendices

APPENDIX A: Recruitment E-mail

Subject: Seeking Participants for an Education Research Study

Dear XX,

You are receiving this e-mail because you are an underrepresented minority-student at UC San Diego and currently enrolled in an engineering major. I am conducting a study that seeks to understand your experiences involving race as a student on the UC San Diego campus. This study will be conducted in a one-on-one interview format and the duration of the interview will be 45-60 minutes minutes. My research topic explores how campus climate factors impact the academic life of underrepresented minorities in engineering programs.

If you are interested in participating, please click on the following link to complete a brief confidential questionnaire. No need to reply if you are not interested.

Please note that participation in the study is strictly voluntary. Should you choose to participate, every effort will be made to maintain your confidentiality.

APPENDIX B: Interview Questions

I will be conducting 'semi-structured' interviews, which will allow for flexibility as well as concrete data. Questions will include:

Q1 – Please state your year and major.

Q2 - I'd like you to reflect back on your senior year of high school when you were trying to decide which college and universities to apply to. What were some factors that helped you to decide where to apply and ultimately which university to attend?

Follow-up:

- How did you make your decision?

Q3 - As you know, I am interested in your experiences as an underrepresented engineering major. With that in mind, I'd like you to think about your first quarter on campus. What were some of the things you were excited about? What made you nervous or anxious?

Follow-up:

- How did you feel sitting in each of your classes?

Q4 – How long did it take you to feel like you belonged at UCSD?

- Can you tell me some of the factors that led to you feeling like you (don't) belong?

Q5 –Do you think race or being a racial minority has impacted your experiences at the university? If so in what ways?

Follow-up:

- Have you ever felt like an outsider while on campus? If so, when and in which settings? Why do you think you feel that way?

Q6 - How would you describe the campus climate in regards to diversity, equity and inclusion?

Follow-up:

- What contributes to the way you feel on campus?

- Does it differ from the school of engineering?

Q7 - Can you describe a time, on this campus, which you've felt you were being treated unfairly, discriminated against, or made to feel uncomfortable because of your race?

Follow-up:

- How did you feel, immediately after this incident?

- How did you respond to this incident?

- How do you feel now about the incident?

- Have you been exposed to similar incidents with other friends or classmates? Faculty members? Staff?

- Are there any other incidents you'd like to tell me about?

- Do you feel this/these incident(s) have had any impact on your academic performance?

Q8 – Now I'd like to ask you a question about microaggression. A microaggression is defined as a subtle verbal or non-verbal insults or gestures or remarks with demeaning implications. For example, an underrepresented minority biology major delivers a presentation to his class and the instructor

seems surprised and remarks, "you are really articulate". Do you think you've ever been exposed to microaggression on your campus? If so, can you describe the incident(s)?

Q9 – Have you ever thought about changing your major? If so, why?

Follow-up:

- When did you this thought first cross your mind?

- What would you have changed to?

- What made you decide to stay?

Q10 – As you know, my study seeks to understand if and how campus climate impacts the experiences of underrepresented minority-engineering students. Knowing this, what question did I not ask that you would have asked?

End Questions.

APPENDIX C: Informed Consent form Student Participants

California State University
SAN MARCOS

<u>**Consent to Participate in Research**</u>

<u>**Invitation to Participate**</u>

Terrance Mayes, a graduate student in the joint doctoral program at California State University San Marcos (CSUSM) and University of California, San Diego (UCSD), is conducting a study that seeks to understand the experiences of underrepresented minority (URM) students in an engineering program. You are being contacted because you have been identified as a URM student studying an engineering or computer science major at your university.

This study has two principal objectives:
1. To understand the racialized campus climate experiences of URM students in engineering, and;
2. To make a set of recommendations for the effective support and retention if URM students in engineering.

<u>**Description of Procedures**</u>

You will be interviewed individually. The conversational style interview regarding your experiences will take approximately 1.5 hour and, with your permission, will be audio taped and transcribed. You will be provided a transcript of the interview for checking and clarifying any information. In addition, you will be asked to complete a 12-question questionnaire as a second and final phase of the study. The questionnaire should take you no longer than 30 minutes to complete.

<u>**Risks and Inconveniences**</u>

There are minimal risks to participating in this study. These include:
1. loss of personal time necessary to participate in the interview, review of the transcript and complete the questionnaire.
2. potential emotional reactions to the interview questions as many pertain to negative
phenomenons such as racism and marginalization.

<u>**Safeguards**</u>

Safeguards put in place to minimize risk include:

1. Interview sessions will be restricted to 1.5 hour; if it persists longer than this duration, it can be stopped at your request.

2. Your interview data will be kept confidential, available only to the research team for analysis purposes. Only the research team will listen to and transcribe the information you provide.
The audio tapes will be destroyed following final analysis; no later than September 15, 20

3. Pseudonyms for participants (you), the engineering school and the university will be used to minimize the risk of *identification*. You will be given the opportunity to review the transcribed interview and to eliminate any comments or references you feel may be identifiable.

Voluntary Participation

Your participation is entirely voluntary, and may be withdrawn at any time. If the length of the interview becomes inconvenient, you may stop at any time. There are no consequences if you decide not to participate. In particular, your academic standing will not be affected if you choose not to participate.

Benefits

Although your participation will yield minimal or no direct benefits to you, we believe that the study has the potential to positively affect the experiences of URM engineering students in the future.

Questions/Contact Information

This study has been approved by the California State University San Marcos Institutional Review Board (IRB). If you have questions about the study, you may direct those to the researcher, Terrance Mayes, terrance.mayes@gmail.com, (619) 534-4992, or the researcher's advisor, Dr. Jennifer Jeffries jjeffrie@csusm.edu, (760) 750-4083. Questions about your rights as a research participant should be directed to the IRB at (760) 750-4029. You will be given a copy of this form to keep for your records.

☐
☐   I agree to participate in this research study. I agree to have the interview audiotaped.

_____   _____

Participant's Name   Date

_____

Participant's Signature

_____

Researcher's Signature

ADDENDA A: Participant generated online questionnaire

Thank you again for taking the time to participate in this study. As a final step, please respond to the nine survey questions, below, created by you and other study participants. As a reminder, your responses are strictly confidential. You will be assigned a pseudonym after this final step of the study and all identifiable information will be removed.

First and Last Name

1. Briefly describe your childhood and background (family, schools, environment, education).
2. Can you describe a specific time that you struggled as a college student? Did you overcome this struggle, if so, how?
3. Are there any programs/services currently not offered at UCSD that would be or would have been helpful to you and/or your peers?
4. How often do you socialize with peers from THE SAME race/ethnicity as you?
   - Never
   - Seldom
   - Often
5. How often do you socialize with peers from a DIFFERENT race/ethnicity as you?
   - Never
   - Seldom
   - Often
6. What can UCSD do to improve campus climate towards race and diversity?
7. Do you feel UCSD represents San Diego as a region? Why or Why Not?

8. Are you drawn to cultural focused student organizations? Why or why not

9. Do you think being a minority will help or hurt you in the job market? Please explain.

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