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CASE STUDY ANALYSIS OF THE EFFECT OF CONTEXTUAL SUPPORTS AND BARRIERS ON AFRICAN AMERICAN STUDENTS' PERSISTENCE IN ENGINEERING

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ABSTRACT

Using case study methodology (Stake, 2006), this research examined the environmental influences, or contextual supports and barriers, that were most influential in contributing to African American students' persistence in an engineering major. Social cognitive career theory provides the framework for understanding the role of contextual supports and barriers in conceptualizing persistence. Eight African American college students at a Large, Midatlantic State University (LMSU) participated in the study. Semistructured interviews, lasting on average 82.5 minutes, were conducted using an interview protocol adapted from Seymour and Hewitt (1997). The six emergent themes that had the most impact on their ability to persistence in emerging are: (1) Cultural Issues; (2) Engineering Identity; (3) Family Influence; (4) Peer relationships; (5) Academic Issues; and (6) Personal Issues. Five of the six were perceived as both contextual supports and barriers to their experience in their major. Cultural issues (e.g. participation in the Multicultural Engineering Program (MEP), involvement in National Society of Black Engineers (NSBE), and other culture-related activities) figured most prominently in providing the necessary support and obviating the effects of any barriers they encountered. Implications for various stake holders and theory were provided. Limitations and strengths of the study and recommendations for future research were also discussed.

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CHAPTER 1

INTRODUCTION

Background of the Problem

The proportion of African Americans graduating in engineering has declined 21% from 1995 to 2004 (National Science Foundation (NSF), 2007c, p. 547). Of the engineering baccalaureate degrees conferred in 2004, African Americans accounted for fewer than 3% of the graduates (National Science Foundation (NSF), 2007d). This was the lowest percentage of any racial/ethnic group (KewalRamani, Gilbertson, Fox, & Provasnik, 2007). This downward trend has created a "quiet crisis" in the production of American scientific and technical talent which "could jeopardize the nation's pre-eminence and well-being" (Jackson, 2002, p. 1). In the coming decades, African Americans and other underrepresented minorities will constitute a larger percentage of new entrants into the US workforce (Chang, 2002). Given these changing demographics and workforce demands, the representation of African Americans and other racial and ethnic minorities in science, technology, engineering and mathematics (STEM) fields must increase accordingly (Jackson; Mervis, 2003).

Statement of the Problem

Proportionately, few African American college students choose to major in engineering. In fact, "only six percent of minority students, nationwide, graduate from high school with the requisite sequence of mathematics courses to pursue an engineering or related degree—effectively barring them from participating in a large and growing sector of the economy" (Markow & Moore, 2001, p. 2). Even when they enter college with the intention of majoring in a STEM field, "relatively few actually graduate with

STEM majors" (Maton & Hrabowski, 2004, p. 547) and "drop out of engineering at a higher rate than their Caucasian and Asian peers" (Jordan, Gardner, & Pinkham, 2005).

The present structure of the U.S. workforce requires workers to be more skilled in technical areas than ever before (Clark, 1999; Moore, 2006). Jobs in science, mathematics, and engineering are expected to "increase four times the rate of all other employment opportunities in the United States"(Bonous-Hammarth, 2000, p. 92; National Science Board (NSB), 2008), translating into a demand for 1.9 million more trained professionals in these areas. In the US, African Americans constitute 4.4% of the engineering workforce (Bureau of Labor Statistics, 2004) and 6% of enrolled undergraduates in engineering(National Science Foundation (NSF), 2007a). To achieve parity in engineering for people of color, universities would have to produce an average of 25,000 graduates of color per year by 2010. Today, they graduate just over one-third that number (Campbell, Jolly, Hoey, & Perlman, 2002; Reichert & Absher, 1997).

More systematic research is needed to better understand from an emic approach that attends to the culture specific variables that influence the persistence of African Americans in engineering. Few studies specifically examine career issues of African American students in engineering. Furthermore, much of the prevailing research assumes their career behavior is determined primarily by the barriers they encounter in the process (Lewis & Collins, 2001). Little consideration has been given to the "positive environmental conditions" (Lent, Brown, & Hackett, 2000, p. 48) that facilitate their career development process.

The applicability of many of the existing career theories to the career development process of African Americans has been questioned (Brown, 2000; Pope-

Davis & Hargrove, 2001). Social Cognitive Career Theory (SCCT) offers a useful framework for examining factors associated with African American persistence in engineering, especially with regards to the effect of contextual variables (e.g., discrimination, academic preparation) on their career self-efficacy. Self-efficacy is purported to have a direct effect on the development of interests and choices and choice actions (e.g. persistence in engineering) (Lent et al., 2005). This theory will be discussed in greater detail in Chapter 2. This study serves to redress the dearth of systematic research on the facilitative factors that inform the persistence of African American students in engineering and the process underlying their ability to succeed despite obstacles they encounter in the pursuit of an engineering degree.

Purpose of the Study

The purpose of this study is to explore the role of environmental influences, or contextual supports and barriers, on the ability of African American students to persist in an engineering major. I used qualitative inquiry—an inductive approach—to understanding their persistence in engineering (Heppner, Kivlighan, & Wampold, 1999). Specifically, I used case study methodology. Social cognitive career theory asserts that contextual supports and barriers mediate persistence through their effect on self-efficacy (Lent et al., 2000).

Part of the problem researchers have in explaining factors contributing to the persistence of African Americans in engineering is finding a suitable career model that accounts for the various sociocultural variables that describes their career development process (Brown, 1995; Pope-Davis & Hargrove, 2001). Social cognitive career theory (SCCT) is considered suitable for this study because of its emphasis on placing the

individual's career development within his or her cultural context, which is considered essential to understanding the career development process for African Americans (Pope-Davis & Hargrove). Social cognitive career theory provides the framework for understanding the role of contextual supports and barriers in conceptualizing persistence.

Research Questions

In this study, I responded to the following research questions:

- What contextual supports contribute to African American college students' ability to persist in engineering?
- What barriers did they encounter in pursuing their degree and how did they overcome them?

Importance of the Study

This study is important because it addresses a gap in the literature pertaining to facilitative factors contributing to the persistence of African Americans in engineering. Few studies examine the career issues of African American students in engineering (Lewis & Collins, 2001) and even fewer studies address students' interpretation of their experiences in engineering (Good, Halpin, & Halpin, 2002). Additionally, by studying the experiences of students in their junior and senior year, the relevant variables that affect student persistence can be more readily identified (Patterson-Stewart, Ritchie, & Sanders, 1997). Furthermore, researchers have called for more systematic research (Brown & Pinterits, 2001; Leung, 1995; Trusty, 2002a) from an emic approach. In this study, I addressed the need for using an emic approach by investigating the culture specific variables that influence the persistence of African Americans in engineering. The information gained from the students' perspectives can be used to develop more relevant

intervention programs that would directly address the perceived needs and concerns of the students themselves (Seymour & Hewitt, 1997).

Brown and Pinterits (2001) assert that more sophisticated analyses are needed for exploring the effect of culture-specific variables on the career behavior of African Americans. Sue (1999), and other researchers in the multicultural research community, are very critical of the current research because it focuses on predictive variables that determine career choice and/or persistence in a major. Morrow, Raksha, and Castaneda (2001) contend that a qualitative method grounded in the lived experiences of those investigated embraces the complexity of people's lives; gives voice to individuals that were previously silenced; and provides an opportunity to explore previously unexplored or undefined constructs, many of which appear in multicultural counseling.

Scope of the Study

The scope of this study is limited to traditional-aged African American college students attending a large, public state university in the Midatlantic region (hereto referred to as Large Midatlantic State University (LMSU)) who have reached junior or senior class status and majoring in engineering. I used case study methodology to explore the influence of contextual supports and barriers on African American college students' ability to persist in engineering. I conducted semi-structured interviews, lasting on average 82.5 minutes, with eight students. Each student represented a case. I based the number of cases on suggestions from Stake (2006) who recommended choosing 4 to 10 participants.

I acquired my participants through purposive sampling and key informants. I focused primarily on juniors and seniors as they represent individuals who have actually

persisted in the major and can provide an insider's perspective on persisting in engineering. As Richie and colleagues (1997) posited, much can be learned from African Americans who have managed to survive and succeed in their major despite the effects of racism, sexism and other indignities, which they face throughout their career. The information that could be gleaned from such studies can figure prominently in identifying effective career strategies that lead to more African Americans pursuing careers in STEM fields (Hargrow & Hendricks, 2001).

Delimitations and Limitations

This study is delimited to African American students in engineering who have persisted to their junior or senior year in college. I delimited the population group to African American students because of my interest in understanding the career development process of African Americans in STEM fields and the facilitative factors contributing to their ability to persist in engineering despite the many obstacles the literature indicates they encounter. The disproportionate focus in the literature on the deficiencies associated with the career development of African Americans (Lewis & Collins, 2001) obscures the environmentally supportive conditions or resources that can lead to improving the retention and graduation rates of African American students in engineering (Lent et al., 2000).

Performing a qualitative study limits generalizability by the very nature of being a qualitative study. As such, there is no intent to generalize the findings of this study to the broader college student population in engineering.

Definition of Terms

Persistence – attaining junior or senior year status in engineering

STEM fields – science, technology, engineering or mathematics fields

Self-efficacy - refers to "people's judgments of their capabilities to organize and execute courses of action to attain designated types of performances" (Bandura, 1986). Social cognitive theory suggests that self-efficacy beliefs are acquired and modified via four primary sources of information (or types of learning experiences): (1) personal accomplishments, (2) vicarious learning, (3) social persuasion, and (4) physiological and affective states. Success with a given task or performance domain tends to raise self-efficacy, whereas repeated failures lower them" (Lent, Brown, & Hackett, 2002).

Contextual Supports and Barriers - Contextual supports and barriers refer to the "environmental supports (facilitative influences) and barriers (obstacles) that people anticipate will accompany their goal pursuit" (Lent & Brown, 2006, p. 19)

CHAPTER 2

REVIEW OF THE RELATED LITERATURE

In this section, I reviewed the literature on some common contextual supports and barriers that contribute to the persistence of African American students in an engineering major. Social cognitive career theory provides the theoretical framework to understand the impact of contextual supports and barriers on persistence for African American students in engineering. Lent, et al. (2005) demonstrated that contextual factors influence career choice and persistence indirectly through self-efficacy. Self-efficacy, in turn, is informed through four sources of efficacy information: (a) personal accomplishment, (b) vicarious learning experiences, (c) verbal persuasion, and (d) physiological and affective states (Bandura, 1997). Consequently, this literature review focuses on the effect of contextual factors on persistence through their effect on the four sources of self-efficacy. I will begin by discussing social cognitive career theory, the theory that frames this study.

THEORETICAL FRAMEWORK

Social Cognitive Career Theory

Social cognitive career theory (SCCT) is described as being particularly relevant to explicating the career development of African Americans and other persons of color because of the cultural context that frames the basis of the theory (Brown & Pinterits, 2001; Pope-Davis & Hargrove, 2001). SCCT considers how social cognitive variables—self-efficacy, outcome expectations, and personal goals—impact career development (Lent et al., 2005, p. 112). The theory applies Bandura's (1986) general social cognitive theory and prior theory and research on career and academic self-efficacy to career development (Lent et al., 2005).

SCCT was designed expressly for the purpose of explicating the career development issues of individuals across a wide spectrum of demographic characteristics (Lent, 2005). Additionally, much of the research associated with this theory occurred in studies with individuals in STEM fields, making it well suited for this study (Lent et al., 2005). By emphasizing STEM activities and fields, SCCT researchers highlight the influence of math, science and technical experiences and skills in expanding, or constricting, individuals' career options (Lent et al., 2005). Furthermore, this emphasis on STEM fields and activities may lead to a greater understanding of the factors contributing to the under-representation of women and particular racial and ethnic minority groups in these fields. Identifying key theoretical constructs can lead to the development of theory-based interventions aimed at increasing the representation of people of color in STEM fields (Lent et al., 2005).

Betz and Hackett (1981) were the first to extend Bandura's social cognitive theory to career behavior in their study with college women. Lent, Brown, and Hackett (1994) subsequently extended Betz and Hackett work to develop a model of career development that considers the interaction between various person, environmental, and behavioral variables that are assumed to affect people's academic and career-related interests, choices, and goals (Lent et al., 2005).

Social cognitive career theory is comprised of three key variables: self-efficacy, outcome expectations, and personal goals. These three variables are considered to be the building blocks of career development (Lent, 2005). These three social cognitive variables represent "key mechanisms by which people direct their own vocational behavior (human agency) within the constraints of the many personal and environmental

influences (e.g., socio-structural barriers and supports, culture, disability status) that serve to strengthen, weaken, or in some cases, even override human agency in career development" (p. 102).

Social Cognitive Variables

Self-efficacy. Of the three main social cognitive variables, self-efficacy has received the most research attention (Lent, 2005; Lent et al., 1994; Swanson & Gore, 2000). Self-efficacy beliefs refer to an individual's belief in his or her ability perception of his or her ability to perform a given task (Lent et al., 1994). Furthermore, theory purports that these beliefs inform an individuals' choice of activities and environments in which to exercise these beliefs. Self-efficacy is purported to also shape the environment in which an individual would choose to engage. Theoretically, these beliefs are acquired and modified via four primary sources of information (or types of learning experiences): (a) personal accomplishment, (b) vicarious learning experiences, (c) verbal persuasion, and (d) physiological and affective states (Bandura, 1997). The assumption is that successful performance at a given task increases self-efficacy whereas repeated failures lower it. Personal accomplishment is asserted to have the greatest influence on self-efficacy (Bandura).

Outcome expectations. Outcome expectations refer to personal beliefs about the consequences or outcomes of performing particular behaviors (Lent et al., 1994). The issue of foregoing a particular career option figures prominently in the career development process for African Americans based on perceptions of whether certain career options are opened or closed to them (Bowman, 1995; Cheatham, 1990; Hall &

Post-Kammer, 1987). Engineering is one of those career fields that few African Americans tend to choose.

Personal goals. A goal is defined as the "determination to engage in a particular activity or to affect a particular future outcome" (Lent et al., 1994, p. 84). By setting personal goals, people "organize, guide, and sustain their own behavior, even over long intervals, without external reinforcement" (Lent, 2005, p. 105). Thus, goals constitute a critical mechanism through which people can exercise personal agency or self-empowerment (Lent). According to the theory, strong self-efficacy and positive outcome expectations are likely to lead an individual to devote the necessary time and energy to succeed in the given area of interest, such as engineering. Progress in attaining goals (or lack thereof), in turn, has a reciprocal influence on self-efficacy and outcome expectations (Lent).

Much of the research using SCCT focuses on the aforementioned social cognitive variables in isolation from the sociocultural variables that influence career behavior (Lent et al., 2000). Lent and his colleagues eventually modified the theory to include the role of contextual supports and barriers on career behavior. This inclusion of contextual factors blunts criticism of the theory that SCCT places too much emphasis on personal agency, disregarding the effect of discrimination and other sociocultural influences that circumscribe the career development of racial and ethnic minorities.

Contextual Supports and Barriers. Contextual supports and barriers refer to the various environmental "conditions that one encounters or expects to encounter" (p. 19) in the pursuit of a given career choice (Lent & Brown, 2006). SCCT presumes that individuals are likely to pursue a given career when they perceive they will encounter

more supports than barriers (Lent, 2005, p. 120). Applied to the current study, this assumption implies that, African American students who choose to major in engineering are more likely to persist in the major provided they experience environmental conditions characterized by the presence of ample support and limited barriers.

Initially, SCCT theorists presumed that contextual supports and barriers directly influenced the transitions from the development of interests to making a career choice and from the implementation of this choice to the pursuit of "choice-relevant actions" (Lent et al., 2000, p. 38). Through further research, it was determined that contextual supports and barriers affect choice goals and actions indirectly through self-efficacy (Lent et al., 2005).

Personal Accomplishment

Personal accomplishment is considered to have the strongest influence on self-efficacy. Personal accomplishment refers to the success and individual one has with a given task. This success has more influence when it occurs under challenging conditions. Easy successes lead to expectations of quick results and limits ability to rebound from experiences of failure (Bandura, 1997). In this study, academic preparation is used to conceptualize personal accomplishment.

Pre-College Preparation

Inadequate pre-college preparation is often mentioned as a significant obstacle to African Americans majoring in engineering. "The early years of schooling have an enormous impact on later success in college, both in terms of access to competitive programs and the ability to complete a degree. Minorities have made great strides" (p. 193) though they still lag behind Whites regarding high school graduation rate and

college participation rate (Wilson, 2000). This "discrepancy in school achievement is the result of several factors: 1) racial and ethnic segregation in schools; (2) language and cultural biases in school practices; (3) limited academic achievement of students; (4) dropping out of school; (5) limited school financing; (6) poor, or low, quality teacher-student interaction; (7) tracking and curriculum differentiation" (Justiz, Wilson, & Bjork, 1994, p. 160). These factors contribute to fewer opportunities to take advanced mathematics and science courses needed to pursue a STEM field. Given that African American children are disproportionately placed in low-level, remedial mathematics classes, their access to the core courses that would qualify them for careers in STEM fields is curtailed.

Course-taking in high school is demonstrated to affect the choice of a STEM major (Trusty, 2002b) and likelihood of graduation from college (Adelman, 2006). Trusty examined the effects of taking academically intensive science and math courses on choice of STEM majors in college. He considered these effects within the context of background variables, early academic performance and educational attitudes and behaviors. Using a subsample from the NELS database, he found that course-taking influenced choice of STEM majors and that there was a gender difference. For women, taking academically intensive math courses increased the likelihood of choosing a STEM major in college. Taking just one calculus course in high school more than doubled the likelihood of women choosing a STEM major in college (Trusty). Additionally, for each additional course taken beyond Algebra 2, "African-American students who started out in a four-year college would hypothetically increase their bachelor's degree attainment rate from 45 percent to 73 percent" (Adelman, p. 5). Interestingly enough, the effect of taking

higher math courses in high school was "independent of the effect of background variables, early science and math performance and educational attitudes and behaviors" (Trusty, 2002b, p. 469). For men, the only course that showed any effect was physics and the effect was small. Trusty concluded that there are "genuine gender differences in the effects of course-taking" (p. 472) and that SES has "little bivariate or multivariate effect for women or men" (p. 473).

Horn and colleagues (2001) had similar findings. In their study examining "the relationship between high school academic curricula and students' persistence path through college, approximately 3 years after first enrolling" (p. iii) they found that a rigorous high school curriculum was a "stronger predictor of bachelor degree attainment than standardized test scores or other measures of high school academic performance" (p. x). Horn et al. used the 1995-1996 Beginning Postsecondary Students Survey, "a longitudinal study of beginning post-secondary students who first enrolled in a 4-year college in 1995-96" (p. iii). A rigorous academic curriculum is identified as including 4 years of English and mathematics (including pre-calculus or higher), 3 years of a foreign language, social studies, and science (including biology, chemistry, and physics) and at least one Advanced Placement (AP) course or test taken. They argue that a rigorous academic curriculum in high school compensates for "socioeconomic disadvantages such as low family income and parents with no college experience" (p. 38).

Summer bridge programs for students underrepresented in engineering programs can fill the void of inadequate pre-college preparation. One such program is the Pre-First Year Engineering & Science Program (PREF) at The Pennsylvania State University (Persaud & Freeman, 2005). It is a selective, residential, six-week program that consists

of intensive academic preparatory courses along with study skills seminars to increase the likelihood of academic success. "The overall objective of the PREF program is to maximize the retention and graduation of underrepresented minority first-year students in engineering and science majors at The Pennsylvania State University" (Persaud & Freeman).

Both university and corporate funding support the PREF program. As a result, the program is limited to admitting only 15-18 students per year, at no cost to the students. Participants are full time students at Penn State admitted during the summer. The program addresses three areas that are considered to be important to the successful adjustment to college: "social/cultural, academic, and professional development" (Persaud & Freeman, 2005).

The total number of PREF participants in the College of Engineering were 200 with an average of 22 students per year from 1991-1999 with a five-year graduation rate ranging from 63% to 88%. Sixty-three percent is still higher than the highest overall graduation rate (59%) of non-minority students in engineering in the same time period (Persaud & Freeman, 2005). The efficacy of the program is demonstrated by the difference in the first semester GPA of participants (2.94) and non-participants (2.59) and an average graduation rate of 74%. Persaud and Freeman argue that the PREF program serves as a strong retention mechanism that fosters success in students' first semester transition and leads to ultimate success.

Familial influence is also shown to enhance pre-college preparation for African American students (Herndon & Hirt, 2004; Maton, Hrabowski, & Greif, 1998). Herndon and Hirt argue that families and extended kinship network can provide students a solid

foundation prior to entering college and that this influence will lead to them graduating in their major. Herndon and Hirt explored the "role of families in the lives of successful black college students" (p. 489). They defined successful students as those who had achieved senior status. They performed a qualitative study with successful African American college students and members of those students' families. They interviewed 10 students each from two large, public research universities with one located in a rural region and the other in major urban area of the state. The student participants' ages ranged from 20-27 and were in a variety of majors including engineering.

Herndon and Hirt (2004) found that from their college success model three stages emerged: pre-college influences, early college influences, and late college influences. Of the three stages, pre-college influences yielded the most comments from the students. Herndon and Hirt concluded that "the groundwork to succeed in college is laid by family members and fictive kin throughout childhood and that the success experienced by students extends well beyond graduation" (pp. 509-510). Their findings are consistent with the results of studies by Richie, Fassinger, Linn-Geschmay, Johnson, Prosser, and Robinson (1997) and Pearson and Bieschke (2001). In both of these studies, "successful" African American women attributed their success to the early influence of their family in their academic preparation.

Herndon and Hirt's (2004) findings are supported by Maton, et al. (1998) who argue that determined parents are "tremendously influential in their sons' high levels of academic achievement" (p. 662) and that this style of parenting can compensate for African Americans for potentially negative contextual influences of neighborhood, peers, schools, and society" (p. 662). The young males in the study "consistently point to their

parents' determined support and consistent pushing as the reason they have done well, stayed focused, and overcome the various challenges faced" (p. 662). Still, "factors other than pre-college preparation and native ability work to depress minority achievement and persistence" (Maton & Hrabowski, 2004, pp. 547-548) in STEM fields.

