A CLOSER LOOK INTO WHY AFRICAN AMERICAN MEN LEAVE AND AVOID STEM MAJORS IN COLLEGE

by

Ricardo G. Bailey, Jr.

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Approved by:

_____
Dr. Elizabeth Stearns

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Dr. Roslyn A. Mickelson

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Dr. Brett Q. Tempest

ABSTRACT

RICARDO G. BAILEY, JR. A closer look into why African American men leave and avoid STEM majors in college. (Under the direction of DR. ELIZABETH STEARNS)

African American males are underrepresented in university Science Technology Engineering and Math (STEM) programs as STEM majors in the United States. I will be investigating why this phenomenon is so prevalent in America's collegiate STEM programs. For this study, I am asking two questions: 1) What factors lead to African American males' identifying themselves as unqualified, uninterested, or unfit for STEM? 2) Do social oppression and racism play a role in African American males' deciding not to pursue STEM? Using Bronfenbrenner's (1979) five systems (microsystem, mesosystem, exosystem, macrosystem, and chronosystem) that define his Ecological Systems Theory, I examine a dataset of 14 interviews conducted with African American males who are capable of pursuing STEM, but have decided to either leave STEM majors, or avoid them altogether. These students were attending college within the University of North Carolina System in the 2012-2013 school year.

Through the use of constant comparative analysis in examining the interviews, I identified emerging themes and placed those themes into the following categories: "Push Factors Away From Majoring in STEM" and "Pull Factors Toward Non-STEM Majors." My findings indicate that all of the students interviewed experienced institutional racism with regard to their levels of exposure to STEM; as these participants were not exposed to the benefits of STEM careers while in grade school unlike many of their White counterparts. Furthermore, some students also attended segregated, predominately minority grade schools which offered substandard levels of education, leaving some of

these students unprepared for college level STEM courses. These findings support the literature regarding this topic.

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INTRODUCTION

African American men continue to be underrepresented in STEM majors in colleges and universities throughout the country. Historically black colleges and universities (HBCUs) produce the majority of African American STEM graduates; however African American women represent a majority of those who graduate with STEM degrees at HBCUs. In predominately white institutions (PWIs), more African American men than women graduate with STEM degrees (Stone 2008). Since a career in STEM is regarded as one of the most stable and financially rewarding, it is important that people in marginalized groups have an opportunity to succeed in this field. Furthermore, in order for the United States to remain competitive, women and minorities must become proficient in these fields as these are the fastest growing groups in the workforce (Borman, Tyson, and Halperin 2010).

African American male college students graduating with STEM degrees in North Carolina mirror the national profile as they are underrepresented. In the sectors that contain STEM concentrations (agriculture & natural sciences, architecture & environmental design, biological sciences, computer & information systems, engineering, health professions, mathematics, and physical sciences) African American men in North Carolina received 5.1% of these degrees during the 2013-2014 school year (UNC General Administration 2014). Nationally, African American men received 6.2% of all science and engineering degrees awarded in 2012 (Bidwell 2015).

Beyond the college environment, African American men seeking STEM degrees face challenges from weaker secondary school preparation and family, cultural, social, and financial capital that is less able to support them than students from other

backgrounds (Gutstein and Peterson 2013; Gillen 2014). African American men often come from working class or financially poor families that promote achievement in other areas such as sports and entertainment over academic achievement. Despite this, the majority of African American families value education, but because many are surrounded by people who lack human, social, and cultural capital, they are less likely to know people who are successful as a result of academic achievement. For those who do know people who have graduated from college, many of the college graduates they know end up in careers unrelated to their major, are underpaid, underemployed, unhappy in their careers, or unemployed (Fordham and Ogbu 1986; Thompson and Lewis 2005).

Using Bronfenbrenner's (1979) Ecological Systems Theory, I will investigate why African American men choose to either leave or avoid STEM majors. Ecological Systems Theory states that an individual is impacted by his bi-directional interactions with the environment, and correspondingly, the individual influences of his environment. There are five distinct systems in the Ecological Systems Theory. These systems include the microsystem (parents, teachers, friends, or a person's inner circle of significant people), mesosystem (lateral connections between a person's microsystems), exosystem (people who are indirectly involved in a person's development), macrosystem (the extant cultural and economic conditions of the society), and the chronosystem (nested relationships that shift as time changes) (Bronfenbrenner 1977; Leonard 2011). Bronfenbrenner's Ecological Systems Theory is the most effective model in examining why African American men decide to leave or avoid STEM majors because it allows a researcher to explore the multidimensional social influences which affect this groups' ultimate choice of major.

Due to relatively scant research focusing on the lack of African American men as STEM majors, this thesis will attempt to answer questions regarding why this underrepresentation exists. More specifically, this thesis will attempt to answer the following research questions: 1) What factors lead to African American men identifying themselves as unqualified, uninterested, or unfit for STEM? 2) Do social oppression and racism play a role in African American men deciding not to pursue STEM? There are perceived differences in the availability of resources available to African Americans and whites on average that contribute to STEM outcomes (whites tend to have more access to educational resources than African Americans); however there are other lesser explored reasons as to why African American men choose not to major in STEM (Beasley and Fischer 2011; Perry, Moses, Wynne Cortes Jr., and Delpit 2010). This thesis begins to fill these gaps. First, I will summarize Bronfenbrenner's Ecological Systems Theory. I will then discuss the literature explaining why African American men disproportionately avoid and leave STEM majors and relate this literature to Bronfenbrenner's Ecological Systems Theory. Next, I will conduct an analysis of 14 interviews conducted with African American male college students who avoided or left STEM majors. I will conclude with discussing my findings and relating these findings to the themes discussed in the literature review.

ECOLOGICAL SYSTEMS THEORY

Understanding Ecological Systems Theory is important because it gives the researcher a glimpse into how an individual's social environment influences a person's overall development. Ecological Systems Theory states that an individual is impacted by his bi-directional interactions with the environment, and correspondingly the individual influences of his environment. There are five sublevels in Ecological Systems Theory: the microsystem, mesosystem, exosystem, macrosystem, and chronosystem. The microsystem consists of the immediate surroundings of the person (e.g., family, teachers, friends). The microsystem can also be described as a person's inner circle of significant people. The microsystem is the immediate setting which includes the person. For example, microsystems include places such as the classroom, home, or office (Bronfenbrenner (1979). The mesosystem consists of the lateral connections between an individual's various microsystems. It is important to understand mesosystems because most people operate within multiple microsystems. An example of a person's mesosystem could be the link between a student's family (microsystem) and his school teachers (microsystem). The exosystem analyses the social settings indirectly affecting a person's immediate surroundings. For example, a portion of a college student's exosystem consists of the school's dean and university president. The macrosystem looks at the underlying cultural values and customs that affect the individual. For example, a STEM student's macrosystem would be customs and ways of thinking from the students and gatekeepers that contribute to the unwelcoming culture of many STEM programs (Jackson, Jackson, Liles, and Exner 2013). Bronfenbrenner also discussed a chronosystem that explains how settings and their influence can change over a period of

time (Leonard 2011). For example, current relationships among faculty and students in many twenty-first century STEM programs differ from what they were in the 1960s.

Table 1 – Bronfenbrenner's Ecological Systems Theory Structures

Microsystem	Mesosystem	Exosystem	Macrosystem	Chronosystem
Activities, roles, interpersonal relations perceived by the developing person within a given setting. An example would be a student's family. Another example would be a student's peer group.	A system of microsystems; or the lateral connections between microsystems. A student's mesosystem consists of all of a student's microsystems combined such as his family, friends, teachers, peer group, worship group, etc.	One or more settings that indirectly affect a student. For example, a student's exosystem could be his mother's place of work, the actions of the university president, or an older sibling's network of friends.	Consistencies or belief systems within the microsystem, mesosystem, and exosystem. For example, a student's macrosystem could be the unwelcoming nature of many STEM programs at US colleges and universities.	The way in which settings and their influences can change over a period of time. For example, current relationships between students in many twenty-first century STEM programs differ from what they were in the 1960s.

A person's parental microsystem is most likely the most important microsystem when it comes to a person's overall development. Parental levels of education and occupational statuses are directly and positively associated with the African American male's ability to be successful academically. First-generation college students have a different experience in college and lower chances of success. Furthermore, there is a positive correlation between the grade point averages of African American male students and the father's highest academic degree (Pais 2011). Conversely, as female headed households have increased, the academic performances of African American male students have decreased, and in addition, their reading achievements have been shown to be directly and negatively affected by this phenomenon (Madyun and Lee 2010). The correlation between African American males and their father's educational accomplishments showcases the developmental influence of microsystematic relationships (Jackson, Jackson, Liles, and Exner 2009).

Overall, parents with high levels of education tend to value education and encourage academic success among their children. Furthermore, African American male students with supportive microsystems including parents and friends have a better chance at academic success than those who lack these supportive networks (Jackson, Jackson, Liles, and Exner 2013).

Certain individuals however, are able to succeed without these supportive microsystems and these individuals seem to be intrinsically or extrinsically motivated to complete college. Ecological theory suggests that certain characteristics such as force, resource, and demand can possibly explain why certain individuals are able to succeed in college despite having to cope with hostile contextual influences. An example of a force

characteristic is describing someone as "developmentally instigative" (Bronfenbrenner and Morris 1998). Students who are developmentally instigative are able to attend school regularly and complete assignments while students who are considered to be disruptive often showcase behaviors that disrupt academic success (e.g., truancy). Resource characteristics describe innate talents and abilities. For example, students with high levels of intellectual capacity are considered to be less vulnerable to negative outcomes than those who do not possess this attribute. Demand characteristics can be described as attributes that are set and unchanging that provoke or encourage positive or negative contextual interactions. An example of a demand characteristic would be an individual's race or ethnicity.

Bronfenbrenner's Ecological Systems Theory can usefully be applied to the experiences of African American men in STEM fields. The "chilly climate" discussed by Conefrey (2001) is relevant to this discussion because it can also be used to describe the experiences of African American men majoring in STEM. Conefrey (2001) discusses twelve commonly held myths about STEM shared among faculty, staff, and the greater society that serves to discredit the notion that discrimination against women occurs in science and engineering programs. Research shows that these myths about STEM and women cause women to feel unwelcome in STEM. African American male students also feel unwelcome due to these commonly held beliefs about African Americans and STEM amongst the gatekeepers in STEM. Some of the myths Conefrey (2001) discusses include: science is a meritocracy; no changes in curriculum or pedagogy are necessary; challenge and competition are essential to science; boys will be boys; the battle has been won; sticks and stones may break my bones, but words will never hurt me; each

scientist's classroom is his castle; and there are many good reasons why women leave science (Conefrey 2001). As an underrepresented group, similar processes may also affect African American men. These commonly held beliefs amongst many people in STEM fields leave no room for change and essentially disregard any notion that these myths only serve those who are currently the majority of the decision makers and gatekeepers in STEM (Frillman 2011). Engineering schools have historically seen attrition as normal and desirable, so much so that many have developed a "gateway" of courses designed to accelerate the process of attrition for students who are viewed as incapable of succeeding in this field (Frillman 2011). Many of the views of the gatekeepers that contribute to the chilly climate are based on stereotypes and not facts. Given the negative perceptions that many people have about African American men, this type of weeding out process is also extremely detrimental to their success in STEM.

