AFRICAN AMERICAN STUDENT PERCEPTION OF PERSISTENCE IN ENGINEERING AT A PREDOMINANTLY WHITE INSTITUTION

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DEDICATION

I dedicate this dissertation to my grandmothers, Flora Flowers and Mammie Bennett.
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ABSTRACT

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This study examines African American student perceptions of persistence in engineering. The research design is methodologically qualitative using a purposefully selected population of engineering students. Semi-structured interviews were designed to develop an in-depth understanding of what completion of the engineering degree means to African American engineering students. This research seeks insight into the linkages between African American student perceptions of persistence as it relates to both the academic and social culture of the engineering department.

Vincent Tinto’s model of Institutional Departure (1975, 1987) is one of the most commonly cited models of persistence in higher education (Braxton, Milem, Sullivan, 2000). Tinto’s model was leveraged in this study to understand perceptions obtained through student interviews. Tinto suggests that exploration of student goal commitment and perceptions of institutional commitment are key to understanding student persistence. Results of this study suggest that African American students have perceptions about the university that may influence the decision to persist in engineering. Ultimately, this study may prove useful to researchers and administrators interested in improving access and success for African American engineering students.
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Chapter 1: Introduction

This research is designed to explore African American student perceptions of persistence in engineering at a predominantly white technical institution. For the purpose of this study, perception is defined as the meaning African American students attach to interactions within the university’s engineering programs. While exploration of both retention (institutional perspective on enrollment continuity) and persistence (student perspective on enrollment continuity) are not uncommon within the literature, there is a shortage of research exploring the explicit perspectives of African American students and how they make sense of persistence in engineering programs. Supplementing the research base exploring African American engineering experiences promises to be helpful in an era where technology is one of the fastest growing sectors of the U.S. economy.

The following research questions undergird this research:

1. What do African American engineering students perceive to be the most critical reasons for their persistence in engineering at a predominantly white technical institution?

2. What does completing the engineering degree mean to African American students at a predominantly white technical institution?

3. What strategies, resources, and relationships do African American students perceive as most important for persistence in engineering at a predominantly white technical institution?

4. What do African American students perceive as the most significant barriers to persistence in engineering at a predominantly white technical institution?
The relevance of this research is highlighted when viewing African American participation in engineering over the last decade. While African Americans represent approximately 7% of the U.S. population between the ages of 18 and 24 (United States Census, 2010) and 13% of the aggregate college population (NSF, 2010), African Americans represent a mere 5% of undergraduate students enrolled in U.S. engineering programs (NSF, 2013). Furthermore, between 2000 and 2010, African Americans and Native Americans were the only tracked ethnic demographic groups that experienced zero growth in engineering enrollment (NSF, 2013). A deeper examination of National Science Foundation statistics reveals that flat engineering enrollment for African Americans, combined with increased engineering enrollment for Whites, Asians, and Latinos, resulted in a net statistical decrease in the representation of African Americans studying engineering nationwide from 7% in 2000 to 5% in 2010.

The demographic trends for African Americans in engineering suggest that a deeper knowledge of this group’s experiences may shed critical light on the attractiveness and future success of African American students within the discipline. In order to fully understand African American student perceptions of persistence I begin by exploring the definition of engineering and how engineering is represented within the literature.

**Engineering and STEM Education**

What is an engineer? Raymond Landis (2000) succinctly defined engineering as turning ideas into reality. Organizations such as the Accreditation Board for Engineering and Technology (ABET) have defined engineering more explicitly:
Engineering is the profession in which a knowledge of the mathematical and natural sciences, gained by study, experience, and practice, is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind. (p.27)

The field of engineering has had a profound impact on the world. Whether using a slick new iPad, placing a cellular call, or shopping for a box of cereal, an engineer has likely played a role in the design and/or manufacture of the experience. In fact, one would be hard pressed to go more than a few moments without encountering an artifact that was created or improved by the engineering process. Just consider the implications of a natural disaster. A flood or tornado rapidly highlights society’s dependence on science and engineering technologies. A catastrophic storm would immediately place pressure on utilities, roads, food and water supplies, communication, and health services (Mackie, 2010). Without engineers, the nation would find it difficult to restore vital services or afford ravaged communities the comforts that citizens of the 21st century have become accustomed to.

Nationally and internationally, the Accreditation Board of Engineering and Technology (ABET) serves as the accrediting body for universities seeking to prepare students to be engineers. The successful engineering student is required to navigate curriculum that demands mastery of both mathematics and sciences courses. As a result of the similarities in rigor and academic preparation across science, mathematics, and engineering disciplines, the National Science Foundation coined the STEM (Science, Technology, Engineering, and Mathematics) acronym in 2001. According to the Great Plains Education Center (2012), 2001 NSF Director Judith Ramaley suggested that
STEM disciplines possess a common core of curricular values. Since that time, the use of the STEM acronym has grown, and much of the research on engineering curriculum and students can be found within aggregated STEM reports.

With the advent of emergent technologies, there is no sign that the demand for engineering innovation will diminish. In spite of the 2008 economic crisis, there has been consistent consumer pressure for better, faster, and more efficient technologies. By 2012, every economic sector (Agricultural, Industrial, and Services) of the U.S. economy was positively influenced by innovations in science, technology, engineering, and mathematics. In fact, the wave of STEM innovation has been so comprehensive that it is difficult to quantify the impact of STEM innovations on the US GDP. Whereas the economic impact of STEM may have been isolated to the industrial and agricultural sectors of the U.S. economy one century ago, today’s technological innovations have indelibly influenced “non-technical” industries as disparate as sales, education, communication, entertainment, and finance. In fact, the wide-ranging impact of STEM innovation has been so profound that a recent report produced for the national academies has encouraged economic researchers to consider development of new internationally-aligned metrics that effectively communicate the influence of STEM innovation on GDP (Litan, Wyckoff, Fealing, 2012). In spite of the economic limitations isolating the impact of STEM innovation, a report produced by the U.S. Congress Joint Economic Committee (2012) predicts that STEM employment opportunities are expected to grow by nearly 20% over the next decade and outpace non-stem opportunities. The report also suggests
that leadership in STEM innovation will be critical for nations that wish to remain competitive in the world economy.

Given the prevailing tendency of the economy toward increased STEM employment opportunities, research that improves understanding of African American persistence in engineering potentially provides an opportunity to meet the burgeoning demand for STEM workers. This in turn would infuse the engineering field with innovative ideas from what appears to be an underleveraged sector of the U.S. population.

Purpose and Implications of the Study

In a world increasingly dominated by technology, each nation must reflect upon the resources available for competition and success. Based upon the 2012 Organization for Economic Cooperation and Development (OECD) report, the U.S. is ranked as the world’s fourth most highly educated nation, with approximately 46% of U.S. citizens receiving tertiary training. However, that only tells part of the story. Further analysis suggests what educated U.S. citizens are trained to do may be as important as whether they are educated. For example, the work of N’Da, Robin, & Tribunella (2012) suggested that the strength of a nation’s STEM workforce correlates most positively with economic growth.

In response to OECD rankings, United States officials have invested in policies aimed at improving the volume of U.S. collegiate STEM graduates (Committee on Prospering in the Global Economy of the 21st Century, 2007). Furthermore, the officials
determined that maximizing the benefit of STEM education on the economy requires (1) increases in the flow of students from K-12 programs to college, (2) aggressive strategies that improve the attractiveness of STEM programs to new entrants and (3) retention of STEM students that are already in the pipeline.

Analysis of the U.S. STEM talent pipeline suggests that African Americans represent an underleveraged population of potential engineering professionals (Slaughter, 2007). There are many studies exploring both the social and academic rationale for minority underrepresentation in STEM disciplines (Tsui, 2007; Morales, 1996; Landry, Stevens, Kelly, Sanchez & Fisher, 2013; Estrada, Woodcock, Hernandez & Schultz, 2011). Each of those studies, addressing issues ranging from preparation to mentoring, sheds light on elements of the access and success continuum for African American engineering students. However, existing research provides less insight into the specific perceptions and adjustments that African American students make when they wish to persist in the engineering disciplines.

This dissertation uses Tinto’s (1975, 1993) model of institutional departure as a lens for viewing African American student perceptions of persistence. Tinto suggests the primary reasons for student departure are (1) academic difficulties, (2) difficulty aligning educational/occupational goals, and (3) difficulty integrating into the social fabric of institution. This dissertation maintains that additional qualitative exploration of African American student perceptions of persistence within engineering will provide a more expansive view of African American student perspectives of academic and social adjustment in engineering as defined by Tinto. African Americans represent a unique
population within the U.S., having experienced the peculiar race-based traditions of slavery, segregation, institutionalized discrimination, and multigenerational poverty. Although slavery was abolished in 1865 with the 13th amendment and race-based discrimination was outlawed in 1964 with the Civil Rights Act, there may be perceptions within the African American community informed by the convergence of these peculiar cultural experiences (Tierney, 1999). This dissertation hopes to add to this growing body of study.
CHAPTER 2: LITERATURE REVIEW

This research aims to expand our understanding of the perceptions of African Americans in engineering at predominantly white technical institutions. Tinto’s Theory of Institutional Departure is the lens used for interpreting the data acquired during the study. In addition to reviewing Tinto’s model, I explored the organization and history of engineering programs, efforts to expand the number engineering graduates in the United States, and the persistence of underrepresented groups within engineering.

Tinto’s Theory of Institutional Departure

This dissertation explores African American student perceptions of persistence in engineering at a private, predominately white, institution with a technical focus. Vincent Tinto’s Model of Institutional Departure (1975, 1987) is one of the most commonly cited models on persistence in higher education (Braxton, Milem & Sullivan, 2000); it undergirds this study and is applied to analyze data obtained through student interviews. According to Hagedorn (2005), the term “retention” refers to an institution’s perspective on college completion while the term “persistence” refers to a student’s perspectives on college completion.

A key element of Tinto’s (1975) theory has been its landmark focus on differentiating the reasons students leave college. According to Tinto, students who leave due to academic failure should be viewed as distinct from students who depart...
voluntarily. Students who voluntarily depart may be retained by universities under the proper conditions. Tinto’s model was heavily influenced by Durkheim’s model of suicide (1961). According to Durkheim, individuals are more likely to commit suicide if they are (1) not thoroughly integrated into the values of a community and (2) disengaged from individuals within the community. By exploring what completing the engineering degree means to African American students, I hope to gain new insight into the connections African American students perceive, as well as the meaning they make from engagements within the community.

Tinto (1975) suggests that colleges and universities have evolved to create their own unique social systems and cultures which students are inclined to withdraw from if they are unable to make meaningful connections within the community. These meaningful connections include, but are not limited to, connections made with students, faculty, and staff. The model acknowledges that students arrive at the university with varied familial backgrounds, pre-collegiate training, and individual attributes. Each of those pre-existing factors ultimately funnels into a student’s perception of personal goal commitment or institutional commitment. In his model, Tinto takes particular note of the power of perception in understanding student persistence:

Finally, the model of dropout proposed here accepts, as central to the process, the notion that perceptions of reality have real effects on the observer, and, for a variety of reasons, persons of varying characteristics may hold differing perceptions of apparently similar situations. In both integration into the academic and social system of the college and in the evaluation of the costs and benefits of that and other forms of activity, it is the perceptions of the individual that are important (p. 98).
While personal goal commitment is expected to have the greatest influence on a student’s grade performance and academic integration, perceptions of institutional commitment are expected to impact peer-group interactions, faculty interactions, and social integration. The interplay of these factors is predicted to influence the student’s determination of whether to remain in school or depart. This study views closely the engagement of students within a university’s engineering program; it views departure as leaving the engineering program rather than the institution.

Since 1975, Tinto and other researchers have continued to explore the original theory and its limitations. Hurtado and Carter (1997) suggest that in spite of the strengths of Tinto’s model of institutional departure, the theory lacks comprehensive sensitivity to the cultural dynamics at play when evaluating student persistence. For example, Hurtado and Carter believe the model lacks a clear explanation of success for students who participate in academic environments where few members of the community have an understanding of their culture prior to enrollment. Further, there are challenges related to how researchers interpret the meaning that students make as they persist in university cultures which are in direct conflict with pre-existing understandings and value judgements. Where and how do these students become integrated into the culture and community of the university? This dissertation will identify and explore African American student perceptions of their connections with the university.

For Hurtado and Carter (1997), the distinction between integration and involvement is critical; they believe that Tinto’s focus on involvement relies too heavily upon behavioral measures of participation at the expense of psychological measures of
acceptance within the university community. Their research suggests how students view involvement may be just as important as the time committed to activities within the university. Further, Tierney (1999) suggests that Tinto’s focus on the behavioral perspective of student involvement is limiting when exploring minority student integration, since the original model implies that minorities are required to suppress elements of pre-existing cultural identity and adopt the dominant values of the college culture. Longitudinally, Tierney suspects that the process of suppression may be harmful to some students. Suppression is a particular concern when membership within the university community is perceived to be at odds with the student’s cultural identity. By providing a qualitative analysis of African American student perspectives at one predominantly white institution, I hope that this study will supplement existing empirical findings and refine our understanding of African American perceptions of persistence in engineering.

Organization and History of Engineering Programs in the U.S.

The history of engineering in the United States sheds light on institutional commitment and the culture of engineering programs as noted in Tinto’s (1975) model of institutional departure. The United States Military Academy at West Point opened the first U.S. engineering school in 1802 to address both the military and public work requirements of a young and growing nation. As the need for bridges, roads, railways, and infrastructure expanded, the demand for engineers quickly exceeded the supply. Grayson (1980) credits growth in engineering and technology with the increased
patent demand during this era. From 1790 to 1865, the U.S. Patent Office issued 60,000 patents. From 1865 to 1896, however, the U.S. Patent Office issued 416,000 patents, and engineers contributed to this growth (Grayson, 1980).

From the literature on the history of engineering, I note (1) historical precedent for national engineering demand, (2) evolving perceptions of prestige influencing early engineering curriculum development, and (3) continuity in the design of engineering curriculum. William Wickenden (1944), the first president of Case Western Reserve University, is often cited for work exploring the history of engineering education in the United States. Wickenden and others observed that schools of engineering evolved differently from professions like medicine and law. Whereas those professions developed in the United States along parallel lines with the British tradition of trade schools, early engineering training had a workshop orientation that was often mathematically, scientifically, and technically rigorous but lacked concurrent training in the liberal arts. In other words, early programs provided a focus on practical technical skills absent the theoretical requirements that were expected in classical arts and science disciplines. Apprentice relationships, like those found in medicine and law, did not exist, and few engineering preparation programs existed before colleges and universities began preparing the nation’s engineering professionals. In fact, whereas schools of medicine and law were founded by professional organizations, engineering colleges founded professional engineering organizations (Grayson, 1980). As a result of those developmental differences, pursuing engineering was not always perceived as a scholarly equivalent to training in the law, medicine, or the sciences. The engineering student of
the 19th century was typically provided with two to three years of training before being sent out to the field (Grayson, 1980).

According to Allen, Jewell, Griffin, and Wolf (2007), Senator Justin Morill’s Land Grant Acts of 1862 and 1890 were designed to incentivize and assist states in the develop of educated citizens while improving agricultural and industrial outcomes for the United States. The Morill Act(s) resulted in the creation of the state university systems, which helped address demand both for more and better prepared engineers. Equally importantly, this era improved the discipline by requiring more liberal arts training. By the early 20th century, engineering programs had embraced a four-year curriculum. Jackson (1916) considered the four-year curriculum, with a practical laboratory experience during the last two years of the program, beneficial to the engineering student’s development:

It is only after a couple of years of the vigorous life of engineering schools that our American young men can profit fully by laboratory work where they are thrown mostly upon their own resources; but, having reached this stage, their progress in self-reliance and effectiveness for solving minor engineering programs go hand in hand under the stimulus of a liberal method exercised by teachers (p. 283).

Much of that tradition continues today: the first two years of most engineering programs are dedicated to math, science, and general education requirements. Engineering courses, which require the integration of math and science skills, are reserved for the final two years of most four-year programs.
Most of the identifiable conflict in the literature regarding engineering curriculum also goes back to the early 20th century where leaders in the hard sciences questioned whether engineering was actually a field of study separate from the sciences (Hendricks, Jacobson, Pederson, 2000). Critics of engineering as a separate discipline suggested that engineering was nothing more than application of the physical sciences. Alternatively, pure sciences were proposed as more important because they valued synthesis over application.

In the last few decades there has been research informing these developmental debates about the import and sequence of courses in engineering. Longitudinal regression analyses of the impact of engineering curriculum on learning, accounting for variables such as socioeconomic status, gender, and race, suggest that work habits and procrastination are the two most significant factors determining whether or not a student persisted in engineering (Hulst, Jansen, 2002). After those two criteria, the number of theoretical courses scheduled simultaneously seems to have some impact on student persistence in engineering.

Bordoga, Fromm, and Ernst (1995) indicate that the traditional design of engineering curriculum, with application-oriented engineering courses reserved for the final two years of the program, may have a negative impact on some students. They suggest that the heavy concentration of math and science courses without any application-oriented exploration in the first two years of engineering school misses opportunities engage students in the practical engineering arts. As an alternative to conventional models engineering education, Bordoga, Fromm, and Ernst (1995) propose
an integrative approach to the engineering curriculum, where students are exposed to engineering applications earlier in program, making engineering more interesting to a wider array of students. Further, the authors suggest that an integrative approach to engineering curriculum might provide opportunities to highlight the social impact of engineering through redesigned general education courses. Redesigned general education course might integrate the social, psychological, political, and economic implications of engineering decisions.

In studies of engineering programs that have demonstrated success in retaining women and minorities, emphasis on the social relevance of engineering has been identified as a key strategy for retention (Harris, Rhoads, Walden, Murphy, Meissler, Reynolds, 2004). It appears that, in addition to positive economic outcomes, some women and minorities are attracted to engineering when it is presented as a discipline with clearly articulated positive impacts on society.