College Experience

Though students' first year GPA has been shown to positively correlate to persistence at least to the sophomore year (Lotkowski, Robbins, & Noeth, 2004; Nora & Cabrera, 1996; Schaefers, Epperson, & Nauta, 1997; Zhang, Anderson, Ohland, Carter, & Thorndyke, 2004), academic performance may not be as predictive of persistence for African American students. Cokley (2003) contends that African American students' academic performance is not necessarily indicative of their perceived academic ability or of their academic self-concept. Cokley defines academic self-concept as the student's view of "his or her academic ability when compared to other students and consists of attitudes, feelings, and perceptions about one's academic skills" (p. 529). Furthermore, "studies have shown little difference in academic status between students staying in engineering and students leaving" (Felder, Felder, & Dietz, 1998, p. 469). Cokley's assertion finds support in the literature (Eimers & Pike, 1997; St. John, Hu, Simmons, Carter, & Weber, 2004).

Eimers and Pike (1997) surveyed 799 college freshmen, of which 88% were Caucasian. The purpose of the study was to "identify the similarities and differences among minority and non-minority freshmen persistence" (p. 81). They found that for minority students, their academic integration was more important than their pre-college preparation in predicting their first year achievement. They defined academic integration

as the combination of both academic involvement and academic achievement. Furthermore, for students of color, their academic performance, alone, was not predictive of their intent to stay or leave the institution. Regarding the ultimate premise of their study, there was no difference in persistence rates between the students of color and the Caucasian students despite students of color perceiving more discrimination than White students. "For both groups, perceived discrimination had a small direct effect on academic integration (negative) and a small indirect effect on intentions to persist (negative)" (p. 93).

St. John et al. (2004) also obtained some interesting results. Using data from the Indiana Commission for Higher Education's Student Information System (ICHE-SIS), St. John and colleagues examined the influence of major choice and financial aid on persistence for White and African American students. They restricted their sample to "freshmen and sophomores enrolled either full- or part- time, yielding final samples of 3,123 White and 5,755 African American freshmen and sophomores that approximate the larger populations they represent" (p. 214). They asserted that academic performance in college is important for persistence and that lower college grades would compromise persistence. The findings in their study indicated otherwise. The African American students in the study showed a "negative association between receiving A averages and the probability of persisting" (p. 224). They speculated that this might be attributable to high-achieving African Americans transferring to "in-state private institutions or more prestigious out-of-state institutions" (p. 224).

These seemingly counterintuitive results may be better explained by other factors such as their motivational framework (Cokley, 2003), interest congruence (Leuwerke,

Robbins, Sawyer, & Hovland, 2004), or other personal factors (e.g. adjustment to college, ability limitation) (Lent, Brown, Talleyrand et al., 2002). It remains unclear as to how African American students' academic performance in college informs their self-efficacy and their decision to remain in engineering. Many students enter college with the intent to major in engineering, achieve academically (Levin & Wyckoff, 1995) yet still fail to persist in engineering (Maton & Hrabowski, 2004).

Theoretically, performance appraisal (e.g. academic achievement) has been noted as having the strongest effect on self-efficacy, affecting persistence indirectly through interest development (Lent et al., 1994). As this phenomenon of an inverse relationship between academic achievement and persistence in college has been noted in other studies (Cokley, 2003; Good et al., 2002; Levin & Wyckoff, 1995), this area of research needs greater scrutiny.

Vicarious Learning Experiences

Vicarious learning experiences provided by role models is purported to be the second most influential source of self-efficacy (Bandura, 1997). Vicarious learning experiences are more influential when individuals share similar traits with the role model. "The greater the assumed similarities the more persuasive are the models' successes and failures" (Bandura, 1995, p. 3).

Researchers (Hackett & Byars, 1996; Herndon & Hirt, 2004; Karunanayake & Nauta, 2004; Murry & Mosidi, 1993) have found that the lack of sufficient role models in STEM fields contribute to African American students' consideration of a career in engineering as viable and achievable. The first opportunity to learn through vicarious

experiences occurs at an early age within the family and extended family network (Hill, 1997).

High achieving African American male students "consistently point to their parents' determined support and consistent pushing" (Maton et al., 1998, p. 663) as being key to their success and their ability to overcome the various challenges they encounter in their pursuit of an engineering degree (Maton et al.). Maton and his colleagues "examine[d] the role of the family in the academic success of very high-achieving African American males" (p. 639). They interviewed 60 African American males in a "multifaceted support program for students interested in careers in science, engineering, or mathematics high achieving students majoring in a STEM field" (p. 644). The students' parents were also included in the study.

One of the key parenting themes that emerged from the data pertained to both emotional support and modeling (Maton et al., 1998). Some students recounted the importance of their father as a role model. Commenting on the pervasive negative portrayals of Black men, one student noted that his "dad was an example of that successful figure" (p. 653) not often portrayed in society. Other comments regarding modeling provided by the father included learning "how to be a man" (p. 653), instilling in them a "desire to learn and achieve" (p. 653) and observing his father "going to school to get his Master's so he can be more of an asset to his corporation" (p. 653). The students attributed their success in college to their "extremely engaged, determined, loving, strict, encouraging, demanding, and resourceful parents" (p. 662). Maton et al. contend that this style of parenting can compensate for "potentially negative contextual influences of

neighborhood, peers, schools, and society" (p. 662) many young African American males encounter.

The literature also points out that students seem to understand and appreciate that having a mentor or role model can enhance their academic success (Lee, 1999). Lee explored students' perspectives on their adjustment to the university along with their perspectives on the value of having a faculty mentor. Lee conducted focus groups addressing three general areas: (1) students' perspectives on their adjustment to the university; (2) "the value of having a faculty mentor" (p. 35); and (3) "the importance of having a same-race mentor" (p. 35). The participants in the study were primarily African American students in a university transition program for students conditionally admitted to the university. The goal of the program is to "facilitate the transition of academically underprepared students into the university environment to [enhance their chances of academic success]" (p. 34). One hundred twenty students were interviewed in focus groups.

Lee (1999) found that some students were initially resistant to using mentors as they assumed there was a financial cost involved. Most students felt that a mentor "would be a tremendous help to their academic and professional development" (p. 36). One student commented:

> I would love to have a person that I could talk to about my field! It would be great to talk to someone who has already been there. I would like to see success … It'll let me hang on to the idea that I can do it too (p. 36).

Regarding the importance of having a same-race mentor, Lee found that the students were more interested in having a faculty mentor in their major field than having one who is an African American. This finding is contrary to those of many studies that point to the importance of same-race mentors (Hackett & Byars, 1996; Karunanayake &

Nauta, 2004; LaVant, Anderson, & Tiggs, 1997). Lee expressed surprise that this was the case. The students stated that they could find the cultural connection elsewhere.

Such was the case of three students in the Lewis and Collins (2001) study. None of these three students indicated that race was a conscious factor in their career decisions. Using a series of semistructured interviews, Lewis and Collins explored three African American students' career decision process to understand why they remained in or left their initial majors in the sciences. Of the three students, only one went on to continue in his major. Lewis and Collins uncovered four themes to explain these students' decision to remain or leave their major. These four themes are: (1) " a degree and coursework is a credential needed to begin practicing science" (p. 619); (2) "science is not always practiced properly" (p. 619); (3) "each scientist engages in the practice of science differently" (p. 619); and (4) "the practice of science can change and [the student] can be a change agent" (p. 619). The two students, who left their major, did not agree to any of these premises, lacked a full understanding of their career field, and did not fully appreciate their own sense of agency in shaping their career. They ultimately made their career decisions based on limited, and seemingly inaccurate, information. For these two students, there was a clear mismatch between their understanding of science and scientists and the "understanding that science educators would like to foster" (p. 619). These two students did not fully understand the nature of science, the type of tasks performed by people in STEM fields or the type of lives that people in STEM fields live. One of the students acknowledged that he knew nothing of what it meant to be an engineer because "nobody in my family has ever done anything like that" (p. 620). This is in contrast to the lone student who remained in his major. The one student remaining in

his major was proactive in pursuing opportunities (e.g. volunteering, seeking a mentor) that would increase his knowledge of his chosen field.

Verbal Persuasion

Verbal persuasion is the third source of efficacy information that strengthens or weakens one's belief in their ability to succeed (Bandura, 1995). Verbal persuasion refers to verbal information and messages conveying encouragement or discouragement (Hackett & Byars, 1996). Theoretically, encouragement serves to enhance self-efficacy, at least when such encouragement is roughly congruent with actual performance capabilities. Conversely, "lack of encouragement and blatant discouragement is very likely to negatively influence low or weak efficacy estimates and may even erode stronger career efficacy beliefs" (p. 334).

A partial explanation for the underrepresentation of African Americans in engineering may be attributed to messages that discourage them from pursuing a degree in engineering. For instances, they may be told that they lack the intellectual capacity to achieve in a STEM field (Brown, 2000; Chung, Baskin, & Case, 1999; Maton et al., 1998; McCollum, 1998; Murry & Mosidi, 1993; Powell, 1990), or that it is not a field for African Americans (Bowman, 1993; Hall & Post-Kammer, 1987). Determined family involvement, as noted by Maton and his colleagues can compensate for negative messages African American students may hear, either directly or indirectly, regarding their choice of and ability to succeed in an engineering program. One student from Herndon and Hirt's (2004) study recounted the importance of having her parents teach her that "because she was black and female, [she] would face obstacles, but could still excel academically" (p. 501). Another student from the same study spoke of his

motivation to succeed by his mother saying, “my degree is hers. Kids have to do the living that the parents didn’t have a chance to do” (p. 504).

Sometimes students must provide themselves with encouraging messages to persist in their program of study. Students in Moore, Madison-Colmore, and Smith’s (2003) study exhibiting the “prove-them-wrong” syndrome, spoke of the need to push back against stereotypes, or telling themselves that they are getting nothing less than a B- in their class. Whether these students are unique in their ability to overcome the psychological and sociological challenges associated with being in an engineering program has yet to be determined (Moore et al.).

Physiological and Affective States

Physiological and affective states represent the fourth and least influential source of efficacy information for which people rely partly on in judging their abilities. Undue stress and tension is interpreted as a barometer of poor performance . Mood also affects peoples’ judgments of their personal efficacy. Positive mood enhances perceived self-efficacy; despondent mood diminishes it. The fourth way to altering beliefs is to enhance physical status, reduce stress, negative emotional proclivities, and correct misinterpretations of bodily states.

Physiological and affective states pertains to persons’ belief in their ability to cope with the stressful vagaries of life (Bandura, 1997). African American students at predominantly White institutions majoring in engineering are likely to find the environment both hostile and isolating (National Action Council for Minorities in Engineering (NACME), 2004). The research is not clear as to the extent that psychological and affective states inform self-efficacy and subsequently persistence in

engineering. Theoretically, moderate levels of anxiety will have a facilitative effect on self-efficacy while high levels of anxiety will undermine self-efficacy (Hackett & Byars, 1996). Two areas that seem to influence physiological effects for African American students in engineering pertain to cultural issues (Cole & Jacob Arriola, 2007; Evans & Herr, 1994; Landrine & Klonoff, 1996; Lent, Brown, Talleyrand et al., 2002; Moore et al., 2003) and social isolation (Fries-Britt, 1998; Fries-Britt & Turner, 2002; Good et al., 2002; Herndon & Hirt, 2004) issues.

Cultural Issues

Career development has frequently explained differences in career choice amongst cultural groups from a deficit perspective suggesting that the career development of African Americans' career development is constricted by their race (Bowman, 1993; Brown, 2000; Chung et al., 1999; Maton et al., 1998; McCollum, 1998; Murry & Mosidi, 1993; Powell, 1990). Race, alone, is insufficient to explain the differences in the career development of African Americans in comparison to that of European Americans especially given that research had yet to determine "what is truly racial about the career behavior and counseling of African Americans" (Brown & Pinterits, 2001, p. 2). Recently, researchers have asserted that understanding the career behavior of ethnic minorities may be better understood in terms of acculturation (Pope-Davis & Hargrove, 2001; Pope-Davis, Liu, Ledesma-Jones, & Nevitt, 2000). Acculturation can provide a more "promising nonracist way of explaining and understanding ethnic differences" (Landrine & Klonoff, 1996, p. 1). Acculturation may be "one of many behavioral strategies used by African Americans to cope with the dominant system within the context of career development" (Pope-Davis & Hargrove,

2001, p. 183). Landrine and Klonoff have developed one of two measurements that assess the acculturation level of African Americans' psychological and sociological adaptation to the dominant culture.

The notion of acculturation fits well with the study's emphasis on the facilitative factors associated with the career development of African Americans' behavior, notably persistence in engineering. Ethnic differences, then, are understood as differences in degrees of acculturation rather than an inherent difference that is frequently couched in deficit terms (Landrine & Klonoff, 1996). Acculturation as defined above connotes some agency in how an individual adapts to a given situation. And so, any adjustment issues can be understood in terms of individual stylistic preferences in interactions with people from another culture verses endemic deficiencies because of race.

Landrine and Klonoff (1996) conceptualized acculturation as a three part continuum: traditional, bicultural, and acculturated. People at the traditional end of the continuum "remain immersed in many of the beliefs, practices, and values of their own culture" (p.1). At the other end of the continuum are those individuals who are considered acculturated. Acculturated individuals reject the beliefs, practices and values of their culture of origin outright or never learn their culture's traditions. In the middle of the continuum are those considered to be bicultural. Bicultural individuals incorporate the values of both the culture of origin and the dominant culture and can participate in the two different cultures simultaneously. Additionally, Landrine and Klonoff noted that regardless of where an ethnic minority begins on the acculturation continuum, he or she would eventually migrate to a more traditional level of acculturation. Acculturation in this study is understood in terms of an individual psychological process.

Much of the research associated with African American acculturation focuses on aspects of African American's psychological health (Pillay, 2005), model and/or scale development (Cole & Jacob Arriola, 2007; Klonoff & Landrine, 2000; Landrine & Klonoff, 1996), and effects of discrimination (Broman, Mavaddat, & Hsu, 2000; Suarez-Balcazar, Orellana-Damacela, Nelson, Rowan, & Andrews-Guillen, 2003). There are little to no valid and reliable measures to assess the role of acculturation in the career development of African Americans (Pope-Davis & Hargrove, 2001). Acculturation research as pertains to racial discrimination has received some attention. Racial discrimination has been mentioned in the literature as something African Americans are highly likely to experience, especially at a predominantly White institution, (Broman et al., 2000; Cole & Jacob Arriola, 2007; Suarez-Balcazar et al., 2003) and has some effect on the career choices of African Americans (Evans & Herr, 1994; Lent, Brown, Talleyrand et al., 2002; Moore et al., 2003).

Broman et al (2000) found that younger African Americans tended to perceive more discrimination than older African Americans and that those African Americans who perceive discrimination have "lower levels of mastery and higher levels of psychological distress (p. 177)." Consistent with Broman, Pillay (2005) found that higher levels of acculturation contributed a modest, yet statistically significant, and positive effect to psychological health. His participants were 136 undergraduate, African American college students who attended a predominantly White institution in the Midwest. His findings supported those of Landrine and Klonoff who found that African Americans who were more traditional were more likely to experience greater levels of racial discrimination and

the associated psychological stress than those who tended to be more toward the acculturated end of the continuum.

Grandy (1998) asserted that "noncognitive factors such as self-concept, understanding of racism and coping ability play more critical roles in persistence than do cognitive factors" (p. 590). Chavous and colleagues (2004) suggested that because African Americans tend not to be particularly valued by a particular group, African Americans will avoid those activities generally associated with that particular group. They stated that African Americans do this in an effort to protect their self-concept. Chavous et al seem to have implied that African Americans anticipate being discriminated against and in order to preserve their sense of self, they (African Americans) will choose not to pursue an engineering degree.

Evans and Herr (1994) found otherwise. They found that the perception of discrimination was not predictive of traditional career aspirations. They studied the "effect of racial identity and perception of discrimination on the traditional career aspirations of African American college students" (p. 173). Evans and Herr defined "traditional," or "protected," occupations as those fields that "provided services primarily to the African American community. They include careers in education, social work, and government work" (p. 173) and tend to be occupations with low prestige and low pay. Engineering is a field that is considered untraditional for African Americans because fewer than 30% of them are currently employed in the field. Evans and Herr argue that the perception of discrimination was not predictive of 'traditional' career aspirations for participants in their study. They asserted that through experiencing a "life-time of exposure to perceived racial discrimination and helplessness, African Americans have

learned to accommodate themselves to a disadvantaged status and have socialized their young accordingly. … racial discrimination is a way of life beyond their ability to alter, eliminate, or avoid. Consequently, they may see little or no utility in attempting to do so in career selection" (p. 182). This conclusion has much support in the literature (Allen, 1992; Cokley, 2003; Lent, Brown, Talleyrand et al., 2002; Lewis & Collins, 2001; Moore, 2006).

Moore, et al. (2003), in their study exploring "the persistence of African American males in engineering programs" (Moore et al.), attributes successful adjustment to the "prove-them-wrong" syndrome. Moore and his colleagues explored the "attitudes, perceptions, and experiences of persistent African American males majoring in engineering" (Moore et al.). They interviewed 24 African American males (juniors and seniors), with a mean age of 22 years. The mean GPA was 2.6, and the mean high school GPA was 3.46. SAT composite scores ranged from 900 to 1370, with a mean score of 1090. The participants were well distributed across engineering disciplines. A grounded theory approach was used and a "prove-them-wrong" syndrome evolved. This syndrome "illustrates and explains the academic and social experiences, attitudes, and personality characteristics of persistent African American males pursuing engineering degrees" (Moore et al.). These engineering students developed a coping mechanism that allows them to persevere despite the obstacles they encounter. Furthermore, they assumed a more assertive academic posture and a stronger sense of purpose, commitment, and confidence in their academic persistence and performance, especially when their intellectual ability was called into question.

One of the challenges that the students mentioned pertains to having to "work twice as hard proving someone wrong as opposed to proving someone right" (Moore et al., 2003) and overcoming stereotypes held by both faculty and peers. This is a familiar refrain for African Americans. They also spoke of their tenacity and commitment to do well in availing themselves of the resources to achieve their goal. Though not restricted solely to African Americans or engineering students, (Lent, Brown, Talleyrand et al., 2002) found similar responses for the students in their study examining the "perceived influences on college students' selection and implementation of career choices" (p. 61). The majority of their participants reported that they "expected to pursue their ideal career choices" (p. 70) despite various impediments they anticipated encountering.

Isolation

Feelings of isolation are posited to pose a significant barrier to the persistence of African Americans majoring in engineering at a PWI (Seymour & Hewitt, 1997). Commenting on the adjustment to college, a rural student attending a large, public, PWI in a mid-Atlantic state said "if you are a Black person … you have isolated yourself just by choosing to come here" (Herndon & Hirt, 2004, p. 502). A family member of an African American student from an urban area recounts the importance of the family instilling "a lot of self-esteem" (p. 502) in the student. This family member continues, "If you don't have it in your family or with yourself, your self-esteem could go down fast" (p. 502). Herndon and Hirt contend that it is important for African Americans to develop a sense of belonging with other African American students on campus. For engineering students, minority engineering programs and similar programming can provide them with such a community (Good et al., 2002).

Fries-Britt (1998) examined "the academic, social, and racial experiences of Black students enrolled in … a merit based scholarship program for students in math, science, and engineering" (p. 556). She conducted interviews focusing on their academic, social and racial experiences on campus. All the students participating in the study were in the Meyerhoff Scholars program which is a selective, honors program at the University of Maryland-Baltimore County (UMBC) that was developed to address "the low levels of performance of well-qualified African American STEM majors" (Maton & Hrabowski, 2004, p. 548). Twelve students were interviewed during their senior year. Tinto's (1987) six principles of academic and social integration formed the basis of the interview questions. The students in the study reported feeling isolated from their fellow African American peers who were not in the program. However, membership in the program helped alleviate some of this sense of isolation. These students also had limited exposure to, and interaction with, other high-achieving Blacks in high school. Additionally, 8 of the 12 students noted that having access to other high achieving blacks was very important. Regarding participation in a race-specific program, the students found that the "program contributed to their success both academically and socially because of resources, community of high-ability students, and faculty who were aware of their ability" (p. 565). Initially, at least half of the group discounted the importance of being in a race specific program. Looking back, more students appreciated being in a program that targeted high achieving black students.

Many schools have similar programs to facilitate the adjustment of students of color to college and the field of engineering. The National Action Council for Minorities in Engineering (NACME) established minority engineering programs (MEP) with the

goal of "enhancing the academic and survival skills of minority students and enabling them to overcome the institutional obstacles they faced" (National Action Council for Minorities in Engineering (NACME), 2004). Unlike the Meyerhoff Scholars program, participation in a MEP is available to all students of color admitted into an engineering program.

Good and her colleagues (2002) assessed the effect of an MEP on academic achievement and retention for students in the College of Engineering throughout the sophomore year of study. The MEP, in this instance, had "no clear impact on academic outcomes" (p. 356). No clear difference differentiated those who stayed in the program and those who left. The cumulative means for grade point average were 2.45 for participants and 2.23 for non-participants. So, even though the students were not differentiated by academic achievement, they were differentiated by non-cognitive factors, such as interest in and commitment to engineering. Those who opted to stay in the program cited familiarity with engineering through "actual exposure to the profession through parents or family friends" (p. 357). Conversely, the students who left engineering had limited knowledge of engineering prior to pursuing the major. Leuwerke, et al. (2004) support the findings of Good, et al. concluding that interest congruence may supersede the impact of race/ethnicity and gender. Though Good et al. did not find support for their hypothesis that MEPs have a positive effect on academic achievement; they posited that the MEP may be instrumental in helping students of color gain knowledge of the myriad of academic support services available to them. Additionally, the MEPs can provide them with a sense of belonging within the engineering community that can help alleviate the potential deleterious effects of isolation.