Furthermore, these commonly held assumptions can reflect a disconnect between one or all of the sublevels of economic systems theory (microsystem, mesosystem, macrosystem, exosystem, and chronosystem). If for example, a African American parent feels that his/her son is capable of achieving in STEM, and his professors feel otherwise, then there is a disconnect and a lack of cultural cohesion geared toward the success of this student in STEM. This represents a disconnect between the student's microsystems. Because he has direct contact with his professors and parents, the lack of confidence his professors have in his abilities could negatively affect his success as a STEM major. The mesosystem is reflected through the cross relationships that these professors, peers, and parents have with each other. In this example, it is likely that the parent(s) and faculty are not communicating and because of this, his college professors are not able to see this

student as being successful as a STEM major. The exosystem is represented by those who have an indirect relationship with the student; for example, the dean of the school or the employers of a student's parents. The macrosystem is the cultural and economic conditions of society; which in this case, include the negative attitudes generally held about African American men in a STEM program and the feeling that the "chilly" environment/ "weeding out" culture is appropriate for all students majoring in STEM. In addition, the macrosystem can be used to explain how disadvantaged economic and cultural positions that many African American male STEM majors hail from that do not align with the culture of STEM programs can lead to poor performance and an unwillingness to major or continue in STEM. The chronosystem is the time period in which everything is occurring, which in this case is the time period that an African American male STEM student spends in a STEM program that sees the "chilly climate" as an asset. The nested relationships within a chronosystem however are situated within a specific time period and are subject to change (Bronfenbrenner 1977; Leonard 2011).

In an effort to negate these myths, curricula are being developed so that STEM culture can become more inclusive and sensitive to the needs of women and other marginalized groups. Citing Chesler and Chesler (2002), Frillman (2011) discusses the concept of a social contract for a caring community that is supportive of all members' professional growth and success. Frillman also discusses the notion of collective mentoring, which directly challenges the current form of mentoring that encourages students to become solitary in their studies. What happens in many cases is that new engineers enter the workforce as "competitive loners" who are unprepared to successfully function in the team environments common in the workplace. Frillman (2001) states that this type of mentoring is in conflict with how other groups of people are socialized, and therefore helps to contribute to the chilly environment experienced by those "outliers." Collective mentoring places the responsibility for the creation and well-being of the mentoring team on senior faculty mentors and department heads. Instead of placing sole responsibility on the student for finding a compatible mentor, a network of relationships is formed with the student and this network is what the "mentoring team" consists of. This type of "caring community" mentoring is designed to show the student that their progress is a top priority, which will hopefully increase retention rates amongst all STEM majors, including African American men and women (Frillman 2011). Leonard (2011) would describe this type of learning initiative as a form of cultural cohesion, as all sublevels of the Ecological Systems Theory are changing and lateral connections are being made between a person's multiple microsystems, which in turn creates new

mesosystems. In other words, a new phase would begin with regard to the STEM environment.

The success of historically African American Xavier University has shown that STEM programs encouraging collaboration instead of competition are very successful as this university sends more African American students to medical school than any other college in the country (Jones 2015). Furthermore, the Meyerhoff Scholars Program at The University of Maryland Baltimore County (UMBC) started by university president, Freeman Hrabowski along with philanthropist Robert Meyerhoff is another successful program that encourages collaboration and a supportive culture over competition. The Meyerhoff Scholars Program has led to a marked increase in the numbers of African American and other underrepresented minorities' pursuing advanced degrees in STEM and embarking on research careers in science and engineering (Hrabowski 2015). The Treisman Model approach created by Uri Treisman has also helped to improve the academic performance of African American and Latino students at the University of California at Berkeley. Treisman's model focuses on helping minority students excel in STEM instead of simply avoiding failure. Treisman's model also emphasizes collaborative learning techniques, small-group teaching methods, and faculty sponsorship (Jones 2015; Hrabowski 2015; University of Illinois at Urbana-Champaign 2007).

THE AFRICAN AMERICAN MALE COLLEGE EXPERIENCE

Overall, all college students experience difficulties with transitioning into college. Navigating through financial issues, coursework, and self-identity can be difficult, and this is especially true for African American male college students. These stressors appear to be particularly difficult for African American men attending Predominately White Institutions (PWIs) (Jackson, Jackson, Liles, and Exner 2013; Jett 2011). These stressors can affect all of the ecological sublevels negatively as African American men attending Predominately White Institutions report experiencing condescension, isolation, supervisibilty, and invisibility. African American male students attending PWIs also frequently report pervasive feelings of discomfort, exhaustion, and frustration (Jackson, Jackson, Liles, and Exner 2013; Jett 2011). Despite experiencing these negative emotional states, African American men tend to be reluctant to seek out mental health services and will often deny having mental health issues. African American men at PWIs report experiencing microaggressions in a multitude of social and academic environments. These experiences can permeate everyday life and lead to decreased self-efficacy, increased attrition, and psychological distress. Research suggests that when African American male students are provided with an environment that encourages social involvement and academic achievement their self-esteem improves, levels of ambition increase, cultural pride is strengthened, and a growth in determination occurs (Jackson, Jackson, Liles, and Exner 2013; Jett 2011).

Attempting to balance societal and personal expectations with academic performance can be difficult for African American male college students. This is often because once African American men enter college, their identities begin to change. This

changing identity can lead to an inability for an African American male student to achieve cultural cohesion in all of his microsystems (Bronfenbrenner 1977; Jackson, Jackson, Liles, and Exner 2013; Leonard 2011). In many cases, African American men in college may fail to meet their personal and societal expectations (at home) because many of their peers will see them as "acting white" (Bronfenbrenner 1977; Jackson, Jackson, Liles, and Exner 2013).

The burden of financing an education is often cumbersome and often impedes students from pursuing advanced degrees. African American men often identify financial aid as a main factor in determining which college to attend as they oftentimes come from financially challenged backgrounds (Palmer, Davis, and Hilton 2009). Furthermore, financial constraints are especially present among African Americans working towards doctoral degrees. The financial difficulties associated with attaining doctoral degrees has led to a shortage of African American faculty members who could serve as role models to African American male students (Jackson, Jackson, Liles, and Exner 2013). This is an example of the effect that negative ecological systems, especially exosystems and macrosystems have on the academic outcomes of African American male STEM majors (Leonard 2011).

THE IMPORTANCE OF HISTORICALLY BLACK COLLEGES AND UNIVERSITIES (HBCUs)

HBCUs appear to mitigate the problems associated with the negative ecological environments that African American men often find themselves in as STEM majors. Although HBCUs account for just 1.7% of the total U.S. college enrollment, 20% of African American college graduates earn degrees from these institutions. HBCUs also produce 22% of African American female graduates in STEM and 20% of all African American male graduates in STEM. Furthermore, between 24% and 33% of all African American doctoral recipients earned their undergraduate degrees at HBCUs between 1986 and 2006 (Jett 2011). Jett (2011) conducted a study in which he examined under prepared African American male students attending HBCUs pursuing degrees in STEM. He found that all of his successful subjects cited having supportive structures and mechanisms in place, and in addition, having African American male mathematics professors contributed to their success as mathematics students and as working professionals in the mathematics field. As previously stated, this type of learning environment has led to the success of African American students in institutions such as Xavier University and The University of Maryland Baltimore County (Hrabowski 2015; Jones 2015; and University of Illinois at Urbana-Champaign 2007).

When HBCUs first opened in the late 1800s and early 1900s they helped to address the need for institutions where African Americans could obtain higher levels of education as they were not permitted into other universities due to race. The mission of HBCUs is unique in that they are designed to produce African American leaders and intellectuals. Roebuck and Murty (1993) cited specific goals for HBCUs all of which

centered on producing exceptional African American scholars dedicated to utilizing their talents for improving the conditions of the African American community. These specific goals are as follows: to continue the historical and cultural tradition of teaching and research about the African American condition; to serve the African American community in various leadership roles; to supply an economic function in the African American community; to provide African American role models who examine social political, and economic issues endemic to the African American community; to produce graduates who engage in tackling race related issues in society; and to produce African American scholars who disseminate scholarly research and teaching to the African American community (Jett 2009). Perhaps the self-efficacy generated from these supportive ecological environments explains why so many African American male STEM college graduates hail from HBCUs (Lent, Brown, Sheu, Schmidt, Brenner, Gloster, Wilkins, Schmidt, Lyons, and Treistman 2005).

LACK OF CULTURALLY RESPONSIVE MATHEMATICS EDUCATION

In contrast to HBCU's, predominately white institutions pose additional challenges to African American male students who wish to pursue STEM. These include a lack of African American male professors, being taught STEM from a perspective that does not include the contributions African Americans have made to STEM fields, and negative stereotypes regarding the capacity of African American male students to learn (Jett 2013). Jett (2013) discusses the concept of culturally responsive teaching in mathematics, which is defined as a style of teaching that recognizes and affirms the diverse cultural backgrounds and experiences of students. By recognizing students' experiences and cultural backgrounds, a teacher is able to increase a student's willingness and capacity to learn mathematics as they can see how mathematics applies to them, thereby reducing feelings of alienation. This method of teaching can serve to strengthen the microsystems of African American male students as they will be more willing to foster relationships with their professors since this ecology is designed to help with their ability to see themselves as STEM professionals (Leonard 2011; Wager and Stinson 2012). Traditionally, mathematics is taught within a paradigm that touts the subject as a white male enterprise (Jett 2013). Ideological paradigms and treatises such as the "achievement gap" frame African American students and other students of color as mathematically deficient. Because of this, many pre-service teachers enter America's classrooms with preconceived notions about the mathematical abilities or disabilities of African American students. These preconceived notions are reflected in the poor learning outcomes of these students (Jett 2013).

Jett (2013) describes many of today's math teachers as "identity thieves" as they teach math from a European perspective, leaving out the contributions of African Americans and other people of color. As a result, disadvantaged, non-white students in many cases simply cannot see themselves pursuing STEM careers due to feeling like outsiders. Orr (1987) suggests that mathematics teachers should possess a profound understanding of their students and form real relationships with them. Establishing meaningful relationships with marginalized students and understanding them can lead to feelings of belonging in STEM fields among these students. Having a math teacher who understands a diverse group of students can encourage mathematical lessons using the cultural norms of each group, therefore leading to a greater sense of belonging among these groups in STEM fields, as they are able to apply mathematical lessons to everyday life situations (Gutstein and Peterson 2013; Jett 2013).