The literature establishes that engineering has played a longstanding role in the industrial development of United States. During the early 20th century, university engineering programs and curriculum expanded with the inception of the Morill Land Grant Acts. These new engineering programs introduced the four-year undergraduate engineering curriculum and enhanced liberal arts and science requirements. This curricula design was believed to provide engineering students with a solid foundation to complete the final two years of engineering study (Jackson, 1916); it continues today. Although that is the most common engineering program design, other researchers believe that alternative approaches to engineering education may broaden the diversity of
engineering students while improving the persistence of students who select engineering (Harris, Rhoads, Walden, Murphy, Meissler & Reynolds, 2004). Gaining more insight into African American student perceptions of persistence, particularly regarding the perceived social impact of an engineer’s work may improve efforts to recruit and retain African Americans in engineering programs.

The Current State of Engineering in the U.S.

Where does the United States stand on the issue of engineering today? In 2004, the National Academies initiated their most recent efforts to envision the future of engineering in the U.S. with the publication of The Engineer of 2020: Visions of Engineering in the new Century. With that effort, the Academies noted that preparation of engineers in the United States must change to overcome socio-political and technological challenges.

Over the last three decades, nations such as China have grown from annually producing equivalent numbers of engineers to the U.S. to producing ten engineers for every single U.S. engineer. Additionally, China has become the single largest high-technology global exporter (National Science Foundation Science and Engineering Indicators, 2012). Increasing U.S. dependence on international producers and exporters of technology has resulted in tremendous financial benefit to many corporations. It also is a prominent risk point in the supply chain during an era of terrorism and international political instability. According to the National Academy of Engineering, the engineer of 2020 will be challenged to embrace the best of classical engineering preparation (strong
analytical skill, creativity, ingenuity, communication, leadership, and ethical standards),
while engaging a future that requires heightened sensitivity to the benefits of new
technologies, cross-cultural communication, global economics, and the contributions of
engineers to unconventional and emerging fields.

The Engineer 2020 clearly outlines obstacles confronting colleges and universities
engaged in preparing engineers for the advent of new technologies, increasingly
interdependent global economies, and a bulging human population. What remains is an
articulation of a solution to the challenge. To close the loop, Rising Above the Gathering
Storm: Energizing and Employing America for a Brighter Economic Future was
published by the National Academies in 2007. This publication specifies that key areas
of opportunity for U.S. development of STEM talent rests in (1) improving the K-12
pipeline, (2) supporting STEM research, (3) Improving Higher Education, and (4)
addressing economic policy. Recommendations for improving K-12 education include
more teachers and improved training for teachers in the STEM disciplines. Additionally,
the Academies emphasized the importance of improving K-12 student performance on
state and national science and math performance assessments. The K-12 arena is a place
where African American students, particularly those in large urban districts have
struggled to succeed (National Academies, 2004).

The Academy’s research recommendations focused on increased and improving
strategic governmental and corporate investments in STEM. Recommendations for
improving higher education focus on recruiting the best and brightest national and
international students to STEM disciplines by increasing the availability of scholarships
and expanding the availability of visas for international students. Finally, recommendations for economic policy discussed fiscal support for promising technologies and improvements in policies associate with intellectual property.

Both *The Engineer of 2020* and *Rising Above the Gathering Storm* (2007) provide macro level analyses aimed at providing researchers, state and federal officials, and university leadership with opportunities to flesh out the micro implementation details necessary to improve preparation of STEM professionals in the United States.

**Efforts to Produce Engineers in the U.S.**

Accepting the National Academy’s (2004) call to action, countless STEM initiatives have been implemented over the last 5 years. Foundations such as the Gates Foundation have poured millions of dollars into secondary and post-secondary education (Honig, 2009). State and federal agencies have invested in national core curricula for K-12 and have created specialized STEM-themed schools and programs (Honig, 2009). At the collegiate level, STEM programs have piloted learning communities (Freeman, Alston, Winborne, 2008), invested in advising, and created transformative programs to improve the graduation and retention rates of students in STEM disciplines. As many of these initiatives are only in their second or third iteration, the longitudinal effectiveness of these programs remains uncertain, as does whether the strategies are transferable from institution to institution and community to community.

STEM innovation is crucial to the future of the United States. The literature referenced in this section also suggests that U.S. production of college graduates in
STEM fields trails projected demand. To close the projected gap in US domestic STEM talent, national investments have been made to improve K-12 education, postsecondary education, and STEM research opportunities. This dissertation aims to extend the impact of the National Academy’s (2004) observations and recommendations by obtaining a deeper perspective on the African American subpopulation.

**Underrepresented Groups in Engineering**

It is important to note that exploring the experiences of African Americans, in aggregate, entails the exploration of the experiences of African American women. Women represent more than one-half of the U.S. population but only 20% of the undergraduate engineering population and African and Latino Americans represent nearly 30% of the population but only 10% of the engineering population. These groups possess great potential as contributors to the U.S. STEM talent pipeline. However, nearly 75% of minorities who begin careers in STEM are not retained (Wilson, Holmes, de Gravelles, Sylvain, Johnson, Mcguire, Pang & Warner, 2012). Reversing the trend of students transferring out of STEM disciplines may meaningfully contribute to the United States’ STEM pipeline while concurrently diminishing the persistent socioeconomic status gap that exists for women and minorities in the United States.

Are race and gender relevant in the study of engineering persistence? Does race matter? In their study of a highly selective institution, Berger and Millem (1999) find that even when African American students enter the university with high levels of
institutional commitment, they are less likely to perceive the university as supportive and they fail to persist. Further, Berger and Millem find it alarming that, when controlling for entry characteristics, being Black was the third highest negative predictor of persistence in engineering study, trailing only measures of non-involvement such as failing to attend class or other forms of isolation.

In her study of race, rigor, and selectivity, Amy Slayton (2010) explored efforts to increase the representation of African Americans in engineering programs in Maryland, Illinois, and Texas between 1940 and 1990. Through case analyses of multiple state institutions, Slayton determined that institutions express assumptions about African Americans in policies and practices ranging from admissions to instruction. Ultimately, Slayton suggests that efforts of engineering schools to expand selectivity are often at odds with efforts to improve diversity. Even when Slayton was able to document extensive institutional investments in minority scholarship and academic remediation, those efforts did not always result in increased African American student representation. What is less clear from Slayton’s study is how African American students perceived institutional efforts, and how those perceptions influenced their desire to continue within the discipline. Where Slayton’s (2010) thoughtful work effectively communicates the institutional intent of African American engineering recruitment and retention programs, her work does an insufficient job of capturing the way these programs were received by African American participants.

average, women make less money than men, and some of this deficit is based on academic major (Marini, 1997). When comparing the male-female wage gap across a representative sample, Marini found that the wage gap dropped from 22% to 9% when controlling for major. STEM majors tend to pay higher salaries than education and social science majors, fields where women have typically been overrepresented (Brown and Corcoran, 1997). Income is strongly tied to social class, and social class frequently makes a difference longitudinally. The results of longitudinal ethnographies (Lareau, 2003) that have followed youth from elementary school through college demonstrate the long-term impact of income on families. A key finding from Lareau’s study suggests that the challenges of income and social class begin early and incrementally increase for poor and working class students as they progress through academic careers.

One of the most disconcerting elements of poverty is its cyclical nature, whether induced by class, race, or gender. Poor parents often lack the resources to live in communities with better schools and teachers. Additionally, those parents have to work more hours to make ends meet (Lareau, 2003). Lacking a surplus of time and money, this often means that the children of the poor and working class do not participate in enrichment activities that more affluent peers take for granted. The obstacles of poverty for poor and working class families also mean that college is not always a serious consideration. The cycle of poverty repeats when poor and working class students start families under familiar economic circumstances. When poor and working class students are fortunate enough to successfully navigate the challenges of limited income, they often arrive at colleges and universities with significant gaps in preparation, culture,
communication, and social interaction (Lareau, 2003). In fact, the poor and working class students in Lareau’s study did not progress to college.

There are myriad reasons why developing a stronger understanding of the African American engineering experience might be helpful. In addition to addressing the U.S. gap in graduating engineers, including women and minorities in engineering career opportunities may provide a powerful opportunity to break multi-generational poverty because STEM jobs pay well. As a discipline, engineering may not be appropriate for all, but it might serve as a viable option for more women and minorities. Most importantly, unique life experience and perspectives often prove powerful sources of innovation and creativity. The inclusion of more women and minorities in the field of engineering provides opportunities for fresh ideas and approaches to resolving engineering problems (Buback, Frank, 2004).

While Lareau (2003) suggests that social and economic status may be a factor influencing some African American college students, that observation does not tell the whole story. All women and minorities are not members from the poor or working classes. Some minorities arrive at college from the ranks of the middle and upper classes. However, despite the occasional benefits of more privileged socio-economic circumstances, African Americans continue to struggle for equitable representation in engineering programs (NSF, 2013).

Leslie, McClure, and Oaxaca (2006) suggest that the struggles of minorities and women in STEM disciplines occur before the students arrive in their dorms on the first
day of college. They believe that the performance of minorities and women in STEM majors results from the convergence of several interrelated phenomenon. They believe that significant problems result from the pressures of peer and family groups who do not value the commitments of time and resources necessary for success in STEM fields. Math and science courses require more time and focus than many other majors. Without appropriate pre-collegiate support, the research suggests that the abilities of women and minorities atrophy from lack of use. Unused and underdeveloped math skills have a negative impact on student self-efficacy. As with most endeavors, a lack of self-confidence is detrimental to positive academic outcomes. The presence of a mentor or family member who shares a love for the sciences was a critical differentiator for women and minorities that persisted in engineering (Leslie, McClure, Oaxaca, 2006).

High school programs lacking academic rigor also present a significant challenge for women and minorities interested in college STEM curricula. Lack of support for the pursuit of math and science-oriented courses, along with the prevalence of weak high school STEM programs, converge in a perfect storm that powerfully impacts the ability of women and minorities to persist in college engineering programs when the “going gets tough.” If women and minorities do not have pre-collegiate or early-collegiate experiences that encourage them, they may choose to transfer out of the engineering major (Leslie, McClure, and Oaxaca, 2006).

While research focusing on the experiences of minorities and women holistically can be readily identified, work exploring the explicit experiences of racial or ethnic subpopulations in the STEM disciplines is more difficult to find. When comprehensive
studies allow for the disaggregation of data by race, information is revealed that informs researcher’s understanding of the differentiated experiences of subgroups within the STEM disciplines (Goyette and Mullen, 2009).

Although there are ample and commonly held perceptions providing rationales for the shortage of African Americans in engineering, these notions are not consistently supported by the research. Yingyi Ma (2009) completed an analysis of college students leveraging the National Center for Education Statistics’ National Longitudinal Study of 1994. Whereas preceding the study it was Ma’s hypothesis that both women and minorities entered the engineering discipline at diminished rates, Ma found that across race and ethnic categories, the engineering major was selected at comparable rates to non-minorities.

In fact, in Ma’s study, African Americans tended to select engineering as a college major at a slightly higher rate than White, Hispanic, and Asian students. As a result, African Americans are over-represented in the national population of students opting into engineering as a major. However, the attrition rate for African Americans and women was more extreme when contrasted with Whites and Asians. Interestingly, departure from engineering programs did not necessarily mean that students did not graduate from college. Frequently, these students went on to graduate from other programs (Jacob, 1989), and some went on to succeed in alternative math and science-oriented disciplines. Ma’s research suggests that further study of African-American perceptions of persistence in engineering might inform future understanding of African American attrition.
Why might African-American students choose engineering as a major? In spite of its rigor, first generation and low-income college students seem to be attracted to engineering at a significant rate. The socio-economic status of students seems to be a significant predictor for pre-collegiate students choosing engineering (Ma, 2009). On average, entry-level employment in engineering may account for a $10,000-$15,000 differential in starting salary. Researchers believe that this differential in salary may be responsible for attracting students who feel vulnerable economically. In the case of African-Americans, economic vulnerability may be attributed to class, however it may also be attributed to the historic difficulties that both women and African-Americans have encountered in achieving fair and equitable treatment in the U.S. workforce. Ma’s work suggests that economically challenged students may experience pressure to identify a major that provides them with opportunities to alter current economic circumstances and allows them to fulfill loan obligations accrued during college.

Alternatively, middle class and high-income students are more inclined to select majors in the social sciences. Although early salary differentials exist upon employment entry, these early differentials may diminish over a career. It appears that affluent students feel more secure selecting majors that lack immediate financial return.
Impact of Socio-Economic Status

College is a critical time for the development of student identity, in general, and selecting a major is a significant component of the formation process. In fact, choosing a major affects how well students engage with college, and it may ultimately determine whether a student persists to graduation (Tinto, 1987). To the extent that African Americans have historically experienced poverty and unemployment at higher rates than most Americans (Allen, 1995), the connection between race, ethnicity, poverty, and degree selection may be profound.

There is no evidence that poor people enjoy being poor. Poverty often means that individuals are challenged to meet basic needs. Wants rarely get addressed. As a result, it is not surprising that poor and working-class college students want to do everything in their power to change their economic circumstances. In addition to choosing majors that presume to improve post-graduation employment and economic opportunities, it is not uncommon for poor and working-class college students to hide their pre-collegiate socioeconomic status from peers (Kaufman, Feldman, 2004). In spite of student efforts to compensate for and hide developmental experiences that preceded their college attendance, understanding these experiences is critical to informing decisions that students make while in college.

While Kaufman and Feldman’s study (2004) acknowledges the impact of socioeconomic status on college student identity formation, it is important to note that socioeconomic status is relative. Students who feel poor in the context of an affluent college may be substantially more well off than their national peers. This distinction is
particularly important in the U.S., which embraces the ideology of individuals pulling themselves up by their bootstraps. The bootstrap mentality presumes that all stakeholders are wearing boots, but the aforemention research findings suggest that may not be true.

For example, in Laurea’s (2003) ethnography following a group of pre-collegiate students through college, the combination of poverty and experience created circumstances where attending college was a tenuous proposition. In Lareau’s estimation, the concepts of concerted cultivation and natural growth were crucial in determining whether students gained experiences that prepared them to meet the expectations of society.

Laurea (2003) notes that there are high expectations young adults in the United States will attend college. Concerted cultivation and natural growth are two distinct parenting strategies that influence student approaches to learning. Concerted cultivation is a construct where schools and parents work together symbiotically to provide young people with planned and scaffolded experiences that prepare them to advocate for themselves and incrementally develop the skills they need to succeed in college and, more importantly, succeed in life. Alternatively, natural growth, a construct that Laurea (2003) noted most prominently in poor and working-class families, involves providing young people with opportunities to learn and associate with the world on their own terms.

Peer relationships and family interaction play prominent roles in the way that students benefit from natural growth during their K-12 education. Students reared in environments where natural growth prevails tend to experience less parental advocacy
and thus, fewer opportunities to observe models that they can apply to future effective self-advocacy. Both models have a distinct impact on the way that parents interact with schools and frame student expectations. In Laurea’s (2003) study, parents who embraced concerted cultivation were stronger advocates for their children, and as a result, were able to provide advantages that poor and working class families were unable to. Most importantly, poor and working-class families often lacked the resources to provide their children with tutors, extracurricular activities, or private schools. This study presents an important opportunity to understand how African American students perceive personal goal commitment, as defined by Tinto, and how that connects with African American student perceptions of their own socio-economic status and experiences as engineering students.

Summary

The development of engineers is a complex process. It is not something that can be turned on or off like a switch. The National Academy of Engineering (2004) suggests that a continuous flow of talent into the engineering pipeline is crucial for the longitudinal sustainability of the U.S. economy. To address the projected shortage of US engineering talent, it is important to adapt strategies that (1) actively identify systemic deficits, (2) improve retention, and (3) attract new students to the profession. The National Academies suggests that women and minorities are underleveraged participants in engineering, and they may offer talent that can be mined to improve the U.S. engineering pipeline. Furthermore, the shortage of literature exploring the experiences of
racial and ethnic subpopulations in engineering suggest that a study of African-American undergraduate perceptions of persistence in engineering may provide insight into the cumulative impact of preparation, socio-economic status, recruitment, self-efficacy, and programmatic design.
The methodology employed in this study is qualitative. I have chosen a qualitative methodological approach because the intent of this research is to explore African American engineering students’ perceptions of persistence. If the focus of this research was to isolate specific cause and effect relationships, I might have selected a quantitative or mixed methods approach. The results of this study cannot be, with any degree of certainty, extrapolated to make predictions about the performances or experiences of African American undergraduate engineering students. The findings of this study are confined to the perspectives of the research participants. Despite the limitations of this qualitative approach, the results may be useful in identifying opportunities for future study of potentially transferable phenomena. Additionally, as this study will focus on the perceptions of African American engineering students at one predominantly white engineering institution, Northeast Technical Institute (NTI), the results may prove useful for leaders within NTI interested in positively influencing the levels of access and success experienced by African Americans participating in one of the institute’s engineering programs.

Qualitative research is often undertaken in circumstances where the researcher wishes to explore why and how human behaviors occur (Yin, 2003). The research questions for this study are designed to provide complex exploration of how African Americans perceive their engineering studies at Northeast Technical Institute. This study leverages in-depth 1:1 interviews to provide insight into the perspectives and personal
histories of subjects to develop an understanding of how they perceive persistence in the engineering program. Any number of qualitative research methodologies might have been applied to my efforts to develop an understanding of African American student perceptions of persistence. However, I have elected to pursue the research questions via in-depth exploration of the complex phenomenon of persistence as defined by Yin (2003). Yin suggests that in-depth study is appropriate in circumstances where boundaries are not clear between the phenomenon and the context. In this dissertation, perceptions of persistence of African American students are being studied in the context of the engineering program(s) offered at Northeast Technical Institute.