Summary of the Related Literature

In summary, the literature reveals:

1. Contextual supports and barriers influence persistence indirectly through their influence on the four primary sources of self-efficacy information (Lent et al., 2005). These four sources of self-efficacy influence the persistence of African American engineering students in various degrees and forms: performance accomplishment, vicarious learning experiences, verbal persuasion and physiological effects. Performance accomplishment is purported to have the strongest effect on students' self-efficacy (Bandura, 1997).
2. Research results have been mixed regarding the importance of performance accomplishment for African American students' and their persistence in college. Course-taking in high school (Adelman, 2006; Horn et al., 2001; Trusty, 2002b), family and extended network support (Herndon & Hirt, 2004; Maton et al., 1998) and pre-college bridge programs (Persaud & Freeman, 2005) demonstrate factors that correlate to African American students' success in engineering. Researchers, have found, however, that academic performance alone is not predictive of students' intent to persist in the major (Eimers & Pike, 1997) and in some instances can have a "negative association between receiving A averages and the probability of persisting" (St. John et al., 2004, p. 224).
3. Vicarious learning experiences in the form of role models and mentoring is purported to contribute to the underrepresentation of African Americans in engineering because of the paucity of role models in engineering (Hargrow &

Hendricks, 2001; Karunanayake & Nauta, 2004; Murry & Mosidi, 1993). The family figures prominently in providing some of the earliest role models and with a determined style of parenting can compensate for "potentially negative contextual influences of neighborhood, peers, schools, and society" (Maton et al., 1998, p. 662). In college, the literature shows that students place more importance on having a mentor compatible with their desired career choice rather than having a same-race mentor (Lee, 1999). This is contrary to what other researchers have noted as being crucial to increasing the number of African Americans in fields in which they are underrepresented (Hackett & Byars, 1996; Karunanayake & Nauta, 2004; LaVant et al., 1997).

4. Verbal Persuasion, or messages from significant others, is posited to have the weakest effect on self-efficacy (Bandura, 1997). These messages can be encouraging or discouraging and have been posited to contribute in a significant way to African American students opting out of engineering as a field not for them (Bowman, 1993; Brown, 2000; Chung et al., 1999; Maton et al., 1998; McCollum, 1998; Murry & Mosidi, 1993; Powell, 1990). Encouraging messages from family members (Herndon & Hirt, 2004; Maton et al., 1998), peers (Fries-Britt, 1998)and themselves (Moore et al., 2003) is demonstrated to facilitate African American students' self-efficacy and persistence in engineering.
5. Regarding physiological effects, culture issues such as acculturation, discrimination (Evans & Herr, 1994; Lent, Brown, Talleyrand et al., 2002; Moore et al., 2003) and isolation (Fries-Britt, 1998; Fries-Britt & Turner,

2002; Good et al., 2002; Herndon & Hirt, 2004) was discussed. The influence of physiological effects related to discrimination vary in degree and form and is influenced by acculturation (Broman et al., 2000). Those holding traditional views were predicted to have higher levels of psychological distress. This higher level of distress may compromise their ability to deal with the discrimination they encounter. The idea that the perception of being discriminated against contributes to African Americans opting out of engineering is not supported in the literature (Evans & Herr). Furthermore, when African Americans experience discrimination of varying sorts, some assume a prove-them-wrong attitude that allows them to continue in their pursuit of their engineering degree despite having to "work twice as hard proving someone wrong as opposed to proving someone right" (Moore et al.). Peers, race-specific programs and family help students deal with the isolation. African American students are very aware that just by pursuing a college degree they are isolating themselves (Herndon & Hirt).

CHAPTER 3

METHODOLOGY

The purpose of this study was to explore the role of environmental influences, or contextual supports and barriers, on the ability of African American students to persist in an engineering major. Qualitative research is an inductive approach to understanding the phenomenon of interest, in this case, the persistence of African Americans majoring in engineering. From a constructivist perspective, my interest is in understanding the participants' social constructions of their lived experience of pursuing an engineering degree at a PWI (Heppner et al., 1999). Social cognitive career theory asserts that contextual supports and barriers mediate persistence through their effect on self-efficacy (Lent et al., 2000). In this study, I conducted a qualitative study using case study methodology. Additionally, social cognitive career theory provides the theoretical framework for conceptualizing persistence. I will begin by discussing the interpretive/constructivist paradigm, the qualitative paradigm guiding the conceptualization, analysis, and interpretation of the resultant data of the study.

Qualitative Paradigm

I used an interpretive/constructivist paradigm to frame my study. This paradigm is characterized by the notion of "multiple, constructed realities, rather than a single true reality" (Ponterotto, 2005, p. 130). 130). Reality, according to the constructivist position, is "subjective and influenced by the context of the situation, namely the individual's experience and perceptions, the social environment, and the interaction between the individual and the researcher" (p. 130). This approach assumes that true meaning is hidden and can only be revealed through the interaction between the researcher and the

participant (Schwandt, 2000). This researcher-participant interaction forms the crux of the process in the search to uncover the deeper meaning of the participants' experiences. Reality is then co-created through the interaction between the researcher and participant, with the goal of focusing on the individuals (idiographic) and the uniqueness of their behaviors (emic) within their sociocultural context (Ponterotto).

Rationale for Research Design

As qualitative research has gained wider acceptance in the counseling community (Reisetter et al., 2004), I chose to use qualitative inquiry for this study because of the dearth of literature that focuses on the facilitative factors that contribute to African American students persisting in engineering. This is also an opportunity to give voice to individuals who have actually persisted in engineering (Creswell, 2007). Much of the existing research on African American career development focuses on their deficiencies and assumes that these deficiencies determine their career behavior (Brown & Pinterits, 2001; Lewis & Collins, 2001). Furthermore, few studies specifically examine career issues of African American students in engineering (Lewis & Collins, 2001; Moore, 2006). Qualitative research methods are particularly suited to studying African American students career behaviors because of the emphasis on placing the persons studied within their sociocultural context (Byars & McCubbin, 2001; Sue, 1999). Additionally, "qualitative research paradigms have philosophical consistency with multicultural counseling, and several are promising for building theory and addressing complex questions in the career development of people of color" (Trusty, 2002a, p. 205).

Qualitative Method

Case Study

Case study research holds a "long, distinguished history across many disciplines" (Creswell, 2007, p. 73) and is the most common method of qualitative inquiry (Stake, 2000). Case study research is unique among qualitative research methodologies as it is "both a process of inquiry about the case and the product of that inquiry" (Stake, 2000, p. 430). Creswell (2007) describes case study as a "qualitative approach in which the investigator explores a bounded system or multiple bounded systems, through detailed, in-depth data collection involving multiple sources of information, and reports a case description and case-based themes" (p. 73). A case is a bounded system and is more of an object than a process, according to Stake (1995). The case researcher demonstrates both the commonality and the particularity of and between the cases (Stake, 2000). For this study, the case— the bounded system—is African American college students who have persisted in engineering at a PWI.

Stake (1995) describes three types of case studies: intrinsic, instrumental and collective case study. For this study, I used collective, or multiple case study inquiry, which is essentially instrumental case study with multiple cases. Instrumental case study is used when exploring a particular issue associated with a given case or cases. This is in contrast to an intrinsic case study that focuses on the specifics of that particular case (Stake). The issue of interest is environmental influences—contextual support and barriers—that contribute to the persistence of African Americans in engineering at a PWI. As is the case with all research, "everything about the case [can not] be understood" (Stake, 2000, p. 439). The nature of this study presumes the issues, the perceptions; the

theory (Stake, 2000) will evolve as the process proceeds. The content of the case evolves in the "last phases of writing" (p. 441) being mindful that the "purpose of a case report is not to represent the world, but to represent the case" (p. 448).

Site and Sample Selection

Eight students attending LMSU* (pseudonym) were interviewed for this study. LMSU is a land-grant institution, public, research university with multiple campuses. LMSU provides undergraduate, graduate, professional, and continuing and distance education. The 2007-2008 enrollment at LMSU consisted of approximately 38,000 undergraduate students and approximately 44,000 total students (Integrated Postsecondary Education Data System (IPEDS), 2009). African American students comprise approximately 4% of undergraduate students and have the lowest 4-year graduation (66%) of all ethnic groups (Integrated Postsecondary Education Data System (IPEDS)). The overall graduation rate is 84%. For the 2007-2008 academic year, LMSU conferred 1289 (13.4%) engineering bachelor's degrees; African Americans received 26 (2%) of the engineering degrees. Engineering bachelor's degrees represent the second largest percentage of all the degrees conferred; business degrees (16%) the largest (Integrated Postsecondary Education Data System (IPEDS))..

I used purposeful sampling to recruit the participants for the study (Creswell, 2007; Stake, 2006). A common sampling strategies in qualitative research, purposeful sampling refers to the process of preselecting participants that best meet characteristics to explain the stated phenomenon (Creswell). I contacted Clarice Davis (pseudonym), the Director of the Multicultural Engineering Program (MEP), a key informant in the MEP to acquire the names of individuals who met the criteria: African American, in their junior

or senior year (according to the registrar), and accepted into an engineering major at LMSU. I included juniors and seniors because they have a sufficient amount of academic exposure and experience in engineering and are highly likely to graduate (Pascarella & Terenzini, 1991). The individual student is my unit of analysis.

Participants and Setting

During the 2008-2009 fall and spring semesters, I interviewed a total of eight participants for this study. Five juniors and three seniors enrolled in the College of Engineering participated in the study. Prior to conducting the interview, the participants signed an informed consent form which provided me with access to their Facebook page and a copy of their resume and/or course project for additional sources of data. These interviews were subsequently transcribed and coded for analysis.

Participants (N=8) were students registered in the College of Engineering at LMSU. Three student participants (David, Edward, and Frank) were seniors and five were juniors (Andre, Benjamin, Charlie, Gina, and Henri) with an average age of 22. They were enrolled in the following majors: aerospace engineering, agricultural engineering, chemical engineering, computer science, electrical engineering, and industrial engineering. The students' self-reported socioeconomic status ranged from low income to "well off." All but two students (David and Edward) had taken an advanced math course in pre-calculus, or calculus, prior to attending college (See Table 1).

Their median GPA was 2.7—three students had a GPA higher than 2.9. Three students reported that their parents divorced; four students' parents were married and one student's parents never married. The students represent the diversity that comprise the African American community (Kimbrough & Salomone, 1993). All the students are

currently United States citizens though three of them spent some portion of their childhood outside the United States (Caribbean and Africa). The students' majors included: aerospace engineering (2); agricultural engineering (1); chemical engineering (1); computer science (1); electrical engineering (1); and industrial engineering (2). The median age was 22 while the median college GPA was 2.7.

Data Collection

Interviews

In case study research, the researcher determines the appropriate sample size that will allow sufficient thick description of the case without comprising the depth of the analysis (Creswell, 2007; Stake, 2000, 2006). As such, I interviewed eight students for the study and used semistructured interviews that lasted on average 82.5 minutes. I used an interview protocol that served as a flexible framework to guide the interview (See Appendix A). This flexibility allowed for the emergence of data needed to respond to the research questions (Maxwell, 2005). The interview questions can be found in the Appendix and are adapted from Seymour and Hewitt (1997). The purpose of interview process is to "acquire a rich understanding of other people's [the students'] lives and experiences" (Rubin & Rubin, 2005, p. vii). Qualitative interviewing is a way of discovering what others feel and think about their worlds. It is an "intentional way of learning about people's feelings, thoughts and experiences, guided by the researcher intentionally introducing a limited number of questions for the interviewee to explore in depth" (p. 2).

Table 1

Demographic information of the participants in the study

Case*	Age	Class	GPA	HS Math	MEP	Major	Parent's Marital Status	SES	Summer Bridge Program	Work
Andre	20	Junior	3.4	Calculus	Yes	Computer Science	Divorced	Low Income	PREF	Yes
Ben	20	Junior	2.7	Calculus	Yes	Industrial Engineering	Divorced	High Income	PREF	Yes
Charlie	20	Junior	2.7	Calculus	No	Aerospace Engineering	Divorced	Upper Middle Income	ASE	No
David	23	Senior	2.6	< Pre-Calculus	Yes	Agricultural Engineering	Married	Middle Income	None	No
Edward	25	Senior	2.6	< Pre-Calculus	No	Industrial Engineering	Married	Low Income	None	Yes
Frank	24	Senior	2.9	Calculus	No	Electrical Engineering	Never Married	Middle Income	None	Yes

Table continues

Case*	Age	Class	GPA	HS Math	MEP	Major	Parent's Marital Status	SES	Summer Bridge Program	Work
Gina	21	Junior	3.4	Calculus	Yes	Aerospace Engineering	Married	Low Income	ASE	Yes
Henri	23	Junior	2.6	Calculus	Yes	Chemical Engineering	Married	Upper Income	None	No

Note. *Names associated with cases are pseudonyms. HS Math = highest math course taken in high school; MEP = active involvement in the MEP; SES = students' self-reported family income level; Summer Bridge Program = the type of summer bridge program students participated in (e.g., PREF, ASE, or none). Work = whether or not the student was employed while in college.

Prior to meeting with the students, I provided them with the consent form describing the study and their participation. As this was a qualitative study, there was no need to resort to deception in the process of gathering data (Creswell, 2007). Immediately after each interview, I recorded field notes of the experience to reflect on my experience of the process. The tape-recorded interviews were transcribed. The resulting recordings, transcriptions and field notes were properly secured in a password-protected file on a password-protected computer to wit I have the only access. Additional data sources included participants' Facebook page and resumes or course projects along with my field notes. All data gathered from participant resources was collected with explicit permission from the participants and in full compliance with Institutional Review Board (IRB) guidelines.

Data Analysis

In case study research, data analysis was done throughout the data collection process (Merriam, 1988). As Stake noted, "There is no particular moment when data analysis begins" (Stake, 1995, p. 71). Analysis is a matter of giving meaning to first impressions as well as to final compilations." The idea is that analysis and synthesis work in concert to inform interpretation (Stake, 1995). Categorical aggregation was a prominent component in the analysis.

Data analysis was conducted using a modified version of Stake's (2006) multiple case study analysis procedure. NVivo® was used for coding and analysis. According to Stake, the two main categories were determined by the research questions "initially identified in the project proposal" (p. 42). As such, the cases were read and coded with the two themes—contextual supports and barriers—in mind.

Case Review and Coding

I transcribed each interview and imported the subsequent transcription into NVivo® for annotation and first coding. I coded the transcripts according to the participants' response to the interview questions, creating annotations and/or memos as new ideas or impression arose during the process. Once the initial coding was done, I kept track of the following case specific information in NVivo®: the uniqueness among other cases, the prominence of each theme in the case, and the expected utility of the case for developing each theme. During the case coding, I identified several important aspects that were most reflected in the case. These important aspects of the case are what Stake refers to as the findings. Prior to the cross-case analysis, I assessed the utility of each case for developing the theme. The relevance of the case to each theme was based on the number of participant responses associated with the theme. Once each case has been reviewed (several times) and coded (and recoded as necessary), the cross case analysis began.

The purpose of the cross-case analysis was to develop the merged findings that would lead to final assertions that inform both the themes and the overall study. The merged findings were derived from the individual findings associated with each case. Because I had some difficulty with NVivo®, this part of the process was done using Microsoft Excel®. I set up a simple database that included the participant's name and the list of several findings that was most relevant to the overall case study (e.g., involvement with MEP, race informs motivation, etc.). Focusing on the findings irrespective of the individual cases, I grouped similar findings into clusters. Upon studying the content of the clusters, I identified the most important ones by ranking them from 1 (most) – 8

(least) in order of importance. These ranked clusters became the merged findings and given a name that identified the central thrust of the cluster (e.g., MEP participation, academic performance, peer/family support, etc.). The cases contributing to each merged finding was subsequently identified. The merged findings led to six key themes (in order of prominence): (1) Being Black at a PWI; (2) Engineering Identity; (3) Family Influence; (4) Peer relationships; (5) Academic Issues; and (6) Personal Issues.

Finally, I entered the six key themes as nodes in NVivo® and recoded each case accordingly. The order of prominence of each assertion was based on the frequency of the responses for each assertion. After recoding the cases according to the six themes, I read through each case again and recoded as necessary.

Methods of Verification

Role of the Researcher

In qualitative research, the researcher is "the instrument of both data collection and data interpretation" (Bogdan & Biklen, 2003, p. 114). As such, understanding how my experiences influenced the data collection and data interpretation processes—or reflexivity—is critical for ensuring rigor. I grew up in a home in which my parents impressed upon me that my race does not limit my career options. My parents also instilled in me that I would face numerous barriers because of my race and that I should not let those negative experiences deter me from achieving my goals. In fact, I was encouraged by everyone who had some influence with me to pursue a STEM major in college because of my aptitude in math and science.

My experience as an African American female of a certain age, with a bachelor's degree in engineering, a master's degree in marriage and family studies, and currently in

pursuit of a doctoral degree in counselor education holds much sway in how I conduct the study, interact with the participants, and analyze and interpret the data (Stake, 2006). Holding a degree in engineering, I have great appreciation for, and understanding of, the difficulty of persisting in an engineering major. One key difference between my experience and that of the participants in this study is that I obtained my degree from a historically black university (HBCU). Research has indicated that engineering programs at an HBCU lend themselves to higher persistence and graduation rates and higher levels of satisfaction for African American college students compared to those at a PWI (Fries-Britt & Turner, 2002). Though I am no longer in the engineering field, my academic experience was very positive and I hope to see more students of color who initially choose to enter the field actually graduate in the major, especially given the increasing demand for STEM professionals in the US Workforce (Bonous-Hammarth, 2000; Chubin & Babco, 2003; Jackson, 2002).

My training and experience in marriage and family therapy inform this process by shaping my understanding of the individual. Systems theory provided the foundation of my training in marriage and family therapy. The theory "directs attention away from the individual and individual problems viewed in isolation and toward relationships and relationship issues between individuals" (Becvar & Becvar, 2003, p. 8). Additionally, understanding from a systems theory perspective requires "assessing patterns of interaction, with an emphasis on what is happening rather than why it is happening" (p. 8). I entered this process believing that these students' ability to find the necessary resources and to overcome various obstacles they may encounter results from the interplay of various internal and external influences in their lives. Consequently, these

influences, along with native ability, figure into the equation of their persistence in engineering.

As part of my identity as a counselor educator, I conceptualize students and their ability to persist from a strength-based perspective. My preferred theoretical orientation for conducting therapy is solution-focused therapy. Solution focused therapy has a present focus with an emphasis on searching for solutions (persistence) as opposed to eliminating the problem (attrition). In the course of treatment, the client and the therapist work together to co-create solutions. One other characteristic of the theory that I believe played a significant role in this process is the idea that small positive changes in one part of the system has the potential to make positive changes in another part of the system (O'Hanlon & Weiner-Davis, 2003). One goal of solution-focused therapy is to help people determine what works for them and help them make the necessary changes to do more of what works (O'Hanlon & Weiner-Davis). As such, I decided that the best way to determine factors that contribute to persistence was to speak to those students who have actually persisted in the major.

African Americans have a proud history in science and invention that remains mostly obscure and unknown (Malcolm, 1990). "We are asking black children to become something that they have not seen and that they may believe impossible or important" (Malcolm, 1990, p. 247). Math and science literacy figures prominently in improving the economic condition of African Americans (Moses & Cobb, 2001). It has been demonstrated that a math background has been connected to more diverse opportunities (Anderson, 1990). This study presents an opportunity to discover how more African

American students of today can continue this proud history of science and innovation in engineering.

Trustworthiness

The overarching criterion for judging the quality of a qualitative research study is trustworthiness (Guba & Lincoln, 1989). Trustworthiness was attained by verifying the accuracy of the transcripts and reviewing the coding process to ensure consistency of coding throughout the coding process (Creswell, 2009). The researcher transcribed the audio taped interviews ensuring the accuracy of the transcripts. To ensure consistent coding throughout the coding process, using NVivo®, memos and code descriptions were used to track changes to meanings of each code and was referred to frequently throughout the various coding processes.

Triangulation

Triangulation is considered to be "the single most crucial technique for establishing credibility" (Guba & Lincoln, 1989, p. 239). According to Stake (1995) only key interpretations and "data critical to assertion" (p. 112) warrant more effort in confirming the findings through triangulation. Stake argued that data considered to be uncontestable description or researchers persuasions require little or minimal triangulation. For this study, I expended my effort toward triangulation in accordance with Stake's recommendations. Triangulation is essential for achieving rigor in case study research. Triangulation refers to the "process of using multiple perceptions to clarify meaning" (Stake, 2000, p. 443) with an emphasis on searching for "additional interpretation rather than confirmation of a single meaning" (Stake, 1995, p. 115).

Triangulation can also facilitate the repeatability of an observation or interpretation and the understanding of the phenomenon from different perspectives (Stake).

In this study, two methods of triangulation were used: data source triangulation and investigator triangulation. Member checking and document review (Facebook page, Resume, and data from the other cases) comprised the data triangulation. Investigator triangulation was accomplished through the use of a peer debriefer who reviewed the coding and the underlying premise of the study to ensure accuracy of the account (Creswell, 2009).

Summary

In this chapter, I presented the methodological process that will be used in this study to explore the effect of various contextual supports and barriers on the persistence of African Americans deal with as they pursue a bachelors' degree in engineering. I began by discussing the interpretive/constructivist paradigm that frames this study. This paradigm assumes the notion of multiple constructed realities as opposite to one true reality (Ponterotto, 2005). This was followed by the discussion of the rationale for conducting a case study analysis of the issues. I pursued a qualitative approach because of the dearth of research pertaining to the persistence of African Americans in engineering from the perspective of African Americans who have persisted in engineering. I then provided the conceptual background of case study methodology noting the importance of thick description in explicating the complexity and particularity of the multiple cases. I continued with a discussion of the data collection and analysis process. These two processes, data collection and data analysis will occur simultaneously with the bulk of the data coming from the semistructured interviews I conducted.

Additionally, I also included data from participants' Facebook page and resumes, along with memos and field notes.

Important to qualitative research is the influence of the researcher on the process. I discussed the importance of attending to reflexivity and explaining the influence of my training in engineering, marriage and family therapy, and counselor education on data collection and analysis. I concluded this section with the description of the triangulation protocols I used to ensure rigor and trustworthiness of the study.

CHAPTER 4

RESULTS

Social cognitive career theory provides the theoretical framework to understand the impact of contextual supports and barriers on persistence for African American students in engineering. Lent, et al. (2005) demonstrated that contextual factors influence career choice and persistence indirectly through self-efficacy. Self-efficacy, in turn, is informed through four sources of efficacy information: (a) personal accomplishment, (b) vicarious learning experiences, (c) verbal persuasion, and (d) physiological and affective states (Bandura, 1997). The discussion below will reflect the role of contextual supports and barriers for students who have persisted in their engineering major.

I responded to the following research questions in this study: What contextual supports contribute to African American college students' ability to persist in engineering? and what barriers did African American college students encounter in pursuing their degree and how did they overcome the barriers?

The comments offered by respondents were grouped into six key themes that were subsequently organized based on the nature of the environmental influence: contextual support or contextual barrier. The six key assertions are (in order of prominence): (1) Being Black at a PWI; (2) Engineering Identity; (3) Family Influence; (4) Peer relationships; (5) Academic Issues; and (6) Personal Issues. The themes assigned to each type of influence are summarized in Table 1. I will begin the discussion by examining the impact of barriers on students' experience and how they overcame them to reach this point in their major.