Understanding why African American men choose whether not to major in STEM can possibly be explained in part by their childhood experiences in math. Berry (2008) studied eight successful African American male middle school students and five themes emerged that seemed to contribute to their success. These themes included having early educational experiences in mathematics before kindergarten; recognition of abilities, i.e., placing African American students in gifted classrooms and exposing them to advanced mathematics; support systems, i.e., having parents and/or extended family members as examples of mathematics success; alternative identity, i.e., participating in programs or athletics, which promote a strong sense of African American culture; and positive identity, specifically having a strong belief that they can be successful in mathematics (Berry 2008). These themes demonstrate that students surrounded by positive ecological

systems with regard to STEM are more likely to demonstrate a higher level of achievement in STEM (Bronfenbrenner 1977; Leonard 2011).

SCHOOL QUALITY

Many of the schools in America's poorest neighborhoods lack the necessary tools for creating successful students. African Americans disproportionately live in these poor neighborhoods and therefore, a disproportionate number of African American young men attend these schools (Gillen 2014). Thompson and Lewis (2005) conducted a qualitative study on a student who was able to convince his school to offer a precalculus/calculus course as he was concerned that he would not be prepared for college. This study is important because it showcases how the five different aspects of Bronfenbrenner's (1979) Ecological Systems Theory affect an academically talented African American male student with an inclination and interest in STEM (Thompson and Lewis 2005).

Schools segregated by categories such as race, socioeconomic status, and family background perpetuate the problem of separate and unequal schooling. Wealthy students (who are most likely white) often attend schools with the best opportunities for success. Schools in wealthy, majority white communities tend to have the best teachers, the highest levels of social, cultural, and human capital, and an abundance of other resources necessary for academic success. Poor and working class students from diverse backgrounds often attend segregated, substandard schools (Bottia, Giersch, Mickelson, Stearns, and Moller 2016; Card, Mas, Rothstein 2008; Teranishi and Parker 2010). It is from this background that a disproportionate number of African American students come and is a possible indicator of how many African American students will perform in college when compared to those from privileged backgrounds (Stewart, Stewart, and Simmons 2007).

In addition to school segregation, tracking within many schools that are racially integrated creates essentially segregated schools within the same building. African American students in integrated schools are more likely to be placed into less rigorous academic tracks while white students are more likely to be placed into rigorous academic tracks. Students within particular tracks also tend to socialize with each other, so the benefits of having an integrated school are diminished due to high achieving students having an advantage in achieving high levels of social capital, while students in lower tracks have a harder time achieving high levels of social capital as they tend to associate with other low performing students (Lucas 1999; Mickelson 2002). The ideal racial mix for the highest levels of academic achievement for everyone is to have a student body composition between 61% and 90% White and Asian American and between 10% to 39% African American and Hispanic (Mickelson and Heath 1999). Studies show that the best learning environments are those that are diverse, with the most disadvantaged students receiving the greatest benefits. Socially, everyone in a diverse school benefits, and no one is at a disadvantage because they attend schools with students from diverse racial and socioeconomic backgrounds (Bottia, Giersh, Mickelson, Stearns, and Moller 2016).

Role Models

Thompson and Lewis (2005) found that successful college students are more likely to have role models and "socializers." The authors define socializers as being individuals who provide a vision of what they can be and achieve in the social world. The authors describe three types of socializers, passive socializers (those who act out a role and by their presence alone they encourage others to emulate them), active

socializers (those who work to manipulate a student's social world by an intentional act), and image socializers (those who establish an image in the mind of a student to which they can attach a value claim) (Thompson and Lewis 2005).

STEREOTYPE THREAT

Stereotype threat can be prevalent in any and/or all of a person's ecological systems. Stereotype threat states that individuals belonging to stigmatized groups may experience anxiety due to the fear of their behavior confirming to others or to themselves the negative stereotypes associated with their group (Steele 1997). Stereotype threat is complicated as it triggers spotlight anxiety, which in turn inhibits mental tasks by increasing blood pressure and reducing working memory capacity. Furthermore, stereotype threat is associated with students withdrawing from the domain in question in order to defend their self-esteem. By withdrawing, expected or actual threats to one's identity become less important to an individual's self-concept (Beasley and Fischer 2012). With regard to African American male students in STEM, there is a perception that they are not capable of achieving academically. The problem with this is that even if a majority of an African American male student's ecological system sublevels generally have a positive outlook on his chances of succeeding in STEM, the likelihood of his success in STEM is reduced simply because one or more of his ecological systems may harbor negative views regarding African American men as STEM majors (Beasley and Fischer 2012; Leonard 2011).

Stereotype threats are not only explicit but they can be implicitly activated in situations in which the stereotypes are widely known. For example, Inzlicht and Ben-Zeev (2000) conducted a study in which women participating in an exam with mostly men performed significantly worse than those who took the exam with only women. Stereotype threat is more likely to occur when an individual of a disadvantaged group has the skills/abilities to succeed in an area with which the chances of success based on the

stereotype are unlikely when compared to the dominant group. In order to restore feelings of self-confidence, the particular individual(s) within the disadvantaged group, will often become disengaged from the particular domain. This continuous disengagement is a result of repeated experiences of racism/sexism, and these experiences allow a person to detach his/her ego from their performance in that particular domain. Lundy-Wagner (2013) states that during the first year of college, self-confidence and self-efficacy were more important to African American men when compared to African American women when deciding to pursue careers in both STEM and non-STEM fields. Furthermore, when compared to African American women, African American men perceived less social support and more social roadblocks to pursuing STEM (Cuyjet 2006; Lundy-Wagner 2013).

African Americans in America's colleges and universities are especially vulnerable to the effects of stereotype threat, as they are often viewed as being unqualified for college at predominately white institutions. Drawing from the work of Torres and Charles (2004) with undergraduate Ivy League students, Beasley and Fischer (2012) show that a large and consistent number of white undergraduates viewed African American students as being unqualified for college citing affirmative action and/or athletic ability as the top reasons for their being accepted into the university. Furthermore, over 75% of African American students from this study felt that whites believed they were unqualified for college (Beasley and Fischer 2012). African American men are particularly susceptible to stereotype threat due to their underrepresentation on predominately white college campuses, and overrepresentation in athletics (Beasley and Fischer 2012). This study shows that a student's microsystem

(peers) can have a detrimental impact on academic success even if all of the other systems reject these negative stereotypes (Bronfenbrenner 1979; Leonard 2011).

Stereotype Threat and Self-Critical Perfectionism

Rice, Lopez, Richardson, and Stinson (2011) conduct a study of how self-critical perfectionism and stereotype threat serve to compromise success by women and minorities in STEM. Understanding how stereotype threat and self critical perfectionism undermines academic performance is important in attempting to understand why African American men tend not to major in STEM or to attend college at all. This is mainly due to the notion that African American men are afraid of falling into the stereotype of being unsuccessful in STEM; especially if they put forth an effort to achieve a high GPA but are unable to perform on the same level as other students. Rice et al. (2013) discusses the idea of discrepancy, which is the perceived gap between expected performance levels and self-appraisal of an individual's adequacy in meeting expected performance levels. Larger perceived gaps are associated with higher levels of self-critical perfectionism. Generally self-critical perfectionism, and specifically, the discrepancy aspect have consistently been tied to a host of stereotype threat relevant variables such as emotion dysregulation, cognitive test anxiety, dissatisfaction with academic performance, avoidance related achievement goal orientations, and low overall grade point average. The experiences of underrepresentation and its resulting stereotype threats are assumed to increase performance related self-doubts and motivations to avoid failure. Furthermore, underrepresentation can weaken the embracing of mastery goal orientations, which have been linked empirically to continued academic engagement (Rice et al. 2013). This study is an example of how unsupportive ecological systems surrounding underrepresented

students can negatively affect their confidence levels while majoring in STEM (Leonard 2011).

Gender Role Stereotypes in African American Families and their Relation to African American Men Majoring in STEM

STEM is often associated with stereotypically masculine traits such as independence and self-reliance, a stereotype that is more prevalent among whites than with African Americans (O'Brien et al. 2015). African American women are often seen as strong leaders in their households (Abrams, Maxwell, Pope, and Belgrave 2014). African American women are also often subjected to the stereotype of possessing masculine traits (Ashley 2014). Furthermore, studies have shown that African American families often compensate for disadvantages on some resources such as socioeconomic status by imparting women with an excess of other resources such as high work expectations, special gender ideologies, and maternal expectations. In many cases these resources are provided to the women in African American families more so than the men (Ashley 2014). Ecological Systems Theory is applicable in this case because African American women are more likely to have supportive ecological systems with regard to academic achievement than African American men. This in turn leads to increased levels of confidence among African American women when participating in academia, or in this case STEM. On the opposite end of the spectrum the lack of confidence within many African American male students' ecological systems leads to a decreased level of confidence in their ability to succeed in STEM and in other areas of academia (Bronfenbrenner 1977; Leonard 2011).

BENEFITS OF THIS STUDY

It appears that African American men are underrepresented in STEM majors because of problems with racism, stratification, and inequality, which are issues that have plagued America since its inception. Each of these areas greatly affects all five areas of a student's ecological system as the problems of racism, stratification, and inequality permeate every aspect of our society all the way down to the smallest microsystems of all students. Using Bronfenbrenner's Ecological Systems Theory can offer understanding of how racism, stratification, and inequality affect African American male academic outcomes including STEM majors. This literature review suggests that there are a number of social and psychological forces that contribute to the paucity of African American men majoring in STEM. In this thesis, I will attempt to investigate the factors that contribute to African American men in the University of North Carolina System leaving or avoiding majoring in STEM. This study will contribute to the literature because it questions if factors such as racism, stratification, and inequality shape the experiences of African American male STEM students. The findings will be interpreted using Bronfenbrenner's ecological framework.

METHOD

This study draws upon 14 interviews with African American male students who avoided or left STEM majors once they enrolled in one of the 16 campuses of the UNC System. The interview dataset originates from a project led by Elizabeth Stearns, Roslyn Mickelson, Melissa Dancy, and Stephanie Moller in the Department of Sociology at the University of North Carolina at Charlotte (Stearns, Mickelson, Moller, and Bottia 2013). The ROOTS of STEM qualitative data set consists of 317 recorded and professionally transcribed interviews conducted from February 2013 through April 2013 with a racially and ethnically diverse self-selected sample of students who attended all 16 campuses of the University of North Carolina System. The sampling frame of the students interviewed consists of those who graduated from a North Carolina high school after 2004 who were 30 years of age or younger at the time of the interview. Eligible students were also required to have more than 90 credit hours. Of these, 9% are with African American men. African American male participants represented 44 majors with 14 being avoiders or leavers of STEM.