Although this dissertation is not explicitly defined as case analysis, the qualitative practices are informed by Creswell (2013). According to Creswell:

> Case study research is a qualitative approach in which the investigator explores a real-life, contemporary bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (e.g., observations, interviews, audiovisual material, and documents and reports), and reports case descriptions and case themes. The unit of analysis in the case study might be multiple cases (a multisite study) or a single case (a site within site study (p. 93).

This study will leverage multiple sources of data that include web data and archival institutional resources to inform the perspectives of study participants. Creswell suggests that boundaries are useful in qualitative study as they insure that exploration of the research questions does not become overbroad. In this dissertation, the phenomenon of African American student perceptions of persistence in the phenomenon is limited to
students participating in one of the engineering programs at the Northeast Technical Institute.

Consistent with Yin’s (2003) categorization of qualitative study as explanatory, exploratory, and descriptive, the themes developed from this study are descriptive in nature; they explore and describe perceived links between participants and persistence.

Site Selection

For the purposes of this study, I selected a single site – the Northeast Technical Institute, a technically focused university with a population of approximately 16,545 full time students. NTI is a co-op school; all engineering programs require a full year of industry experience as part of the curriculum. Tuition is not required while completing the co-op year. No NTI engineering student is certified for graduation without completing the co-op requirement.

NTI has both undergraduate and graduate students, but this study focuses exclusively on undergraduate engineering students. Of NTI’s 16,545 students, 13,561 are undergraduates and 3,979 of these students are in engineering majors. NTI is a predominantly White institution and approximately 3.5% of engineering and engineering technology students self-identify as African American (140 students). Within the broader student community, African Americans represent 6.3% of the university’s total student population.
NTI offers both the bachelor’s degree in both engineering and engineering technology. For the purposes of this dissertation, I have included both engineering and engineering technology students in the pool of participants. Both NTI’s engineering and engineering technology programs are accredited by the Accreditation Board of Engineering and Technology (ABET), but engineering students tend to enter NTI with higher grades and SAT scores than engineering technology students. Over the course of their programs, engineering students are expected to graduate with a higher theoretical foundation than engineering technology students. Engineering tech students tend to graduate with more hands-on or lab-based courses than engineering students. Further, engineering technology graduates have the option of taking more trigonometry based courses than engineering students. Engineering students are required to complete calculus based preparation. Both engineering and engineering technology students apply for the same corporate engineering vacancies after graduation.

NTI was founded in the early 19th century and primarily served as a regional technical training resource for the first century of its existence. During this era, NTI easily filled its rosters with students from the Northeast and was able to provide its graduates with regional employment opportunities in manufacturing. Northeast Technical Institute is situated near major midsized northeastern cities that served as home to former industrial giants. During the late 1980s manufacturing began to decline in the U.S. and throughout the Northeast. To combat declining regional populations, NTI began to recruit a broader range of national and international students. Today NTI has
campuses in the Middle East, Europe, and Asia. Nationally, the university successfully recruits students from all 50 states.

Over the last 30 years, NTI has ranked in the top 10 northeast regional universities offering a master’s degree as the highest degree. NTI has expanded its portfolio of doctoral programs, and currently the engineering program ranks within the top 100 among national universities where the highest degree offered is the doctorate. With 140 African American engineering and engineering technology students, NTI provides a healthy pool of students for this study.

Participants in this study were selected purposefully as prescribed by Patton (1990). Patton suggests that quantitative analysis often rests on larger sample sizes, selected randomly. It is not uncommon for qualitative analysis to rely upon smaller sample sizes that have been selected purposefully. According to Patton, the power of purposeful sampling is the selection of a population of research participants that is capable of providing rich information regarding the phenomenon under analysis. Participants selected for this study will be first through fifth year students in good academic standing. First through fifth year students have been selected for this study to provide perspective on distinctions in the way that year in program might influence perceptions of persistence. Clearly, students with longer academic standing will possess a longitudinal perspective of their persistence as African American students and that may provide opportunities for delivery of rich perspective on the research phenomenon. Participants were contacted through a solicitation letter and asked to volunteer for
participation in this study. Additional information about research participants will be addressed in subsequent sections.

In this study, the participants are bound by their common membership within the university community. The intent of this research is to develop a better understanding of the experiences of undergraduate African American engineering students and their perception of what is required to persist in engineering. Understanding the experiences of African American students is important for two reasons. First, national concerns about the number of engineers produced in the U.S. suggests that understanding the experiences of engineering student is crucial to strengthening the talent pipeline (National Academies, 2004). Second, research suggests that while African Americans tend to opt into engineering at comparable rates to Whites, Asians, and Hispanics, they also leave the discipline at higher rates (Ma, 2009).

Data Gathering and Interviews

Interviews serve as the primary source of information for this dissertation. I coordinated and scheduled interviews with two sets of African American undergraduate engineering students. The first group of students consisted of first and second year undergraduate engineering students. As I receive a strong response rate to participation, priority was given to second-year students, since they possess a stronger academic track record and are likely more strongly steeped in the academic and cultural traditions of the institution. The second group of students selected for interviews were junior or senior
level students. NTI follows the traditional design of engineering programs with math, science, and general education courses dominating the first two years of the program (Hendricks, Jacobson, and Penderson, 2009). The application-oriented engineering courses are reserved for the final two years, and I suspect that junior and senior level undergraduate African American engineering students will be best positioned to articulate a holistic perspective of what persistence means for them.

One of the benefits of this study is the ability to immerse researchers in the context of the study environment (Khan, 2008). As noted in the literature review, I employ Tinto’s model of student departure as a lens for processing data gathered from participants. Given the limited information available on the perceptions and experiences of African American students in undergraduate engineering programs, it was preliminarily unclear whether the expressed experiences of the students in this study would mirror traditional performance or retention literature.

A list of interview questions can be found in Appendix A. Open-ended interview questions provided the most insight into the sense that African American students make from their time in engineering programs. By having students discuss what the engineering program means to them and their perceptions of what is required to persist, I was able to capture the unique ways that African American students engaged with engineering programs at Northeast Technical Institute. The research also helped develop an understanding of the differences in African American perceptions of persistence in engineering as students move from their freshman to senior years.
In addition to information gathered through personal interviews, I took advantage of multiple sources of data to understand the African American undergraduate engineering experience. These additional sources of information were used to develop an understanding of the structure of the engineering programs and the support services students were taking advantage of to support their persistence. Furthermore, institutional resources were leveraged to assist in confirming the articulated academic standing of participants. Institutional sources of information that proved useful include (1) the biannual student survey; (2) the university’s most recent climate study; (3) Presidential Commission reports; (4) reports from the national survey on student engagement; (5) Web and paper-based engineering department publications; (6) information available in the university’s student information system; and (7) information from the university’s academic early alert system.

**Study Participants and Analysis of Data**

I aimed for saturation by pursuing interviews until continuity appeared in the response data. The volunteer pool for this study was exhausted and every student meeting the minimum protocol (self-identified African American citizen) was invited to participate. Interviews were professionally transcribed with responses coded. Thematic groupings of student responses were accumulated using NVivo qualitative software. Study participants shared many perceptions about their motivation to persist in engineering. Additionally, there were many challenges and intervention strategies discussed. Once all the transcribed responses were loaded in NVivo, a frequency table
was utilized to sort and refine themes that appeared in the data. Preliminary response data was sorted according to research questions. Initial data focused on reasons for persisting, significance of the degree, relationships, and barriers to persistence. Whereas themes related to the socio-economic motivations for persisting appeared in the data with high frequency, frequency was not the sole determinant in the importance of data. Novel data was also considered in the analysis. For example, the identification of a group of African American students making concerted effort to hide their ethnic identity in public records was a very informative finding. Themes continued to be refined throughout the study and the salient themes will be elaborated upon in chapter 4.

The interview protocol can be found in the appendix. Students selected to participate in the study were in good academic standing (at the time of the interviews) and possessed cumulative GPAs ranging from 2.0 to 3.7. I selected students in good academic standing for this study because academic standing is a critical component of student persistence. If students are not in good academic standing, they are on track to be involuntarily severed from the institution. Upperclassmen were preferred in this study for similar reasons. Upperclassmen have a lengthier record of meeting institutional grade and program requirements.

All students participating in the study were provided with anonymity; only pseudonyms were used to refer to participants of note. A demographic survey was also presented to participants in the study, which requested basic information such as student name, availability, and specialization within engineering. Contact information and GPA was also requested. Self-reported grade-point averages were confirmed with permission.
of university administration. Within the study, students with grade-point averages lower than 2.7 were considered “moderately performing” engineering students, and students with grade-point averages of 2.7 or greater were considered “high performing” engineering students.

To identify participants for this study, support was solicited from the dean’s office, departmental offices and organizations such as the National Society of Black Engineers (NSBE). Candidates identified for participation received written communication explaining the intent of this research as well as the approximate time commitment (one hour). Special care was given to provide equitable distribution of male and female, upper and lower division, and moderately performing and high performing participants.

**Pilot Study**

In preparation for this research, I completed a pilot study at Northeast Technical Institute with a small sample of engineering technology students. Methodologically, the pilot applied the strategies proposed for this dissertation. A total of six African American undergraduate engineering students were selected from volunteers solicited through the National Society of Black Engineers to test the interview instrument and evaluate the flow of student interviews. As a result of the pilot, confusing interview questions were eliminated or refined. In addition, the pilot enabled me to better understand how long each interview would take and the effectiveness of technology acquired to complete this
research. Ultimately, a target interview length of 60 minutes was established with most interviews concluding within 10 minutes of the target time. The pilot provided opportunities to test recording equipment, transcription processes, and software acquired to assist with interview coding.

**Study Validity and Limitations**

Some of the harshest criticism of qualitative studies has been the perception of a lack of precision. One of the ways researchers have been able to parry this criticism has been through thoughtful consideration of design, data collection, and data analysis (Dube, Parre, 2003). Dube and Parre suggest that qualitative research design improves by identifying clear research questions and using pilot studies to refine research questions. Qualitative data collection is improved through triangulation of multiple sources that confirm or deny the validity of research observations. Qualitative data analysis is also improved by clear descriptions of the analytic methods, as well as a comparison of findings with both similar and conflicting research.

Methodologically, this study considers multiple sources of input to anchor understanding of the African American undergraduate perception of persistence in engineering. Data from interviews with African American undergraduate engineering students were contrasted with relevant data gathered from the university, including surveys completed by the engineering program. I used available data to confirm the validity of self-reported grades and grade point averages. All participants accurately
represented academic performance, even in circumstances where the academic record was unflattering. To enhance triangulation methods, I concluded each interview of the pilot with a summary of salient points and confirmed my understanding of responses with participants. The goal of these collective practices was to improve the credibility of gathered data. This is equivalent to validity in quantitative research (Merriam, 1998).

One of the most significant challenges of this research has been identifying effective boundaries for the interviews and the ideal number of participants. The study of a single institution provided a common institutional culture during the analysis and assisted in the identification of themes across participants. This dissertation leverages the population of a single institution with multiple participants. I considered group interviews instead of individual interviews, but given a total engineering population of less than 150 African American engineering students, there was concern that participants would be affected by each other’s comments and spontaneity in their responses would be lost (Stewart & Shandasani, 1990). If the engineering program had a larger pool of students, the risks associated with group interviews and suppression of ideas might be ameliorated.

A significant limitation of the design proposed in this methodology is the narrow institutional perspective. Each engineering school and university has its own culture, and the methods that African American students use to make sense of those cultures vary. Future studies may elect to explore and contrast the perspectives of predominantly Black institutions or smaller predominantly White institutions. Whereas NIT is distinctive
because of its size, it possesses common accreditation with other engineering schools and the findings here may be transferable to other engineering communities.

Trustworthiness is also a key area of concern in qualitative research. I am both African American and possess an undergraduate degree in engineering, so preconceived notions about the African American undergraduate experience in engineering presents a clear risk point. To balance these risks, a tenured African American member of the engineering faculty of Northeast Technical Institute was solicited to review this dissertation. Additionally, the African American participants of the dissertation were invited to review the transcripts, results and findings of this dissertation. Neither the faculty member nor the participants expressed concern about the accuracy of the transcripts or results. All students reviewed their transcripts and two students agreed to review the results and findings of this dissertation.
Chapter 4: Results of the Study

While first-year students do not possess a longitudinal track record of persistence at the Institute, their responses potentially shed light on early African-American student perceptions of what is required to persist in an engineering program. As these interviews were conducted in the spring semester of the academic year, first-year students in this study were also able to reflect upon their performance during the first term at NTI. A total of 30 students responded to the solicitation to participate in the study and I engaged participants from New York, Pennsylvania, New Jersey, Maryland, California, Texas, and the District of Columbia. None of the participants attended a common high school or school district. Table 4.1 provides a profile of the 24 students selected for this study.

Interviews were professionally transcribed and coding software, NVivo, was used to identify and track common themes across responses. Of the 24 participants in the study, seven were first-year students, two were second-year students, five were third-year students, two were fourth-year students, and eight were fifth-year students. Seventeen of the 24 selected participants were male and seven were female. The five strongest themes drawn through the coding process included: (1) strong affinity for organizations supporting first generation college students and African American culture, (2) issues of confidence and concern about being viewed as competent, (3) perceptions that completion of the engineering degree will improve social and economic standing, (4) perception that study groups and friends within the major are critical to success, and (5) the significance of faculty relationships.
As students discussed points of academic and social engagement across campus, there was an understandably broad range of contacts that students found useful. However, the cluster of MCAS, CSTEP, McNair Scholars, NSBE, Student Support Services, and the Academic Support Center were the most common with 100% of interview participants expressing a connection with two or more of these campus support services. Information about each of these programs and services was garnered through a combination of conversation with program staff and information provided on the program web site.

Table 4.1: Participant Profile

<table>
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<tr>
<th>Name</th>
<th>Program</th>
<th>Year in Program</th>
<th>GPA</th>
</tr>
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<tbody>
<tr>
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<td>Amanda</td>
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<tr>
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<td>Engineering</td>
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<td>4</td>
</tr>
<tr>
<td>Donald</td>
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<tr>
<td>Name</td>
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<td>Year in Program</td>
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<td>Tully</td>
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</tbody>
</table>

MCAS is an acronym for the Multicultural Center for Academic Success. MCAS is a center entirely supported by university resources. MCAS provides an optional summer bridge experience for students interested in actively engaging in a cross-cultural educational experience (across academic disciplines). The center also provides advising services, professional coaching/mentoring, social programs, and networking opportunities. NTI’s creation of MCAS was inspired by nationally recognized minority support and retention efforts initiated by the University of Maryland Baltimore County (Meyerhoff Scholars) and Georgia Tech (Office of Minority Educational Development).

CSTEP is an acronym for the Collegiate Science and Technology Entry Program. CSTEP is a grant-funded program from New York State that provides access to free
tutoring, graduate exam prep, and undergraduate research opportunities. Participants in CSTEP must be New York State residents. McNair scholars and Student Support Services are both federal grant funded programs supporting students. McNair Scholars supports first generation and minority students that are interested in exploring post-graduate opportunities. Student Support Services assists first generation and low-income students in their transition to college through tutoring, coaching, and other forms of academic support. The Academic Support Center is the name of a university funded center providing free and paid academic tutoring services on campus. The Academic Support Center’s resources are available to all NTI students. In addition to providing tutoring, the Academic Support Center provides NTI students with training in time management and organization.

Finally, NSBE is the acronym for the National Society of Black Engineers. NSBE is a student run national organization dedicated to increasing the number of African-American students successfully obtaining engineering degrees. NSBE strives to achieve this outcome by coordinating regional/national conferences, engineering competitions, job fairs, and training programs. All of the students participating in the study expressed awareness of NSBE and engaged in at least one NSBE activity during their time NTI.

Twenty-two of the students interviewed indicated that they attended public high schools that were diverse, but predominantly African-American or Latino. One student had attended a private school that was predominantly white; one student was home-schooled prior to attending college; and one student was a ward of the state and in foster
care prior to attending RIT. The rich nature of the semi-structured interviews provided interviewees with an opportunity to tell their unique stories and helped me understand how their experiences inform perceptions of academic difficulties, educational goals, and their ability to integrate into the social fabric of the institution.

**Ethnic/Racial Identity**

Like many institutions, NTI can only document the racial/ethnic backgrounds of students who self-report. If students elect not to check the racial/ethnic background box on financial aid or other documents, NTI has no way of knowing that they identify as African-American. As a result, there are students participating in NSBE and other cultural organizations at NTI who did not initially receive my communication targeted to African-American engineering students.

Some of my earliest responses to the solicitation to participate in the study were from students who had heard about my research from peers. These students indicated that they self-identified as African-American but rejected the nomenclature on the census sections of various government and university documents. Additionally, they explained that the term African-American was not comprehensive enough to capture the diversity of their cultural backgrounds. In other words, these students felt that the term African-American was limiting even though one or more of their parents was of African or African-American heritage.
Ultimately, these students contacted me to determine whether they were eligible to participate in the study. My consistent response to this inquiry was “yes.” I determined that it was not my role to determine the racial/ethnic “authenticity” of students interested in discussing their perceptions of African-American persistence in engineering programs. All students who indicated that they were of African-American decent were allowed to participate in this study, whether they appeared on RIT’s formal roster of African-American students or not. Students who indicated that they did not have United States citizenship were excluded from the study. As a result of communications, I worked with my liaisons in both engineering and engineering technology programs to assure that my solicitation to participate was extended to the entire engineering student population. At least three students participating in this study would not have otherwise been aware of my study.