Table 2:

Emergent themes associated with environmental influences

Environmental Influences	Themes
Barriers	Academic Difficulties
	Personal Issues
Contextual Supports	Black at a PWI
	Engineering Identity
	Family Influence
	Positive Peer Influence

Barriers and Overcoming Barriers

The two most prominent themes associated with Barriers include: (1) Academic Issues and (2) Personal Difficulties. All the students in this study experienced some form of academic and/or personal issues. Three students stand out because the barriers they encountered almost led them to leave the engineering program all together. One student eventually took a leave of absence because the stress and strain of the engineering degree was wearing him down. Despite the difficulties they encountered, they eventually found majors more to their liking.

Academic Issues

As would be expected every student in the study experienced some form of academic difficulty. Three cases—Benjamin, David and Edward—presented as the most compelling and relevant to this particular theme. All the other students indicated some academic difficulty but not so much that it was a significant part of their experience. In

these three cases, the students' academic difficulties led them to switch from their original intended majors into other majors. For Benjamin and David, their academic issues precluded them from gaining entrance into their intended majors.

Due to "limitations of space, faculty, or other resources," (The Pennsylvania State University, 2005a), some universities use administrative enrollment controls which limit the number of students allowed entry into the major. The College of Engineering has five controlled majors: (1) aerospace engineering; (2) architectural engineering; (3) bioengineering; (2) computer science and computer engineering; and (4) mechanical engineering. These controlled majors account for 26% of engineering majors within the College of Engineering. Students also have the option of majoring in engineering majors that may be administered by the College of Engineering but housed in another college. Agricultural Engineering is one such major.

These controlled majors require students meet certain requirements prior to being accepted into the major. Among those requirements is a cumulative GPA of 3.0 and in some instances higher (The Pennsylvania State University, 2005a). Benjamin and David initially intended on majoring in mechanical engineering which is one of the controlled majors. Edward, on the other hand, initially intended on majoring in chemical engineering, major that is not controlled. For all three, their first year had an inauspicious beginning in different ways.

Benjamin began school in the university's PREF program. As such, he had access to variety of resources designed to improve students' retention rates in engineering. Additionally, PREF afforded Benjamin the opportunity to begin his first year with an established network of friends. Academically—as Benjamin describes it, the PREF

program "show[s] you just how much work you actually have to put into to … being a college student." This was a very structured program that "helped [him] a lot," initially. He accumulated five credits and a 3.67 GPA. He explained that he believed that this "weighted grade" was responsible for him getting a paid summer internship after his freshman year.

Problems arose for Benjamin during the following fall semester. As he noted:

> First year was mainly the party scene [which] affected me a lot. And like I was not, my head was not where it should have been and so like my GPA shows it now. Like, it's just, I wasn't doing what I was supposed to be doing … my first year (Benjamin).

One class in particular caused him considerable distress. That was calculus 2 which "was by far one of the toughest classes I had ever taken in my life." He ended up dropping the class and retook it the following semester. He eventually passed the class with a D. This was "really devastating for Benjamin. … [He] didn't get past it till like probably half way through the next semester." Furthermore, because of his grades at the end of the spring semester of his sophomore year he couldn't major in mechanical engineering. He was devastated by this.

> I was just I just I didn't know what to do. Like it was just like everything I lived up for just to come to this school, and now I can't even do it. Like, I was thinking about transferring schools and stuff like that. But I rethought it over and like my mother she told me that … I should really stick with it and take something else and stuff like that. (Benjamin)

As a result, he was forced to find another major. He really wanted to stay in the College of Engineering and considered majors that were not subject to enrollment controls. He thought about electrical engineering because "it had seemed interesting." After taking an electrical engineering class and consulting with upperclassmen in major, he decided against that for a major. He reported that he could "understand why it's not a

controlled course because the stuff that they do is just ridiculous." As a holder of an electrical engineering degree, I can vouch for the unbelievable difficulty of the major. Even after this experience, he did not move directly to industrial engineering. "[He] did [his] research" and spoke with a student who was a senior majoring in electrical engineering.

> I wanna know what he thinks and stuff like that. And like he started going on about yeah I took that first class like three times and then I took this other class four times and then I took this other class two times. And I'm like OK so when are you gonna graduate? You know I'm not trying to be here for seven years. I asked him, " how long have you been here"? And he said since 2001. And I'm like wow! Okay, like I'm not saying that's going to be me but I don't want to ever be put into a position like that where I've just been here for seven years and I still didn't graduate. And like that wasn't the only person I talked to. I talk to other people and that they had very similar stories. And I'm just like you know what like I honestly don't have a passion for this enough to stay in it like this. (Benjamin)

He decided on industrial engineering after consulting with alumni and Clarice.

> But after like talking to alumni who were from that [industrial engineering], they were saying that [though] it may seem easy, it doesn't mean that it's easy because it's still engineering. No matter what any type of engineering is … there's still work in there, you know. And like they were just saying like one thing you should ask yourself is like where do you see yourself in like 5 to 10 years. And like yeah I see myself in like a non-technical part of the company like management or something. You know, like managing people like that's down in industrial engineering's alley and like so I was like hmm … maybe there are some correlations here I might want to look into. So like I went to my advisor recently and I just talked to her and she was like yeah … you should do it if you want it. And this is where I am—*right now* (emphasis Benjamin). (Benjamin)

After deciding to major in Industrial Engineering, he expressed some concern that it was "kind of like the easy major. [He didn't] just want to take the easy way out." He opted not to avail himself of Career Services during this major choice process.

Meanwhile, David did not enter school under the auspices of any of the available summer bridge programs. This was the case for three other participants (Edward, Frank, Henri) as well. He believes that not being in any of the programs hindered him because

he had to take remedial math. Prior to entrance to the university, students are assessed through the LMSU's testing program that evaluates first-year students' educational plans. Because he did not have the necessary prerequisites enter calculus in his first year, David had to take remedial math courses.

> I couldn't just jump in and taking calculus because I never had calculus before. So I had to take like two other prerequisites for math. It kind of like slowed me down. And the same thing with chemistry, I had to take another class before the actual chemistry I could take. So that was a little hard adjusting to the big university, the big classes, everything just totally different. The exams were totally hard. It was so big. (David)

Additionally, David indicated the highest math course he attained was something lower than pre-calculus. He could not recall the actual name of the course. He ended his first semester with a 3.0 which he felt "wasn't too bad. [He] did spend a lot of time working on stuff." However, he had not taken calculus yet.

> Once I started taking calculus and getting towards harder—really, really tough classes, that's when it all went downhill. So first year was actually good compared to what I hear from most people. It was in my second year [that] was bad [spoken in whispered tone] (David).

In his second year, David decided to join a "type of organization that wasn't the smartest thing for [him] to do because it hindered [his] academics." He ended up losing scholarships because his GPA dropped substantially. He could not readily recall his second semester GPA.

> I know I had to drop a class. Umm, I don't remember the exact grades. But I know that I dropped. That semester['s] GPA was probably like a 2.0 something which brought my cumulative down to like 2 something. And it's been a struggle just to get it back up. (David)

David's self-reported GPA at the time of the interview was 2.59. As an aside, this was slightly higher than Henri's GPA at the time. Henri is a junior majoring in chemical engineering who reported few issues associated with academic difficulties.

As mentioned previously, David initially planned on majoring in mechanical engineering when he started college. In the College of Engineering, students are accepted into their major based on meeting requirements at the end of their sophomore year. Because of the decline in his grades, David was unable to major in mechanical engineering. He even considered majors outside of engineering.

> I've actually went through a process of talking to other advisers in different departments to try to get out. There was just something that kept telling me: No, stay here, you know, stay in engineering. … I tried to switch to different types of engineering. And then I tried to go to Kinesiology. I was even trying to think of Business or HDFS. I was trying to do something that was more—because I feel I am a more people person now—into that soft skills, you know. I don't know. Just something about engineering just kept me here. (David)

He eventually decided on agricultural engineering. Below he describes his process of finding a suitable major.

> So I came in mechanical engineering. Didn't meet the requirements. Bad semester. So then I was trying to go into aerospace. Let me go back to aerospace, and the same thing— didn't meet the requirements. So then I had to choose something else. So I still had this machinery kind of thing I wanted to do, so I went to agriculture. You know because they have like a machinery option. But then once I did machinery, I didn't like it so I went to natural resource. So like it just kept on changing and like now I love it. I love the natural resource [option], just the environment. (David)

Though going through a somewhat convoluted process because of enrollment controls, David insisted on staying in the broader major of engineering and spoke with much passion about his chosen major.

> Because what really struck me was like certain things like water, we take for granted. Other people in other countries you know are dying every day because they don't have clean water to drink or just sanitation. So that kind of environmental issues really impacted me and realizing how all this technology and all the stuff that we're doing is impacting the environment which also impacts us. So just realizing how important that was how much do we just take it for granted. … I have really gotten motivated and excited. (David)

David ruminated about his future plans indicating that he had considered going to graduate school in engineering. I was somewhat surprised that he was thinking about going to graduate school in engineering. This was reflected in my question directed to him. It had a distinct and obvious incredulous tone. I apologized immediately and profusely for my reaction. He responded:

> That was another thing [laughing]. I was like. That was good because that's exactly [sentence trailed off]. I was like man do I really want to do this. And another thing that was motivating me was just the water scarcity problem. I was like, man, I have all these ideas that I would love to do, different technology that would help. And that's what kind of made me want to do engineering again. I was also thinking between engineering and engineering education. I definitely understand like how you said you want to help the whole curriculum and stuff like that because I feel like that could be improved. And I was also looking at the Peace Corps. The end of last semester just got confirmation that to go into full-time ministry. (David)

He plans on going into full-time Christian for at least two years. He feels that given "the stuff that I am passionate about especially for other countries and just environment and energy engineering, I feel it's going to be used in some way. I don't know how or when." He seemed very satisfied with his choice.

Edward's experience closely resembles that of Benjamin and David. He had difficulty in his math and science core courses. Like David, he did not participate in a summer bridge program prior to starting college. He did go through FTCAP prior to his first year. Initially, his testing indicated he should begin in a remedial math course before taking Math 140 (Calculus 1). "But because [he] wanted to be in calculus, they give a second chance to take it. So … I did. The second time I did test into Math 140." He acknowledged that that was probably not the best course of action for him.

> In high school I went up to trigonometry. So I didn't even have calculus. So I went to first class I remember my 140 class and I had a Russian teacher and everything was very hard to understand her … and I couldn't get what she meant

> by limit. … I kept asking her what is limit and she would never explain quite. It is a very simple concept but I just was lost from the get go. (Edward)

He remained undaunted in his pursuit of completing his math requirement.

> I am very persistent. I hate losing and I hate giving up. And I think just my stubbornness is probably what got me here [senior year]. And at the same time though, I did find some few loopholes here and there. Like if you take math 140, in continuing education at night, it's completely different than taking it in the regular. It's like night and day. Because I was taking math 140 in the regular, like the regular time, like during the day and it was so difficult. And when someone—I don't remember how—someone suggested in continuing education things are a little bit easier because they start from the beginning. There are some adults who haven't taken courses in a while so they go at an easier pace. And for some reason, I decided to take math in continuing education and they had this great teacher who just wrote everything about math. And he was so into it. He made you get excited about it. And … that he taught 140 in the fall and 141 in the spring. And so I had him for both years and really he taught me really well and I probably learned it. But I don't know if I even could have passed math 140 or 141 without his help. (Edward)

Edward's preparation for math was representative of the overarching issue of not having a full understanding of the rigors of college life in so many areas. Once he finally completed his introductory math requirements, he encountered yet another academic obstacle—his science core courses. Edward had originally planned on majoring in chemical engineering because he "really enjoyed chemistry in high school." That changed after he took the chemistry lab classes. He ultimately chose to major in industrial engineering because it had "the least chemistry." Andre and Gina also indicated that the chemistry requirement was a determining factor in their respective majors of computer science and aerospace engineering. Edward is quite pleased with his major choice. He describes his choice of major as "one of the best decisions I've made]. When I asked him about his reaction to those who do not consider industrial engineering to be 'real' engineering, he dismissed this notion out of hand.

> We always get into fights with other engineering friends. But you know what I think? … What I like about industrial engineering … it is like the common sense the things people should know. But the funny thing is that there is little common sense in this world. And I don't know, I enjoy because they teach you a little bit of everything which is what life is. I think you can't just run one area because you are dealing with so many different things. And they give us so many tools of analyzing different situations whether its machines, whether it's people, whether it's [a] project and I think I like the diversity of it. (Edward)

Though Edwards "first year GPA wasn't that bad." He "late dropped everything. So it was like a 3.0 but kept sinking really fast." He characterized is first year as "really rough." During his second year, he continued to struggle academically.

> At that point, I felt like so stressed and nothing is going right and I keep trying. And really like, especially for me, I finished my math courses not a problem. But then the problem became physics. And the physics just, I mean, I don't know. For some reason, I just couldn't pass the physics with a C. I dropped it I think once. And another time I got a D. I know they require four which is chemistry math 140 and 141, 211 and I passed three but physics-- just couldn't do it. (Edward)

Edward is the only student participating in the study who took a leave of absence because of the stress associated with his unsatisfactory academic performance. "…[A]t that point, [he] was just ready to like give it up." He took some time off to "figure out things."

> I even took time off. I took a year and a half off. I was like, which I worked for a while. My parents weren't really happy about it. But I think once I got out, and I had a real job, and I'm seeing how life is like and that's what really brought everything back home. And they are like okay you got to go and got to get your degree and you got to finish. And I think that's what really brought it home. (Edward)

Though his parents "weren't really happy" about his decision to take some time off, they saw that Edward was "exhausted" and eventually acquiesced and came to accept that this was something Edward needed. Edward was "glad" that he took the leave of absence.

> I think everything happens for a reason. You might not understand why but I think I am so glad that I did take the time out because I think I came back with the right attitudes and right ways of working. And actually, like right now, I feel like things are finally starting to line up and going well. I guess it's bittersweet. Every year I'm always nervous and like you know hope I pass everything. And somehow, I always tend to pass it. That's a good thing. (Edward)

Despite his struggle, Edward has made it to his senior year in industrial engineering, a major that he thoroughly enjoys. His "stubbornness" and "persistence" seems to work well for him. Though he considered taking the "easy route," he was always drawn back to engineering. He credits his faith to playing a pivotal role in his returning to and staying in school to complete his degree.

> I am a very religious person. So I pray a lot. I think probably some reason it's like I will say at the end of the semester: I'm done. Business would come so much easier. And for some reason like I always feel like I always find a reason. I don't know. I usually talk to a person with an engineer to get me back interested in it. Because at the end of the semester, every time I will say, I am done. I'm just going to go take the easy route. But at the same time it's like, because I always feel like, there is... whenever I say I'm done I feel like God just like using other people and be like no [followed by laughter] and I keep going. And for me that's what that… because every year-- the first year was really rough. The second year was really rough. I even took time off. I took a year and a half off. I was like, which I worked for a while. My parents weren't really happy about it. But I think once I got out, and I had a real job, and … seeing how life is like. … That's what really brought everything back home. And they are like okay you got to go and got to get your degree and you got to finish. And I think that's what really brought it home. (Edward)

Upon his return from his leave, Edward blossomed, especially in his industrial engineering classes. He continued to use strategies that kept his course work manageable. One course he mentioned was a required electromechanical course. He opted to forgo the one five credit course in favor of two three-credit courses that met the requirement. Once he finished his core requirements and began with his industrial engineering courses, he really came to enjoy his major, particularly the diversity of the major.

> The weird thing about industrial engineering every class we take is like different. Like you get from learning about like linear programming to manufacturing to CAD program to the simulation program and then to database. And then at the end of the day they try to take all that and tie it in together. And in a sense they try to teach you a little bit of everything because you're going to have to deal with everything. But at the same time you get from hard-core manufacturing to like oh linear programming—do this. And then to … database, where you feel like you are an IT guy. (Edward)

Edward expressed confidence regarding his impending graduation in August 2009. It wasn't until the beginning of his senior that he realized the he "was okay."

> You finally finished all your classes C or better. Now all the rest of my classes I can get a D and still graduate. And I never, ever since from the first year, I never feel comfortable. Every time I was going to be like I don't know if I'm going to be able to do it. I don't know if I'm going to be able to do it. But I find that truly engineering classes they are I find them easier than the math and the physics. Because at least if some of them are hard but you're studying, all the classes … are somehow interconnected. So what you learn from one place it enforces what you learn from another place. And at the, now right now, as a senior, they're trying to tie everything together. I'm like oh, this stuff I learned; I'm like using it in another class. (Edward)

Academic difficulties exacerbated any personal difficulties students were experiencing. All the students in this study performed well academically in high school. So when they encountered lower than expected grades, some students questioned whether they had the intellectual capacity to persist in their major, even when they put in the effort.

> Oh yeah. Oh yeah, it definitely hit to my pride and ego and just self-worth. It really did do a number on me. It was very discouraging. It was very negative and stressful and depressing. Because like you excelled at something like you're just so good. And then you come here and it's like you're struggling just to get Cs. And all you're seeing is like C's and D's and C's and D's and occasionally you get a breakthrough and you get a B. What was frustrating was like I was putting in the time. I was always working trying to figure out stuff but when it came to exams like I just didn't do good. And that is what was really frustrating. You're working you're putting in your time but you're not doing it right. And so it was very hard adjusting to that. (David)

> I was just like I can't believe this just happened and so I'm just talking to him like, like come on you gotta help me out a little bit you know like. Like cut me some slack. He was like oh talk to the math coordinator. I was just like wow like wow thanks for that. Yeah and then like she was the math coordinator and like she was saying like the same thing. I'm sorry but I can't do anything. And like I was just… That was a tough time for me. I don't know. That was tough to hear that. (Benjamin)

> I never been challenged academically before. So it was really hard and the fact that I am like wow I can't just pull things out of my head like I did in high school. And so that really played a big role and I was probably more frustrated the first year than I've ever been because it's just that it seemed that I was going to school and I wasn't getting it. You know it's like I will sit there, I'll read for hours, but it just didn't click. And so that was my first challenge because it's like I wasn't sure what I was doing wrong. (Edward)

Peer tutoring, personal initiative and students' faith figured into students' ability to lessen the effect of their personal issues on their academic performance.

> Every year, even like last year, I was wavering back and forth. Should I stick with this engineering? Even though I had like a year left. I think it was that year, that was the year I was beginning to realize why I wasn't excelling the way I wanted to. Once realizing those things, I was like okay I can work on these. So I started to, another service that I used was the University Study Center. Study habit tutor? Yeah, learning skills. And that was really, really good. And I met that person and it was another student for couple of times. And it's helping me to focus on stuff that. It was like an accountability partner because I had to come back and meet with them and see how I am improving on these certain skills. So once realizing that there are certain things that I can work on now, I was like okay I can finish this off. (David)

> I guess the way I'm here is that I… I am very persistent. I hate losing and I hate giving up. And I think just my stubbornness is probably what got me here. And at the same time though I did find some few loopholes here and there. Like if you take math 140, in continuing education at night, it's completely different than taking it in the regular. It's like night and day. Because I was taking math 140 in the regular, like the regular time, like during the day and it was so difficult. And when someone-- I don't remember how-- someone suggested in continuing education things are a little bit easier because they start from the beginning. (Edward)

> Throughout this whole time, like I would say that's probably the most important thing that I've learned. It did test my faith in God and brought me closer to him. It made me into such a better person. And just realizing that the one thing I could hold onto… that was my foundation so. Even though everything around me was a

> mess, you know I was able to hold onto what I believe in. I was able to hold onto God. And just know that he loves me, and no matter what's going on, no matter how many exams I failed, no matter my GPA. Like I wasn't, I was no longer allowing my self-worth to be in my grades or my performance. You know, it's just, it's in who I am in God, you know in Christ. And that's what kept me going. Like to the core of it like that was what kept me at peace. That's what kept me joyful. Yeah, that was the essential piece that brought me through this. (David)

> I am a very religious person. So I pray a lot. I think probably some reason it's like I will say at the end of the semester: I'm done. Business would come so much easier. And for some reason like I always feel like I always find a reason. I don't know. I usually talk to a person with an engineer to get me back interested in it. Because at the end of the semester, every time I will say, I am done. I'm just going to go take the easy route. But at the same time it's like, because I always feel like, there is... whenever I say I'm done I feel like God just like using other people and be like no [followed by laughter] and I keep going. … I feel like God has a plan. I'm here. So I am hoping if the next 20 years of my life is going to be as crazy as the last one, I don't know. We just have to see what God's planning and just keep going. (Edward)

Because of enrollment controls, these students' academic problems forced them to consider other majors. The process of finding another major further increased the level of their stress and frustration.

> And so like whenever I heard that [couldn't get into mechanical engineering], like my second semester sophomore year, like I was just I just I didn't know what to do like it was just like everything I lived up for just to come to this school, and now I can't even do it. (Benjamin)

> I've actually went through a process of talking to other advisers in different departments to try to get out. There was just something that kept telling me: No, stay here, you know, stay in engineering. Because I tried to switch to different types of engineering. And then I tried to go to Kinesiology. I was even trying to think of business or HDFS. I was trying to do something that was more… because I feel I am a more people person now to try to go more into that soft skills, you know. I don't know. (David)

Summary of Academic Issues

Academic issues was one of the most prominent assertions that evolved from the data. All the participants in the study recounted instances of dropping a class to salvage their GPA or they simply took the bad grade and the subsequent hit to their GPA.

Additionally, at least three students (Andre, Gina) based some aspect of their chosen major based on chemistry requirements—only one chemistry class was required. Andre and Gina are also the only two students with a GPA above 3.0. Benjamin, David, and Edward presented as the most compelling of all the students with regard to the impact of academic issues on their collegiate experience. For David and Benjamin, their academic issues precluded them from entering their desired majors that were under academic enrollment controls. Furthermore, they both lost scholarships because their GPA dropped below 3.0. Benjamin restricted his major choice to other engineering majors and eventually chose to major in industrial engineering, letting go of his initial reservations of it being the "easy [engineering] major." David, on the other hand, briefly considered majors outside of engineering major. He ultimately found an engineering degree—agricultural engineering—to his liking. Regarding David and Edward, both students entered college with no prior experience in either pre-calculus or calculus. David chose the route suggested by his FTCAP test results taking the remedial math classes while Edward insisted on disregarding his FTCAP testing and opted to delve into calculus as his first college-level math class. This did not bode well for Edward. However, he did manage to find a "loophole" by completing his math requirement in Continuing Education.