Interviews were conducted by the research team of five PIs, the Senior Researcher, and 10 graduate research assistants. In order to contact the students, online recruitment surveys were sent out to all potentially qualified students in the University of North Carolina System after permission was granted from each institution. The research team then analyzed the responses of each student and all qualified students were organized into three categories: major (students currently majoring in STEM), avoider (students who have never majored in STEM, but had displayed a strong interest or preparation in STEM fields), and leaver (students who were former STEM majors).

Beginning in February 2013 and ending in May 2013 emails were sent to qualified respondents. The emails contained information regarding the details of the interview and that interview participants would be compensated $25. If the emails were not successful, then a series of telephone calls were made to students unable to be reached via email. Once students agreed to an interview, a date and time was scheduled. The research team then conducted 30 – 60 minute interviews with each participant (Stearns, Mickelson, Moller, and Dancy 2013).

When assigning interviews, the research team made a conscious effort to match the gender and/or ethnicity of the interviewer with the interviewee, however this was not always possible. Before an interview could be conducted, each student was given a consent form to read and was given an opportunity to ask questions regarding their understanding of the form. After each student understood the terms of the interview, they then gave their consent. All interviews were recorded utilizing software such as Google Voice, Callnote, Evernote, and Skype. All interviews were confidential and identifying information for each respondent was not mentioned during the interview. Interviews were then uploaded to a confidential Dropbox folder and all interviews were identified by a respondent number, date of the interview, and the interviewer's name (Stearns, Mickelson, Moller, and Dancy, 2013).

Qualitative Analytical Procedures

For this paper, I analyzed interviews from 14 African American male students who are "leavers" (those who once majored in STEM but left), and "avoiders" (those who have the capacity for STEM, but chose a non-STEM major). The students analyzed

in this study had to at least have either average to above average math SAT scores, and/or average to above average high school GPAs (see Table 2). Furthermore, eligible students had to indicate that they expressed an interested in STEM at some point in their lives. The mean age for this sample is 22. The students in this sample had to have attended North Carolina high schools and could not be above the age of thirty.

The percentage of students in this sample attending predominately white institutions is 78.6% while 21.4% of students in this sample attend historically African American colleges and universities (Stearns, Mickelson, Moller, and Bottia 2013). Throughout this analysis, I will be utilizing pseudonyms to identify the respondents. Basic demographic information about the respondents is presented in Table 2.

Table 2 – Respondent information

Pseudonym	Leaver or Avoider	Major	Minor	SAT Math Score Range	H.S. GPA Range	University
Allen	Avoider	Business Management (Concentration: Entrepreneurship)	None	410-500	2.51-3.0	North Carolina A&T
Austin	Leaver	African American Studies	African Studies	610-700	3.01-3.5	UNC Chapel Hill
Brandon	Avoider	Accounting/Finance	None	510-600	3.01-3.5	UNC Charlotte
Christopher	Leaver	Criminal Justice	None	410-500	3.5-4.0	UNC Charlotte
Dante	Avoider	Parks & Recreation	None	610-700	3.51-4.0	North Carolina State
Douglass	Avoider	Management Information Systems	None	610-700	3.51-4.0	Winston-Salem State
Jeffrey	Leaver	Criminal Justice (Concentration: Safety Studies)	None	310-400	3.01-3.5	North Carolina A&T
Kevin	Leaver	Psychology	Chemistry/Biology	510-600	3.51-4.0	UNC Chapel Hill
Louis	Leaver	Sociology	American Studies	510-600	3.51-4.0	UNC Charlotte
Marcus	Avoider	Psychology	Spanish	610-700	3.01-3.5	UNC Greensboro
Robert	Leaver	Music Therapy	None	610-700	3.5-4.0	Appalachian State
Travis	Avoider	Communications (Concentration: Public Relations)	None	510-600	3.01-3.5	UNC Charlotte
Troy	Avoider	Criminal Justice	Software Information Systems	410-500	2.51-3.0	UNC Charlotte
William	Avoider	Sociology/African American Studies	Women's Studies	610-700	3.51-4.0	UNC Chapel Hill

Using the constant comparative approach to data analysis, I utilized the narratives from these interviews to establish themes related to this project (Boeije 2002; Rubin and Rubin 2012). The analysis began with coding the interviews. I then generated initial categories, selected and defined concepts, and compared events relevant to each category. The next phase of this analysis included breaking interview responses into units of information and categorizing applicable units. Following this procedure, I verified each of the categories produced from the first stage by examining the frequency and distribution of concepts, merging categories and phenomena, and triangulating data.

Coding Procedure

I examined each of the 14 interviews of African American men who either avoided or left STEM majors. During my examination, I identified student responses that were key in determining the reasons behind their choices in major. Each of these key responses were placed in thematic categories that fell under one of the five sublevels of Bronfenbrenner's Ecological Systems Theory (microsystem, mesosystem, exosystem, macrosystem, chronosystem) (Bronfenbrenner 1979). Key responses and themes that did not fit under the Ecological Systems Theory were placed in a category identified as "Other Motivations." Themes were determined by examining the interview responses for certain key phrases indicating motivating factors for either leaving or avoiding STEM majors. Multiple key phrases indicating a similar motivating factor to either leave or avoid STEM majors were grouped together into their respective themes. In order for key phrases to be placed together in a theme, a total of at least three had to be found throughout the interviews analyzed.

FINAL PHASES and SIGNIFICANCE of this STUDY

The last phase of this analysis involved interpreting concepts and categories and consolidating this information into findings (Seidman 2013). I used Bronfenbrenner's ecological systems model (microsystem, mesosystem, macrosystem, exosystem, and chronosystem) to interpret the findings. This study is significant because it will increase the amount of literature on the subject of the lack of African American men in STEM. This study is also important because it may increase the level of interest in this topic making it more likely that schools will pour more resources into solving this problem.

FINDINGS

After a thorough examination of all fourteen interviews, several themes emerged. All themes were organized into separate categories including, "Push Factors Away from Majoring in STEM (Pre-College)," "Push Factors Away from Majoring in STEM (College)," "Pull Factors Toward Non-STEM Majors (Pre-College)," and "Pull Factors Toward Non-STEM Majors (College)." Each theme was then categorized into its corresponding ecological system. As Table 3 indicates, there were 10 "Push Factors Away From Majoring in STEM (Pre-College)" themes and 7 "Push Factors Away From Majoring in STEM (College)" themes. Table 4 indicates that there were 2 "Pull Factors Toward Non-STEM (Pre-College)" themes, and 5 "Pull Factors Toward Non-STEM Majors (College)" themes. All of these themes fit into three of Bronfenbrenner's ecological systems including the microsystem, macrosystem, and chronosystem. Other themes that did not fit within the ecological systems framework were placed in the "Other Motivations" category. The chronosystem (time period in which nested relationships occur in a particular setting) is the early twenty-first century. Although Bronfenbrenner's Ecological Systems Theory includes discussion of the mesosystem and exosystem, my findings indicate that the individuals within this dataset had no activity within these two systems.

All of the students who described experiencing racism in their academic careers described forms of institutional racism. Institutional racism is a concept that describes the general practices and customs within a society's institutions that benefit a particular racial group and leave other racial groups at a disadvantage (Murji 2007). Blatant, overt

forms of racism were not mentioned; however, two respondents described incidents in which they experienced microaggressions.

Table 3 - The systems of Ecological Systems Theory & other motivations push factors away from majoring in STEM (frequency of emerging themes)

Pre-College				
	Microsystem	Macrosystem	Chronosystem	Other Motivations
Push Factors Away From Majoring in STEM (Themes)	Bad experiences with STEM teachers - 7	All AP classes in HS were majority female – 8	Relationships between AA male STEM high school students to STEM faculty & peers in the early 21st century	HS science was not enjoyable to the student – 4
	Parents not in STEM careers – 6	Not exposed to STEM careers early in life – 6		
	Student felt out of place in HS STEM classes – 5	Predominately African American HS – 3		
	Unsupportive peers – 4			
	HS science teachers were not engaging – 4			
College				
	Microsystem	Macrosystem	Chronosystem	Other Motivations
Push Factors Away From Majoring in STEM (Themes)	Felt out of place in college STEM classes – 9	College science STEM classes were too difficult for the student – 6	Relationships between AA male STEM college students to STEM faculty & peers in the early 21st century	
	College STEM professors were not engaging – 3	College STEM classes were too large – 4		
		STEM professors/teachers had low expectations of African American male students – 3		
		STEM classes in college were lecture based – 3		

Table 4 - The systems of Ecological Systems Theory & other motivations pull factors toward non-STEM majors (frequency of emerging themes)

Pre-College				
	Microsystem	Macrosystem	Chronosystem	Other Motivations
Pull Factors Toward Non-STEM Majors (Themes)			Relationships between AA male STEM high school students to STEM faculty & peers in the early 21st century	Career aspirations in a non-STEM field – 6
College				
	Microsystem	Macrosystem	Chronosystem	Other Motivations
Pull Factors Toward Non-STEM Majors (Themes)	Student feels as if he belongs & fits in among his peers in the non-STEM major – 11	Non-STEM majors had more African Americans (more diverse) – 3	Relationships between AA male STEM college students to STEM faculty & peers in the early 21st century	Student enjoys/is passionate about non-STEM majors – 8
	Better experiences with professors in non-STEM majors – 6			

Push Factors Away From Majoring in STEM - Pre-College
Microsystem
(Table 3)

The most commonly found theme in the category of "Push Factors Away from Majoring in STEM" is the "Bad experiences with STEM teachers" theme with seven respondents. Allen, a business management major at North Carolina A&T states the following about his experiences with some of his high school math teachers by saying "...in some of my math classes some of the teachers didn't really enjoy teaching math and their kinda sluggish ways and attitudes toward math pushed off on us a little bit." Allen goes on to say the following about his math teachers during his senior year in high school:

> I had instances in high school where teachers basically quit on us like a month before and into the school year and so we didn't have a teacher the whole year and I kinda felt that I was lost when I got to college that I really didn't learn anything in math. I passed the classes but really didn't learn anything like we should've learned if we would have had that teacher the whole year of course. When I stepped into [North Carolina] A&T, I saw where that year kinda hurt me a little bit, so I had to kind of start over from scratch [once] I saw that, it kind of impacted me... (Allen, Business Management Major at North Carolina A&T)."