Charles was one of the students who was unsure whether or not he would be able to participate in the study, because he had failed to check boxes on forms that would self-identify him as African-American. His father is African American and his mother is of European decent. Charles, however, indicates that the world often visibly identifies him as only “black.” Charles shared a perspective on why he does not consistently check the cultural identity box:

I think it goes back to the joke that my friends said. “It’s because you checked the other box, that’s why you got into NTI.” And so I think that isn’t for me… is it because they actually care about my education or is it because they just want, at the end of the day, to be able to say that an African-American graduated from NTI?
While Charles elected not to use the cultural identity box because he believes it calls into question his earned status at NTI, participants like Joe articulated different reasons for resisting identity by culture on university forms. Joe states:

Well, the term African-American, I see it as very inaccurate, because as a black person myself, although I guess our ancestors did come from Africa, I don’t have any connections to Africa from a national sense of view, you know? I’m more Haitian-American, since I’m a first-generation American and my parents came from Haiti. So I identify with like, that part of my lineage. Since I’ve been here I understand like, both cultures, and I’ve been raised in that setting. So that…that identifies me… So I rather people just call me “black” if you don’t know my nationality and I won’t get offended.

Alice suggested that her mixed heritage was what makes it difficult for her to complete ethnic identity classification forms. Alice’s responses to ethnic identity inquiry vary depending upon the questioner’s expressed degree of interests and the perceived purpose of the conversation. In Alice’s words:

I describe myself as being multiple, I guess, races or ethnicities, because my dad, he’s Puerto Rican, and then my mom is African-American. However my grandpop is like, part Jamaican, and my great grandmom is Native American from two different tribes. So I just …most of the time, nobody ask for all the extra details. So I just say Puerto Rican or just say African-American, some days I’ll say both. But if ever…anybody ever like, really wanted to know like, my whole background story, then I be like, yes I’m African-American, Latino-American and Native American.

Racial/ethnic background appears to have some influence on the way study participants navigate RIT. For Charles, Joe and Alice, their decisions not to formally self-identify as African-American influenced their receipt of targeted communications transmitted by the
University. They appear to be aware of these challenges and, in some cases, leverage social connections within the university to compensate for the limitations of their decisions.

Educational and Occupational Goals

Tinto (1975, 1987) suggests that student perceptions of educational and occupational goals are important to understanding why students depart from programs and universities. In this study of African-American students, respondents shed light on some factors that influenced their educational and occupational decision to pursue engineering.

Participants in this study expressed pride in their acceptance at NTI and specifically, into one of university’s engineering programs. Even when students did not receive their first choice engineering college or program, they viewed acceptance as a significant accomplishment. Not surprisingly, the decision to major in engineering was something that most had considered carefully before applying to college. In spite of the time and energy dedicated to identifying the “perfect major,” however, it was not clear that selecting a degree program was easy. Flora, a third-year engineering technology student, remained conflicted about her decision to major in engineering:

Well, I had an epiphany maybe, about changing majors. I’ve been having like, two or three now [chuckles] and – I’m not going to change it, but I was like, maybe I should go to liberal arts in some type of writing, because you know, that’s what I like. I have a passion for it and you know, I don’t know, but I thought about that. But then I was like, why did I go to NTI for a writing class when I could have just gone to Howard or something
where it’s cheaper. But then after I thought about it, I was like, but you know as a career, I don’t see myself doing that, because financial needs or stuff like that. I don’t know, but I was like, maybe I could just have more classes in that just to improve on it and you know, have fun.

Flora’s thoughts suggest that her decision to major in engineering was a conflict between her practical needs and her passion. Growing up in Southeast Washington DC and attending public schools there, Flora was first exposed to engineering through the curriculum of her high school science and mathematics classes. She performed well in those classes and as a result, was encouraged to major in engineering by her teachers:

Multiple teachers were like, you’ll be really good, and I didn’t know which type of engineering I wanted, but I knew I wanted something. And then when I got to high school, I was just looking up different engineering things because I loved to make things, and then I was like, maybe I can do biomedical engineering. I don’t know what I was thinking [chuckles], and you know, build sports equipment or some type of – I don’t know. I don’t know what I was thinking. I don’t know. Mechanical would have been the first thing, but biomedical? So I just – I really loved engineering. I still do.

Flora wasn’t the only student who articulated a practical rationale for selecting engineering – that of meeting financial needs. Fred, a third-year engineering technology student from Brooklyn New York, explained that his inspiration for choosing engineering was his mother. Fred’s mother did not finish high school and she struggled to take care of her family. Fred believed that obtaining a degree in an area that would insure high income was one of the most important factors in the college decision:

It was pretty much in my freshman year in high school. You know, I’m seeing how much my mother was struggling with everything around the house, paying bills, keeping food on the table, things like that, and the
struggles continue to grow as the years went on. So you know, being that she didn’t have a college education, she dropped out of high school at a young age. Being that she was living with a GED and made it …I made a promise to myself that I’ll go to college and get a college degree so that I can have the life that she wanted to have for herself. Engineering pays well, and that helps.

Charles is a first-generation college student who was homeschooled in Syracuse New York. Charles’s inspiration for a bachelor’s degree in engineering was slightly different from Fred’s. Charles grew up in a family where his father made enough money to support the family, but in a very physically demanding job. But similar to Fred, quality of life emerged several times as an issue while Charles discussed his motivation for selecting engineering at NTI:

I was like, if I get the 4-year engineering degree, I’m going to get a desk job, and I was really thinking far ahead. When I’m 50 years old and need a back brace, do I still want to be working with my hands? So that’s part of it. And my mom always kept saying, “Do you really want to be like your dad, doing that at his age?” She’s like, “It made him get old real fast.” She’s like, “Do you really want to be like that?”

A few study participants were not first-generation college students, did not characterize themselves as economically challenged. Brenda attended public schools in Syracuse, New York, and both of Brenda’s parents were college-educated. Brenda expressed a tremendous amount of respect for her parent’s educational and professional achievements. Brenda’s concern was not so much exceeding her parent’s accomplishments but rather, living up to their high expectations. Brenda relates that her parents had the most profound impact on her decision to attend college and to major in engineering:
My parents were pushing the idea of a STEM field just because that was like, a field that was in demand, where hopefully I would be able to find a good job and be able to take care of myself. My mom signed me up for every possible STEM program for children. When I actually applied to college, I didn’t know what I was going to major in. That was really hard for me, because I can like, pretty much do anything, so that didn’t help. But I applied to schools for physics and chemical engineering. I chose chemical engineering over chemistry because it’s harder to get in for engineering than science, and I thought that chemical engineering would give me more opportunities than being a chemist.

Brenda’s decision to major in chemical engineering was affirmed when she discussed her decision with peers, family friends, and high school teachers. Brenda says:

As I went along and started telling people, “Oh, this is what my major is going to be,” people are like, “Oh, well, good luck!” And I’m like, “Thank you.” They’re like, “It’s really hard.” So I kind of had a sense of pride now – oh, it’s hard, but I’m doing it.

Brice is the son of a college-educated mother with a technical background. Brice is from Philadelphia, Pennsylvania, and he attended a small, predominately white, private high school. As a fifth-year NTI student, Brice was able to reflect holistically on his preparation for the engineering technology program and his time at RIT. Brice noted that his mother played a significant role in his decision to major in engineering:

I feel that people should be able to do what they want to do, because they want to do it inherently, not because they need to have money or a job tied with it. And I kind of felt like, … I can get to that transition later, but I felt as though now, looking back, I would have probably done something different, because I was more passionate about those other things than I am about engineering. Engineering was kind of – though I am still interested in it – more of a monetary decision, and I need to survive out here. It’s a reaction to what I went through with my mom in high school… that kind of pushed me into this direction.
While in high school, Brice’s mother lost her high-paying job and was required to take a lower paying job to ensure Brice’s continued attendance at his private school. Brice was conscious of his mother’s struggles during this time and believes that fulfilling her dream of seeing him become an engineer is a small token of appreciation for the sacrifices that she made. Brice’s mother also hoped that his successful completion of the engineering degree would provide a degree of economic insulation and security that other professions might not be able to provide.

Nathan, another study participant, was one of the rare students who did not draw a connection between the decision to major in engineering and the desire to select an academic career perceived to provide a higher quality of life or job security. Nathan is a second year engineering student from the Bronx, New York. Nathan’s mother did not go to college, but she expected him to do well in school. She encouraged him to attend college, but didn’t suggest a major for him. By Nathan’s account, although he was a strong student, he really didn’t give much consideration to his mother’s encouragement until his senior year in high school:

She gave me freedom on what I wanted to major in ‘cause she didn’t go to college herself. So she didn’t know too much about the types of majors. But I knew she wanted me to go to college.

After giving consideration to a variety of majors, including history and religion, Nathan came to the decision to major in engineering for the following reason:
I feel like if I do engineering, that that’s the best way that I can give back to the world, because engineers, in essence, they make dreams come true. All throughout history you’ve seen engineers develop products and even buildings we see all around us. And I feel like with my personality, with my skills, a natural skill… that’s a way that I can give back to the world.

As evidenced in these student examples, study participants followed a variety of paths in determining their educational and occupational goals. They went to different high schools, lived in different states, and had varied familial experiences. Each was challenged to identify a college major. Ultimately, the students were guided, or drawn, to a major in engineering. Expressed academic strengths in science, technology, engineering, and mathematics were crucial to their decisions. Occupationally, students believed that their strengths in STEM areas would be meaningful, lead to better employment opportunities, and improved quality of life. Once the decision to major in engineering was made, the students attributed their success, or failure, within the major to the ability to identify and overcome academic difficulties.

**Academic Difficulties**

There are several reasons why students might change majors or transfer from NTI. These reasons can be both voluntary and involuntary. The students involved in this study are currently in good academic standing and none indicated ever experiencing academic suspension. Nonetheless, each participant was able to clearly articulate areas of academic difficulty. In some cases, these difficulties resulted in students being placed on
academic probation. In others, the academic struggles resulted in course grades that students found unacceptable.

According to NTI policy, students must maintain grade point averages of 2.0 or better in order to remain in good academic standing. This policy applies to both the student’s term and cumulative grade point averages. Consecutive probationary terms may result in academic suspension from NTI. Suspension requires students to leave NTI for at least one term and suspensions may only be waived with an appeal that is approved by both the student’s department chair and dean. Students in this study who experienced academic probation did so as a result of individual terms when their grade point average dipped below the 2.0 threshold. Whether these students experienced academic action related to their performance or were just disappointed, their comments about these experiences illuminated their perceptions of what is required to be a successful engineering student at NTI.

Trayvon is a second year mechanical engineering technology student from Brooklyn, New York. Trayvon experienced one probationary term at NTI and attributes that probationary term with improving his NTI experience. While Trayvon felt that his pre-collegiate training prepared him academically for college, he was not fully prepared to leverage the benefits of working in groups. In high school, Trayvon worked and learned on his own, but he soon realized that group work was valued more at NTI. He recalls:

Preparation-wise, for the basic demographic of college, like knowing certain course work and trying to fend for your own, I was prepared for
that. Engineering-wise, I felt like I was undersold, because my first year here I was very terrified of the engineering department, because when I had my first class… they’ll say build this and work in a team… Now all of these things were kind of tough, because in high school, it was all about work on your own, and I was so used to working under that mentality.

In addition to struggling with group work expectations, Trayvon admitted that he was a little bitter upon arrival at NTI. NTI was his last choice of colleges and he had really hoped to attend an Ivy League school after making a visit to that campus with his high school. Trayvon felt that he excelled in high school, particularly in mathematics, and he indicated that he was “sad and heartbroken” by failing to progress to the interview stage with the ivy. To add insult to injury, although Trayvon was accepted into NTI, he was denied a seat within the mechanical engineering program. Trayvon was ultimately accepted into the mechanical engineering technology program at NTI, but remained unclear about the distinction between engineering and engineering technology:

So when we called them [NTI] up, they said there are still some places left, but you can’t be a mechanical engineer. I was like ooo-kay. My mom said you could be in mechanical engineering technology. I was like what’s that? And she didn’t know, because these were all terms that were almost Spanish to her. I looked it up and I was like, okay, it doesn’t look half bad… So I’m like, this seems pretty good. This seems like, more hands on… if I ever go to a job interview.

If Trayvon had not accepted the invitation to attend NTI, he said that he would have elected to attend the engineering program at Philadelphia University, where he was also accepted. Trayvon’s comments suggest that his college admission challenges put a chip on his shoulder that made it tough for him to come to grips with being a successful
NTI student during the first year. It especially made it difficult for Trayvon to connect with people:

I would figure stuff for my own. If I can’t figure it out, I was like, well, that’s the end of the game. And also, finally finding outlets. That was also an issue, because something would really stress me out, and I would stay there working through my stress. Now my work’s getting sloppy because now I’m unfocused. I’ll get upset like, okay now my answers are all wrong. And they [peers] would say you’re wrong, and I would say, no, I’m not wrong, and I would get kind of hyped up about it, and that wouldn’t resolve anything. It would just dig a hole…

Trayvon believed being placed on academic probation in his first year saved him because the experience required him to expand his academic support network. Trayvon learned that he would not succeed if he remained unwilling to connect with every students, program, or faculty member who was prepared to help him. As a result of receiving a GPA below 2.0, Trayvon’s academic advisor recommended that he participate in a special program called the college restoration program (CRP). CRP allowed Trayvon to take additional courses, but also required him to engage in intensive advising /counseling that encouraged him to reflect on his study skills and choice of major. At the close of his term in CRP, Trayvon remained committed to engineering, but felt that he had learned to take advice, work more effectively in groups, and handle the pressure that he put on himself. He commented:

I take a wellness course now. It’s actually pretty good for just getting active a little bit, but I feel like all of this would have never started if I didn’t have that hiccup in my first year and I was sent to CRP. Because that’s when actually everything came into view, like of, here’s your flaws and all this stuff. He [the counselor/advisor] was like the problem isn’t you, per se, it’s just that maybe the timing was off, these certain conditions weren’t really in your favor … But you should really work on –
we’ve got to find what is your fault at the moment, work on it, make sure that it doesn’t happen again, and also help you out in the future.

At the time of the study, Trayvon’s grades were not as strong as he would like them to be. He has a 2.4 cumulative grade point average. Trayvon has, however, completed two successful academic terms following the stint in the CRP program, and he remains optimistic about his prospects.

Brenda is chemical engineering student who has also reflected on her academic challenges. Brenda is currently in her third term at NTI. However, she has second year standing within the university (based on credits) because she matriculated in the summer and transferred both AP and college credits into NTI. Brenda was able attain a GPA of 2.9 in the first term, but her academic struggles increased with subsequent terms at NTI. By her second term, she had withdrawn from her first course and, in her third term, she earned her first F, D, and an incomplete. Brenda feels that the strength of her high school experiences gave her a false sense of the ease of the chemical engineering program. She notes:

Academically, the transition was really easy. The first semester wasn’t challenging. When I had my second semester that was more challenging, it was like a wake-up call. I mean, I had to work hard before, but it was even harder.

Because Brenda perceived that she had her academics under control, she got involved in more extra-curricular activities during her third term. She did not realize that she was in over her head until much too late:
So last semester, I had the opposite problem – I had too much. I was working like 8 hours a week and I joined a club, Engineering World Health, and they were planning to go to Guatemala over intersession and I wanted to do that. So that was 4 or 5 hours of training every Saturday. And I was still dancing on my dance team, so I was so busy all the time. And I like being busy, but not that busy. That was so stressful. At first, everything was fine, but then, like I slowly started getting behind in things and it took me like, all the way until week 10 to realize, oh, I’m in trouble. By that time, there isn’t that much time left to fix things.

Probing further, Brenda seemed to resent the amount of time that the engineering curriculum demanded from her. When asked to reflect upon the courses she enjoyed, Brenda articulated a love for her language and history courses. She expressed the least confidence about her ability in math and was very concerned because the courses she performed most poorly in were prerequisite chemical engineering requirements.

Brenda was feeling so dejected about her recent term that she broke into tears discussing it. Brenda holds out hope that her co-op experience will reinvigorate her interest in her chemistry and math courses. She explains:

I mean, one of the main reasons my mom wanted me to go to NTI was because of the co-ops, and I think that, since I’m still kind of unsure about my major, co-op’s really important, so I can get an idea of what it would be like to be a chemical engineer.

Additionally, Brenda wishes that she had been more engaged with her faculty and classmates earlier in her program. She indicated that she was too focused on the lack of students who looked like her in class to realize what they had in common – a desire to complete a degree in chemical engineering. Once she began to work more with students in her program and talk more to faculty, Brenda learned that she had no idea how to study
for a college course. She was proud that she identified this shortcoming but realized that
changing her habits and committing the time to change her habits, will continue to be
very difficult:

… this sounds really weird when I say it, but sometimes I don’t study. But I’m not aware
that I don’t study, because it’s like you go to class, you take notes, and you do your
homework. But doing your homework is not studying, so it took me a while to realize
like, the actual difference, at least at the college level, and then making myself do it,
because I wasn’t consciously aware that I wasn’t doing it. But then once I realized, it was
trying to implement the study portion of it.

Although Brenda has opened lines of communication with a few friends in the
chemical engineering program, she continues to prefer to study by herself:

I have studied with other people and I think that I process things slowly, so it takes me
longer to understand things. And I feel like when you work with other people, that can
be annoying for the other people if you’re not moving at the same pace, or it’s stressful
for me if they’re like, way ahead of me and I don’t get something, but they don’t want
to go back to explain things.

Brenda has identified faculty as her most commonly leveraged academic resource,
despite admittedly waiting too long to avail herself of faculty support on several
occasions.

Both Brenda and Trayvon spoke candidly about their challenges identifying
barriers to academic success and adapting to the varied difficulty levels of the
engineering program curriculum. By their own accounts, there are times when their
confidence is high until they become shaken by academic outcomes that do not meet their

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expectations. Brenda and Trayvon’s academic struggles caused them to reflect upon their connections with other students, the appropriateness of their decision to major in engineering, heuristics, and the ways others at NTI view them. As students in the first two years of their programs, their perspectives are not unique to the students participating in this study.

Fabian is a 5th year engineering student participating in his final term at NTI. Fabian went to high school in Maryland and admittedly has experienced academic challenges during his time at NTI. Fabian has a current GPA of 2.7 and his responses during his interview allude to a conflict between his perceptions of easy and difficult coursework within his program. When referring to his first year at NTI, Fabian commented:

Actually, I thought it was going to be a little bit harder. I actually thought it was going to be like some other college experiences you hear about… like having all these lectures, lecture halls, papers assignments… I threw that out the window when I was doing my engineering class. I’m like, how am I going to do this?