Once he resolved the issues with his math requirement, he encountered difficulties with his science requirements. The stress and strain of his first two years proved more than he could bear. After his sophomore year, Edward took a year and a half leave of absence—much to his parents' chagrin. His experience was unique among the participants in this study. No other students took a leave of absence at anytime in pursuit

of their major. Edward indicated that the leave was necessary and provided him with the needed time to figure things out. He ultimately returned to and speaks with great enthusiasm and delight about his chosen major—industrial engineering. As with Benjamin, Edward has had to deal with taunts that industrial engineering is not 'real' engineering. Despite the "fights" with students in 'real' engineering majors, Edward is thoroughly satisfied with his major and is on track to graduate in August 2009.

Personal Difficulties

Students' comments were coded under Personal Difficulties when students made comments that reflected mental health related issues such as "feeling down," or "depressed." Social isolation and Being Black at a PWI informed this theme. Social isolation was particularly salient for students who did not participate in one of LMSU's summer bridge program. As students struggled in establishing a supportive peer network, they initially isolated themselves which compromised their adjustment to college.

> So that was a little hard adjusting to the big university, the big classes, everything just totally different. The exams were totally hard. It was so big. I felt a little bit alone, too. It was like an adjustment period. Of just being by yourself learning how to study, just relearning everything. It seems like everything that I had that I was good in high school I did know, didn't really work. College, it's totally different. It's totally different. (David)

> And I think socially I just at that point, I was so concentrated on school that I really didn't want to make friends. It was actually a really tough time for me that year because I guess the way that I am is that if I'm doing well in school then I am relaxed and I'm okay and I can do other things. But when I'm struggling it's just that I almost pulled back from everything else and that's the only thing I'm concentrated on. For that that was a really tough year. I tried to get help from the counselors that I went and I talked to. (Edward)

> So socially, it was challenging because again, I had just moved here. I'm coming from a background where I have a vast network of friends. So for me to come here and not have anybody, it was kind of … and until there are certain levels they cannot relate to me on because they are not experiencing the things that I am experiencing. Not to say that theirs might not even be worse but it's not the same

> or very similar. So, it was challenging in that too. You know what I mean. And then that kind of trickles over into certain other aspects of your life. I mean, not depressed but, you'll be kind of sad and you want someone to work with on some of your schoolwork, you know if it's some one of your same race you could easily say hey, what's up blah blah. And there's a certain bond by default but that really wasn't there. (Frank)

In the three instances of social isolation above, each student resolved the problem by taking the initiative to reach out to likeminded individuals or by seeking support from the available student support services.

> I had to make all the moves. I had to kind of decide early on, I can fall into the woodwork and fall out of this or I can decide and go I'm a just say hi and if they don't want to talk they don't want to talk. I swallow my pride and keep it moving. And basically, that's what I did. Surprisingly, the vast majority of people aren't vicious. (Frank)

> I had this one counselor and that was another person I was meeting throughout freshman and sophomore year. But then she left, and I never went back to the MRC. I went once or twice but it was a new person. But it wasn't the same. But that counselor there was like another support system. You know just listen to me and gave me advice on who to talk to and the different issues that arise. It was really, really supportive. Just really encouraging. When she left, that really hurt to see her go. CAPS, I never used CAPS. The University Learning Center, I went, I think it went once or twice, a few times like math. Career Services was really good. I found another good counselor there. The same thing, always working with me to set career goals and internships different programs. Things that I wanted to do. It was really, really supportive. So it was a lot of key supporters that I had. (David)

> Actually I went to and I talked to one of the [counselors] they have at the Multicultural Resource Center (MRC). …He helped me out and trying to figure out a way to study and to talk to the teachers. And I also went to the engineering advisors which were not very much help at all. Maybe it's because they have so many students who wants to be an engineer, but it just seemed like they just don't care. You go talk to them they will help you but at the same time you do feel like you're just a number to them. And they're like I have probably seen so many kids' face. At that point, they are immune to it if you're having any problems. (Edward)

When student support services proved unhelpful, difficulties related to social isolation was remedied through self-introspection or by leaving for a year and a half.

> And everything was just revealed to me of why I've been struggling so hard. I remember reading this one thing. This lady, she has this organization that talks about insecurities that minorities have and why they struggle. Feeling inferior to other groups. That was also a click and a reassurance like confirmation that you know why I have been acting that kind of way. Yet I think it was just one of those epiphanies like those moments just like wow I never realized that. And I guess I was kind of absorbing like just looking at how other majority white kids are altogether and I realized that I am always by myself and they're always doing good and I'm not. And I started to question myself. Why am I you know why don't you want to go over there to 'em. So I think was just a combination of things just started to click and questions starting to get answered and my eyes opening. (David)

> And I think at that point I was just ready to like give it up. So I was like I'm just going to take time off and figure out things. And I think that's probably one of the worst things that we do is like coming from high school straight to college. Because really you don't know what you're doing. Like no matter how much people try to say. I think that once you go outside for a while and you really seem how really life is outside, all the bills you have to pay, how you go and work and you don't bring anything home. Then the reality really hits and says okay I got to go back and I got to really make something out of myself. And I think that's truly what [was] damage for me. (Edward)

In one instance, isolation was the preferred method chosen to deal with personal issues related to family members.

> Well coming to school, I had a lot of personal issues but I've just been able to get thru them. Because like when I was coming out of high school, my mom lost her house. So like my little sister, lived with my aunt. She lives with her dad now because like because my mom lost her house. Child services took her away even though she had living arrangements with my aunt. … And then when that—and then when that happened it put my mom into a depression. So like so she … it really put her in a bad spot, made it worse, like she's not nursing anymore because of that. Like she started having agoraphobia. So like I was having some personal issues with that and then luckily my dad stayed out of jail. So that hasn't been weighing on my mind at all. Just like personal issues like that and then something happened to my grandma. … So like those personal issues came forth a little bit more my sophomore year because they had been down for so long, but I got through it like everything else. (Andre)

Andre got through it by relying on a few close friends and venting.

> I had some good friends to help me out a little bit. And really, all I needed to do was just vent. Nobody still, some of my close friends, know my situation. Nobody knew my situation at all. 'cause I just kept it my freshman year, because

> you know I figured that's not their problem. They probably have enough problems because I'm not the only person in the world with problems. I understand that. I understand it could be worse for me. So I just try not to push my problems on other people. So I kept them in too long and then it started hitting me again in my sophomore year and some points it was really bad. (Andre)

Encouragement from peers and family played the most central role in helping them find alternative majors. Eventually, students were able to find major that was more in line with their passion.

> Like I was thinking about transferring schools and stuff like that. But I rethought it over and like my mother she told me that like I should really stick with it and take something else and stuff like that. … Yeah, my mom helped me a lot with that [him leaving]. She was just I mean she was just saying like you cannot let people make you decide what you want to do. You have to decide what you want to do, you know. Like just basically pointing out like you know you got a bad grade, but you just got to know how to pick yourself up and keep going, regardless, 'cause it's going to happen and you just got to be able to move on. Because as long as you graduate, that GPA does not matter. I mean it does matter … But I mean the most important thing is graduating. You know. (Benjamin)

> They [his parents] have always been encouraging me like, you know, don't give up. We're not disappointed in you. We still love you. We are rooting for you. It's just that constant like positive encouragement. Don't give up don't give up. Don't feel bad if you have to stay here an extra semester, an extra year. You know, get it done. And they always took away the stress of money from me. Even though I was an RA for two years. That helped out, but they never—they always told me, you know, don't get a job. We're going to take out loans. My mom's working two jobs to pay off stuff. So they made sure that there wasn't any added stress on me to manage job and school work. (David)

> Just having that support system of engineers especially upperclassman. They was like don't leave, stick in there, hang in there. So having like people who know what you're going through and that's been there and you can see that they are about to graduate. That there is success. And just, I had a great support system. A really great support system that kept me in here. I remember one friend he kept telling me, don't switch out. You got a keep… He's like, what else you gonna do, huh? [Unintelligible]. I say you got a point, you got a point. (David)

> So just a sense of community seemed to help out a lot. And like if people are in community they are less likely or seem less likely to drop out because it's always somebody like, "Nah, don't drop out." You know you can do this. However if you really need help I guess I can help you out I guess you know I guess I can help you out. And this has been with a lot of my friends. (Andre)

There were also times that being an African American at a PWI in engineering exacerbated students' personal difficulties. All the students remarked on the lack of diversity within the College of Engineering. In most instances, students seemed nonplussed by the experience because many had been in similar situations in high school. For some, though, they were unduly influenced by the negative connotations associated with African Americans in technical fields. They were keenly aware that there were few students of color in their classes and felt some responsibility to avoid being "a typical black person who knows nothing" (David).

> It kind of was like my self-esteem—a lot of self-esteem issues and insecurities did play a major part in my academics. Because I was always afraid of—something that I only realize like last year this in like my fourth year of being here—I realized the reason why I don't ask questions. I'm afraid to raise my hand or ask for help or work with other students, especially in engineering. It's majority white students so it's like I always felt like I don't want to seem I'm dumb or they think a typical black person doesn't know anything; they always want help; they always need this and that. So that was—is stuff I was playing in my mind. So I always shied away from asking for help or working on group projects or work in on group teams with homework or studying with people. Because I always just felt insecure and just like I don't want people thinking that about me and stuff like that. And even in class, I never really raise my hand to answer questions to say things just being afraid of getting it wrong. People say ahh look at the black kid. And just all this insecurity and stuff that played a major part in me. (David)

> You could tell certain students weren't—I guess probably weren't used to—I guess that's probably one of my insecurities coming out [spoken softly under his breath]. I just saw sometimes that people felt uncomfortable sometimes when I approached them for help. Or you could tell they making up excuses, they don't want to work with you or they don't want to help or they don't know how to solve something but they actually do. So there's stuff that I just noticed but people never really came out and say oh… (David)

> You do feel like you're beneath. Like I don't know, they treat you a little different in a sense. But I don't know. It's like truly I haven't really thought about it in those terms that you described, and I think that now that you say that maybe that it's a little clearer because in a sense, you go in and no one says anything. They treat you. But at the same time, you do feel like there's something there so. (Edward)

A particularly unique finding associated with the effect of acculturation revolved around discrimination within the African American engineering community. Three of the students participating in this study immigrated to the United States from other countries. Two of them reported that American Black students seemed somewhat stand offish.

> I think there is a difference between African-Americans and us Africans who for some reason, I don't know. I have felt that tension because I mean whenever I ask two black kids usually African-Americans you know I say hi they always come approach me and they say hi. But then at the same time as soon as they hear the accent it's almost like for some reason they feel uncomfortable. I have felt that attention. (Edward)

> Even though we were approximately 50% Black, I mean, on campus what happened to me was that everybody else had their friends from home and stuff like that. So no one really kind of made the effort to make friends. And as a people, Black people, we tend not to reach out by default. Now you and I are friends and you have another friends that person and I can kind of become friends but that person isn't going to walk over here and just randomly say hi, how are you. That doesn't really happen as a people. We don't really do that generally speaking. So, the few friends I have were friends of my classes. Again, they are not Black. (Frank)

Summary of Personal Issues

All the students in this study recounted at least one instance of a personal issue posing a barrier for them. Issues related to social isolation and acculturation was representative of the types of personal issues the students experienced. Students were able to ameliorate the damaging effects of these barriers through personal initiative, peer and family support, and student support services.

Contextual Supports

Four prominent themes relating to students' contextual supports emerged from the data. They include, in order of prominence: (1) Being Black at a PWI; (2) Engineer Identity; (3) Family Influence; and (4) Positive Peer Influence. I will begin the discussion

with the theme that proved most prominent in the responses. The rest of the findings associated with the subsequent themes will be presented in decreasing order of prominence. The first two themes—Being Black at a PWI and Engineer Identity — contributed approximately 40% of all comments related to contextual supports. The role of Being Black at a PWI will be presented first.

Being Black at a PWI

All eight of the students indicated that Being Black at a PWI (BBP) was a significant source of support. Participation in the university's MEP generated the largest percentage (37%) of the comments within this theme. Other comments associated with the benefit of BBP include experiences of differential treatment by their professors and peers, not wanting to be a statistic, and previous exposure to being in classes in which they are considerably underrepresented. Data analysis reveals a confluence of BBP with some of the other themes (Engineering Identity, Personal Issues, etc.) associated with contextual supports. As such, the intersection of the other themes with BBP will be discussed in this section. I will begin with discussion of the support the students received through their participation in the MEP and its associated programs.

Participation in MEP and associated programs. The MEP provides engineering students from underrepresented minority groups with various opportunities designed to improve their retention in the college of engineering. Additionally, students can participate in one of two summer bridge programs that fall under the auspices of MEP. Four students participated in the summer bridge programs. Gina, along with Charlie, participated in the Academic Summer Enhancement (ASE) while Andre and Benjamin

participated in PREF. They all spoke highly of their summer program experience. They really appreciated the effect of starting college with a GPA buffer.

Students in PREF attend a six week summer session on the main campus and live in the residence halls. A key component of the summer bridge programs are the preparatory classes in calculus, physics, chemistry and english along with courses related to professional development, study skills and networking with other college students (The Pennsylvania State University, 2005b). Because they received credit for their course work, the students started the fall semester with a good GPA. As Andre remarked,

> I was lucky to do PREF cuz that just started me off with such a high ground because like one of the things you learn especially in PREF, is start off with a good GPA. It's like, you know, I started off with a good GPA and it's stayed around a 3.36. … I started out with a 3.7. My sophomore year, it went down a little bit because I had to drop a class. … I started out with such a good grounding. That semester I dropped to like a 3.47. So it wasn't bad but it's just that I was so low and like it kept my GPA up. Cuz my sophomore year, as a whole, was a lot more worse than my freshman year but I still kept it at a 3.36. So it stayed high because I started out with such a good spot. Because like even the way it is, I didn't have to worry much about my GPA. So PREF helped out a lot. The problem is they don't have much funding for it. (Andre)

Benjamin held similar sentiments to Andre regarding PREF and his GPA. This was really important for him because in his freshman year, Benjamin did not do well academically.

> I um went to this PREF program. …Yeah and I did that and met Clarice, of course, that helped me a lot. And then first year like, I think first year was mainly the party scene affected me a lot. And like I was not, my head was not where it should have been and so like my GPA shows it now. Like, it's just, I wasn't doing what I was supposed to be doing … my first year. (Benjamin)

Charlie and Gina participated in the ASE program. It differed from PREF in that the students attended a four week summer session, instead of a six week summer session.

Charlie indicated he particularly benefitted from the social aspects associated with being in ASE.

> It's called Academic Summer Enhancement (ASE). I think Clarice started it or she's in charge of it. She got a bunch of different multicultural kids that were in engineering from off campuses mostly. I think there was one person from up here. Then she brought them up for about a month. And we started on like chemistry and math and one other course. It was kind of like to start us out early. So you know we get used to college life. She made sure we went to see our professors during office hours and things like that. We got to know each other. It was just a head start. We got a grade for it and two credits. It was definitely helpful. We learned a lot up there. You get to know people that are, you know, African-American as well and different other races and ethnicities. You just get to know people. (Charlie)

Gina felt "very prepared for college … [because she] took college level courses in high school." Because of her pre-college high school experience, she had grown accustomed to successfully maintaining the appropriate balance between academics and extracurricular activities.

> So I got here and I pretty much had the one program that I was in which is MEP. And I just had my classes. So for the most part it was pretty—you know—a lot of work but I was used to doing a lot of work. (Gina)

As such, Gina benefited mostly from the sociocultural aspects of ASE.

> [J]ust that clarification that hey not a lot of people that start engineering actually graduate and there is even less Black people who start and actually graduate, it wouldn't have really occurred to me that African-Americans were such a minority until I actually got here. Because we have a pre-summer type of session playing and that kind of eased me in to the whole [college] experience. Without that whole shock of hey what I'm the only girl? What's that about? And it was nice to have, just to know that yes she was hard on you but if you needed it she'd be there. It just made things easier. (Gina)

Besides the help with the GPA, students stated that the summer bridge programs did facilitate their adjustment to college in various ways. Andre indicated that though he did not initially fully appreciate the benefits of having so much work amid the rigid

structure of PREF, he came to see how it facilitated a successful transition to the subsequent fall semester. He recounted:

> That summer in PREF was like the worst summer I ever had [because of the structure and the amount of work]. … We had to get up—we had class at 8 am and then we had class and studying including dinner and lunch until probably 10 o'clock at night. And then we still had homework left over usually to do. Everybody else in the summer had two classes, maybe, maybe one or two classes a day and they were out by like noon. So we had to see them walking all over campus having fun while we were going to lunch then we had to go back to studying. So that was so much work that once I came to like regular classes in the fall … that wasn't too bad because I was already studying so much. (Andre)

Charlie described the benefit from ASE as a "big head start." He recounted:

> Like I said, because of the ASE program; it definitely helped. It gives you perspective on what you need to do. I actually had a pretty good GPA to start out in my first semester. I had like 3.3. It wasn't too bad. I had the engineering community to help me out. (Charlie)

For Benjamin, he asserted that his participation in PREF—though still being helpful—hindered his transition to college. He stated that during the three-week break between the end of PREF and the beginning of the fall semester, he "completely forgotten [sic] … what [he] just learned in the past six weeks." Needless to say, he had difficulty with his new found freedom preferring to make up for the lost "play time" over the summer.

> Well, the thing with PREF, like I just think it's funny 'cause like it like prepares you for college but it doesn't at the same time. ... The thing about PREF from what I got out of it was like … they are going to show you just how much work you actually have to put into to like being a college student. But the thing about the PREF is that you are still kind of babied like you still have the feeling of parents there. Like there's no sense of social aspects there at all. It was just academics and that was it. Like no type of play time. … We did go out and party and stuff like that but it was just like it was just us. It wasn't a lot of people like different people. It was all like engineers at the time. And I can't explain it. It was just like I guess like the fact that we worked so hard and then I just feel like the three week period between PREF ending and the beginning of school was just like… I completely forgotten of what we just learned in the past six weeks. I

> mean that's how I felt about it. And that's how… And that's how a lot of people felt, too. I think it did help but it was just. (Benjamin)

In response to a clarifying question as to what he was trying to convey about the downside of no longer having the rigid structure of the MEP, he continued:

> It made you not think about that aspect. You know like you know like socially because everything was like very structured. And stuff like that. You know, we're going to class from 8:00 in the morning to 9:00 at night from Monday through Friday. I mean yeah. I mean it's pretty fierce. That's what I'm saying it's very structured. Very structured yeah. … It was kind of just like oh you know you kind of fall out a little bit. No one's really saying you have to do this. You know like it was kind of like OK I'm going to do what I want. And you know I should do this but maybe I'll wait a few more days before doing it. You know stuff like that. And umm… I think that's what a lot of people felt like. I mean there are a few—there are some—that didn't feel that way. You know came up here with a good head and stuff like that but there are also few that didn't. (Benjamin)

Participation in the MEP

All but three students—Charlie, Edward, and Frank—actively participated in the MEP during their first year of college. Charlie and Frank were transfer students from other campuses. Edward was unable to be actively involved in MEP because of his work schedule, usually working 20 hours a week. For those students who remained active in MEP throughout their college career, MEP was instrumental to their ensuing success in college. This support was mostly from the director of the MEP who was mentioned as being actively engaged in and committed to their success. Gina stated that the director was "amazing." She was credited for instilling in to be persistent. When Andre began school, he lacked the necessary funding to matriculate despite having an obvious need. He said that he went to the "financial aid office everyday for two or three weeks straight [his] freshman year." He eventually received the financial aid to get through his first year. When asked what drove him to be so persistent, he remarked that the director "kind of

instilled it [persistence] in us. … [S]he always taught us that we can't give up; you know she just told us they're not going to just give us anything."

Gina commented similarly to Andre with regard to the director instilling in the MEP students the need to remain stalwart in having their needs met. She remarked:

> I liked it because pretty much it was a constant reminder that hey, we are here for you. We [MEP office] will help you but we can only do so much. You have to have enough persistence to make sure you go to office hours, make sure you do what you have to do to get through. (Gina)

David, who had a particularly difficult time transitioning to college, also found the MEP extremely helpful in facilitating his transition to college. He noted:

> The MEP was really helpful like the director always helpful. Whenever I would go to her just giving her updates on what was going on with me and stuff like that. So she's very helpful. The MEP office is very helpful. … They always encourage you to come talk to them whenever you feel you need to talk to somebody. They have advisors and counselors there. And they have like scholarships and internships. Yeah. And like now they have like a mentor, a mentorship program which I wish they had back then. And it's really good now, because you can see that people who are in it, like they stay in engineering. So what they're doing right now is actually really, really good. Just like they did a good job and now you know you can just come to me. Even as busy as Ms. Davis* was…That's another thing. I think I got lucky half the times how I was able to schedule a meeting with her you know to just talk to her. And that's really good. They're always willing to hear what the student had to say. (David)

Gina had greater appreciation for the social aspects associated with being in the MEP. As she stated:

> … I liked that [MEP] initially because I was in it for the first two years until I got my co-op, which kind of threw all my schedules off. From there I liked it just because it was like hey if I was annoyed, hey here is Black people [sic]. It's just that community you have with certain people and it's just like well I can go here when I'm annoyed with the world and everything will be better. And it was nice to see. … It's just reassuring [referring to the MEP]. (Gina)

Henri also indicated the significance of the MEP in facilitating his transition to college. He said, "…MEP has been a good part of my college [experience]. Any time I

get e-mails from them I always like to review it and see like if I can go to this event and go and meet new engineers." He spoke glowingly of the impact of the MEP assistant dean on his entire college experience.

> Like throughout my entire, college career here at LMSU, I have been going to her [because she has been…anytime I have questions I would think about maybe I should go and talk to [the assistant dean]. So she is like the prime advisor for me. (Henri)

Notably, he was drawn to seek out the services of the MEP because of the "nice invitation" he received from the MEP office.