Marcus (avoider), a psychology major described his 10th grade biology class as follows:

> My 10th grade Biology teacher she wanted to be I believe a physician's assistant and she said she didn't get the job so she just became a Biology teacher and so I felt on the first day of class like I just got the short end of the stick. Chemistry was interesting then my teacher got pregnant about a month and half into the—maybe 2 months into the semester and then she went home for the rest of the semester and didn't come back. Then we kinda got this guy who was retired that was teaching science—teaching Chemistry and that was—the point and everything he was saying was all misleading (Marcus, Psychology Major at UNC Chapel Hill).

Allen and Marcus feel that because they attended high schools that did not have dedicated teachers and a rigorous curriculum, they were academically unprepared for college.

Within the microsystem of this category, the theme with the second largest number of respondents is the "Parents Not in STEM Careers" theme with six respondents making statements related to this theme. Both of Marcus' (Psychology Major at UNC Greensboro) parents are veterans who worked in the Army in non-STEM fields, Allen's (Business Management Major at North Carolina A&T) parents never attended college, and Jeffrey's (Criminal Justice Major at North Carolina A&T) father is also a veteran. Jeffrey never mentioned his mother's occupation, Austin's (African American Studies Major at UNC Chapel Hill) mother is an educator but his father's occupation was never mentioned. Brandon (Accounting/Finance Double Major at UNC Charlotte) has uncles who are engineers; however his parents are not in STEM careers. Last, Dante (Parks and Recreation Major at North Carolina State University) states that his mother is an accountant, but does not mention his father's occupation. Dante simply states that, "Both of my parents weren't involved in science at all so…it just never occurred to me."

Allen (STEM avoider), a business management major describes his feelings about not having parents who attended college and are not knowledgeable about opportunities in STEM fields:

> I'm not trying to be racist but just saying how society is, a lot of times the Caucasian people kind know about college, [they] kinda know about those opportunities and stuff like that and with a lot of the African American people I went to school with [they] really didn't have an opportunity and weren't used to [the idea of attending college]…More than likely my Caucasian friends had parents that went to college whereas, I didn't have parents who went to college and stuff like that, so a lot times I would have to learn to network and meet people and find things [about college] on my own but [attending college] was already kind of enforced in them (white students) (Allen, Business Management Major, North Carolina A&T).

Allen feels that more often than not, White students are advantaged over African American students with regard to the benefits of attending college due to having parents

who attended college. Allen feels that because White students often have parents who attended college, they have more social capital, whereas Allen has to work harder to network with others while in college in an effort to raise his social capital (Harper 2012).

None of the other respondents mentioned anything about their parents' working in STEM occupations. Thompson and Lewis (2005) found that students who have role models are more likely to succeed in college. Jett (2013) found that many African American students cannot see themselves as STEM professionals due to a lack of African American role models working in STEM. Jett (2013) also cites that STEM subjects are taught in ways that center around the contributions of White men, which further alienates African American students and other disadvantaged students of color.

The "Unsupportive Peers" and "HS Science Teachers Were Not Engaging" themes each had four mentions from the participants interviewed. With regard to the "Unsupportive Peers" theme, Troy, a Criminal Justice major at UNC Charlotte in response to the interviewer's question regarding support from his peers in high school stated that, "um… they… they did not really care, um… yeah we didn't really talk about courses, like math or science and what not." The interviewer then asked Troy if he ever studied science and math with his high school peers and he responded by saying, "Um… not at all."

With regard to the "High School Science Teachers Were Not Engaging" theme, respondents stated that most science classes were lecture based and did not incorporate hands-on techniques. Every participant identified themselves as hands-on learners and four respondents described how some of their high school science classes went against

their hands-on learning styles. Dante, a Parks and Recreation Major at North Carolina State describes his high school biology class as such:

> Biology always seemed so boring to me…I would fall asleep. The teacher would just sit there and read out of a book. We didn't really ever do anything fun. Not a good class…Pretty much, yeah, just read out of the book. We did a lot of the exercises out of the book. It was ridiculous… My biology teacher, you could tell she didn't want to teach that class. I believe she was forced to teach that class. She was actually hired to be an anatomy teacher. It was a freshman class and she had to teach it. She took the simple approach, bookwork, reading out of a book. (Dante, Parks and Recreation Major - North Carolina State).

In this statement, Dante points out the lack of focus that many STEM teachers place on making these subjects interesting and relatable to their students. Jett (2013) discusses this issue and uses the term "identity thieves" to describe today's STEM teachers as he believes that African American and other disadvantaged students of color have "natural mathematical identities" which are "stolen" from these students as STEM subjects are taught in ways that don't include the contributions of people of color.

With regard to the "Student Felt Out of Place in HS STEM Classes" theme, respondents stated that they felt out of place with regard to their lack of interest in STEM when compared to other students in the class and/or race. Brandon, an Accounting and Finance double major at UNC Charlotte describes his feelings with regard to feeling out of place in his high school science and math classes:

> I think I may have felt out of place just because there were students in there that you could tell really had a passion for the class… I was just trying to kind of finish it because I knew I had to for high school and to get to college. So, I feel like…I may have been out of place…not as if I was at a magnet school though. So, I mean I know if I was in a magnet school for sciences and math I would definitely feel out of place. (Brandon, Accounting and Finance double major - UNC Charlotte).

With regard to feeling out of place racially and ethnically, Travis states that as the only African American student in his high school STEM courses, he experienced microagressions such as the following:

> There were a couple of times in courses where people would make…certain jokes. And they [were] lighthearted and I don't think there was anything where someone was trying to be malicious. And even if they were, I am not the type of person to really get caught up on things like that. But there would be times where you would kind of feel like there was like an awkward shift…I don't know how to explain it. Like there would be problems that you would discuss…If we discussed…certain diseases that are more prevalent in one race over the other such as high blood pressure and diabetes being higher in African-Americans…there would be…certain jokes around that. I know one time someone had joked about five chickens and…certain things that were offensive…in terms of how it would be received….I don't think it was meant to actually hurt anybody because we were all very cordial to each other but those things kind of made it to where you were always—those sometimes unrelated and sometimes unrelated jokes would make you feel like your definitely—while you feel like you are kind of just blending in you are definitely noticed…as the oddball in the class if that makes sense. So, that would make it sometimes uncomfortable because…you are the black person in the class. You don't necessarily want to have to be reminded that you are the black person in the class. (Travis, Communications Major - UNC Charlotte).

In this statement, Travis reveals that in his high school STEM courses, non-African American students would make jokes about African Americans with regard to class discussions about diseases more prevalent in this ethnic group. Because Travis was the only African American in his high school STEM courses, being in this environment would make him uncomfortable.

Push Factors Away From Majoring in STEM – Pre-College - Macrosystem (Table 3)

The largest theme in this category of push factors was the "All AP Classes in HS were Majority Female" theme with eight respondents making this observation. This observation was more pronounced in schools with majority African American student bodies. Louis described his school as being a majority African American college prep school in which all of the classes were either honors or IB (International Baccalaureate)

classes. In Louis' school, however, the proportion of males to females was unusually skewed. Louis states, "I would have to say over about 80% or more were female in each class." O'Brien, Blodorn, Adams, Garcia, and Hammer (2015) add that a large number of African American families expect women to be independent and self-reliant, which are traits of exceptional students. In many cases, African American women are expected to be more independent and self-reliant than African American men as they are seen as leaders in the home. These high expectations of African American women in the family are reflected in the successes of African American women in academia (Abrams, Maxwell, Pope, and Belgrave 2014; Ashley 2014). In addition, African American women are more likely to have supportive ecological structures in place because they are expected to perform at high levels in all areas of life including academia, whereas African American men are held to lower standards (Ashley 2014).

The "Not Exposed to STEM Careers Early in Life" theme of the "Push Factors Away From Majoring in STEM" category had mentions from six respondents. All six respondents stated that they would probably be interested in STEM as a career if they were exposed to it early; however Dante had the most to say with regard to this category. Dante states:

> I got kind of a lot I can say about that. I guess me and my friends, I don't know how to explain it. I guess the exposure to it. When I was young I wasn't really exposed to it, especially the science as much. It wasn't really my parents, maybe society. Anything to do with sports was what I did, who I was. Accounting a little through my mom, other than that, I wasn't really exposed to science. Besides what you learned in school. I mean you went home and other places...I mean parks and recreation I was around that all my life. Business, I heard about that. The less flashy, appealing things, science. If you asked me who the top ten scientists were I couldn't tell you that. If you ask people the top ten stars, yes. I feel that they're not exactly exposed. I feel that's one of the biggest contributors to that area. (Dante, Parks and Recreation Major - North Carolina State).

Dante explains to the interviewer that he was not exposed to STEM because no one he knew was in the field. Furthermore, the schools he attended did not inform him of the benefits of a STEM career. Dante chose a career based on what he was exposed to through his mother and society's depictions of what a successful African American male looks like (Thompson and Lewis 2005).

The next largest theme in the macrosystem of this category was the "Predominately African American High School" theme with three respondents. Three respondents (Kevin and William) mentioned that they attended majority African American high schools. Louis and William attended college prep high schools so all of the students had to take advanced classes (honors, International Baccalaureate, and Advanced Placement). Despite this, in response to a question posed to him about which academic track he took in high school William stated:

> I guess the AP track. We only had [a few AP classes]...because our class was the first graduating class. They had just opened the school and so every year they would kind of add more so I think they encouraged everyone to take at least one AP class but I think I ended up taking more than anybody. (William, Sociology/African American Studies Double Major – UNC Chapel Hill).

Kevin stated that in his school, students were not able to take Advanced Placement classes until Junior year and when describing his experience in his AP Calculus class and other AP classes, he states, "I think in some of the AP classes, I was the only one or one of the few ones who got, like, what a three on there or passed the exam. So I was, like, one of the students who actually did well in the class." Kevin also added that although his high school was 80% African American, his AP classes were only about 50% African American. Gutstein and Peterson (2013) found that segregated, predominately African American schools often offer students a substandard education, due to a lack of resources necessary for academic success. Mickelson (2002) and Lucas (1999) found that in

integrated schools, African American students (especially males) are disproportionately placed in low level academic tracks, and that White students (even those with equal abilities as African American students in low level tracks) are more likely to be placed in academic tracks that are more rigorous.

Push Factors Away From Majoring in STEM – College -Microsystem (Table 3)

The largest theme that emerged within this category of college-level push factors away from STEM was the "Felt out of place in college STEM classes" theme which had nine respondents mentioning experiences related to this theme. Kevin (leaver), a Psychology major at UNC Chapel Hill (and former biology major) described the African American segment of the Psychology department as "really low…there is 10% maybe." When asked about the amount of African American students in the Biology department he states, "it's even less, I would say." When asked about the African American portion of the Biology department in comparison to other minorities, Kevin states that the department has, "…fewer African Americans." As a Biology major, Kevin stated that although most of the students in the biology department were White, "most of the people I study with are Indian or mostly Asian of some sort."