As an incoming freshman, Fabian had the perception that his courses were easy. Especially when he realized that his courses would not be writing intensive. While taking his first year courses, he thought the focus on math and science would play to his strengths. As his first term proceeded, however, he realized that he was not doing as well as he had hoped. In his first few years in engineering, Fabian said that he practically lived in NTI academic support centers:
Yeah man, it was quite a transition up and down – my grades. It was up and down. I could never get over that 3.0, but as a student, I’ve learned to utilize my resources. I learned to understand the resources are there, are available. It’s not about just being diligent about doing your work, which is something that I still need to work on, but using the resources that are available to you.

Although Fabian felt he benefited from the university’s academic support center, he ran into difficulties in his third year that could not be ameliorated by that core of tutors. By the third year, Fabian expressed that his engineering courses had become so specialized that generalist tutors in the NTI tutoring center were unable to assist him. Fabian began to flounder academically, and he was placed on academic probation. Ultimately, Fabian’s solution to these challenges was to make better connections with peers in his cohort. When he could not find a tutor for an upper level course, Fabian would look for successful peers to assist him. He credits this strategy with boosting him from academic probation to good standing:

Really networking, talking with your classmates and creating study groups. My third year I realized … when I got into my engineering courses, study groups were the thing. Once I had study groups… I knew exactly how I’m going to get through this major.

As Fabian reflected on his academic challenges, he noted that it was emotionally challenging to applying hours of effort to coursework without achieving the desired results. He said, “That class damaged me emotionally,” when referring to the third year course he struggled with. He elaborated and said:

If you didn’t have a certain type of mindset to actually achieve the results that you wanted, it just becomes even harder. I spent countless nights till
five or six in the morning, go back to my apartment, come back here and
do more work, bang out more work than any other class.

Fabian noted that connecting to the right resource at the right time was the life preserver
he needed. He says his anxiety stemmed from the possibility that he might not actually
be able to figure out what he needed to do outside the classroom to be successful. During
every challenge he thought, “Maybe I’m not good enough.”

In addition to connecting with university resources to help him succeed in his
engineering courses, Fabian also found other academic strengths within himself that got
him through to his senior year in engineering. He observed that his engineering courses
were beginning to make him question his overall talent and intellect. He started to
question whether there was something wrong with him, until he took his first
communications course:

Would you believe me if I told you that the classes I was good at are not
even in my major? I have public speaking skill and the [communications]
professor broke me down, was like listen, you’re good. I’m going to make
you great! And by the time …after I took that class, I realized I had not
only talent but I had the skill to show for it in public speaking.

Fabian believes that identifying his strength in communication made it easier for him to
reach out to peers for assistance and helped him identify his strength as a member of
professional work teams. He made the following observation about one of his co-op
experiences:

My strength is in communication. I know what I can provide if I
communicate. I actually work better with people than by myself. I told
one of my bosses and they seen it happen. By myself, you’re not going to get the output. Put me in a group and sure enough, we will flourish.

Communication and comfort with communication was Fabian’s key to success.

As a 5th year engineering technology major from the Bronx, Oscar concurs with Fabian’s assessment on the power of communication. Oscar indicated that he only experienced probation once in his academic career – in his first year. After that experience, he felt that he needed to make a wholesale change in the way that he approached his courses. He needed to humble himself and ask for help:

I would say reaching out to professors in times of uncertainty. I’m not afraid to ask for help. I guess that’s the greatest academic strength, and putting my ego aside and saying, “Hey, I need help with this. Can you please give me a helping hand?” Academically that’s one of the many things that you need to be able to do, because you really can’t figure out everything on your own.

Oscar expressed a healthy respect for the sea of talented students surrounding him at NTI. He believes that recognizing and using this talent as a resource is important for being successful in the engineering major:

I realize there are a lot of intelligent people at NTI, and it’s very intimidating at times. People are graduating early with honors and going on to do their masters. And people are doing their bachelor’s and their masters before I even finish my bachelors. So there are a lot of very, very intelligent kids at NTI, and it’s a wakeup call for us. It’s a much bigger world out there, and there’s people doing things or have done things before you that you’ve never even conceived.
Oscar believes that being humble has allowed him to connect with people and to perform his best in class.

Oscar indicated that he was accepted into the engineering program at a competing univeristy but was not accepted in the engineering program at NTI. He is pleased, though, that he made the decision to attend NTI engineering technology program, because he has enjoyed the opportunity to work frequently and closely in the machining and laboratory spaces. Unlike Trayvon, Oscar expressed no bitterness about not being accepted into the engineering technology instead of engineer program at RIT:

Engineering technology has provided me with everything that I expected and more actually. I thought it was just going to be… come here, we’ll teach you some stuff and then we’ll let you blossom or let you go… It’s been more than that. There’s been a lot of encouragement. There’s been a lot of one-on-one student to professor relationships. I’ve been mentored. I am being mentored by a couple professors right now. I’ve done some independent projects to make the college a little better. I’m working on some inventory systems for a couple of the labs. So it’s been more than I expected, really.

Oscar suggested that developing close relationships with his engineering faculty and friends has been the greatest help in learning to think like an engineer. Oscar says that one of the most frustrating things about becoming an engineer is learning that the discipline is not solely about acquiring a finite skill set. It is developing way of thinking that uses math and science:

No matter how hard I try to figure it out [an engineering problem], or how much time I put into it to study, there’s always something that I can’t quite comprehend. But the most frustrating part is, I guess, still not knowing a lot even though you’re putting in a significant amount of effort ... So you try to study, try to figure something out, but at the end of the day there’s
always that one thing where someone says, “Oh no, it’s not that. That’s actually this.” … all the different aspects of engineering, like safety and fatigue and all this other stuff, branch off the original problem.

Oscar is nearing the end of his undergraduate academic journey. He is projected to graduate in May 2015 and has a 2.8 GPA. Oscar is among the interviewees who expressed a level of comfort with his status within the engineering and engineering technology community at RIT. In circumstances where he was not pleased with academic outcomes, he readily identified changes required to remain in good academic standing. Oscar was not the only student who expressed comfort in his ability to navigate the engineering curriculum. There were several participants in this study that never experienced the emotional distress associated with academic probation, but they were keenly aware of their academic weaknesses and of successful strategies for navigating the engineering curriculum.

Tim is a 3rd year engineering student from Queens, NY. He has a 3.7 GPA and transferred into NTI during his second year. Tim commented that even as a 3rd year, he requires more time than other students to complete labs:

Like, I get A’s but if someone, if they are going to complete the lab project in two hours, me, I have to multiply that by three. So, it is six hours. I always stayed out in the lab late… sometime even I had one teacher last semester, he stayed with me like two more hours. He doesn’t mind.

Tim feels most comfortable with the traditional academic courses. He enjoys working through problem sets, but he believes that his peers are often confused by his success.
Tim indicated that he does well in courses because he participates in study groups that help him understand difficult questions and test his understanding by requiring him to explain his solutions to problems. Tim believes his classmates see his academic success as innate trait, when it is as much about hard work:

If I have homework, I always look at the homework. At home, like I start the homework, like ahead. So when we come to study together I already know what we’re doing, you see. So they [classmates] think, oh, this guy is really smart, and I tell them, no, it’s because I did it before. They say, no, you did it before because you’re smart.

Tim could not think of a time when his approach to academics didn’t involve engaging his peers as part of a study group or just as a resource to check his understanding. In our conversation about courses, Tim indicated that his favorite courses were not always the course that he was the most successful in. For example, he’s been very successful in most of his engineering courses, receiving As, but his favorite course was a physics course that he received a B in. He explains:

My favorite class so far is not even engineering – maybe similar to my engineering – it was physics… I wasn’t successful in the class. I got a B, but I really like the way she was teaching. I felt like I learned a lot, because I have problem visualizing physics problems and looking at things on the nano level, like, in raw energy and stuff. But in that class I learned a lot about how to approach that, and it was my favorite class.

Tim wanted to perform better in this physics course but still saw his B grade as a success. Tim’s thinking about challenging courses is similar to his thinking about forming study groups and reaching out to faculty. If he sees students or faculty who appear passionate
about engineering, he is not afraid to reach out to them to see what he might be able to learn from them.

Tully is a 5th year engineering technology student with a 3.6 GPA who expresses a similar outlook on academic challenges to Tim:

   When you get into those classes that you’re either struggling in, or you don’t care for, it makes it hard. We all have that turnoff switch, where I don’t want to do this. You start readdressing, is this what I want to do? Being able to look at it and see the end state, and being able to stay focused on that, is probably one of the hardest things. Especially with engineering, because the degree of difficulty changes as you go through it. If you don’t pick up something from the very first year and carry it forward, it can completely throw you off.

Tully went to high school in Louisiana and never felt that he was the smartest student in his class. He has never failed a class and never been on academic probation. Tully attributes his success to being painfully honest about his weaknesses and being unafraid to ask for help. This meant that during his first term at NTI he took lower level math course than required, because he wanted to develop his comfort with the basics before moving on to calculus. In Tully’s estimation, “Engineering is too difficult for you to complete it for someone else. You need vision that it is something that you want to complete for yourself.” Tully explained that he is a first-generation college student and his personal passion and commitment to complete the engineering degree fuels his efforts.

Sasha is also a first-generation college student in her 5th year of the engineering technology program. She comes from Maryland and has a 3.3 GPA. Like Tully, Sasha
believes that the key to overcoming academic challenges is passion and commitment.

Sasha said that her biggest challenge was not having equivalent preparatory experiences as many of her peers:

Well, I think in the engineering discipline, it’s being exposed to terminology, opportunity, and kind of being able to put theory to real-life application. So I think coming from a city where a lot of people aren’t really educated, you don’t really get exposed to those types of things… People older than you aren’t really educated, so you’re kind of limited as far as vocabulary, what things are. I mean, something as far as what gears are, transmissions, it’s kind of like, hold on, what? So even though my high school prepared me as far as like, theory, when it came to application, I was kind of blinded. So I think that’s what my downfall was. You kind of got to like, learn what you should’ve known compared to your peers

Sasha indicated that there were several circumstances during her first two years of college where she was embarrassed to encounter concepts or terminology that most of the class seemed familiar with. To overcome this challenge, she spent time with faculty, peers, or researching in the library. Sasha said that it required more work from her, but she was especially sensitive to gaining competence as one of a few women in her program. Sasha noted that in classes like mathematics, it is smarter in the first year to take a lower level class and build up, if things are not going well. The only area where Sasha demonstrated frustration was with the limitations of her pre-collegiate preparation. Based upon her experience she would encourage others to do the following:

Try to go beyond what your high school has challenged you as… Your high school might not even be capable of preparing you for what you’re going to experience at NTI. So that you’re not behind, start taking college courses over the summer when you have free time. Even do reading… taking calculus, even if it’s not required.
The suggestions Sasha made for future freshman accurately reflect the articulated strategies for success identified by the most successful engineering students in this study. Stay focused, work to get ahead of problems, and never be too ashamed to obtain assistance with on your academic gaps. Even students with the most time and the highest GPAs were able to identify meaningful academic struggles at NTI. The primary difference between the ways interviewees discussed academic difficulties seemed to be associated with their perceptions of comfort and acceptance within the university. In the next section, I explore responses that shed light on the subject’s perceptions of their integration into the social fabric of the institution.

Social Integration

According to Durkheim (1961) and Tinto (1975), social integration plays a powerful role in persistence. In Tinto’s research, students who persist appear to demonstrate greater connections to the culture of the campus and community than those who depart. Students in this study have articulated their perceptions of their personal goal commitment through discussion of their (1) educational goals, (2) occupational goals, and (3) and academic difficulties. What remains is an exploration of study participants’ perceptions of congruence between their personal goals and the institution’s commitment to helping them meet their educational and occupational goals. Did students in this study feel that the NTI, and its community, are mutually committed to their university goals? The simple answer is yes, but the issue is more complicated than that.
As demonstrated by students like Trayvon in the previous section of this chapter, approximately 25% of the students participating in this study (6 students) indicated that NTI was not their first choice college. These students had hoped to attend Cornell, Carnegie-Mellon, UCLA (2 students), and Columbia University (2 students). Thirty-three percent of the participants (8 students) indicated that NTI was one of several closely ranked college options, and 17% of participants (4 students) indicated that NTI was their clear first choice college. For students with closely ranked competitive schools, the determining factor for choosing NTI was the strength of the student financial aid package offered.

Participants in this study gave varying degrees of consideration to the entire college selection process. Some students deferred their college decision to their parents, while others received very little familial input. Some students began college visits years in advance of the standard fall college application deadline, while others barely got their applications submitted before the deadline. All students in this study indicated that they enjoyed their time at NTI and believe that NTI was doing a good job assisting them reach their goals through the rigor of the curriculum, extra-curricular programs, and co-op experiences. Additionally, each study participant could readily name a campus program, faculty and/or staff member who was making a positive impression on their studies.

Despite uniform expressions of pride and respect for NTI, however, students readily identified areas of opportunity and concern, suggesting that their perceptions of institutional commitment were not wholly positive. There were clear statements and observations that indicated that participants questioned the effectiveness of NTI efforts to
integrate them into the community. Frequently, these conflicting perspectives were articulated spontaneously while answering a question that was not directly related to their perceptions of how welcome they felt at NTI.

When Brenda, an engineering student completing her first year at NTI, discusses her improving relationships with faculty, she specifically notes the positive impact her department chair had on her when she began to struggle during her second academic term at NTI. The department chair boosted Brenda’s spirits about her struggles and made her feel that she could turn things around. Additionally, her department chair was willing to provide tutoring in courses that he did not teach. In Brenda’s words:

He would tell me, “Okay, well if… the way your professor showed you didn’t work, I will try to show you a different way or try to explain it in a way that makes sense to you.” And the fact that he understands, that makes me feel so much better about myself… he’s trying to help me figure out if this is what I want to do too. So the fact that I failed your class, you didn’t write me off. You’re like, investing time in trying to help me be where I need to be.

Brenda’s comments about her department chair’s commitment suggest that she perceives the department chair to be committed to her integration in the engineering community. However, when asked to explain how her experiences in engineering have influenced her opinion of the university, she stated the following, “Like, I really like NTI, and I think the people are really nice. I also think my department is nice, but I have had like, issues.” In follow-up I asked Brenda to give me an example of one of the issues that concerned her. Her response highlights her struggles to make meaning of her relationship with her department chair and academic advisor:
Well, I mean, when I first started re-considering my major, like, one advisor was like, maybe you want to switch to something easier. But that word “easier” offended me. Like, oh, so you just think this is too hard and I should do something easy. So I took it that way. That might not be how she meant it, but that’s how I took it. So I was just like, “Oh, so you don’t think I can do this?” So then that made me want to do this [major] just because it seems like people are thinking maybe she can’t do it, which I haven’t really experienced before. And then that was – even the head of my department was like, “Well, you like to do so many other things; if you switched to something that was easier, less time-consuming, you’d have more time for fun activities.” Well yes, I like activities, but I am here for college, so that should be like, my main focus. And then they were saying maybe the packing science major. I never expressed interest in that, really, but they’re like, maybe you could be more creative there. It’s like, that’s so far from where I am right now, and I just – I got really upset about that.

Further discussion with Brenda suggested that she was in real conflict about what this feedback meant. While she did not think it was the intent of either the faculty or staff to be offensive, she was offended by their comments. As a result of the conversation, she spoke to others about the incident to assist her in obtaining an objective point of view. Brenda is conflicted about remaining in the engineering program but she believes that by having her department chair frame the conversation about change of major as, “taking the easy way out,” she is being excluded from a major rather than escorted to a major that might be a better fit.

After a great deal of reflection about the first incident, Brenda decided to return to her department chair for assistance with one of her engineering course. She elected not to mention how offended she was by the previous conversation, and instead focused on questions relating to the classes she is taking in the current term. To Brenda’s surprise, her department chair returned to the change of major conversation without prompting:
He was like… he told me that… like, “I had a feeling last semester that this program wasn’t a good fit for you.” I mean… That made me mad, too. I mean, like, I understand that I had a lot of questions, but especially since that was like, my first year, you know… like a learning period… Like after he told me that… I went and cried. I was like, so last year, you didn’t think I should be here, but you didn’t tell me?

While Brenda expressed comfort and pride about NTI on numerous occasions throughout our interview, these comments suggest that there are at least occasions where she does not feel comfortable with the engineering faculty. The lack of comfort appears to add to Brenda’s academic anxieties as she remains unsure whether those entrusted with her development truly believe she is worthy of their support. Further, these isolated instances of discomfort seem to have caused Brenda to question the veracity of commitment and support that she perceived a year prior.

Although the catalyst for Brenda’s concerns within the engineering major has been poor academic performance, her perceptions about race and culture are not far from the surface. When asked to discuss how she believes her peers view her, she noted the following:

I think that’s an interesting question, because my first semester, like all of the people in my year and my major, we had like one class together, and they were just like – there was one black person, that was me… That was like my one big culture shock here. So in my head, I was always just so taken back by that fact. So I always thought that like, people were noticing that as much as I was, but they really weren’t. It was just in my head. So I would always think that people were like, “Oh, maybe she doesn’t know what she’s doing.” But it’s all in my head; people actually think I’m smarter than I would think that I am myself. And I think that’s fascinating.
When Brenda thinks about herself in the context of her engineering cohort, she views herself as the only black person in the class. Brenda’s perceptions of how students in her class view her are interesting; they provide potential insight into why she is so offended when members of her department suggest that she entertain an “easier” major. Further, Brenda’s perception that perhaps other students in her engineering cohort do not see her in the same intellectual light as she views herself is insightful because of its tenuous nature. Although she believes they see her as a smart African-American woman, there is an air of doubt in her tone.