> When I was [at home in the Caribbean], I got this nice mail from MEP. I cannot forget that yet. It's like this nice invitation saying, come to this event. There'll be people to mingle-- different engineers to mingle with … I actually remember that and it was how many years ago? Two and a half years ago and I actually remember the invitation. Because it was so nice of LMSU to send an invitation all the way down to my home in the Caribbean for me. It was well printed out and well showcased. I looked at it and I remembered MEP. And since when I first came here, I knew about MEP and I tried to get as involved as possible and meet other engineers and so on. So that was a very nice gesture that they did. (Henri)

One other notable finding of a contextual support, or positive acculturation issue, includes comments related to being treated differently by their professors. Comments related to this theme were in direct response to the following question: Do you feel you have been treated any differently because of your ethnicity or gender? Explain. I purposely phrased the question as being "treated differently" as opposed to being discriminated against in hopes of not influencing the students' focus. Interestingly, they all answered the question from a discrimination perspective. All eight students stated that they did not feel that they were treated differently by their professors because of their race. Gina, however, found such was not the case for her as she did feel that she had been treated differently; however, it was not because of her race, but because of her gender. As she stated, "I don't think I'm treated differently because I'm Black; I think I'm treated

differently because I'm female." When asked how she makes that distinction, she responded:

> Because I can tell the difference between my male and female teachers. But I think I've had one Black teacher so I have that much to compare with. I think it was the Assistant Dean of Engineering Diversity I think that's the only one. But the difference between my male and female teachers are, typically males are more lenient than females. I do find that. And with my female teachers those have been some of the hardest classes I've taken. Because they don't give you that leeway. I don't understand it. But I think that female teachers are harder on females in male teachers are harder on males. That just seems to be the way things go. (Gina)

Summary of Being Black at a PWI

The students participating in this study reported acculturation related issues more frequently than they did any other theme. This was due in part to the preponderance of students who participated in summer bridge programs prior to beginning their fall semester. The discussion of this theme focused on the most prominent factor that explained the role of acculturation as a contextual support; involvement in the MEP and its associated programming. Students reported the main benefit of participating in the program was the support from the Assistant Dean of Engineering and the sociocultural aspects of having a support network already established early in their collegiate experience. Those students who participated in the summer bridge programs also appreciated the GPA buffer which took the pressure off of them in their first fall semester. Many students remained actively involved in MEP throughout their collegiate career. Finally, all the participant students reported fair treatment from their professors.

Engineering Identity

Pre-College Experience

All eight students showed evidence of this theme. This is one of the top three most discussed topics, accounting for approximately 20% of the coded comments within contextual supports.

All the male students recalled having an interest in the engineering field at an early age. Gina, the only female participant and aerospace engineering major, was the exception. When she was "really little," she "wanted to be a Supreme Court judge" because she liked the prestige of being part of such an exclusive group. She eventually changed her mind, influenced by her father exposing her to computer programming at an early age.

> So he brought me up and showed me computers. He taught me how to program. He taught me math. Because he knows those are the basic functions I'd need for pretty much any career I'd want. Because, you know, the way computers are booming and everything now. So, it was pretty much he'd made sure to lay the foundation for if I wanted to be a mathematician or whatever. I at least have the basic skills and the foresight to know that if I wanted it I could get it as long as I was willing to work for it. (Gina)

Benjamin was inclined toward engineering because he "just loved engines. … [He] just loved the way they worked and everything like that. They were just like engineering type of stuff. And I was like oh engineering? Why not?" Frank recalled wanting to be an engineer when he was around 6-years-old.

> Sometime around me being six years old, I just decided I wanted to be [an engineer]. Well I started out mechanical engineering because I had a neighbor who always worked on cars and I loved cars. And that's what I thought mechanical engineering was. I know now that's actually not what it is. But it's weird because I think at times and think back and I'm like where did I even learn the term engineering. I don't know but that's when I wanted to be an engineer. (Frank)

Other students' aptitude in math fostered early development of this engineering identity.

> I've always known because growing up I've always liked math. like growing up I was always like I'm going to be a mathematician like when everybody else was like I'm going to be an astronaut I was like I want to be a rocket scientist. … [J]ust growing up I was so good in math. I was just naturally good. I like math. So I always knew I was going to go into math, so naturally engineering came along. (Andre)

Charlie shared similar sentiment remarking that his aptitude in math and science "got [him] interested in engineering."

High school provided students to further explore their interest in engineering. Two students—Andre and David—attended "technical high schools." David, however, did not take a math course in pre-calculus or calculus.

> I'm lucky; I went to a technical high school. … I don't think I would have actually known about engineering and computer science coming out. I learned about computer programming and computer networking because of my technical high school but if I had went to a regular high school like at home, I don't actually know if I would have known about engineering coming up. (Andre)

> It was called aviation high school. So it was a technical high school that prepared you to be aircraft mechanics. So it was a five-year program where we were certified aircraft mechanics. So it was a lot of shop classes. So we graduated being licensed mechanics basically for the airlines. (David)

The other students attended high schools that afforded them the opportunity to take the advanced math and science courses that increase the likelihood of graduating in a STEM major (Adelman, 2006).

> My mom and dad put me into a private school in Delaware seventh grade. It was a college preparatory school. So it's 97% go to college. So I had a lot of help there and then I discovered over there that I like math and science. So that got me interested in engineering. And then I had a really good college guidance counselor, I guess. [My guidance counselor], he was very helpful. he got me into LMSU. (Charlie)

> In high school [home to two magnet programs: International Baccalaureate and Robotics Technology], they never said you should be this or you should be that. It was pretty much we just had different levels of classes. We had something called the International Baccalaureate. … But it's basically just advanced placement. So I got calculus in high school. …
>
> So I got into that program and there were a couple other programs like CAS, Center for Advanced Studies which is basically like advanced courses. So if you had the aptitude or they even thought you had the aptitude, they pushed you into these harder classes, assuming of course you had a good advisor. I should clarify that. So that is pretty much why I got so much math physics and programming oriented is because the last two years of my high school were very oriented towards that. (Gina)

Engaging in STEM-related activities also reinforced this engineering identity.

> I mean my parents both they tried getting me like in different programs with engineering and architecture stuff like that 'cause I said that was my interest. And actually at the University of Pittsburgh they have really good pre-college like programs for minorities that would get them interested in engineering and stuff like that. So I was very involved with that. (Benjamin)

> So for me, I just ended up going into the sciences because I liked science. And part of that was his influence on me, too. Because I remember one time he took us to a field trip down to [his father's office]. He showed me and my sister and I all the pipelines down at [his father's office]. Because [his country] has a lot of natural gas that we export all over the world, especially in America. So he showed us all the pipelines. All that stuff just influenced me and just by him being in environmental science and so on just lead me on to looking at the sciences. Of course, I looked at business as well, too. But I thought I was more of a science person so I just went off to do the sciences instead. (Henri)

> The last year was an internship with Delta Airlines. We actually worked with actual mechanics. … I learned a lot about airplanes. I loved it. But I didn't go into it directly because I wanted to focus more on like engines, like aircraft engines and stuff like that. ... I realize that … I wanted more than that. Because I saw some other engineers around the airlines and realizing the kind of stuff they were doing was much more interesting. (David)

College Experience

In college, this engineering identity manifested itself through students' involvement in student organizations such as the National Society of Black Engineers (NSBE). NSBE is a non-profit organization "dedicated to the academic and professional

success of African-American engineering students and professionals" through "leadership training, professional development, mentoring opportunities, career placement services" (National Society of Black Engineers, 2009). Andre took his responsibility as president very seriously.

> Uh well I was program chair my sophomore year—well partially my sophomore year. The fall semester I started kind of like an interim programs chair because they didn't have one and needed one. … [The] second one (general body meeting), I went to them and said you still need somebody. I can do that if you need it. And then I got in the programs chair. Went to nationals in Orlando—'cause if you're on the executive board which I didn't know before was pretty happy to find out you automatically go to nationals and that was in Orlando. … So I went to that [NSBE Conference] and then like after going to that and just seeing everything and seeing how much NSBE can really affect somebody I decided to become pres cause I wanted to see NSBE do good and hopefully I can do something to make it better. Because they have been doing better every year I think since I've been here we've been doing better every year. So I thought maybe I could affect something. (Andre)

Benjamin was the "college entry chair." Henri, who joined NSBE as a freshman, was the "temporary endowment chair for NSBE." For Frank, "NSBE was a beautiful experience."

> But I walked into a meeting accidentally. I didn't even know they were here. I was walking by and I was like NSBE meeting going on. I'm like okay. And I started finding out what the organization was about and got involved in that and that kind of built on that. So then eventually yes there was a bit of a drive there initially but you build on that if you know now what you wanted to do with yourself. I think that's the key. It has to come a point when you have to decide what you want to do. (Frank)

College Job and internships

This engineering identity was reinforced through their part-time jobs and college internships. Additionally, many of the students secured paid internships after their freshman year.

> The job came through I think I got something from the MEP office. It was through the MEP office or the College of Engineering and I applied for it and

> basically I think one of the things that made me better in interviews whenever there were people like can you do this you can't think of something to say the actual answer then you say I know there is some way I can do it. And that's what basically got me the job there 'cause they had this whole database thing and I said that you know I can't think of anything but I know there's gotta be a way I can do it. And with basically I did a project on that first scholarship program … So basically that's what they said got me the job the fact that I said that there has to be another way. (Andre)

> I had to work at UPS to get some income, but when I interned at FedEx that was another reason why they hired me because I had worked inside the facility, so I understand. But I also worked for the competitor. So I bring a certain bit of information that no one else brought in. So things like that where I had it as a need to but then it became a really good opportunity thereafter.

> I just need income. I'm in there sorting packages and this has nothing to do with where I'm going to go in my life. Or it just doesn't appear that way in the beginning. But funny enough, and then, also you learn that engineers are EVERYWHERE! I mean, I tell people that I interned at FedEx. They're like, and I at first, I don't deliver packages. And people fail to realize how much technology is behind the scenes of a lot of these companies. (Frank)

> Before, I didn't know what engineering would do. I had a broad idea, but now it's more concise now in my head. I know exactly what an engineer has to do and what the standards are, what procedures need to be followed, from safety procedures right up to process procedures like ESTM standards that must be followed. I know a lot about different processes that needs to be carried out to get a final product. Like what percentage product needs to be gotten. What is the goal? How much like what percentage gas you want and what feed and all that. Because I worked at Air Products and Chemical—I had two internships with them because after freshman year I worked in Allentown. So I had experience with one of my managers [redacted] and at the headquarters in Allentown. So we went through P & I sheets with them. (Henri)

Over the years, they developed a deeper understanding of the field. The three seniors spoke with great enthusiasm regarding their career choice. Though some were challenged at great length along the way, they seemed fully ensconced in, and pleased with, their engineering major.

> That's an interesting story by itself. So I came in mechanical engineering. Didn't meet the requirements. Bad semester. So then I was trying to go into aerospace, let me go back aerospace, and same thing didn't meet the requirements. So then I had to choose something else. So I still had this machinery kind of thing I wanted

> to do so I went to agriculture. You know because they have like a machinery option. But then once I did machinery, I didn't like it so I went to natural resource. So like it just kept on changing and like now I love it. I love the natural resource just the environment.
>
> What is it that I like about it? It's just the environment. Because what really struck me was like certain things like water, we take for granted. Other people in other countries you know are dying every day because they don't have clean water to drink or just sanitation. So that kind of environmental issues really impacted me and realizing how all this technology and all the stuff that we're doing is impacting the environment which also impacts us. So just realizing how important that was, how much do we just take it for granted like. I have really gotten motivated and excited. (David)
>
> At first I came in industrial engineering, I read a little bit about it… I just couldn't grasp what it is they do. Because even people will still ask you like what is really industrial engineering? And one answer I have all along was it's basically business with engineering background. That's the only thing I had. But at the end of the day, I think that industrial engineering has evolved from what it used to be. Because now… it started in manufacturing and the whole manufacturing process which they made manufacturing really efficient. So now they're trying to get those concepts to different areas. And one thing that they've been able to do is in supply chain. They take the manufacturing which is like reducing variation which is the big thing. … they're also adding another two of the simulation model where you can create your system before you implement it. … And another thing with industrial engineering, other engineers pretty much is that they don't… like basically we also have to work with people like the resource and that's another thing I guess we have to do is manage and we actually worked with people and incorporate that with working with machines. (Edward)
>
> Because just getting into it, as I said I didn't have anyone to guide me to tell me about it-- I just kind of knew I wanted to do it. And I was thinking alright as electrical engineer I'm gonna be doing circuits and that's about it. That's really what I thought it was going to be. Over the years, as technology advanced, you learn more. The school has instituted new things and just my interest also by watching programs on TV. But also it's just the fact that meeting actual engineers or meeting people pursuing the same things and hearing what they want to do; you realize I can do that too. It has deftly changed not so much in what is but what you can do with it. That's it has definitely progressed. (Frank)

Summary of Engineering Identity

Comments related to Engineering Identity accounted for approximately 20% of all comments associated with contextual supports. This engineering identity was formed

early on in the career process. All the students spoke of "just knowing" they wanted to be in engineering. Furthermore, they had diverse experiences prior to coming to college that nurtured and enhanced their aptitude and interest in engineering. Involvement in MEP, NSBE and other engineering related organizations further developed this trait. Finally, through part-time work and college internships students gained a depth of understanding of their respective fields.

Family Influence

Family influence played a central role in the student's persistence in their engineering, primarily at the pre-college level. At the pre-college level, students cited family influence had the most effect in two areas: choice of an engineering major and acculturation. Additionally, students discussed the motivating effect of their parents' unfortunate circumstance. At the college level, family influence served primarily as a source of encouragement for the students, especially when the students contemplated leaving their major, or school, all together. I will begin the discussion of family influence at the pre-college level.

Pre-college

As stated previously, at the pre-college level, this theme was most influential on students' choice of a STEM major and their adjustment to a PWI. Family influence related to their choice of a STEM major garnered the most comments. Students primarily reflected on the role of their parents' occupation—or hobby—on choosing to major in engineering. In three cases, students had parents who were versed in STEM fields through their occupation or through their hobby. Both David and Henri had family members who were in engineering and science related fields. Though Gina's father

graduated from college with an accounting degree, he was “all into that world [of computers]”. Gina stated that her father wanted to ensure that his daughter develop sufficient math and computer programming skill to provide her with the greatest flexibility in her career options.

> I know my parents always expected me to go to college. That was the standard that they set, that they did set—wanting us to go to college. My father is like [an] electrician. He works for cable companies. So just having him there—and all my uncles are the same thing, all electricians. So, just having them there, you know kind of set the tone for like that technical kind of atmosphere for guys in the family. I didn't really start getting interested until I guess elementary school, the last year in sixth grade yeah. I guess somebody came in. All I remember is that that was the year when I was interested in airplanes and just like aerospace, and anything aerospace. I was just really interested in that. And that's how I was able to choose aviation going to high school. (David)

> Well my dad, I always take advice from my dad because he's a smart guy. One day, he told me because I'm good at math that I should be able to do chemical engineering because chemical engineering is all about math. It's just not all about math only it's about the sciences and so on. But I have been in the sciences since secondary school. So I thought that would be a good fit for me to do chemical engineering. And plus, my own take now, I know with chemical engineering you can broaden your horizons by branching out into any field. Like natural gas, the oil companies. Because my dad, he worked at the natural gas company in [my country]. He knows exactly what the fields are so I took his advice and I went to it because I love math, I'd love to work equations. I liked to find out new things about the environment [and] what you have to do with different processes. I feel I am complete now. (Henri)

> My dad is an honest to God nerd. He builds his own computers and he's all into that world. So he brought me up and showed me computers. He taught me how to program. He taught me math. Because he knows those are the basic functions I'd need for pretty much any career I'd want. Because, you know, the way computers are booming and everything now. So, it was pretty much he'd made sure to lay the foundation for if I wanted to be a mathematician or whatever. I at least have the basic skills and the foresight to know that if I wanted it I could get it as long as I was willing to work for it. (Gina)

Conversely, for those students whose the parents did not work in STEM related fields, family influence affected their choice of their STEM major in terms of the type of

high school they attended, the courses they took in high school, and the type of enrichment programs they participated in during the summer.

> I'm lucky I went to a technical high school though because I don't' think I would have actually known about engineering and computer science coming out. I learned about computer programming and computer networking because of my technical high school but if I had went to a regular high school like a home one I don't actually know if I would have known about engineering coming up. (Andre)

> And like my parents they always put me in camps and stuff like that, kept me active. So I think that was like a good thing. …
>
> I mean my parents both they tried getting me like [in] different programs with engineering and architecture stuff like that 'cause I said that was my interest. And actually at the University of Pittsburgh they have really good pre-college like programs for minorities that would get them interested in engineering and stuff like that. So I was very involved with that. (Benjamin)

> My mom and dad put me into a private school in Delaware [beginning] seventh grade. It was a college preparatory school; so it's 97% go to college. So I had a lot of help there and then I discovered over there that I like math and science. So that got me interested in engineering. And then I had a really good college guidance counselor, I guess. Dr. Glenn he was very helpful. He got me into LMSU. …
>
> My dad made sure I took physics in high school because he told me it was going to be useful. And he was right. You know I didn't believe him. I guess I could've been more prepared but it was all right. (Charlie)

Acculturation related issues

Family influence regarding Being Black at a PWI was discussed primarily in terms of how attending high schools with limited diversity facilitated their adjustment to a PWI. All of the students in this study commented on the racial composition of their classes. As Benjamin noted, "I was used to being like the only like African American in my classes and stuff like that."

> I wanted to make money they [African American students from high school] gonna call me a sellout. So, I mean I was just used to that type of stuff. Like this you know just being like the only black guy in most of my classes and stuff like that. So that didn't really I don't think that really affected me that much on a cultural level. (Benjamin)

> I'm kind of used to it actually because the high school I went to it was out of like 1000, there were 64 African-Americans. So I'm kind of used to it. … I think there are 105 juniors in aerospace and three of us are African-American. I actually don't know the other two but apparently they know each other. They're like foreign. I think they were born in different countries. (Charlie)

> Oh my parents told me yeah, there is no Black people at LMSU. You know, everybody says that. There is none there. And so I expected it. Fine. Whatever. I'm antisocial so honestly, it doesn't matter either way to me how many Black people or how many White people Asian, whatever. …

> My family is predominantly Black I went to a private school for elementary school which was pretty much all White. So I grew up used to being around White people, but then middle school and high school predominantly Black. So I've kind of reverted back. And I'm going to have to revert again because work is predominantly White. … It's just a matter of making the switch. … It's automatic. I talk differently around different people. Because you don't have a weird accent, I feel okay using my normal accent I suppose. Like when I go to Texas my accent changes. If I'm talking to someone who uses big long words for no apparent reason, I start using big long words for no apparent reason. It's just a habit of fitting into your surroundings. (Gina)

Gina, when asked if she ever believed that she was precluded from pursuing a STEM major because of her gender. She replied,

> Yes, I did, when I was little. But my mother is very, yeah, you're a girl but so what. So that kind of brought me out of that. My dad wanted a boy so in a lot of ways he treated me like a boy. So I grew up playing tennis. I grew up being just a very kind of muscular girl. So I was kind of used to the fact that yeah, I am a girl but that's not all I am. (Gina)

One other issue that students considered to be supportive for students in a seeming paradoxical fashion pertained to the effect of a commonly held concern in the African American community: not wanting to be a statistic.

> I don't even know if I believed it, you know, like that statistic thing. I knew I wasn't going to be a statistic anyway I'm going to use it because I was like that's what makes me go to college. I don't want to be a statistic. And back then, I don't know if I was thinking about it much that way as much as I just wanted to get into school. But right now when I think about it, I guess it kind of is [unintelligible] because my dad was a statistic. I didn't want to be like that plus I kinda want have … my family has had so much bad luck. Can we get some good luck sometime maybe it's with me maybe I can bring some good luck. (Andre)

> I think umm I mean being just a minority in engineering is just … being able to pick yourself up again. I mean everyone's going to have a downfall sometime like. It's going to happen sometime you got to be able to just breathe and just be able to keep going without any issue. I mean just without pondering on it because when you ponder that's whenever you start thinking too much and you're like should I do this, should I keep going, you know and stuff like that. … I feel like I, myself, am like setting, I'm setting a precedent. Like without being a statistic of someone who did drop out. (Benjamin)

Learning from the mistakes of their fathers was also beneficial for the Andre and Benjamin.

> Yeah my dad was kind of a role model. He was actually like the perfect role model for me because he wasn't somebody who I wanted to be. He was somebody I didn't want to be. So every time if somebody was like oh like in high school I just stayed out of it because I was watching my sister all the time. In high school especially my senior year, I was either watching my sister or working. So that kept me out of trouble, but then every time somebody said aww do this. I was like, naw, because I always think back—my dad's in jail. I don't really want to end up the same place he is. So it was perfect for me. Because I think it's actually better for me just because they're not … cause some people like end up hating their parents and like I don't want to be like that. (Andre)

> I think it was almost good because he was smart. So I knew that that was something I wanted to be. He was in electrical engineering; he was always the smartest person I knew. So I wanted to go into some kind of math or engineering. But then he did stuff. like I got to see he's still similar to me like people could see I'm related to my dad. I look like him and then we got the same personality. So I got to see what I don't want to do. When I come out of high school and go to college. So I say I was lucky in a way. (Andre)

> [M]y dad he was always saying, don't be like me and stuff like that. And like it's just like just hearing that is just like. I mean, what do you see yourself as? You know like I mean you've [his father] had your downs and stuff like that but you [his father] should never look down upon yourself. You know like just as a person. Because he's a good guy. It was just unfortunate like just like that he was adopted and stuff like that. You know, the way he was upbrung. I mean it's not really his fault but like he makes it his fault like it's his and I don't know. I just like [unintelligible] I don't want to look down on myself even like with anything I do you know. (Benjamin)

There was one notable finding related to effect of parents' role modeling on having a positive impact on students' persistence in engineering. Andre remarked,

> Yeah my dad was kind of a role model. He was actually like the perfect role model for me because he wasn't somebody who I wanted to be. He was somebody I didn't want to be. … In high school especially my senior year, I was either watching my sister or working. So that kept me out of trouble, but then every time somebody said aww do this I was like, naw, because I always think back my dad's in jail. I don't really want to end up the same place he is. So it was perfect for me. Because I think, it's actually better for me just because they're not … 'cause some people like end up hating their parents and like I don't want to be like that. … [and] when he was out [of prison], he would always … make sure I was doing good in math and all that stuff. He was like no matter how much he was in jail he always made sure I was doing good in school when he was out. (Andre)

College

At the college level, supportive family influence pertained to encouragement during challenging times, such as profound academic difficulties which led to some students considering leaving school. All students were asked if they had ever contemplated leaving the program. All of them acknowledged that there were many times when they considered leaving their major "every month or so" because their work is "so hard." "We'll say forget it I give up. I'm changing to business" (Gina).