Louis (leaver), a sociology major (formerly biology major) at UNC Charlotte describes his experiences as a biology major below:

> Well my peers that I worked with saw that um I've had a lot of struggles with biology and they have expressed that biology wasn't a course that was well suited for me…A lot of them seemed to be either really stressed out at times or seemed to be [know it alls] like they knew more than everyone else in the class like when you would talk to them it felt like you couldn't really approach them because they would kind of like sum you up, if that makes sense…Well I guess it was more so my level of ability and certain subjects or concepts I didn't have a good grasp on and so it was really hard to figure out what students I could like or which one of my peers I could really turn to for help. Getting some one on one help or forming study groups

> without running into like certain students who were not as interested in helping you out [was difficult]…they kind of patronized some of the other students as well (Louis, Sociology Major at UNC Charlotte) .

Marcus, a STEM avoider and Psychology major described his experience in his college math and science classes as follows:

> There were some days when that course content was a little [difficult]—it was a little challenging. I would tell myself, well I'm still in the add and drop [period] so I could still drop a couple classes. So there were some days where I felt like I didn't exactly fit [in], but being that I did have moments where I did understand, I feel the majority of the time I did get it. [But] even with that there were a couple of classes I didn't really understand that were really challenging (Marcus, Psychology Major at UNC Greensboro).

Marcus is stating that he did not understand the material and that is why he felt as if he did not belong in his math and science classes in college. In many schools, STEM courses are designed to weed students out as the environment in many of these departments is cold and unforgiving, especially to African Americans and other minority groups (Frillman 2011; Jett 2013).

The next theme that emerged was the "College STEM Professors Were Not Engaging" theme with three respondents. Marcus (STEM avoider), a Psychology major at UNC Greensboro who describes himself as a hands-on learner was asked about whether his college science professors cared about his learning of the material and their level of engagement with students and his response is as follows:

> A few of them did. Some [of] them seemed to be just a little disconnected but they were connected to the subject but not so much the classroom but that was fine I mean I expect to have a couple of [unclear] in college…But the majority of the teachers they were really good teachers but whenever it came to interacting with students they just seemed a little—a little more robotic…I think most of them encouraged students to ask questions mid-lecture and as we went through the material but for the most part they lectured for most of class because they had so much to cover and so little time they were given in the semester and I think that meant it was—I think it was pretty successful…I think I probably wouldn't have benefited from a different

> approach from—that maybe wouldn't have affected me with the material but as for learning it the method that they had worked but it didn't make the class stick out any more than the next class did (Marcus, Psychology Major, UNC Greensboro).

Orr (1987) suggests that it is best for teachers to understand and develop meaningful relationships with marginalized students in order to engage them in the material. Jett (2013) finds that once a teacher understands diverse groups of students, he/she can develop lesson plans that allow the students to see how STEM applies to their daily lives. This in turn, increases a student's ability to see themselves as future STEM professionals (Gutstein and Peterson 2013).

Furthermore, the only two respondents (Kevin and Troy) who minored in STEM subjects were those who had connections with African-American men in their microsystems already working in STEM fields. Kevin, a senior Psychology major at UNC Chapel Hill who is of recent African origin (Ghanaian descent) developed camaraderie with his high school math teacher who is also of recent African origin (Togolese descent) minors in Chemistry and Biology. Troy, a senior Criminal Justice major minoring in Software Information Systems at UNC Charlotte has friends in his microsystem who work in STEM fields. Many of these friends work in IT without IT degrees, and Troy has decided to do the same thing since he already works in the IT Department at UNC Charlotte.

Push Factors Away From Majoring in STEM – College - Macrosystem (Table 3)

The largest theme within the macrosystem of the "Push Factors Away From STEM" category is the "College science STEM classes were too difficult" theme with six respondents. Austin, when asked about why he switched from Biology to African American Studies stated that it was due to "academic difficulty." Kevin, a Psychology

major and STEM leaver who now minors in Chemistry and Biology responded to a question asking him about his interest level in science increasing or decreasing since entering college and he responds by stating, "Again, I'm going to have to say my [interest level] increased although the classes are harder. I've learned a lot about human anatomy and physiology, and I've taken organic chemistry now, and it's fascinating stuff, although it's really tough..." Troy, a criminal justice major and an "avoider" of majoring in STEM stated the following when asked (at the end of the interview) if he wanted to add any additional comments relating to his reasons for avoiding STEM:

> Well, I did want to let you know [that], software information systems, like, all... computing and infomatics [subjects] [have] weed out courses.... And I feel like they make [their introductory] courses extra hard to weed people out like C++ and Java (Troy, Criminal Justice Major at UNC Charlotte).

Troy feels that his software information systems course is a course that encourages attrition from the Computer Information Systems major. This is indicative of the work of Frillman (2011), which shows that many collegiate STEM departments find this type of "weeding out" as desirable. Having prerequisite courses that encourage attrition helps to eliminate students who are perceived as incapable of succeeding in STEM (Frillman 2011).

The second largest theme within this macrosystem is the "College STEM classes were too large" with four respondents mentioning this as a STEM deterrent. Austin, a senior African American studies major at UNC Chapel Hill (STEM leaver) described his classroom as follows:

> ...Our class was a lecture of about 300-400 people and having a much larger lecture professor I never attended office hours. [Not going to the professor's office hours] was one of my regrets that I do have from the class, but the actual classroom setup for lectures was not very entertaining. They didn't keep me engaged in the material (Austin, African American Studies major at UNC Chapel Hill).

Austin is saying that his biology class was simply too large; and it was difficult to establish any kind of meaningful connection with his professor. It was this type of environment that contributed to Austin's decision to leave STEM for an African American Studies program. This is another example of a marginalized student feeling disconnected to his STEM professor and STEM as a whole. This example indicates that students enjoy STEM classes that are engaging due to a teaching style that allows them to see themselves as STEM professionals (Gutstein and Peterson 2013; Orr 1987).

The next largest theme in the macrosystem of the "College push factors away from majoring in STEM" category is the "STEM classes were lecture based" theme with three respondents mentioning this as a STEM deterrent. In the quote above, Allen states what the other participants mentioned by stating that his freshman biology class was not engaging for him due to the lecture based format.

The fourth largest theme in the macrosystem of the "College push factors away from majoring in STEM category is the "STEM professors/teachers had low expectations of African American students" theme with three respondents. Austin, a STEM leaver from UNC Chapel Hill described another experience in his biology class as follows:

> I do believe my biology teacher actually thought less of me and my abilities to perform in the setting…well it was just the nature of a conversation that a student that sat beside me in the classroom had. We both took the course at the same time and he, this student, as well was an African-American student and when he went to her office hours to talk to the professor about his grades and his questions of how he did in the course he received the grade of a C and she told him that that was a good grade for someone like him and I guess somewhat of a like racial attitude towards [him] possibly so that was just my personal outlook on the situation (Austin, African American Studies Major at UNC Chapel Hill).

Austin feels that his former biology professor believes the negative stereotype of African Americans not being capable of succeeding in STEM. When marginalized students feel as if the gatekeepers in their program view them as incapable of succeeding, these students are less likely to succeed (Beasley and Fisher 2012; Leonard 2011).

Pull Factors Toward Non-STEM Majors (Frequency of Emerging Themes)
Pre-College – Other Motivations (Table 4)

At the same time that respondents felt pushed out of STEM, they also frequently felt pulled toward non-STEM fields. The emerging theme in the "Other Motivations" section of the "Pull Factors Toward Non-STEM Majors" category is the "Career aspirations in a non-STEM field" with six respondents. Jeffrey, a STEM "leaver" majoring in criminal justice at UNC Charlotte stated how his aspirations to work in law enforcement began in the following statement:

> Growing up in an impoverished environment, you know, I saw a lot of crime, and I've been the victim of certain crimes before, so that impacted my decision the most, and also influences by my father. He's a retired veteran from the military. He was in the army. So that had a little bit…to do [with my choice of major], but mostly, my surrounding environment and knowing a lot of victims of crime; that really impacted my decision to be in law enforcement (Jeffrey, Criminal Justice Major at North Carolina A&T).

Jeffrey feels that his experiences growing up in an impoverished, high crime area influenced his decision to pursue a career in criminal justice.

Pull Factors Toward Non-STEM Majors (Frequency of Emerging Themes)
College - Microsystem (Table 4)

The largest theme that emerged in the "Pull Factors Toward Non-STEM Majors" category is the "Student feels as if he belongs and fits in among peers in the non-STEM major" with eleven responses. Christopher (STEM leaver formerly computer science), feels that he fits in with his peers as a criminal justice major. Christopher claims that, "I

met friends in that major [criminal justice], but all my friends did that major [computer science] as well… a lot of my closest friends are in either one of those two majors [computer science and/or criminal justice]." Dante (STEM avoider) imparts the following in response to a questions regarding how often he socializes with students in the Parks and Recreation major:

> [I socialize with them] daily. Three of my best friends are [parks and recreation] majors. We're so...parks and recreation...the college of natural resources is so secluded from the main campus. Truth is I have more classes, from 8:30 until I get out at 3:00. I'm pretty much there all day. I am there on that side in that area. Most of us, you know the parks and recreation people are all pretty friendly, all talkative. We're so secluded from the main campus, so that's who your friends are (Dante, Parks and Recreation Major at North Carolina State University).

The next largest theme that emerged in the microsystem of this category was the "Better experiences with professors in non-STEM majors" theme with six responses. Troy, (STEM avoider) described the faculty in the criminal justice department at UNC Charlotte as follows:

> …A lot of them [criminal justice professors] will just bend over backwards…for you… like, it's just amazing... like, I'll have to say…a lot of them are also advisors…you could just stop by anytime, they're always there for you, it…was just amazing (Troy, Criminal Justice Major at UNC Charlotte).

Austin (STEM leaver, former Biology major), describes his interactions with his professors in the African American Studies department and UNC Chapel Hill as follows:

> I feel like I'm where I should be in my major because [of] the [positive] feedback I've gotten from my work with my professors and just getting more involved with them and talking to them more. They are very supportive of me and…my work and I would say I feel somewhat at home in my current major (Austin, African American Studies Major at UNC Chapel Hill).

Pull Factors Toward Non-STEM Majors (Frequency of Emerging Themes)
College - Macrosystem (Table 4)

The emerging theme in the macrosystem of this category is the "Non-STEM majors had more African Americans (more diverse)" theme with three respondents. Christopher, a STEM leaver states the following in response to a question regarding the racial composition of his criminal justice program, "depending on some of the classes I've taken, I'd say it's probably 50/50 [50% African American and 50% White]." In his former computer science program, Christopher states the following in response to a question about the racial composition of his computer science classes, "…Probably 30 percent...30 or 40 [percent African American]." When asked about the diversity of the Parks and Recreation program compared to other programs at North Carolina State Dante, a STEM avoider who considered majoring in engineering states the following:

> …Compared to the rest of the campus, it's [Parks and Recreation Major] about average, maybe a little below. It's maybe...I'd say it's about average…Compared to sports management, the ratio [of African Americans to Whites] is a lot higher or more equal. The humanities are more equal [racially], business is a lot more equal [racially]. It's not terrible like engineering, it's slightly below average. [Engineering is]…one of the worst, one of the least...diverse (Dante, Parks and Recreation Major at North Carolina State University).