None of the subjects in this study communicated examples of overt racism, exclusion, or antagonism. More often, respondents were inclined to share observations about the African-American engineering experience that they were struggling to understand in non-polarizing language. For example, Brenda provided this additional kernel of insight into her integration into the engineering community: “My program? Yes, I think the people in my program are nice. Well, the people that I meet are nice, but I don’t really know them. I should probably get to know them.”

Tim, a successful third year engineering student with a 3.7 GPA, also demonstrated a keen awareness of being African-American in classes. While Tim is not the only African-American in the engineering department, Tim is often the only African-American in class. He said:

Sometimes it’s frustrating… like, you come to a class and you’re the only black person there. Yeah, like I had a class here, like, 150 students. I would look up, look back. I don’t see any black person there. So sometimes it makes me feel like really sad that it’s not diversified.
By Tim’s account, he makes friends readily and has never experienced challenges obtaining assistance when he needs it. However, his comments suggest that those conversations are easier, because he is meeting members of the community on their terms. He is not as certain that they are interested in learning more about him. That is where he believes he would benefit from having more African-Americans in class. Tim has good friends in class but, for him, it is all about business.

So I’m focusing more academic. Like, I just come here [the engineering building]. I come at 7 a.m. and go back home at 11… sleep and come back to the library and class. Friends… I study with, not hang out.

Tim seems to be comfortable with this relationship with his friends and does not seem to expect more from those academic relationships. Tim notes that he did not have many financial resources growing up, so he sees the opportunity to study at NTI as a privilege that he plans to take full advantage of. Prior to attending NTI, Tim went to school in New York City. He recalled a speech that he heard while attending a NSBE Jr. Conference that informed his approach to studying engineering at a NTI, where he is frequently in the racial minority:

If you are the only black person in the class, make sure whenever people talk about GPA, you got the highest. Like, you don’t want them to remember you as the one who was the only black person in the class. You want them to remember you as the highest GPA in the class. And I really liked this speech…
Tim’s comments suggest that his status as one of the few African-Americans in his classes has motivated him to perform well academically. Based upon Tim’s 3.7 GPA and his third year status, it appears that he is responding well to the high standards he has set for himself. It is interesting to note, however, that the prior statement is not the sole indicator of his perceptions as an African-American engineering student.

It’s really difficult [engineering]… I take examples to my brothers, because… like they don’t think it’s possible. Like, they don’t believe. Like, whenever they see… like, even me, there’s still, I see there are still people in my own family doubting if I can succeed in this environment.

Tim believes that his most enduring quality is his belief in himself; he credits this with his success as an engineering student. In addition to helping him work through the curriculum, he feels that self-confidence has helped him work through the relationships that support his academic progress.

Joe, a first year engineering technology student with a 3.1 GPA, expressed views similar to Tim’s. Joe was one of the interviewees who was uncomfortable with wide use of the term African-American. Joe’s parents are of Haitian decent and he preferred to be referred to as “black” during our interview. Joe indicated he started to bolster his self-confidence after upperclassmen told him that he should be prepared to teach himself in some of the engineering classes:

Some teachers are just going to, like… just push you off to sea – sink or swim. And that was my …that was my Fundamentals of Engineering teacher, first day of class. They owed me nothing and no, we’re not going to provide you extra… And it took me by shock, but when looking back, I …now I can say that I did that on my own. I took the initiative…
Joe did not feel that all of his engineering courses were this “cold,” but he felt that self-confidence and hard work are critical for getting through courses that separate out weaker students. Joe said that the lack of support in that specific course didn’t offend him, because other students told him that it was normal. Joe was, however, required to modify some of his personal expectations when he arrived at NTI:

It just means that my A days, those straight A days are just gone. I have to learn...I have to learn how to discipline myself... I was honestly praying for like a C. A C stands for like, competent, right? So I had to get used to that fact that, you know what, that’s normal. That is okay. It doesn’t mean that you’re dumb. It doesn’t mean, like …it doesn’t mean like, you’re incompetent, you know, some people are just good at one thing and other people are just good at another thing. You just have to really, like put some time and effort into how you learn it.

In addition to changing his grade expectations, Joe indicated that the courses in his engineering major have impacted his feelings about being part of the university:

Social transition, internally speaking, I felt that I went from extroverted person to a very introverted person now. In my first semester I was really like, outgoing – saying hi to people and stuff like that. Now, as of right now, I’m very reserved. I’m very reserved. I keep to myself and in a way, I’m a little bit selfish, since I always just have like, myself in mind and I couldn’t really care less what other people are doing around me... Because it seems like in this college is...there’s like, just a couple social groups.

Joe went on to note that he has not been able to identify a social group within the college that matches his own experiences and interest. He said that he readily finds students to work with academically, but that it’s difficult to find students within engineering
technology who a match with his social interests. As a first year student, Joe is still working to identify the most effective social connections.

Joe has determined that strong academic connections are much more important than social connections, and he provided insight into how and why he develops his academic connections:

I’m very sure most “smart people” can relate to when you go your whole life being called smart, smart, smart, smart, right? As soon as you start to fail, that’s now a big blow to your ego because you start to question whether or not you’re smart, you know. Because I always liked that title that they put on me. So now when you sort of do something that goes against that title, you fail at something, especially academically, that’s like, wow! What am I now? You know, so I really had to learn to like, keep my ego down, but not like, berate myself and call myself dumb… But I had to act like I’m a smart guy… but I don’t know everything. And by that I actually made a good decision …sorry… I actually made a decision to just surround myself with like, smart people. Learn. Learn from them and see how it helps me.

Joe believes that it is critically important for engineering students to take responsibility for their decisions and to avoid blaming their challenges on their culture. Joe says, “I want to show that I am an engineer and that being black has nothing to do with it.” Like other subjects in the study, Joe does not feel the being an African-American has been a liability during his time at NTI, but he is aware that being an African-American may influence the way that others see him.

For Oscar, a 5th year engineering technology student from the New York City with a 2.8 GPA, having friends outside of the engineering technology major has proven
the most effective mechanism for developing social connections within the university community. Oscar describes his perception of social connections in the following way:

I feel like they [relationships] could be a little better… It can get lonely at times, because it’s harder for people to reach out to you and, I guess, approach you just because of your background – what you look like, where you come from and stuff like that. So it can get a little lonely at times. Being a different journey, yeah, at certain crossroads, it could be for certain I guess, intervals we cross. It could be a different journey. The journey’s really what you make of it, I have to say.

Oscar notes that all African-American students don’t have things in common, but when he has a rare moment to decompress, he finds it nice to have a few friendships and conversations with African American peers that are comfortable and natural, whether the students are in his program or not:

You find that birds of a feather fly together when you’re at NTI. You have similarities with that person, you can relate to them more, and it’s just a much more comfortable relationship because it’s just so easy to just relax and let loose and not have to constantly try… And I guess impress them, or I guess try hard to be someone that you’re really not naturally. So when you’re hanging out with your black friends or whatever, you’re more relaxed and you’re more able to just free flow.

Within the major, Oscar feels that he has benefited from interacting with students from around the country and the world. He characterizes the multicultural interactions as one of the best learning experiences that he has had at NTI. Oscar believes that the multicultural interactions have, “helped me develop parts of my personality that really were not there before, and made other things stronger, like caring about other people and sticking up for the little guy.”
As a student scheduled to graduate at the close of this academic term, Oscar’s commitment to helping the “little guy” is apparent in his efforts to reach out to underclassmen before he leaves. Oscar indicates that he has been reaching out to African-American underclassmen who he encounters in the lab and common areas of Engineering Technology Hall. In fact, Oscar indicated that he participated in this research hoping that discussing his experiences might help future generations of NTI engineering and engineering technology students. If Oscar could leave any advice for incoming students, it would be to encourage them to get out of their rooms and build a wide network of support:

So when you find out that interest, find out what you want to do, I would say, stick to it and reach out to as many people that have the same interest as you so they can make your skills stronger and make your time at NTI easier. Because then you have that close-knit group of friends where if you’re having trouble, you can always go to them… But professors really didn’t care what you look like, where you’re from. They want to see you succeed. And when it comes to professors and faculty and staff, they treated everyone the same. When it came to students and the social academic relationships, it was very complex, for the lack of a better word.

For Oscar, successfully navigating the culture of the engineering department and becoming integrated into it presented him with a unique set of challenges. Some of these challenges appeared to be related to his perceptions as an African-American student.

Charles, a fourth year engineering technology student from Syracuse, had the highest GPA of all the students participating in this study. In addition to his academic success, Charles has reflected on the perceptions that faculty students and staff have about him. He perceives being viewed within the university community as both an
African-American and a high-achieving student presents a unique set of challenges. Charles was one of the participants in this study who declined to identify his racial/ethnic heritage on university forms. Earlier in this chapter, Charles alluded to the questions he wanted to avoid when applying for admission to NTI. Charles felt that withholding his racial/ethnic identity during admission might address latent concerns that he was accepted because of his race. Later in our interview, Charles spoke somewhat self-consciously about his A average. He shared his impression of how good grades had impacted his NTI experience. When Charles first arrived at NTI, he found it difficult to get advisors and faculty to answer questions about his program. However, he thought the treatment changed after he demonstrated his ability to perform at a high level:

   When I first arrived at NTI... I would go in and no one would tell me anything about anything. I just remembered my first semester, they kept blowing me off about all sorts of stuff. I just wanted to know because I needed to go on co-op... And then my first semester here I got a 4.0, because it was a lot of physics and dynamics, that stuff that I really like, so it came easy to me. And all of a sudden, all these people knew who I was, and I’m getting all these emails from people. My adviser’s like, “Great job,” and they’re saying all this stuff to me. I was like, “Wait, so now you care about who I am just because you found out that I’m smart?” What about before? What if I wasn’t this smart? You guys should be trying to help me.

Charles articulated two points of concern about the attention that he received as a successful African American engineering technology student: (1) would he have continued to garner modest attention if his academic performance had been pedestrian? and (2) how would people treat him if he were unable to continue to perform at a high level? When he first arrived in college Charles indicated that he would, “Feel them
[faculty] coddling me in class and stuff, and then all of a sudden they’d found out that I got the highest grade on some test, and I was like, “Why do you guys think that I’m stupid?” Charles was uncertain whether the treatment occurred because of preconceptions about his race or because he had been home-schooled before going to college.

Charles indicated that he enjoyed working in groups and enjoys helping people, which he says helps him understand things. Most importantly, he enjoys helping others. As one of the brightest students in his class, Charles perceived that other bright students resented both his sharing and openness. That was something that Charles struggled with and that he believes it was a barrier to developing certain relationships in his cohort:

… that was something that weirded me out here when I came to this school. It seemed like a lot of the kids didn’t want to help each other out, like, they were just competing to see who was better. And so they all viewed it as – this is what I felt, I don’t know if this is actually what has happened, but this is what I personally feel. If we got some assignment, it basically was they couldn’t help each other out, because I guess they all viewed it as cheating or something like that. You’re not giving them the answer, you’re just helping them. And that’s why for me, I feel I learned better when I help people.

Charles, an engineering technology student, was not the only student to mention the tensions that sharing created within student groups. Fabian, a 5th year engineering student, also provided a response that shed light on the degree of sharing that exists between students:

You know… to be successful, you need upper-classmen helping you. Upper classmen… you know, showing you… you know… okay, all right, this is the way you do the problems. Or showing you the past test and say
all right, you should probably do it this way because every student does it like this… I can tell you right now, you know, every student asks for past student tests or past students problems or homework problems. If they tell you that they don’t, that’s a lie, that’s an absolute lie. It’s the absolute truth that they actually do ask for people’s past test and stuff like that. That’s what happens in engineering.

Both Charles’ and Fabian’s tone suggest that conversations about sharing and discussing academic work are challenging. In Charles’ case, he believed that these tensions influenced his relationships. As a group, it is less clear how these tensions might also be connected to perceptions of race within the respective cohorts of those studied.

In summary, this chapter has helped expose themes providing insight into African American students’ perceptions of persistence at the Northeast Technical Institute. Through this study, both upperclassmen and underclassmen were provided with an opportunity to share the influences that encouraged them to persist in engineering, academic experiences, resources they perceive as critical, and the challenges they confronted. Underclassman, being closest to the preliminary transition to college, provided fresh insight into early experiences. Upperclassmen, possessing a comprehensive view of the NTI experience, were able to discuss the ups and downs of the NTI engineering experience. Most importantly, upperclassmen provided useful perspective on adjustments they perceive as critical to persistence in engineering.

Uniformly, participants in this study expressed strong pride in their acceptance into an engineering program. Even when NTI was not the first choice institution during the college search process, subjects projected a high degree of respect for the quality of NTI engineering programs. In effect, students were happy with the quality of the NTI
engineering program and felt that the program provided all that was promised. Additionally, participants in the interviews believed that the NTI experience would have a positive impact on their educational and occupational outcomes with the cooperative education requirement being sited most frequently as a driver of career success.

As one might expect, academic outcomes for the twenty-four participants in the study were varied. Although all of the participants in the study are currently in good standing, some have experienced academic probation as a result of poor academic performance. Although some of these students have experienced an occasional D or F, none of the participants in this study had experienced an academic suspension.

On the opposing end of the academic spectrum, some study participants have been consistent high performers. Whether an academic rock star or a more modest academic performer, participants expressed faith in the desire of the university, faculty, and staff to provide African American students with an experience designed to help them reach both their academic and profession goals. In spite of participant perceptions that institutional efforts supporting student success are strong, supplemental insights articulated by students suggest that African American engineering students are conflicted about their academic success and the success of their integration into the culture of the institution and engineering programs. The next chapter will be dedicated to a more extensive exploration of the themes drawn from the data here and subtleties of African American student perceptions of persistence at NTI.
Chapter 5: Conclusions & Further Study

This chapter builds upon key themes identified in the results section of the study by tethering thematic concepts with the research questions that guided the study:

1. What do African American engineering students perceive to be the most critical reasons for their persistence in engineering at a predominantly white technical institution?
2. What does completing the engineering degree mean to African American students at a predominantly white technical institution?
3. What strategies, resources, and relationships do African American students perceive as most important for persistence in engineering at a predominantly white technical institution?
4. What do African American students perceive as the most significant barriers to persistence in engineering at a predominantly white technical institution?

With further consideration of the results, it is obvious that study participants reflected upon their persistence in NTI engineering programs both strategically and tactically. Strategic responses captured students’ overarching goals while tactical responses tended to focus upon the incremental steps that participants believed would lead to achievement of their goals. The most persistent strategic goal mentioned by students in this study was the goal of completing the engineering degree. 100 % of the African American students in this study matriculated at NTI to obtain a degree in engineering. Although NTI possesses a robust undeclared major, none of the participants of this study transferred into engineering from undeclared or any another major. Tactical decisions mentioned by African American engineering students in this study included study methodology, use of professor office hours, and deciding which student clubs or
organization to join. While study participants’ tactical decisions often assisted them in overcoming obstacles, their decisions were equally capable creating barriers to success.

Longitudinally, I suspect that continued exploration of African American student perceptions of persistence may prove critical in assisting researchers and institutions seeking to expand the success of African Americans engineering students. Throughout the study, participants clearly articulated how their decisions, ranging from choice of major to study tactics, were heavily influenced by the cultures of their high schools and communities prior to arrival at NTI. For example, when students arrived at NTI they often observed an informal culture of study groups. However, awareness of study groups proved inadequate motivation to draw some student participants into the culture of networking that pervades the engineering department. The students that did not leverage study groups, clearly, did not perceive that aspect of the informal culture of the engineering department as helpful. It was a blind spot impacting some participants in this study and that blind spot is not addressed by existing academic intervention programs on the NTI campus. While there are engineering courses that intentionally pair/group students to complete graded projects, those groups serve a very different purpose from the informal groups devised by students as they complete homework and projects.

While the perceptions expressed by study participants may not prove of primary, or even secondary, significance when informing instructional or institutional policy on the recruitment and retention of African American engineering students, the insights certainly provide tertiary insight into the development of unique interventions. Further, the results suggest that African American engineering students have a tendency to
perceive the engineering major as the single best means to change their economic circumstances. It was rare to hear participants discuss their love for the discipline or the implications of their engineering work on society. Not surprisingly, students who expressed clearly articulated passion for engineering work were among the participants maintaining the highest GPAs in the study. Perhaps, future opportunities lie in more effectively matching African American engineering students with specialties within the discipline that inspire passion for the major.

It is useful to note that none of the participants in the study expressed concern about the overt intentions of NTI to do anything other than support their success. The results of the study do not imply that African American students perceived NTI as derelict in its responsibility to African America engineering students. However, in spite of the perceived intentions of the university, African American engineering students are represented in lower proportions within the NTI engineering community than the university’s stated goals. NTI would like to see African American representation that is competitive with the broader population. Of further concern is an African American graduation rate that trails the institutional rate by nearly 10%.

This study acknowledges the complexity of phenomena that contribute to a lack of African American engineering representation both nationally and at NTI. No two participants in this study were exactly alike and it is unlikely that a single intervention has potential to ameliorate concern about the lack of African American representation in engineering programs. In the long term, the simultaneous implementation of multiple interventions may prove the best hope for increasing African American success and
representation in engineering. Future studies should build on this work by stepping outside of the lines established by conventional engineering program design to consider how African American engineering students’ perceptions about the major and the way that they navigate the major might be at odds with the prevailing culture of engineering schools. I believe that institutions and students will benefit from initiatives moving engineering program culture and African American engineering student perceptions into closer alignment. Subsequent sections of this chapter explore results, research questions, and areas of opportunity.

**What do African American engineering students perceive to be the most critical reasons for their persistence in engineering at NTI and what strategies, resources, and relationships do African American students perceive as most important for persistence in engineering at a predominantly white technical institution?**

Research questions one and three stimulated similar strategic and tactical perspectives from study participants. As a result of the commonality in the way that students reacted to this component of the research protocol, I have elected to discuss the findings in this shared section. The most successful students in the study indicated that consistent participation in study groups was critical to engineering success at NTI. Participation in study groups appeared to serve a variety of purposes for the African American participants of this study. First, students viewed work groups as a mechanism for improving academic efficiency. Engineering is a time intensive area of study and by working together students were able to investigate specific questions during the
resolution of problem sets or labs. Once the individuals in the group come back together, they were able to help others improve their understanding of the course assignments.