Then there were those for whom leaving their major was a realistic possibility. Academic difficulties led to some students to change their major from their initial choice. Their parents' support and encouragement provided them the impetus to persevere in the face of adversity. Ultimately, the students were able to find majors that were more consistent with their passion.

> And so like whenever I heard that [couldn't get into mechanical engineering], like my second semester sophomore year, like I was just I just I didn't know what to do like it was just like everything I lived up for just to come to this school, and now I can't even do it. Like I was thinking about transferring schools and stuff like that. But I rethought it over and like my mother, she told me that like I should really stick with it and take something else and stuff like that. And that's when I decided electrical engineering. (Benjamin)

> They have always been encouraging me like, you know, don't give up. We're not disappointed in you. We still love you. We are rooting for you. It's just that constant like positive encouragement. Don't give up don't give up. Don't feel bad if you have to stay here an extra semester, an extra year. You know, get it done. And they always took away the stress of money from me. Even though I was an RA for two years, that helped out, but they never… they always told me you know don't get a job. We're going to take out loans. My mom's working two jobs to pay off stuff. So they made sure that there wasn't any added stress on me to manage job and school work. (David)

> They [his parents] played a big role. My parents never got a chance to go to college. Education is very big in their eyes. My sister went to college and actually, I always wanted to be an engineer so I always told them and whenever it got rough at first year, I was like maybe it's not for me. They pushed me to just stay with it and continue on. So in that they play a big role. (Edward)

Summary of Family Influence

Family influence played a central role as a contextual support for these students. The nature of the support differed between the pre-college level and the college level. Pre-college students were positively influenced by family members in STEM related fields. For those students whose parents were in unrelated, they benefitted from their parents enrolling them in schools or enhancement programs that nurtured their burgeoning interest in STEM fields. Regarding the effect of acculturation at the pre-college level, students spoke of how their early experiences of being 'one amongst few' prepared them for when they experienced this phenomenon in college and ameliorated their transition to a PWI. Students also learned valuable lessons from their parents' adverse circumstances, avoiding becoming a statistic or repeating the mistakes of their fathers. At the college level, students' family support pertained to encouraging the students when they experienced profound difficulties mostly associated with their academic. Their parents' encouraging words figured prominently in their ability to persist in their major.

Positive Peer Influence

Positive peer influence was experienced as a contextual support by providing a feeling of connectedness to the engineering community. For some students positive peer influence was readily established through their involvement with MEP and its associated programming. For those students who participated in a summer bridge program and began college on the main campus, race played a central role as to who comprised their peer network insofar as they had access to these programs because they were members of an underrepresented group. For other students who did not participate in summer bridge programs or who were transfer students, their peers usually were in their classes and shared similar values (e.g. commitment to excellence). For the most part, students eschewed the idea that they needed to affiliate solely with other students of color. They considered it more important to associate with the "right people" (Charlie).

Charlie frequently described himself as "lazy" and "needing to be pushed." Apart from his father's diligence in "pushing" Charlie to do well, Charlie said this about himself:

> I really don't have too much initiative. I need to be pushed. I'm dead serious. I have to be honest. I have to be pushed to do everything. I have a good buddy; he pushes me to go to the gym now. So I go to the gym with him. And my dad pushed me to make sure I applied to school along with my guidance counselor. So it's just having the right people. (Charlie)

Frank echoed Charlie's contention regarding the importance of friends, especially associating with individuals with similar traits.

> They're important. They're important. I don't think we really sit down and analyze and really look at it, but they are because you need to get away from work sometimes. You just need to. And you also need friends that are going to be similar to you. And by that I mean, if you're all about partying, you're going to need some party friends. If you're all about academics, you're going to need some

> friends that are about their schoolwork. You can't have it the opposite so to speak. So they're important. I mean it, I know you need to have that social aspect, that aspect where you interact with people. If they're friends in your major, it can be good and bad. Friendships sometimes come in the way of work, but at the same time, that person really understands what you're going through. (Frank)

Students established their peer network in a variety of ways. Students participating in one of the summer bridge programs had a ready-made peer network for them which facilitated their connection to the engineering community.

> A lot of people would feel alone because there are so few minorities in the college. But me personally, I really don't have a problem. I don't even notice it too much just because of my friends. Because I already have my friends around you know I also have a girlfriend too so that helps out. But my friends were always around penny packer. There were so many minorities around when I lived in engineering house my sophomore year part of my sophomore year um the people around me were my friends. … So there was enough around that, I already knew. And then I was in the society of professional engineers. (Andre)

> Like, just from living in Pennypacker. … Yeah, I mean that's like 30%. So you know you meet everyone. So I feel like I am acquainted with a lot of the minority population, just from being in engineering and living where I had lived, and just knowing everyone, and stuff like that umm and I keep in touch with people and I see them everywhere. (Benjamin)

Charlie mentioned that being part of an "engineering community" was very helpful to him making connections, getting his work done and developing lasting relationships.

> Like one of the big things that I think helped me in college is that, there is this community. This engineering community that started us out back at Abington. It was [mostly] just for engineers. … We had all the same classes so we kind of did all our work together. I'm still friends with a lot of them up here. Only like two of them are actually in my major but they're spread out over the other engineering. But that helped me because you get to know people. And then it's like oh, did you do the homework? We'll do the homework together. So that definitely helped a lot. (Charlie)

> If it wasn't for the engineering community that I had back at Abington, the buddies I have now. One of them was actually in the engineering community. And he, he's the one reason, probably one of the reasons why I'm up here because

> he got me through. I remember thermodynamics. The material was so difficult combined with the papers you had to write. (Charlie)

Participating in student organizations also proved beneficial to students finding supportive peers which led them to feel more connected to the overall engineering community.

> Organizations like the MEP, and NSBE, now building you again because now you're kind of forced to be here but then you meet someone else, you meet someone else, you meet someone else, you meet someone else. And that's kind of how, now I am perfectly fine. A lot of my friends have graduated but I'm fine. (Frank)

> Definitely felt more a part of the engineering community especially just through NSBE and even now, even now like I see myself as a mentor to those who are coming up now. So I kind of feel like an old head. Like I feel a major part still. And it's no longer isolation. I really feel like it's… like I'm a part of something. (David)

Role of acculturation

All the students participating in this study mentioned that they had previous experiences of being in school settings in which students of color were woefully underrepresented. When students in this study had negative encounters because their peers were unaccustomed to seeing black students, they used the incident as a motivating factor to succeed in their major.

> I think schoolwise, like first they every time like I walk into one of my engineering classes like and they see like there's like me like a black guy. And they're like, oh, there's a black guy. Ooo, there's a black person in here. You know like I mean I don't feel I don't feel like, like a little person. I just feel I think that just ups me like ok like I have to do less is hard. I have to go twice as hard just because like I'm here you know. And there's not many of us here. … Like high school, I'd be the only black person like in all my classes. So like there was in high school that's like how I felt. But now I'm just like OK, what else is new? (Benjamin)

> And socially and culturally, the thing is because LMSU is so diverse, I have been mingling with all different types of people from different types of backgrounds like Caucasians, Asians Latino of course Africans and so and so. I have mingled

> with all different types of people so it wasn't trouble for me to fit in. The thing is, I don't go around looking for friends... that's just how I operate, very businesslike. … But so like mingling with other people and so on was not a problem for me at all. I always fit in. And it helps when people just love you for some reason you know. (Henri)

> To be honest with you, I got used to it in high school. Most of my classes they are were what five, six Black people. That was about it. When it got to graduation time and when everybody in my year got together and we sat alphabetically look to your left, oh, I don't know that Black person. I don't know that back person. I don't know that one. I don't know that one. So was just pretty much the way our classes were divided. I didn't get to see Black people then. (Gina)

In fact, other than Gina, most of them did not feel compelled to affiliate exclusively with African American, or other students of color. Gina was the only one who expressed a preference to associate with other African American students, stating that "[m]ost of my friends are Black. Just because to be honest, I'm just more comfortable hanging out with Black people." This was particularly true for students who were not born and raised in the United States.

> But what I do personally, everybody gets a blank slate. Sure, there are a few stereotypes. We're never going to get rid of that because as a people, you can prove that most Asians are this, most Blacks are this so on and so forth. So let's not be naïve. But at the same, I try to take that person for who that person is. Now if you play into the stereotypes, then hey it's on you. But if you're outside the box, then sure; I've had friends from so many different countries and have learned so much. (Frank)

> …I have been mingling with all different types of people from different types of backgrounds like Caucasians, Asians Latino of course Africans and so and so. I have mingled with all different types of people so it wasn't trouble for me to fit in. The thing is I don't go around looking for friends... that's just how I operate, very businesslike. Like about my business, … I'm going to do what I have to do in that time. And then head back to class and go wherever I have to go. But so like mingling with other people and so on was not a problem for me at all. *I always fit in* [italics added]. And it helps when people just love you for some reason you know. (Henri)

Students in this study also relied on their peers for emotional support and encouragement when they became discouraged for any number of reasons.

> Just having that support system of engineers especially upperclassman. They was like don't leave, stick in there, hang in there. So having like people who know what you're going through and that's been there and you can see that they are about to graduate. That there is success. And just, I had a great support system. A really great support system that kept me in here. I remember one friend he kept telling me, don't switch out. … He's like, what else you gonna do, huh? … I say you got a point, you got a point. (David)

> So I mean it was great meeting some of the other people from NSBE I know who were originally in Pennypacker with me. So just a sense of community seemed to help out a lot. And like if people are in community they are less likely or seem less likely to drop out because it's always somebody like, "Nah, don't drop out." You know you can do this. However if you really need help I guess I can help you out I guess you know I guess I can help you out. And this has been with a lot of my friends. (Andre)

Summary of Peer Influence

Students' peer influences were an important part of the participant students ensuing success in engineering. Peer influence was primarily experienced as a source of encouragement which served to ameliorate the effects of isolation and contribute to them having a sense of community. Students' did not feel that peer's race was particularly important. Students were more interested in surrounding themselves with "the right people" who shared their values to pursue excellence. For some students, establishing a peer support network was made easier because of their participation in a summer bridge program still managed to develop affirming relationships with their peers and contribute to them feeling connected to the engineering community. Regarding Being Black at a PWI, students experienced both positive and negative interactions with peers. Both the positive and negative peer interactions contributed to students' success.

CHAPTER 5

DISCUSSION

Of all the social cognitive variables that comprise social cognitive career theory, self-efficacy has received the most attention in the literature and is purported to mediate choice actions such as persistence in a college major. Regarding the purpose of this study, contextual supports and barriers mediate persistence through its effect on the four primary sources of information of efficacy information (Lent et al., 2000). This study examined how the contextual supports and barriers experienced by the students in this study influenced their persistence in engineering though their effect on self-efficacy.

In this study, six prominent themes emerged from the data. Four themes were perceived primarily as supports: (1) Being Black at a PWI; (2) Engineering Identity; (3) Family Influence; and (4) Positive Peer Influence. Academic Issues and Personal Issues are the other two emergent themes and they were primarily discussed in terms of barriers. As contextual supports and barriers' influence on persistence is predicated on their differential effect on self-efficacy and these six themes inform contextual supports and barriers, the factors that contributed to participant students' persistence will be discussed in terms of the differential effect of these six emergent themes on the four primary sources of information of self-efficacy.

Personal accomplishment

According to SCCT, personal accomplishment reflects one's belief that they can accomplish a given task and is posited as having the strongest influence on self-efficacy (Lent, 2005; Lent et al., 1994; Lent, Brown, & Hackett, 1996). The theory purports that success serves to enhance self-efficacy while repeated failures detract from self-efficacy.

With more self-efficacy, an individual is more likely to follow through on a stated choice action, such as persistence. Conversely, lowered self-efficacy will contribute to opting out of the related choice action. Early success facilitates similar success in college and vice versa. The most prominent theme related to personal accomplishment was academic difficulties, a significant barrier in the experiences of three students—Benjamin, David and Edward. Regarding the other students, academic performance was not a prominent aspect in their experiences. Most of the difficulties were related to their core math and science courses, prerequisites for admission into their engineering major.

Research indicates that inadequate pre-college preparation figures prominently in contributing to African American students' underrepresentation in STEM fields (Wilson, 2000). Justiz and colleagues (1994) also suggested that racial segregation, poor teacher quality and limited academic achievement in high school that are purported to present a substantial barrier to African Americans representation in STEM fields. For two students, their pre-college preparation impinged upon their success in college. David and Edward had not previously taken a calculus class in high school. By not taking calculus in high school, David was "kind of like slowed…down" once he started college. He had to take remedial math classes before he could take the required calculus courses for engineers. Edward was so intent on starting calculus his first semester in college, that he retook a placement test to place into calculus. He soon came to regret that decision. He said,

> But the fact that you never see it, I think they just expect that you have taken calculus because they go through really fast. And for a person who has not taken it, it's very, very difficult. (Edward).

Benjamin also experienced difficulty with calculus and other core courses during his first year. He began college with many of the advantages research indicates contribute

to choice of an engineering major and success in college (Adelman, 2006; Horn et al., 2001; Maton et al., 1998; Trusty, 2002b). He went to "camps and stuff like that" sponsored by a local university while in high school, his parents (at least his mother) were very involved in his education, and he had taken AP calculus in high school. Furthermore, he participated in LMSU's summer bridge program. Despite all these advantages, Benjamin had such difficulties in calculus that he briefly contemplated abandoning his engineering major.

All three students resolved their academic issues differently. David simply suffered through his core courses.

> [Y]ou're struggling just to get Cs. And all you're seeing is like C's and D's and C's and D's and occasionally you get a breakthrough and you get a B. What was frustrating was like I was putting in the time. I was always working trying to figure out stuff but when it came to exams like I just didn't do good. And that is what was really frustrating. You're working you're putting in your time but you're not doing it right. (David)

Edward, on the other hand, employed some creativity, finding "loopholes" to meet his math requirements. He took calculus in "continuing education" where the class was taught at a slower pace facilitating Edward's understanding of the course. Finally, Benjamin eventually settled for a D, after taking the class two times.

According to retention literature, students' academic performance, especially the first year GPA (Lotkowski et al., 2004; Nora & Cabrera, 1996; Schaefers et al., 1997; Zhang et al., 2004), is purported to correlate positively to retaining students in their major, at least to the sophomore year. To some extent, the findings from this study can be construed as supporting the importance of academic performance in student persistence in engineering as all of the students in this study performed well academically during their first year and achieved a cumulative GPA above 2.5. Research has indicated that

students who achieve academically fail to persist in engineering (Levin & Wyckoff, 1995; Maton & Hrabowski, 2004).

For three students, their exceptional first year academic performance resulted from taking remedial classes (David), late-dropping classes (Benjamin and Edward), or beginning college with a GPA buffer resulting from participation in one of the summer bridge programs (Benjamin). Upon taking the required core courses, two students (David and Edward) experienced profound academic difficulties and seriously considered leaving their major. Retention literature asserts that academic and social integration is especially important for retaining African American students attending a predominantly White institution (Jones, 2001). For the students in this study, social integration figured more prominently in their success and in some instances, facilitated students' academic integration into their engineering program through their involvement with the MEP, NSBE and positive peer influences. Grandy (1998) found similarly noting the importance of non-cognitive factors (e.g., early interest in STEM fields, encouragement from family and friends, participation in the MEP, etc.) to students' persistence in their engineering major, especially for those students who experienced academic difficulties early in their program.

Vicarious Learning Experiences

Vicarious learning experiences provided by role models is purported to be the second most influence on self-efficacy (Bandura, 1995). Role models have more influence on an individual when they share similar characteristics with those role models. "The greater the assumed similarities the more persuasive are the models' successes and failures" (p. 3). The three themes that most informed vicarious learning experiences are:

Being Black at a PWI, Family Influence, and Positive Peer Influence. Of the three themes, Positive Peer Influence figured most prominently in their experience at LMSU.

Research has frequently asserted that role models in STEM fields is important to African American students' consideration of a career in engineering as viable and achievable (Hackett & Byars, 1996; Herndon & Hirt, 2004; Karunanayake & Nauta, 2004; Murry & Mosidi, 1993). They assert that African Americans need to see other African Americans in the field to consider it to be a viable major choice. The first opportunity to learn through vicarious experiences occurs at an early age within the family and extended family network (Hill, 1997).

Regarding the pre-college family influences, students primarily reflected on the role of their parents' interest—or hobby—on choosing to major in engineering. In three cases, students had parents who were experienced in STEM fields through their occupation or through their hobby. Both David and Henri had family members who were in engineering and science related fields. However, though Gina's father graduated from college with an accounting degree, he had a very strong interest in computers and computer programming and felt Gina needed to develop computer and math related skills. Gina recalled spending "long nights crying at this stupid white board while [her] dad tried to force [her] to learn multiplication tables. I hated those stupid things. But after that, math became so much easier." Students in Maton and colleagues (1998) study shared similar sentiments of their parents' "determined support and consistent pushing" (p. 663). as being instrumental to their success and their ability to overcome the various challenges they encountered in their pursuit of an engineering degree (Maton et al.). Maton et al 1998 suggest that "parents' determined support and consistent pushing" (p.

663) was instrumental to the success of the African American male students in their study.

Charlie's dad "was really into [his] future" to the point of strongly suggesting that Charlie take physics. Notably physics is the one course that was predictive of choice of a STEM major for African American males in Trusty's (2002c) study. He credits his parents' decision to send him to a private school ("97% go to college") as being instrumental to him choosing to major in engineering. He asserts,

> I had a lot of help there [private school] and then I discovered over there that I like math and science. So that got me interested in engineering. And then I had a really good college guidance counselor, I guess. Dr. [Jansen, pseudonym of guidance counselor] he was very helpful. He got me into LMSU. (Charlie).

Neither of Charlie's parents is employed in a STEM major.

While students in Maton et al.'s findings benefited from a "dad [who] was an example of that successful figure" (p. 653) not often portrayed in society, students in this study demonstrated that a parents' negative role modeling could also prove beneficial.

> Yeah my dad was kind of a role model. He was actually like the perfect role model for me because he wasn't somebody who I wanted to be. He was somebody I didn't want to be. [italics added]. So every time if somebody was like oh like in high school I just stayed out of it because I was watching my sister all the time. In high school especially my senior year, I was either watching my sister or working. So that kept me out of trouble, but then every time somebody said aww do this; I was like, naw, because I always think back my dad's in jail. I don't really want to end up the same place he is. So it was perfect for me. (Andre)

Both Andre's and Benjamin's fathers explicitly instructed them not to "be like [them]." Andre's father spent much of his [Andre] childhood in and out of jail and,

> when he [Andre's dad] was out [of prison], he would always … make sure I was doing good in math and all that stuff. He was like no matter how much he was in jail he always made sure I was doing good in school when he was out. (Andre)

Andre was able to incorporate some of his dad's redeeming qualities into his own way of being primarily because of the similarities he and others saw between Andre and his dad.

> I think it was almost good because he was smart. So I knew that that was something I wanted to be. He was in electrical engineering; he was always the smartest person I knew. So I wanted to go into some kind of math or engineering. But then he did stuff. like I got to see he's still similar to me like people could see I'm related to my dad. I look like him and then we got the same personality. So I got to see what I don't want to do. When I come out of high school and go to college. So I say I was lucky in a way. (Andre)

Andre's and Benjamin's fathers conveyed to both students the importance of doing well in school so as not to end up like them (their fathers).

Once in college, Positive Peer Influence was considered to have more influence than Family Influence on students' success. This was especially true for Charlie. Throughout the interview, Charlie frequently stated that he was "really lazy" and had a proclivity to "procrastinate." He had his father "push" him in high school and he had his friends, "the right people," push him in college, helping him "get through a lot."

When he was making plans to change to a major that was more soft skills, David commented,

> Just having that support system of engineers especially upperclassman. They was like don't leave, stick in there, hang in there. So having like people who know what you're going through and that's been there and you can see that they are about to graduate; that there is success. (David)

Engineering Identity was another factor that influenced vicarious learning experience source of self-efficacy. At the early stages of data analysis, this theme seemed to be the most prominent factor for understanding their persistence in engineering. Consistent with findings from (Lewis & Collins, 2001), students' race was not determinative of their choice of major. Students' interest in the field held considerably

more sway in their decision to pursue and engineering degree. Frank's comments on this issue encapsulate what many of the other students seem to believe about majoring in a STEM field. Frank grew up in another country and did not "get … race until I came here [United States]." He readily eschewed the "idea of the vast majority of Black people don't do this [a particular career] the vast majority of the White people do this [a particular career]." Student's interest in engineering became evident at an early age. Benjamin "just loved engines." Frank recalled wanting to be an engineer when he was around 6-years-old. Frank "had a neighbor who always worked on cars and [he] loved cars." Andre "always knew" he would go into a STEM field and ultimately computer science. David, who encountered many barriers in his pursuit of an engineering degree, attributed his persistence in engineering to feeling like engineering was an integral part of his identity.

> I just felt like I was an engineer. Like I have this engineering personality inside of me, [italics added] and I want to do it. Especially when I started getting passionate about you know water and the environment and energy. I was like man that's my goal. I want to get there. I want to be able to help people. So that started being like a driving force for me. (David)

The other students had similar comments. Lewis and Collins suggested that both lacking a full understanding of their chosen major and failure to exercise their own agency in shaping their careers can contribute to a students' early withdrawal from their STEM major. Contrary to Lewis and Collins' findings, most of the students acknowledged they did not begin college having the most accurate understanding of what engineers do. However, most of them were very active in shaping their career while in college through their part-time jobs and internships and co-ops.

In his freshman year, Frank found a part-time job just to meet his financial needs. When he applied for an internship, Frank stated that the part-time job figured prominently

in him being hired for the internship. Andre found a part-time job directly related to his major. For all the students in this study, as they progressed further in their major, they eventually developed a much deeper understanding of their chosen career and exercised their agency in shaping their long term career goals.

Verbal persuasion

For students in this study, support and encouragement from all aspects (peers, family, MEP) of their support network proved instrumental to their decision to remain in their major. This is especially true for students who experienced considerable obstacles to earning a degree in engineering.

Family's support and encourage was instrumental to students' persistence in engineering. Knowing that their parents' would be there for them and encourage them speaks to the positive relationship they had with their parents. Edward took a leave of absence for 1 ½ years. He remarked about how his parents' supported him in his decision to leave, despite their reservations. That leave of absence was critical to Edward's ultimate success in engineering. He will be graduating in August of 2009.