Dante feels that there is a good amount of diversity among majors such as Parks and Recreation and the Humanities. Engineering however, according to Dante is one of the least diverse majors at his university.

Pull Factors Toward Non-STEM Majors (Other Motivations) College – (Table 4)

The emerging theme that emerged in the "Other Motivations" category is the "Student enjoys/is passionate about non-STEM majors" with eight respondents. Robert (STEM leaver, former computer science major) stated the following about choosing a

major his parents approved vs. choosing a major he was passionate about in the following passage:

> Well, originally when I was applying to colleges, my parents kind of kept rehashing the idea of doing something that was going to be financially stable for me in the future. So I kind of felt like I had to pursue a science-oriented field like computer science, which I was a computer science major for like one semester until I switched. But I always have been involved in music in high school. I've been playing [music] since I was in sixth grade. It was always something I really loved to do, and also I knew that my nature is that I enjoy helping people in just any way I can. I looked into music majors, options for music majors, and I knew I couldn't be a teacher. I'm just not cut out to teach, so that took that out of the equation. And then, I didn't want to be a performance major because it's hard to really make it as a performance major unless you're incredibly talented, and the only other two options that I noticed were Music Therapy and Music Industry that were offered here at Appalachian State. And so I had a friend that I went to high school with that...that got in the program...so I kind of talked to her a little bit about it. So my first semester my freshman year, I took the intro class that anyone can take without actually having to be a major to see if it was something I was interested in, and I fell in love with it, and so I decided that was what I wanted to do (Robert, Music Therapy Major at Appalachian State University).

In this statement, Robert decided to leave the Computer Science major to pursue Music Therapy due to the passion he developed for music during his childhood and adolescent years. Robert feels that he can use his passion for music to help others.

Marcus (STEM "avoider"), a senior Psychology major and Spanish minor at UNC Greensboro states that in the eighth grade, an experience with a school bully influenced his major/career choice. He continued by stating:

> I was in a home economics class and there was this young man who every day I would say anything he would always tell me shut up stupid, stop talking shut up and it got to the point where it was irritating more than offensive so jokingly I said why is it that you continue to call me stupid and tell me to shut up whenever I'm clearly not stupid and whatever I have to say actually has substance, is there—do I threaten you, do you have any problems from your childhood that affects the way your perceive me as a person and then after that he didn't really say much else he was like oh this kid is smart and so then I heard from someone that there were people who tried to help people work through their problems in their childhood and on through life. I found out they were Psychologists and I said yes that's what I wanna do and it's been the same every since (Marcus, Psychology Major - UNC Greensboro).

Marcus' passion for Psychology began after confronting a childhood bully.

Respondents' Feelings about Having More African American Women in Academic Settings than African American Men

Many of the respondents stated that of the African American students in their academic settings, the majority of these students were African American females. African American females were always the majority (sometimes overwhelmingly) of African American students in advanced level high school courses and college courses especially at predominately African American high schools and HBCUs. Despite this, none of the respondents stated that this phenomenon had a negative impact on their academic abilities. Travis (Communications major, STEM avoider) stated that he feels more comfortable studying with female students. Travis states the following:

"…A lot of the people I studied with in high school were female because they were just doing better in the courses and I felt like girls were always more organized. They took better notes and they were just better (laughter)…"

African American families demand a high level of success from women, many times even more than men. African American families often provide the ecological framework for women to be independent and self-reliant because they are seen as leaders in the family (O'Brien et al. 2015). These traits (independence and self-reliance), which are more likely to be considered to be masculine among White families in the United States are not gender specific traits in the African American community. This could possibly explain the gap between African American women and African American men with regard to academic achievement (African American women are outpacing African American men with regard to earning college degrees) (Frillman 2011).

DISCUSSION

Before beginning my research, I expected that the reasons why African American men decided to leave and avoid STEM majors would be complicated. Because of this, I found Bronfenbrenner's Ecological System's Theory to be the most effective model as it allows a researcher to explore the multidimensional social influences which affect the college major choices of African American male college students.

My first research question asked, "What factors lead to African American men identifying themselves as unqualified, uninterested, or unfit for STEM?" It appears that several factors led to the choice to either leave or avoid STEM. When the participants were asked about their confidence levels with regard to their abilities to succeed in STEM, all stated that they have the capability to succeed in STEM if they so desired. However, only two respondents (Kevin and Troy) minored in STEM subjects while majoring in non-STEM subjects. So what happened? It appears that a variety of factors, including segregated schooling, poor academic preparation, a lack of role models working in STEM fields in their social circles, and the appeal of non-STEM subjects combined, led the African American men in this study to major in non-STEM subjects.

Segregated schools have long been a problem in American society. These schools tend to leave African American children at a disadvantage as these schools are often substandard and lack the basic necessities required for academic success. Conversely, predominately White, wealthy schools usually have all of the necessities required for their students to excel academically (Gillen 2014; Thompson and Lewis 2005). Furthermore, even in integrated schools, tracking perpetuates unequal academic outcomes for African Americans and other disadvantaged people of color when

compared to White students. African American students, especially males are disproportionately placed in lower, less rigorous academic tracks, while White students are more likely to be placed in more rigorous academic tracks (Lucas 1999; Mickelson 2002).

Because African American students are more likely to attend segregated and substandard schools that engage in academic tracking than other groups, at the time of graduation, many are unprepared for college, especially college STEM programs (Thompson and Lewis 2005). In addition to being academically unprepared, many African American students are faced with faculty members and students in STEM programs who feel as if they do not belong. These hostile macrosystems breed an expectation of failure from African American students due to negative stereotypes about the learning capacities of African American students (Beasley and Fisher 2012). For too many African American male students, the challenges they have to face while majoring in STEM programs contribute to their underrepresentation in STEM programs (Rice et al. 2011).

STEM careers are less likely to appeal to African American male students for many reasons; however one of the main reasons is that there are not many role models for them to look up to for guidance (Thompson and Lewis 2005). Furthermore, school systems do not discuss the contributions of African Americans in STEM throughout history nor do they teach it in a way in which African Americans and other disadvantaged people of color can feel welcomed in these fields (Jett 2013). The only two students in this study who minored in STEM subjects while pursuing non-STEM majors (Kevin and Troy) had African American men within their microsystems working in STEM careers.

All of the respondents stated that they are hands-on learners and did not enjoy most of their STEM classes because they were lecture based. All of the respondents stated that they enjoyed STEM classes that allowed them to apply the skills learned to "real life" situations. Instructors who were able to capitalize on the natural inclinations of these students were able to engage them, as they were able to see themselves as a part of these subject areas as opposed to being outsiders, thereby developing or redeveloping their STEM identities (Gutstein and Peterson 2013; Jett 2013).

My second research question asks, "Do social oppression and racism play a role in African American men deciding not to pursue STEM?" Instead of overt racism, the students appear to have experienced forms of institutional racism (Murji 2007), which would fall into Bronfenbrenner's (1979) macrosystem. All of the fourteen respondents took Advanced Placement courses, or knew African American students taking Advanced Placement courses in high school, in schools with significant numbers of African Americans within the student body. With the exception of students who attended majority African American high schools, all of the Advanced Placement STEM courses taken by the respondents had African American students being underrepresented when compared to their actual percentage of the entire student body. It also appears that for those who attended majority African American schools, students were less likely to know about their career options in STEM as there were not any programs that told students about career options and none of these students had parents who worked in STEM.

Limitations of this Study

Some limitations of this study include the small sample size, the historical nature of this study, and the self-selected sample. The sample also is not representative because it only includes schools in the University of North Carolina System and of these schools five are HBCU's (North Carolina A&T State University, Winston-Salem State University, Elizabeth City State University, North Carolina Central University, and Fayetteville State University). The historical nature of this study does not allow for the continuous tracking of African American men leaving or avoiding STEM majors in the years following the 2012-2013 school year. It also does not allow for the tracking of the participants' progress throughout their lives to see if they decide to pursue STEM careers in the future. The self-selected sample could be inaccurate because, only students who were motivated to participate in this study were interviewed. This in turn, could mean that the sample has a bias and is not truly representative of African American men leaving and avoiding STEM majors. Only examining students in the University of North Carolina System leaves out those students attending private institutions. Perhaps, African American men have different experiences on private campuses in North Carolina. North Carolina's African American population is significantly larger than the national average, and this could pose a problem because many African American students in the United States function in areas of the country in which their numbers are not as large. These differences could possibly mean that the experiences of African American men in colleges in other areas of the country are completely different than those living and studying in North Carolina. Last, North Carolina has a large number of HBCUs when compared to the national average, which is an indication that there is an

overrepresentation of African Americans attending colleges and universities in this state as opposed to other areas of the country.

Possible Solutions

In an effort to ameliorate the pressures African American men face with regard to majoring in STEM, counselors and student affairs staff should be well prepared to observe and capitalize on the personal characteristics that are conducive to college success in an effort to help African American male students succeed in college (Jackson, Jackson, Liles, and Exner 2013). Jackson, Jackson, Liles, and Exner (2013) state that counselors and other professionals involved in student affairs should have an understanding that although collegiate environments provide opportunities for growth and development, positive experiences are not necessarily assured. Forecasting college student success is complicated due to many intrinsic and extrinsic factors, however it is even more difficult when considering African American men, especially those from lower socioeconomic backgrounds. When using Ecological Theory to view the African American male college experience, it becomes apparent that the individual's perceptions, environmental factors present with college enrollment and transition, and individual characteristics play simultaneous roles in student adjustment. Because of this, when working with African American men in curricular and co-curricular settings, it is important to pay attention to issues of diversity constrained through Ecological Theory, and allow for cultural and individual differences. By adopting this approach, hopefully college campuses will become more conducive to producing successful outcomes for African American male students (Jackson, Jackson, Liles and Exner 2013). Having staff

dedicated to helping current and future African American men and other disadvantaged people of color in STEM can help to alleviate feelings of supervisibility and alienation experienced by many of the participants in this study.