Imbedded in the efficiency motivation for participating in study groups is the opportunity to teach course content to teammates. Students indicated that teaching others about coursework improved their individual pride in mastery of a concept and reinforced their learning in the process. In circumstances where their understanding of a concept was deficient, the structure of the groups allowed students to identify problems before examinations and assured that there was a resource, other than the professor, available for assistance.

In many cases, students who received academic probation attributed improvements in their academic performance to their willingness to actively engage in group work. This transformation in thinking was critically important as it was diametrically opposed to previously held student perceptions about behaviors required for academic success. In addition to noting the importance of group work, successful students were sensitive to the composition of study groups. Whereas many of the students who experienced academic probation were gradually convinced of the power of study groups, successful students spoke savvily about their strategies for joining or developing groups. The strongest academic performers in the study demonstrated an awareness of the strongest students in their engineering classes and worked to add those students to their network. They expressed persistence in their outreach to peers and they suggested that race and gender played no determining role in the formulation of their study groups. Only study participant who had experienced academic probation expressed
ongoing reticence about using study groups. Study participants that remained on the fence about the tactical advantages associated with using study groups, often cited study groups organized through the National Society of Black Engineers as their sole investment of time in study groups. Most importantly, study participants expressed an awareness of the preponderance of study groups as a component of the culture of the NTI engineering program whether they elected to participate in study groups or not.

Effective outreach and communication with faculty was also cited as an important tactic for success in the engineering program. The most common time to connect with NTI engineering faculty was during scheduled office hours. For those students who valued this time, meetings with the faculty presented an opportunity to obtain assistance with problems that persisted after consultation with peers. For study participants that were less inclined to work with peers on day to day assignments, faculty office hours also seemed to be of less interest. Most participants in the study were able to identify at least a single faculty member that they seemingly had a strong relationship with. However, the professors that participants perceived the strongest relationships with were not always engineering faculty. Inspirational faculty relationships were equally prevalent across liberal arts, business, mathematics, and science faculty.

Faculty that students identified as inspirational seemed to serve as counselors as often as they were tapped to solicit explicit academic assistance. In other words, inspirational faculty functioned as informal mentors to participants in the study. When asked to drill down on the faculty that they felt the strongest connection with in the engineering department, study participants found it more difficult to respond. The
difficulty responding suggests that those study participants did not have a particularly close relationship with a member of the engineering faculty. In the future, the lack of formal participant connection with a member of the engineering faculty might present new challenges should a student choose to apply to graduate engineering programs. A reference from an undergraduate engineering faculty is traditionally a prerequisite for master’s programs and it is difficult to believe that a student could receive a strong letter of reference without a more than passing faculty relationship.

Although all of the study participants were in good academic standing and had not experienced an academic suspension, there were varying levels of academic performance across study participants. As with the example of study groups, high performing students seemed to value relationships with engineering faculty more strongly than lower performing students. However, this study does not provide clarity on whether stronger academic performance occurred as a result of the perception of strong relationships with the engineering faculty. The high performing students may have done well in courses absent faculty interaction. While the answers to those questions cannot be gleaned from this study, they appear to be ripe areas for future exploration as the perceptions of high performing African American engineering students are distinctly different from their lower performing peers. If lower performing African American engineering students receive, even imperceptibly, cooler reception from faculty during office hours it may influence the willingness of the lower performing students to pursue relationships with faculty. I will return to the topic of faculty relationships when I discuss perceived challenges later in this chapter.
What does completing the engineering degree mean to African American students at a predominantly white technical institution?

Participants in this study came from various parts of the United States; most attended public high schools. With the exception of those attending private schools, students indicated that their high schools were predominantly black and Hispanic, but ethnically diverse. Although they characterized their high schools as diverse, they did not uniformly believe those experiences fully prepared them for cultural adjustment to a predominantly white institution like NTI. Prior to arriving at NTI, study participants perceived themselves as competent and capable academic performers. After arriving at NTI, however, many found their confidence shaken.

There were numerous reasons why participants found their confidence shaken. Some students struggled with the balance between academic passions and the career prospects they perceived would come from completing a degree in engineering. Others struggled to meet academic requirements. Even the most successful students expressed concerns about their degree of acceptance and inclusion within the NTI and engineering communities. Regardless of the reason for student doubts, or when they experienced challenges during the academic career, the most common motivation for persisting was the belief that completing a degree in engineering would provide them with occupational advantages that would not be readily available with a different degree.

Consistent with the work of Tinto (1975, 1987), participants in this study were able to frame their success in the context of their perceptions of career goals, academic challenges, and academic integration. The African American participants in this study
expressed strong economic rationales for their decisions to select and persist in the engineering major at NTI. Study participants further identified the career paths offered by engineering as a positive vehicle for obtaining a better life for themselves and their families.

Ma (2009) showed that low socio-economic status correlates strongly with African American students who elect to major in engineering; this is consistent with findings in my study. While measures of socio-economic status were not formally considered in the selection protocol for this study, most participants indicated that they were first-generation college students who, at some point in their youth, experienced challenging economic circumstances. Their expressed perception of being economically disadvantaged seemed to influence their decision to remain in the engineering major. In Laureau’s (2003) longitudinal ethnography, her findings suggest that it is not uncommon for issues of income and social class to have pronounced impact on the aspirations, preparation, culture, and communication of students.

For some of the African American engineering students at NTI, obtaining an engineering degree represented an opportunity to make a social leap. Within the culture of NTI, engineering occupies a perceived position of prestige that is highly coveted. NTI’s college of engineering attracts students with the highest SAT scores and boasts the highest number of honors students admitted to the university annually. Even when African American engineering students in the study were not meeting their personal academic goals, they remained proud of their status as engineers and loathed the prospect of changing majors. Furthermore, in circumstances where students articulated
occupational interests outside of engineering, they only gave fleeting consideration to a change of major. They were much more inclined to consider pursuing their intellectual passions after graduating from one of NTI’s engineering programs.

While the drive to pursue engineering was personal for some students, parents played a meaningful role for other participants in this study. This is consistent with the literature (Leslie, Mclure, Oaxca, 2006) as subjects in this study indicated that their parents enrolled them in private schools, STEM-focused high schools, and special programs to improve their preparation for the study of engineering in college. The single participant in this study who attended a private high school indicated that the decision to attend the private school was influenced by parents hoping to improve his likelihood of getting into an engineering school.

The parents of students in this study who were vigorously involved in the development of their child as a potential engineering student seemed to closely exhibit the concerted cultivation parenting style described by Lareau (2003) in her longitudinal ethnography. These parents provide their children with intensive, scaffolded experiences in hopes that the experiences would improve long-term occupational prospects. As in Lareau’s study, parents who demonstrated this parenting style seemed to be more active in their child’s development, and participants who expressed this level of familial engagement frequently connected their parent’s desires to their personal and professional goals. For these study participants, persisting in the university’s engineering program was not merely seen as a mechanism to improve economic and financial standing. Remaining in engineering seemed to be viewed as a way to fulfill familial dreams and aspirations.
Further, responses seemed to suggest that both families and communities succeeded vicariously through study participant exploits in an honored discipline. As a result, if participants failed, they perceived that they were failing all who had placed faith in them or sacrificed to make their collegiate dreams come true.

Clearly, attending college as a reflection of an entire family or an entire community is a heavy burden. Whether the burden is self-imposed or externally imposed, students articulating this perspective appeared more confused and stress than participants that did not provide responses suggesting that they integrate this level of responsibility into their lives as students. Student participant Charles, who possessed the strongest GPA among participants, spoke eloquently of his perspective on this concern. Charles was the second member of his family to attend college. His older brother attended college four years prior to him but stopped out and never returned. The last bit of advice that Charles’ brother gave him before departing for college was to make certain that Charles was choosing a major and going to college for himself. His brother informed him that the commitment is too great and the work is too hard to attempt to complete the degree for anyone else. Charles suggests that it was among the best advice that he has ever received and it informs his day to day commitments as an engineering student at NTI.
What do African American students perceive as the most significant barriers to persistence in engineering at a predominantly white technical institution?

Several of the study participants noted that they had attended STEM-focused high schools and/or STEM focused supplemental education programs. Within these pre-collegiate programs they were exposed to advance content, hands on projects, and unique approaches to learning about science, technology, engineering, and mathematics. African American students in this study found their pre-collegiate programs interesting but incongruent with the ways that they were expected to demonstrate mastery of engineering concepts at NTI. For example, students in the study were not consistently clear about how courses they were studying would prepare them for success as an engineer. While this could be symptomatic of other academic interests, it may also highlight a strategic opportunity to assist African American student within the NTI engineering program. Perhaps there are unrealized opportunities exist to stimulate African American engineering student interests in engineering that extend beyond the prospect of high salaries. Additionally, engineering programs may view the perception that there is no connection across coursework as a catalyst for endeavors designed to assist African American engineering students in making connections between foundation math and science courses and the skills that they will need as they complete the pure engineering curriculum. Currently, the engineering curriculum is stacked in the third and fourth years of undergraduate programs. During the study, an academically successful senior shared his frustration with having to re-teach himself certain mathematical concepts as there had been so much time between his instruction in fourier transforms and application of the concepts in a senior engineering project. Further, the student wished he had known how
important the concepts would be to his eventual work as it would have changed his approach to the original math course.

Although some students had experience with alternative methods of STEM instruction during their pre-collegiate training, they were not convinced that these alternative approaches to teaching curriculum were the best preparation for success within their highly competitive engineering programs. Student perceptions of the styles of instruction that best suited the study of collegiate engineering paralleled the recommendations found in the work of Harris, Rhoads, Walden, Murphy, and Reynolds (2004), which suggest that innovative alternative pedagogical strategies might be critical for improving the number of African American students in engineering. More explicitly Harris, Rhoads, Walden, Murphy, and Reynolds recommended earlier integration of engineering concepts into math and science requirements of the programs. Unfortunately, student participants did not feel that the innovative approaches they encountered in their pre-collegiate training were reflected during their instruction at NTI. It was not clear whether that distinction in pedagogical delivery was reflective of an overt decision by NTI’s engineering curriculum committees or just the way that it has always been done. As the college of engineering accepts the highest performing students in NTI’s freshman class, the engineering program may also be making presumptions about the preparation of incoming students. Faculty impressions may not be aligned with the experiences of the African American students participating in this study. Although NTI departmental faculties are responsible for the development and delivery of curriculum, study participants indicated that they had never discussed their concerns outside of
forums held by the National Society of Black Engineers. Active participants in the National Society of Black Engineers indicated that representatives from the university rarely attended NSBE meetings even though they have a standing invitation to attend. When experiencing difficulties, study participants responses suggested students were more inclined to provide self-critique than criticism of the engineering program or faculty.

Consistent with the work of Berger and Millen (1999) the African American students in this study expressed high levels of institutional confidence and commitment. They were proud of their admission into an engineering program and expressed faith in the capacity of the Northeast Technical Institute to prepare them to compete for employment opportunities in engineering. Participant confidence in the preparation provided by the university was even clear in circumstances where NTI was not the student’s first choice college. No students expressed a persistent desire to transfer institutions but some indicated that they had considered a move. Expressions of doubt about the decision to major in engineering were fleeting and only came about when the interviewer asked clarifying questions. Inevitably, interview participants who expressed concerns cycled back to an attitude of resolve and commitment to complete the degree.

During the interviews completed for this study, study participants spent a substantial amount of time discussing their perceptions of where they struggled. Whether an upperclassmen, underclassmen, high academic performer, or challenged academic performer, study participants were able to readily identify areas of academic opportunity. Hulst and Jansen’s (2002) research suggests that work habits and procrastination are the
most significant factors determining student success in engineering when using longitudinal regression analysis to account for factors such as race and gender. Perceptions of participants in this study were congruent with Hulst and Jansen’s findings, as many participants agreed that procrastination and work habits were occasionally challenging factors for them. Procrastination in required engineering courses did not always mean that students were not working. Many students became heavily engaged in volunteerism, clubs, and organizations that fed interest other than engineering. In addition to intellectual interests, some students indicated that they were working as many hours as possible so that they would be able to send money to help out at home. Given the common limitation of 24 hours in a day, any distraction presents a barrier to success. As the NTI engineering program is designed for students committed to full time study of engineering, students attempting to complete the program while viewing the major as a part-time investment of labor are at a distinct disadvantage. The most glaring work habit concerns appeared to be failure to understand or embrace the importance of work groups and faculty relationships. As noted earlier in this chapter, research subjects indicated that team/collaborative aspects of study outside of the classroom were crucial for success.

Study participants that expressed interest in other majors indicated that engineering work took too much of their time and that their interests in other academic areas competed for their attention. Many participants were actually pursuing minors and academic concentrations in areas outside of science, mathematics, engineering, and technology. There were divergent areas of academic interest across study participants. Students were excited to discuss their interests in history, public policy, communication,
foreign languages, music, and business. This excitement was a distinct departure from the level of energy expressed as students discussed their engineering projects. Whereas their discussions about engineering seemed superficial, participants spoke in great detail about entrepreneurial interest in business, education, writing, and government. Student perceptions suggest that many of the study participants may not be appropriately matched with majors. Students entering NTI matriculate directly into a major. This enrollment process presumes that incoming students are equally capable of making an informed decision about major. Further, the enrollment directly into the engineering major assumes African American engineering freshmen have considered the academic and financial implications of failing to make adequate progress should they struggle. Engineering programs within predominantly white institutions would benefit from closer analysis of the tendency for African Americans to persist in engineering even when the major does not appear compatible with their long term career interest. Even participants who’d experienced modest levels of success were closed to the prospect of a change major. If students that received a prior probation were to earn a second probation or academic suspension, it is not evident that they would be less fervent in their desire to persist in engineering. Perhaps some of these students would be more successful if they were involved in tactful advisement about their progress and options in other majors.

Most study participants had not given much consideration to how their secondary interests might bridge with their primary studies in engineering; they discussed their interests in government or law in isolation from engineering studies and had not given consideration to how their engineering major might position them to be an effective
practitioner of patent law, for example. However, the students interested in business and communications were able to more readily tether their secondary interests with the engineering major and long-term career plans.

Study participants with business and communications interest seemed to believe that they would be able to enter a corporation via engineering and bridge out to other areas after a few years of experience. When asked why they did not major in their area of primary interest, participant indicated that they perceived it would be more difficult to achieve their goal that way. Participants articulated no objective rationale for the perception that engineering was the best corporate entry point for them. Reflecting upon the results of this study, I wondered whether participants perceived themselves as less competitive in a major outside of engineering. The perceived intense study time reported by study participants may be indicative of pre-collegiate preparation. It was clear that participants with the lowest GPAs perceived that successful students spent more time studying than they did. Low performing students suggested that their minors and other intellectual outlets provided a balance that they perceived to be lacking in more successful students.

Some students also indicated that the intensity of the math and science courses required within the engineering major had caused them to lose their passion for math and science. In these cases, students seemed to look toward internships and coops to reinvigorate their interests in the engineering program. This finding is consistent with the observations of Bordoga, Fromm, and Ernst (1995). Bordoga, Fromm, and Ernst suggest that an intense academic infusion of math and science courses without including an
engineering problem solving context, might be prove non-motivating for some engineering students. Perhaps the addition of courses with a social context might also be beneficial for these students. For example, providing students with opportunities to complete integrative engineering projects exploring solutions to real urban problems might be inspirational.

Barriers and keys to success were discussed in equal measure by participants of the study. Of all the work habits discussed in the study, participating in study groups and utilizing university tutoring services were considered the most important. Study participants with the longest track record of persistence uniformly credited their success in engineering with the networks they created through formal and informal group work. Moreover, upper classmen indicated that the use of tutoring services and faculty office hours were not merely a tool for crisis intervention. In their eyes, consistently and actively talking through problems with peers, tutors, and faculty was a critical requirement for success in engineering. As members of the study with the longest track record for persistence, upperclassmen considered navigating engineering in isolation from peer and institutional resources as the most challenging way to pursue the engineering degree.

Although commitment to group work was identified as one of the most critical reasons for persistence in engineering, participants indicated that it was also one of the most challenging adaptations to make in the transition to college. Several of the African American participants in this study indicated that both formal and assigned group work was difficult to navigate for a variety of reasons. In some cases, students noted the
absences of group work in their pre-collegiate environments. These students had
experienced pre-collegiate success without study partners, tutors, or a network of
academic peers. As a result, they had no frame of reference for how to approach a
classmate, create a study group, or obtain an alternative view on problem sets. One
upperclassman discussed his perception that working with others was cheating. The
student did not overcome his apprehension about sharing problems or old quizzes with
peers until he realized that it was a common practice for non-African American students
in the engineering program. In his estimation, when African American students only
collaborated with other African American engineering students their common
experiences working in isolation were magnified. This student’s most effective study
groups were diverse in composition.

Occasionally, study participants discussed their perception that classmates viewed
them as less smart when they asked a question in class or asked a classmate to study with
them. Although all participants were aware of other African Americans in the
engineering major, they indicated that it was not at all uncommon to be the only African
American student in the their section of a course. As a result, African Americans lacking
confidence in their abilities and uncomfortable reaching out to non-African American
classmates appeared to feel more isolated in the classroom environment. When discussing
perceptions of the way that one student’s classmates viewed her, the student indicated
that she assumed her classmates presumed she was less intelligent because she asked so
many questions in class. As with many students in this study, she struggled to create or
join study groups. When she was able to join a study group, she was never entirely
comfortable. She believed, however, that the students working most closely with her had respect for her abilities.