For those students who were most active in the MEP, Ms. Davis and the rest of the MEP staff was a significant support for many of the students in this study. When Benjamin and David were forced to change majors, Ms. Davis was one of the people they consulted. When David was prepared to leave the College of Engineering, Ms. Davis in the MEP office encouraged him to remain. Thus, all the students in this study had few discouraging methods that would discourage them from choosing and persisting in engineering. These findings are consistent with other research (Herndon & Hirt, 2004; Moore et al., 2003).

Physiological and affective states

Physiological and affective states pertains to persons' belief in their ability to cope with the stressful vagaries of life (Bandura, 1997). Theoretically, moderate levels of anxiety will have a facilitative effect on self-efficacy while high levels of anxiety will undermine self-efficacy (Hackett & Byars, 1996). The two themes that contributed the most influence on physiological and affective states were Being Black at a PWI and Personal Issues. Being Black at a PWI was discussed primarily in terms of support, while Personal Issues were discussed in terms of a barrier.

Two areas that research indicates as relevant to the influence of physiological effects for African American students in engineering pertain to cultural issues (e.g., discrimination and acculturation) (Cole & Jacob Arriola, 2007; Evans & Herr, 1994; Landrine & Klonoff, 1996; Lent, Brown, Talleyrand et al., 2002; Moore et al., 2003) and social integration (Fries-Britt, 1998; Fries-Britt & Turner, 2002; Good et al., 2002; Herndon & Hirt, 2004). Being Black at a PWI played a central role on the effect of both cultural issues and social isolation on students' persistence.

Research pertaining to the career development of African Americans has frequently explained differences in career choice amongst cultural groups from a deficit perspective suggesting that the career development of African Americans' career development is constricted by their race (Bowman, 1993; Brown, 2000; Chung et al., 1999; Maton et al., 1998; McCollum, 1998; Murry & Mosidi, 1993; Powell, 1990). However, race, alone, is insufficient to explain the differences in the career development of African Americans in comparison to that of European Americans especially given that research had yet to determine "what is truly racial about the career behavior and

counseling of African Americans" (Brown & Pinterits, 2001, p. 2). In this study, none of the students mentioned that race informed their decision to pursue a degree in engineering. The one person, Gina—the lone female in the study, was the only who indicated that an immutable (naturally) cultural aspect of herself briefly impinged on her consideration of a STEM major when she was "little." Her mother quickly disabused her of that notion: But my mother is very, yeah, you're a girl but so what. So that kind of brought me out of that. My dad wanted a boy so in a lot of ways he treated me like a boy."

Discrimination

Research has suggested that perception of discrimination may deter some African American students from pursuing a STEM major (Bowman, 1993; Chavous et al., 2004; Cheatham, 1990; Chung et al., 1999; Hall & Post-Kammer, 1987) while other research has demonstrated that discrimination has no bearing on choice of STEM major (Evans & Herr, 1994; Lent, Brown, Talleyrand et al., 2002; Moore, 2006). None of the students in this study gave any indication that perceived discrimination informed their decision to pursue an engineering degree. Furthermore, they all experienced some measure of discrimination from their peers, but most seemed to use the slight as a motivating factor to succeed. They seemed nonplussed in their discussion of differential treatment by their peers. For them, discrimination was a given and a natural consequence to being an African American at a predominantly White institution. Andre summed up his experience:

> … I see it [being Black at LMSU] as an advantage. As much as you may be discriminated against here [and when] you get out of college, but when you're in the LMSU College of Engineering, there are so many opportunities. Our MEP office is really good. … I just feel like being Black at [LMSU] you—well Black

> in engineering at least—you almost have it better because there's nobody else in minority engineering. So, I mean when you get recruited, there are people who recruit for minorities. (Andre)

Many of the students experienced some form of discrimination from their peers. Benjamin felt that

> … I don't feel like a little person. I just feel I think that just ups me like ok like I have to do less is hard. I have to go twice as hard just because like I'm here you know. And there's not many of us here. (Benjamin)

Frank recalled a similar experience.

> I can't recall anyone explicitly saying to me you can't do so-and-so. But what I can recall is there's been numerous times, even recently, where I'll say to people what I do and they are amazed. But not amazed because of —you can tell the difference where it's not that you're a rocket scientist; it's that you're Black and you're a rocket scientist. There's two different things: like there's a sheer shock and awe that come on their face. And it's just like, why is this so surprising? On one hand, let's be honest, there aren't that many African-Americans in the tech fields, or STEM fields. But on the other hand, it's 2009 why does that still surprise you so much. So in that sense, it's a little bit disheartening but I'm the kind of person where look unless you have a direct impact on my life I personally don't care what you have to say. (Frank)

Many of the students in this study exhibit traits that contradict the detrimental effect of discrimination (Broman et al., 2000; Suarez-Balcazar et al., 2003). David was the exception. He had internalized many of the negative stereotypes associated with African Americans that research indicates contributes to African Americans lacking the intellectual capacity to pursue an engineering degree (Brown, 2000; Chung et al., 1999; Maton et al., 1998; McCollum, 1998; Murry & Mosidi, 1993; Powell, 1990). As discussed earlier, he would not seek help from his classmates or ask questions in class because he did not want to "seem … dumb or [like] a typical black person doesn't know anything, they always want help, they always need this and that." He did seek counseling

from one of the student support services on campus, but he attributed his persistence to his family, his faith and to the MEP.

Acculturation

As with the other sources of efficacy information, physiological and affective states informed the influence of acculturation on students' experience. One factor, Being Black at a PWI, was indicative of students' acculturative experiences. This theme was discussed primarily as a source of support for all the students.

All of the students in this study evinced behavior consistent with a bicultural level of acculturation. According to Landrine and Klonoff (1996), bicultural individuals incorporate the values of both the culture of origin and the dominant culture and can participate in the two different cultures simultaneously. All the students in the study were thoroughly ensconced in and retained many of the values and traditions of their culture of origin while successfully participate in the dominant culture. This may contribute to their primarily positive acculturation experiences.

All the students entered college with previous academic experiences of being 'one of few' or "the only one" in their high school classes. They were "kind of used to [being 'one of few']" (Charlie). Gina commented on her parents' guidance that "there is no Black people at LMSU" (Gina). Gina identifies strongly with being an African American yet she remarked on the importance of "making the switch" and developing a "habit of fitting into your surroundings." She commented:

> So I grew up used to being around White people, but then middle school and high school predominantly Black. So I've kind of reverted back. And I'm going to have to revert again because work is predominantly White. … It's just a matter of making the switch. … It's automatic. (Gina)

They spoke of "making the switch" as if it was a given. They gave no indication that doing so was particularly burdensome. Students' involvement with the MEP also had a positive effect on students' acculturative experiences. Those involved with the MEP frequently cited support from Ms. Davis as an essential source of support. Andre commented, "she [Ms. Davis] always taught us that we can't give up; you know she just told us they're not going to just give us anything." Similar to the students in Lee's (1999) study, the students in this study found a cultural connection through their involvement with the MEP.

Two students commented on an issue that falls more on the traditional end of Landrine and Klonoff's (1996) continuum of acculturation; the notion of being a statistic. Andre confidently stated that he knew he "wasn't going to be a statistic," especially given that his "dad was a statistic." Similarly, Benjamin offered that he felt he was "setting a precedent. Like without being a statistic of someone who did drop out." Both Andre and Benjamin spoke of being a statistic as a positive motivating factor in their desire to graduate with their engineering degree.

Isolation

Regarding the effect of Being Black at a PWI on students' isolation, students' participation in MEP and NSBE served as a significant source of support. This is consistent with the findings of (Good et al., 2002) who found that students who participated in MEPs were more likely to persist than those who did not. Frank had not been particularly involved in the MEP, but he extolled the benefits of it based on comments from his friends who attended LMSU because of the MEP outreach to them in high school.

> I know students who are here in engineering now that are here because of MEP because MEP reached out to them while they were in high school. So it's really good in that sense. And when they are here, it kind of forges another bond. Alright because I am kind of familiar with you before I got here to Penn State. They know some of the faculty and staff already. So in that sense it's a good program. (Frank)

Frank did not have that built-in community that the summer bridge program participants had. When he first entered college, he indicated that getting connected was "a challenge." He took it upon himself to remedy his sense of isolation. He "had to make all the moves" to introduce himself to people, which required him to swallow his pride and keep it moving when he encountered people who were not interested I being friends with him. In this process, he discovered, "surprisingly, the vast majority of people aren't vicious." I believe this is something that can benefit a number of students who may be apprehensive about establishing a support network when they come to college.

There were also those students who intentionally isolated themselves when personal issues arose. Andre and Edward chose to engage a few close friends and family. Andre did not want to burden his friends and Edward tends to isolate himself when he is under a seeming insurmountable amount of stress.

Implications of Study

College of Engineering

Research has indicated that African Americans attending a predominantly White institution are likely to experience it as a hostile and isolating environment (National Action Council for Minorities in Engineering (NACME), 2004). The findings indicate that the College of Engineering at LMSU provides African American engineering students with a variety of opportunities that contribute to their persistence in engineering.

The College of Engineering's MEP program was indicated as critical to the persistence of the African American students in this study. Expanding the outreach of the MEP and its associated programming may prove instrumental to improving the retention and graduation of African Americans and possibly other underrepresented students of color in engineering. Students' participation in summer bridge programs facilitated an easier adjustment to their engineering program at LMSU. The summer bridge programs provided participating students with ready established support networks they considered essential to their persistence in their engineering major. Those who did not begin college through a summer bridge program benefited greatly from their involvement with the MEP or organizations such as NSBE. Support from the staff of the MEP during their college experience was frequently cited as pivotal to the persistence of most of the students in the study. The retention and graduation rate of African Americans and other underrepresented minorities would benefit from the continued, and perhaps increased funding, of such programming, especially at predominantly White institutions.

One other notable finding pertained to the participating students' experience of differential treatment from their professors and their peers. None of the students felt they were treated differently by their professors because of their race. The lone female participant in the study, however, mentioned that she felt she had been treated differently by her professors because of her gender. Most of the students indicated that they found their professors helpful when they solicited help. Conversely, the students in this study frequently mentioned incidents of differential treatment from their peers. These negative interactions from their peers served primarily to motivate the students in this study to succeed.

High School Counselors

The overall mission of the American School Counseling Association (ASCA) National Model is to promote "academic achievement, career planning and personal/social development" (American School Counselor Association, nd). The findings from this study support the mission of the ASCA National Model, especially with regards to academic achievement and career planning. None of the students indicated that they used the services of their school counselors and only one student gave any indication of a positive experience with their high school counselor.

All of the students in this study reported performing very well in high school. Students' high school academic performance, however, did not always transfer to college. Those students with the most academic difficulties cited the lack of study skills as a significant barrier to their success in college. Evidenced by this study, students would benefit from developing sound study skills, along with their participation in a rigorous curriculum appropriate for consideration of a STEM major in the future. Additionally, for African American students, less than stellar academic performance in math and science classes may not be a disqualifying factor for consideration of a STEM major. For the students in this study, their early interest in engineering contributed significantly to their persistence despite the academic difficulties they experienced.

Career planning is one other component of the ASCA National Model. Despite considerable difficulties with core courses, students' interest in engineering, along with support from friends and family, compensated for their academic deficiencies factor in their pursuit of an engineering degree. In high school, students may be prematurely discouraged from pursuing a curriculum leading to consideration of STEM majors

because of less than stellar math and science grades. Granted, students must demonstrate at least a modicum of interest and aptitude in their math and science courses. School counselors can figure prominently in helping students develop clear career interests that increase the consideration of a STEM field as both viable and achievable.

This study also demonstrated the importance of parental involvement in both academic achievement and exposure to opportunities that enhance students' stated career interests. All of the students in this study remarked on the importance of their parents fostering an environment of high expectations and excellence in their academic performance. For a number of the students, their parents' occupation and/or hobby in a STEM related field influenced their choice of an engineering major. Parents were also involved in providing students with opportunities that served to strengthen the students' interest in engineering. Students' parents are a valuable resource for school counselors and should be part of a comprehensive school counseling program.

Career Counselors

For career counselors working with African American students, special consideration should be given to the role of acculturation in African Americans career development. By conceptualizing acculturation in terms of a psychological process, counselors can help their ethnic minority clients develop strategies that foster ethnic minorities' identity along with developing adaptive skills to succeed in environments that lack diversity. Counselors should also pay attention to the strengths (e.g., support from friends and family, involvement with the MEP, desire to be an engineer, students' faith, etc.) that circumscribe African American students' college experience. Parental support figured prominently in participant students' persistence in their major. Career counselors

should assess the quality of the student-parent relationship to develop effective strategies that facilitates students' ability to overcome obstacles they encounter in pursuing their engineering degree.

Career counselors working with African American engineering students experiencing academic difficulty in their core courses should be carefully assessed regarding the appropriateness of the major. For the students in this study, various contextual supports had a significant support on the students' ability to remain in their major and ultimately graduate. Students may also benefit from assistance with developing relevant strategies to mitigate any maladaptive adjustment to the university (e.g., involvement with cultural organizations, student support services, family support, etc.).

Student Affairs Personnel

For the students in this study, their main interaction with student affairs personnel was through academic advising. The preponderance of the students' experiences with academic advising was negative. The majority of the students eschewed meetings with their academic advisors in favor of their friends in developing their schedules. They usually sought assistance from their friends, or relied upon their own initiative to select the classes required for graduation. Many of the students had negative experiences with their academic advisors, prior to admittance into their major, with one student commenting:

> [LMSU campus] made me see things in a certain way. So I was like no adviser because I have my friends. And I have heard I don't know how many stories about advisors messing up people's schedules. It seems like everybody's adviser was just not helpful (Charlie)

Academic advising in their major was viewed more positively. Some of the displeasure may be attributed to academic advisors' high caseload. Discovering creative ways to reduce the ratio of advisees to advisors may lead to greater student satisfaction.

Few students used any of the other student support services provided by LMSU. Those students who were unduly affected by Personal Issues did not seek assistance from the clinical staff in LMSU's counseling center. However, two students sought counseling from counselors at LMSU's counseling center for students of color (CCSC) rather than the school's counseling and psychological services (CAPS). These students noted they had a positive experience from meeting with counselors at CCSC. As evidenced by this study, students of color attending a predominantly White institution need emotional support, they are more likely to seek counseling from those services provided especially for them (e.g., CCSC rather than CAPS). In fact, students had a strong negative reaction to the mention of seeking services from CAPS. Continued funding of the CCSC along with appropriate training and professional development of the counselors and outreach will contribute positively to African American persistence in engineering at a predominantly White institution.

Implications for Theory

Social cognitive career theory is grounded in Bandura's (1997) social cognitive career theory that asserts that four primary sources of information inform overall self-efficacy and ones' belief in his/her ability to accomplish a given task. This theory presumes that personal accomplishment has the strongest influence on self-efficacy. Findings from this research suggests that issues associated with physiological and affective states and verbal persuasion may figure more prominently in African American

students' choice of and persistence in engineering. In this study, themes associated with physiological and affective states generated the most comments regarding both contextual supports and barriers. As pertains to the career development of African Americans in STEM fields, and perhaps in general, SCCT researchers need to reevaluate the strength of influence of the four primary sources of information.

One other implication of this study for theory is the consideration of other sources of self-efficacy. One additional source to consider is the influence of culture on self-efficacy. Cultural self-efficacy could be added to the theory to further delineate culture's role in the career development of African American college students. Acculturation can be conceptualized as influencing cultural self-efficacy. Cultural self-efficacy could refer to the individual's belief in their ability to perform effectively in various cultural situations. Usher and Pajares (2008) include cultural self-efficacy that is connected with African Americans' acculturation level. Exploration of coping self-efficacy should also be explored.

Limitations of the Study

There are a number of limitations to this study that are endemic to qualitative research. Researcher's prior success in engineering along with the study emphasis on students' strengths may minimize the potency of the barriers the students' encountered. Furthermore, this is retrospective study of students who shared many of the criteria that research indicate would predict their persistence in engineering. As this is a qualitative study, generalizability of the findings to the larger population of African American engineering students at LMSU, let alone to the overall engineering student population, was not the main focus of this study. This is characteristic of case study research (Stake,

1995). However, some generalizations can be drawn from the findings (Stake) and prove transferable to students in other engineering programs, other majors, and other institutions. Finally, because the students in this study were currently enrolled in the College of Engineering, the experience of students who transferred from the college was not considered.

Strengths of the Study

One of the main strengths of this study is that it presents a different perspective of African American persistence in engineering. This study provides a rich and deep understanding of the career development of African Americans from a strengths-based perspective. Furthermore, this research demonstrates that early impediments (e.g., poor academic performance, adjustment difficulties, personal issues, etc.) do not have to lead to abandoning one's decision to pursue an engineering major. All the students encountered some obstacle in pursuit of their engineering degree, but they all used a variety of strategies that helped them overcome those obstacles. The findings from this study may lead other to reconsider transferring out of their engineering major when they encounter obstacles similar to those the students in this study experienced.

One other strength of the study pertains to my experience in earning a degree in engineering. I bring an insider perspective to this research and fully understand the desire to contemplate choosing an easier major after doing poorly in core courses. As a result, I interpreted their discussion of contemplating changing to an easier major as par for the course for engineering students. The students in this study in this study used the contemplation of transferring to an easier major as motivation for them to remain in their major. As the students noted, something kept drawing them back to the major. In most

cases, friends and family figured prominently in the students' decision to remain in their major.

Future Research

Hargrow and Hendricks (2001) noted that few studies explicate the career development of African Americans in STEM fields. Notwithstanding that there are a multitude of social, economic and political barriers with which African Americans are faced; if research continues the current extensive focus on what hinders the career development of African Americans, discovering what facilitates their career development, particularly in STEM fields, will be overlooked.

Understanding more of the factors that contribute to students' success may uncover more aspects of their experience that bolster self-efficacy or other positive features that improve persistence in the face of adversity. The majority of the research pertaining to the persistence focuses on students in their first two years of school who left prematurely. By studying the experiences of students in their senior year, the relevant variables that affect student persistence can be more readily identified (Patterson-Stewart et al., 1997).

One other area of inquiry may focus on explicating the processes through which some of the theoretically weaker informational sources inform self-efficacy. Bandura (1997) asserted that role models are more influential when they share traits similar to those observing them. Research would benefit from determining the importance of which characteristics are most critical for African American students in STEM majors. With regard to a role model's racial and ethnic makeup, research has yielded conflicting results (Hackett, 1995; Karunanayake & Nauta, 2004; LaVant et al., 1997; Lee, 1999). The

majority of the students in this study benefited greatly from African American role models. In fact, only two of the students in this study found support and inspiration from role models who were not African American.

More research that explores the relationship between acculturation and career development (Pope-Davis et al., 2000) is needed. A useful area of inquiry would be to explore the role of acculturation on the choice of a STEM major. Existing research on the career choice process of African Americans focuses disproportionately on factors that constrict their career choice (Bowman, 1993; Brown, 2000; Chung et al., 1999; Maton et al., 1998; McCollum, 1998; Murry & Mosidi, 1993; Powell, 1990). Starting from the premise of acculturation as a mutable aspect of an individual's psychological makeup and behavior, more study on how different levels of acculturation inform choice can lead to the development of strategies that lead to greater congruence with African Americans' interests and career choices. Additionally, further research pertaining to the acculturation process of African Americans at various points on Landrine and Klonoff's (1996) acculturation continuum may prove helpful in facilitating the development of useful coping strategies to deal with potentially difficult cultural transitions, such as being an African American at a predominantly White institution in engineering.

Many of the students in this study commented on the importance of social supports from various sources (e.g. peers, family, MEP staff, etc.) as critical to their persistence in their major. However, they all had prior academic success which may have been more of a factor in their persistence than they indicated. Future research is needed to elucidate the role of emotional supports in African American students' persistence in an

engineering major. It would be interesting to see the types of emotionally supportive experiences that compensate for deficiencies in academic performance.

Finally, research on African Americans needs to be updated to reflect the changing role of race and ethnicity in a 21st century environment given the pervasiveness of the Nickelodeon/Disney Channel/MTV effect. Many of the students attending college now grew up seeing numerous depictions of racially and ethnically integrated casts as nothing of particular note. Research has to account for the difference it makes for the career development of African Americans, especially after the election of the first African American President in the United States. Frank suggests that a generational shift has occurred.

> [T]hat's what makes it hard for me because any kind of racism or any kind of that backward thought tends to come from older folk who were around that time. Now in my generation and the one behind me, they really don't care. I mean, a friend is a friend. Yes, they'll grow up with the knowledge of certain things and yes, we still stereotype regardless. … But what I do personally, everybody gets a blank slate. Sure, there are a few stereotypes. We're never going to get rid of that because as a people, you can prove that most Asians are this, most Blacks are this so on and so forth. So let's not be naïve. But at the same, I try to take that person for who that person is. Now if you play into the stereotypes, then hey it's on you.

I believe the research related to the career development of African Americans needs to make that generational shift as well.

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APPENDIX

INTERVIEW PROTOCOL

1. Let's begin with you telling me a bit about yourself. How did you decide on LMSU?
2. How does it feel being an African American majoring in engineering at a predominantly White institution? Do you feel you have been treated any differently because of your ethnicity or gender? Explain.
3. How did you decide to major in engineering?
4. Describe how your pre-college experiences affected your choice of engineering and preparation for college.
    a. What role did your family play in this decision?
    b. How many math courses did you take in high school? What were they?
    c. What kinds of role models were available to you?
    d. What types of engineering-related experiences contributed to you choosing to major in engineering?
5. Describe your first year in engineering: academically, socially, culturally, and psychologically.
    a. How prepared did you feel upon entering college?
6. What kind of experiences do you feel prepared you to succeed in engineering?
7. What difficulties did you encounter in pursuing your degree in engineering? How were you able to overcome them?
8. What kind of support systems did you regularly rely upon? How did you establish these support systems?

   a. What role did student support services (career services, CAPS, etc.), academic support services (ULC, etc.), race specific programming (MEP, PREF, etc.) play on your persistence in engineering? How helpful were they to you in helping you reach this point in your major?

9. At what point in your engineering major were you confident that you would graduate in the major? Had you ever considered leaving engineering? Why? What changed your mind?
10. What has been the most rewarding aspect of majoring in engineering? What has been the most challenging or difficult aspect of majoring in engineering?
11. How connected did/do you feel to the engineering community at the university? Explain.
12. How has your knowledge about engineering changed over the years?
13. What advice would you give to a high school student who tells you that they are considering engineering as a college major?
14. What changes would you recommend the College of Engineering make to improve the retention of African Americans in the major?

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