A key finding was that many participants in this study appeared to struggle to create partnerships with members of the engineering and NTI community when they perceived individuals had limited understanding or interest in their African American backgrounds and cultures. This finding is supported by Hurtado and Carter (1997). Even upperclassmen with high GPAs indicated an awareness of their presence as the sole African American in their engineering classes and often perceived that their race/ethnicity was being observed and evaluated by faculty and peers. Although they were unable to identify confirming evidence that race was a factor in their classes, some students implied that perceptions of inadequacy motivated them to become high performers. All participants in the study, however, did not view their presence as the only African American in a class as a motivating factor. Some students perceived that being the only African American in an engineering class garnered undue remedial attention from faculty. These students were sometimes offended when they perceived that a peer or faculty member expressed surprise at seeing them perform in an exemplary fashion on a quiz or examination.

The findings related to the inclusion of the African American engineering students in the culture of the engineering department highlight the distinction that Hurtado and Carter (1997) make between being involved and being integrated into the university community. The distinction between being involved and integrated is perceived by some researchers to be a blind spot in the way that many interpret Tinto’s
(1975, 1987) seminal work on retention. By virtue of the simplest interpretations of Tinto’s work, most participants in this study indicated they felt like welcome members of the NTI community. Many attend office hours, were aware of tutoring services, participated in assigned groups, joined university organizations and, in some cases, developed study groups. However the observable, quantifiable, involvement of African American study participants in activities supporting engineering success did not mean that study participants perceived they were integrated into the university or engineering cultures. Tinto suggests that academic persistence is reliant on both student commitment and student perceptions of institutional commitment. When this study was completed, all of the participants were in good academic standing. However, findings on participant perceptions suggest that African American engineering students at NTI are not consistently convinced of the institution’s commitment to their success.

Tierney (1999) suggests that a limiting factor of behavioral measures of integration is the presumption that minorities have or will fully adapt to the culture of the institution. The subjects in this study appear to have adapted to the culture of engineering at NTI in many ways. However, when students discussed issues that frustrated them, their comments suggested that they were not always confident of the intentions of faculty, staff, or peers. One of the most illustrative examples of these tensions occurred when a student, who believed the engineering faculty was supportive, was encouraged to look for an easier major after performing poorly in a critical course. In addition to the relevant concerns she had about her ability in the major, her reflective comments suggested that she questioned the veracity of every preceding conversation between herself and the
member of the faculty – Did he ever believe in her ability to become an engineer? Was he coddling her? If he wasn’t honest with her before, could she trust his suggestions now? These are all difficult question that she had to work through as she was attempting to complete her degree in engineering. In spite of her doubts, the student elected to presume that the faculty member had her best interests in mind and concluded that she was reading too much into the interaction.

For all intents and purposes, the aforementioned student was involved with her faculty. However, it is much less clear whether she perceived a fully integrated relationship. These findings are not intended to suggest that the faculty, staff, or students interacting with African American engineering students at NTI are unsupportive or unwelcoming. On the contrary, African American students participating in this study responded positively to direct questions about how welcoming the Northeast Technical Institute is. However, when asked to tell more about a difficult class or asked to expand on their relationships, student responses suggested that even the highest performing students experienced moments where they were not confident of their cultural acceptance and integration into the community.

Conclusions

The findings of this study potentially inform institutional strategies to recruit, retain, and graduate more African American students in engineering. The study provides African American students with a unique voice that is absent in the literature on engineering student persistence. With a growing national focus on addressing fairness and equity for African American men and women this is well timed. With the election of
President Barack Obama in 2008, many Americans openly questioned whether the nation was on the cusp of a post racial era. An era where the ghosts of slavery and segregation held no sway and race was not a consideration in matters of access and success. While the thought of a post racial America is inspirational, the results of this study suggests that a post racial America is only aspirational for African American students pursuing engineering.

While engineering programs on predominantly white campuses are arguable more accessible than anyone could have conceived during the civil rights era, gaps in African American representation and retention continue to require institutional attention. This study explored perceptions of persistence for a population of successful African American engineering students at one predominantly white institution but the insights gained here are transferable. Overt institutional racism is not part of the culture at Northeastern Technical Institute but interviews suggest that the students in this study could be integrated more effectively into the culture of NTI.

Many of the participants in this study affirmed their status as first-generation college students, and they both intentionally and unintentionally serve as role models and motivators for their families and communities. As participants in this study, these African Americans expressed hope that their contributions to this study might have a positive impact on future generations of engineering students. Furthermore, as trained technological problem solvers, these students expressed passion for the opportunity to return to their home communities after graduation to assist in addressing challenges there. NTI is nationally recognized for its ability to prepare engineering graduates that are
capable of competing in industries all over the globe. The findings in this study should not only inform NTI’s activities but other engineering schools with African American engineering populations.

Participants in this study communicated a general feeling of welcome at NTI, which suggests that NTI is successful in recruiting students and making them feel that NTI is a good place to study engineering. At the level of overt institutional behavior, students demonstrated confidence in the institution and its engineering programs. However, beneath the surface, students struggled with the engineering major and expressed difficulty identifying gaps in communication and study style unique to their personal experiences. Participant responses suggest that students do not feel excluded but they occasionally question whether they are fully included in relationships with students, faculty and staff.

The work of Slayton (2010) provides potential insight into the phenomenon documented in this study, as well as efforts that might allow African American students at NTI to longitudinally feel more integrated into the culture of the engineering programs. Slayton examined initiatives to improve the success of African Americans at public and private institutions over several decades. One of Slayton’s key findings was that the drive of some institutions towards increased selectivity is often at odds with institutional diversity goals. In other words, the institutional drive to improve status and rankings may lead institutions to become tone deaf to the challenges encountered by African American engineering students. Even though institutions like NTI are not being tagged for civil right violations, opportunities to improve conditions for the African American
subpopulation of engineering students go unrealized. This study focused on revealing student perceptions.

In environments where departments and faculty are focused on the elite nature of their students and programs, it is often the students who least effectively conform who are left out. In a competitive engineering environment, cutting students out might be viewed as a strategy that supports efforts to improve the selectivity of the engineering program. However, for students questioning their inclusion in the culture of the institution, strategies that support increased selectivity may cause them to perceive a lack of institutional commitment. A perceived loss of institutional commitment is dangerous as it may eventually lead to course failure or the underachievement.

Have increased selectivity strategies led to decreased student commitment in the NTI engineering programs? Over the last decade, activities at NTI have focused on improving the standings of the university in national and international ranking systems. NTI has moved to increase the importance of research as a component of the tenure process, increased the percentage of tenured faculty, and converted its Carnegie classification to bolster a move from regional to national ranking. Additionally, NTI has become more aggressive in its recruitment of African American, Native American, and Latino American students. However it is less obvious, from NTI documents, that the institution has assessed the expectations of African American students and the challenges they may perceive.
This dissertation suggest that engineering programs with African American students would benefit from considering a more intensive faculty advising/mentoring relationship for students who appear to be floundering in any aspect of the engineering curriculum. Considering the results from this study, such a program should not be exclusive to African American engineers but should include the entire engineering population. This recommendation reflects both the need for support and the concern of high performing African American engineering students who were offended by the presumption that their African American status implied that they were in need of academic remediation. Further, successful African American engineering students noted the power of culturally diverse study groups.

Proactive measures to influence the tenor of advising conversations that take place between African American engineering students and faculty may lead to more productive academic interventions and seamless conversations about change of program when students express greater interests and abilities in another academic area. Feedback from subjects in this study suggest that implying engineering work is too hard, or that students should attempt easier work, is viewed negatively and increases some student’s self-doubt and isolation.

From a curricular perspective, engineering programs should consider extended collaboration with departments providing service courses for engineering students. Common service courses for engineering students include physics, chemistry and calculus. Closer collaboration between the instructors of engineering and these courses may present opportunities to expand existing efforts to teach the foundation curriculum in
math and science with engineering problem solving in mind. Collaborative STEM curriculum initiatives may positively impact perceptions that the work of engineers is boring and tedious. Furthermore, curricular engagement across STEM requirements may also present opportunities to introduce support in the formation of informal study groups. Direct acknowledgement of the engineering college’s informal study groups, and their integral relation to student success, is important as it addresses a concern that incoming freshmen are not equally prepared to tackle the informal culture of the engineering program.

Over the last decade, the Northeast Technical Institute has engaged multidisciplinary faculty and staff teams to consider institutional persistence and retention data. These teams have historically looked at the overall retention of the institution but targeted women and minorities as groups worthy of special consideration. This study identifies new areas of inquiry for NTI and other institutions concerned about the success of African American engineering students. This study has shed light on the reasons that many African American engineering students have elected to study engineering, the resources they consider important to success, and the challenges they encounter when attempting to become integrated members of the engineering community. Developing a better understanding of how African American students respond to support and academic intervention may be as important as understanding metrics such as D, F, W rate and GPA.

Finally, the findings of this study suggest that more than superficial inquiry into African Americans engineering students’ views is required to understand the African
American engineering student experience. A clipboard survey that asks whether African engineering students like the faculty and classes would not capture the rich content reported here. With deep inquiry each study participant identified concerns, which if addressed, might improve the experience for future African American engineering students.

This study has proven to be both an exciting and challenging intellectual journey. The experience has expanded my professional perspective and sparked my interests in directions the research may take in the future. I hope that the work is equally beneficial to universities with African American student populations and that attention applied to this subject will improve access and success for African Americans with interest in engineering.
APPENDIX A: INTERVIEW PROTOCOL FOR STUDY PARTICIPANTS

1. Where are you from? What was your high school like? How well did your high school prepare you for success as an engineering student?

2. When did you make a personal commitment to attend college? Why did you decide to attend college?

3. What role did your family play in your decision to attend college? Which family members played the most significant roles and why?

4. Why did you choose to major in engineering? What does a degree in engineering mean to you?

5. Why did you choose to attend this college/university? If you didn’t attend this institution, where would you have gone and what would you have majored in?

6. How would you describe your transition to college academically and socially?

7. What would you consider your greatest academic challenges during your transition to college?

8. What would you consider your greatest academic strengths during your transition to college?

9. Considering all of your peers in engineering, how would you grade your abilities as a student in comparison to other students in your year? How do you think your peers would rate you? Why?

10. If you compared your abilities as a student to all students (in all majors), how would you grade your abilities in comparison to all students in your year? How do you think your peers would rate you? Why?

11. What have you found most fulfilling about majoring in engineering? Is this consistent with what you expected when you chose the major? How? Why?

12. What have been the greatest challenges in majoring in engineering?

13. What excites you about engineering? Can you share a few examples?

14. What frustrates you about engineering? Can you provide a few examples?
15. Do you have a strong relationship with any one on the faculty of the University? Who? How did you make that connection? Which Department is the faculty associated with?


17. Which classes have you found most difficult/challenging? Why?

18. Which courses have you been most successful in? Why?

19. Which individuals and resources have been most important in your academic support network?

20. Which individuals and resources have been most important in your social support network? Why?

21. When you run into challenges on campus, who you consult with to resolve them? Why? How often?

22. Do you believe that your experiences as an African-American engineering student are different from the experiences of your peers? Why or why not? How?

23. Do you have any academic or social networks that are specific to your experiences as an African-American engineering student? How do those relationships work?

24. If you were to give advice to an African-American student following in your footsteps, what would you tell them is the most important strategy for persisting in engineering?

25. How have your experiences as an engineering student influenced your opinion of the college/university?

26. What do you like most about the college/university? Can you explain? Why?

27. What do you dislike most about the college/university? Can you explain? Why?

28. Is there anything that the engineering department can do that would help you be more successful as an engineering student?
Greetings,

I am a doctoral student in the University Of Pennsylvania Graduate School Of Education and an employee at the Rochester Institute of Technology. My dissertation focuses on African American Engineering student perceptions of persistence. As part of my study, I am looking for opportunities to interview African American Engineering and Engineering Technology students. If you self-identify as an African American Engineering student and are interested in participating in this study, I would like to have a conversation with you about your experiences in engineering and your reasons for choosing to remain in the engineering program.

The commitment requires approximately one hour for the interview. Your confidentiality will be retained throughout the process, and you can participate in a telephone interview if you are on co-op.

If this sounds interesting to you, please let me know as soon as possible. I am glad to answer any questions that you may have about the interview. I look forward to hearing from you, and thank you for your participation.

Best Regards,

Sean T. Bennett
stbennett@post.harvard.edu
(P) 585-475-7852
Title of the Research Study:
African American Student Perceptions of Persistence at a Predominantly White Technical Institution

Protocol Number:

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You are being asked to take part in a research study. This is not a form of treatment or therapy. It is not supposed to detect a disease or find something wrong. Your participation is voluntary, which means you can choose whether or not to participate. If you decide to participate or not to participate there will be no loss of benefits to which you are otherwise entitled. Before you make a decision you will need to know the purpose of the study, the possible risks and benefits of being in the study, and what you will have to do if decide to participate. The research team is going to talk with you about the study and give you this consent document to read. You do not have to make a decision now; you can take the consent document home and share it with friends, a family doctor and family.

If you do not understand what you are reading, do not sign this form. Please ask the researcher to explain anything you do not understand, including any language contained in this form. You may ask to have this form read to you. If you decide to participate, you will be asked to sign this form and a copy will be given to you. Keep this form – in it you will find contact information and answers to questions about the study.
What is the purpose of the study?

The purpose of the study is to learn more about African American students’ perspectives of what is required to persist in engineering programs. As an African American engineering student at the Rochester Institute of Technology, you will be asked to participate in an interview sharing your experiences within your engineering program. This research is being conducted as a requirement for the Executive Doctoral Program at the Graduate School of Education at the University of Pennsylvania.

Why was I asked to participate in the study?

You are being asked to join this study because of your status as an African American student in engineering. This study seeks to inform efforts of engineering programs and university administrators seeking to (1) increase the retention of African American students in engineering and (2) recruit African Americans to undergraduate engineering programs.

How long will I be in the study?

The study will require you to participate in a single one hour interview. The interview will be a private 1:1 discussion.

Where will the study take place?

You will be asked to come to conference room 1120, located in the Ross Building on the campus of the Rochester Institute of Technology or you will complete a phone interview. Interview times will be coordinated to accommodate your course and work schedule(s).

What will I be asked to do?

You will be asked to answer a series of questions that will inform the researcher about your perspective of the academic culture of the engineering program and the program’s commitment to your presence. Additionally, you will be asked to share your perspective on the programs, services, and policies that you consider meaningful for remaining in the program. Interviews will be taped and transcribed, with your permission, and all audio recordings and transcriptions will be kept in a secure location. If you do not feel comfortable being audio recorded, you may decline to be taped. If so, I will take notes instead. Either way, your identity will be protected and a pseudonym will be used. All publications and presentations will ensure your confidentiality. To assure accuracy, you will be provided an opportunity to review a copy of the interview transcription. Transcription should be completed and available within one week of the interview. Please let me know during the interview if you would like to review the transcript. If you decide that you would like to review the transcript after the interview is completed, please contact me at stbennett@post.harvard.edu.

What are the risks?
This research is being completed by an employee of the [redacted]. As a result, there is a risk that you will feel uncomfortable or provide less candid responses. Please rest assured that your responses, and comments, will be held confidential. Pseudonyms will be created to preserve your anonymity and comments that make you individually identifiable will be protected. The primary method of protection will be exclusion from the results of the study. However, there is always some risk that information from the study might be tracked back to the participant. I will attempt to minimize that risk. None of your responses will be held against you. Additionally, you may skip or refuse to answer any questions that make you feel uncomfortable.

How will I benefit from the study?

There is no direct benefit to you from participating in the study. However, your participation could help us understand factors meaningful in the recruitment and retention of African American engineering students, which can benefit you indirectly.

What other choices do I have?

Your alternative to being in the study is to not be in the study.

What happens if I do not choose to join the research study?

You may choose to join the study or you may choose not to join the study. Your participation is voluntary.

There is no penalty if you choose not to join the research study. You will lose no benefits or advantages that would potentially come to you, or would come to you in the future. The researcher will not be upset with your decision.

When is the study over? Can I leave the study before it ends?

The study is expected to end after all participants have completed interviews and all the information has been collected.

You have the right to drop out of the research study at anytime during your participation. There is no penalty for withdrawal from the study. Withdrawal will not interfere with your status or relationships at [redacted].

If you no longer wish to be in the research study, please contact Sean T. Bennett, at stbennett@post.harvard.edu.

How will confidentiality be maintained and my privacy be protected?

As a participant in this study you may request to receive a copy of the summary findings upon completion of this project. Upon your consent, this interview will be audio taped. The audiotape will be transcribed for research purposes, but will never be played for any audience other than the researcher directly involved in this project. Upon completion of this project all audio recordings will be erased.
During the study all notes, recordings, and transcriptions will be retained in a locked and secure office. Participant privacy will be preserved throughout this study. Pseudonyms will be created for all interview subjects and no student names will be used in any reports or publications.

Will I have to pay for anything?

There are no costs associated with your participation in this study.

Will I be paid for being in this study?

There is no compensation for participation in this study.

Who can I call with questions, complaints or concerns about my rights as a research subject?

If you have questions, concerns or complaints regarding your participation in this research study, or if you have any questions about your rights as a research subject, you should speak with the Principal Investigator listed on page one of this form. If a member of the research team cannot be reached or you want to talk to someone other than those working on the study, you may contact the Office of Regulatory Affairs with any question, concerns or complaints at the University of Pennsylvania by calling (215) 898-2614.

As an student, you may also elect to contact the Human Subjects Research Office (HSRO) if you have questions, complaints or concerns about your rights as a research subject. HSRO can be reached by contacting:

Human Subjects Research Office (HSRO)

Mail location:

Office location:
When you sign this document, you are agreeing to take part in this research study. If you have any questions or there is something you do not understand, please ask. You will receive a copy of this consent document.

Signature of Subject

Print Name of Subject


Disruptive technologies may have an economic impact of $33 trillion. (2013, May 23, 2013). Mint, pp. n/a.