Student affairs professionals can help reduce some of the challenges faced by African American men in STEM by developing African American student groups and encouraging them to become involved, encouraging multicultural training for faculty and staff, developing positive mentorships with African American faculty, and conducting staff/faculty evaluations measuring multicultural competence (Cuyjet 2006). Encouraging participation in African American student groups can help African American male STEM students develop another microsystem of peers with whom they can relate, therefore reducing the effects of the disconnect between an African American male STEM student's family microsystem and school microsystems (Bronfenbrenner 1977; Jackson, Jackson, Liles, and Exner 2013). Many of the participants in this study lacked African American male role models to look up to for guidance with regard to majoring in STEM. Initiatives such as this can help current and future African American male and other disadvantaged minority groups find potential mentors and like minded individuals on campus.

The purpose of this study was to examine some of the reasons why African American men decide not to pursue STEM majors in college using Bronfenbrenner's (1979) Ecological Systems Theory. It appears that many of the reasons contributing to the lack of African American male STEM majors can be attributed to institutional racism (Smith, Hung, and Franklin 2011). This institutional racism which has been interwoven in the fabric of American society has contributed to a culture within the African

American community that is not conducive to supporting African American males' achieving academically in STEM subjects. Because African Americans have been shut out of this country's economic and intellectual developments and their contributions to STEM have been minimized, the group as a whole tends to have less of the social, human, and economic capital needed to succeed in academia (Oliver and Shapiro 2006). During my research, none of the participants had any significant activities occurring within their mesosystems, meaning that for example, parents were not communicating with college faculty and had no meaningful connections with college faculty. The reason behind this is because large numbers of African Americans did not attend college until after the Civil Rights Movement because they were not allowed to. Throughout America's history, African Americans attended segregated schools with little resources and unfortunately this legacy continues today.

Implications

Hopefully, this discussion will help educators in their quest to improve the quality of education African American males receive in STEM subjects. Improving upon this issue will help to alleviate the problem of finding high quality talent to fill in demand STEM positions and reduce the poverty rate among the African American population. Increasing the number of African American men working in STEM fields could lead to a realization among African American boys that they too can have successful careers in STEM.

During my time as a social worker at a halfway house in Camden, NJ where the majority of the inmates were African American men who attended poor quality schools, I taught a cognitive skills class and I would always have to listen to the black inmates

laughing at the notion of anyone they knew working as a scientist during a cognitive skills exercise which asked them to think about a world without critical thinkers, such as scientists. They would often call the exercise "dumb" and refused to complete it simply because they could not fathom the idea of themselves or anyone in their social circles working as a scientist. They would state that the exercise was not relatable to them and that the creators of the exercise knew nothing about what it is like to be black and poor. Some of these inmates would often ask questions about what a scientist does once they were tasked with completing this exercise. In order for them to complete this cognitive skills exercise, I always had to attempt to answer their questions and address the issues they had with the exercise in order for them to buy into the importance of being a critical thinker. Perhaps, if these inmates were taught STEM subjects in a school which encouraged a culturally inclusive method of teaching, they would be working as STEM professionals.

As stated earlier, the Triesman model used by Xavier University and UMBC has proved effective in increasing the numbers of African American students earning STEM degrees. The Triesman model encourages an inclusive STEM culture, unlike the exclusive culture at most American colleges and universities. Students learn in group settings and are encouraged to study together. Students check each other's work while in study groups, and information on how to solve difficult problems is freely exchanged among students during these group study sessions (Tsui 2007). A Culturally Responsive teaching style is another innovative teaching method that Jett (2013) utilizes. It allows African American and other underrepresented minority students to see themselves as STEM professionals through the use of common scenarios in which students apply

mathematical concepts to solve problems commonly faced in their communities. In addition, it teaches students about mathematical contributions made by STEM professionals of color. Utilizing these culturally inclusive methods of teaching STEM could be a deterrent to criminal activity as these methods appear to build a sense of hope and purpose among disadvantaged youth.

Having a diverse workforce in STEM will benefit the country because the minority share of the U.S. population is increasing rapidly, and this is having a drastic effect on the workforce. If African American men and other underrepresented students continue receiving substandard forms of education in STEM subjects, then it will likely lead to the United States falling even further behind in STEM innovations as other, more progressive countries will continue surpassing the United States in STEM innovations. Furthermore, the maintenance of our current infrastructure requires a large population of STEM educated professionals; however, the U.S. suffers from a void in this area. This void in the population could lead to an overall lower standard of living due to our crumbling infrastructure, costing the U.S. billions of dollars and potentially thousands of lives in the near future. The survival of the United States is not dependent upon the maintenance of the privileged status experienced by some, but the freedom of everyone to achieve happiness and contribute to the society at large in our own unique ways.

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APPENDIX A

Percentages of Bachelor's, Master's, and Doctor's degrees received in STEM related categories based on race, ethnicity, and sex (year 2014-2015)

Source - Digest of Education Statistics

	White		Black		Hispanic		Asian		Native American	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bachelor's Degree STEM Graduates	31.2%	37.6%	3.1%	6%	4.6%	5.7%	5.6%	5.7%	0.13%	0.28%
Master's Degree STEM Graduates	24.9%	44%	3.3%	8.4%	3.1%	4.6%	4.9%	6.2%	0.16%	0.3%
Doctor's Degree STEM Graduates	32.6%	37.6%	2.1%	4%	2.76%	3.2%	7.7%	9.6%	0.19%	0.21%

The categories included in this table include biological and biomedical sciences, computer and information sciences, engineering, engineering technologies and engineering related fields, health professions and related programs, mathematics and statistics, and physical sciences and science technologies (Digest of Education Statistics 2014-2015 from tables 322.40, 322.50, 323.40, 323.50, 324.30, and 324.3

APPENDIX B

Leavers Interview Protocol
February 26, 2013

Warm-Up	• Thank you for agreeing to be interviewed by our team. • I am _____. {say a little about yourself, i.e. where you are working, what your role is student/faculty/ what field you are in, etc.) • Confirm the respondent's name. Tell them you won't use the name again in order to assure anonymity. • We are interested in the factors that influence how people choose their college majors. • Press record. • Give them a chance to ask questions about the process. • Get verbal consent: "You have read the information in this consent form. You have had the chance to ask questions about this study, and those questions have been answered to your satisfaction. You are at least 18 years of age, and you agree to participate in this research project. You understand that your verbal acknowledgement indicates your informed consent." • Mention the respondent's number (i.e., you are respondent #2).
General Questions about Majors	1. Currently you are a senior at {your school} and you are majoring in {your major}. Correct? 2. *If they are a double major* a. *Why did you decide to double major?* b. *Which major do you consider to be your primary major?* *From this point forward consider their primary major to be their*

	major unless they have one STEM and one non-STEM major. In this case, consider them a STEM major and ask questions based on that major. 3. We are interested in hearing the story of how you came to major in {your major}. Thinking back over the course of your life, what contributed to your becoming a {your major} major. 4. What do you think was the most influential factor in your decision to major in {your major}? 5. When did you first know you would major in {your major}? 6. Did you have any career/life plans in mind when you chose {your major}? *If yes:* • *What were the reasons behind your career plans?* • *Did you see this major as fitting in with these plans? If so, how?* *If not: then go on to question #7:* 7. What kind of career/life plans have you made since you decided to major in {your major}? • Did you see this major as fitting in with these plans? If so, how? • If planning a career in science … what about a career in science appeals/does not appeal to you? • If not planning a career in science …. Assuming you had the qualifications to do it, what aspects of a job related to science would appeal to you? 8. How did you come to attend {your current school}? 9. What other majors did you consider? Why did you not pursue a major in those areas? 10. Are you happy with your decision to major in {your major}? Would you pick a different major if you could start as a freshman again? (if so, why and what major would you pick?) 11. Has your ability to pay, or the way you pay, for your college education impacted what you majored in? 12. Over the course of your life, what experiences stand out as encouraging you toward first declaring a major in {your original major}?

	13. Over the course of your life, what experiences stand out as discouraging you toward first declaring a major in {your original major}? 14. If not clear, follow up with more questions to understand why they switched. i.e. what lead to your decision to leave { original major}?
Interest in Science	1. How interested were you in science when you were very young? What contributed to this interest or lack of interest? a. *{If not mentioned} How did your family influence your interest?* b. *{If not mentioned} How did your experiences at school influence your interest?* c. *{If not mentioned} Did you have any experiences outside of school or the home that influenced your interest, such as camps or summer programs related to science?* 2. How did that interest level change as you went through middle and high school? Explain. 3. Since you started college, has your interest in science in general and your major (if a science major) increased/decreased? If so, what do you think contributed to this shift?
Pedagogical Experiences and Interactions with Teachers	1. Did you take more math and/or science classes in HS than what was required for graduation? Why or why not? (i.e. personal interest, external expectations from family, society, college admissions, etc.) 2. Did you enjoy your math classes in HS? Why or why not? 3. Did you enjoy your science classes in HS? Why or why not? 4. Do you feel your HS math classes were taught well? Why or why not? 5. Do you feel your HS science classes were taught well? Why or why not? 6. *If not mentioned for (4) and (5) above follow with* a. *Do you think your math and science teachers in high school were interested in teaching? Explain.* b. *Do you think your math and science teachers cared about you and your learning? Explain.* i. *Probe (if necessary): could you provide an example of one-on-one interaction that made it seem like one*

	of them cared about you and your learning? c. *To what extent did your math and science teachers lecture vs. use more active approaches such as, encouraging student discussion, cooperative learning and hands on activities?* i. *Would you have preferred a different emphasis?* d. *Did any of your math and science teachers stand out as being very influential in your choice of major, positively or negatively, why?* 7. How many courses did you take in college in {your dropped STEM major}? 8. Did you enjoy the {dropped major} classes you took in college? 9. Do you feel your {dropped major} classes were taught well? Why or why not? *10. If not mentioned for (8) and (9) above follow with* a. *Do you think your {dropped major} instructors at college enjoyed and were interested in teaching? Explain.* b. *Do you think your {dropped major} instructors cared about you and your learning? Explain.* c. *To what extent did your {dropped major} teachers lecture vs. use more active approaches such as, encouraging student discussion, cooperative learning and hands on activities?* i. *Would you have preferred a different emphasis?*
Identity and Confidence Issues	1. Do you feel you have the ability to complete a math/science major as well as other people if you chose to? Have your feelings about your ability to do math/science changed over time? If so, what led to these changes? 2. How have your teachers /professors viewed your abilities to do {your old major}? Did they think you are more or less able than you think you are? Do you feel their views have changed over time? Explain.

	3. How have your peers viewed your abilities to do {your old major}? Did they think you are more or less able than you think you are? Do you feel their views have changed over time? Explain. 4. Describe a typical {major} major. Describe a typical {old major} major. 5. Did you feel like you belonged in {your old major}? Did you ever feel out of place? Did this feeling change over time, and if so what led to these changes? 6. Do you feel like you belong in {your major}? Do you ever feel out of place in {your major}? 7. How often did you socialize with people who are {your old major} majors? Do you enjoy socializing with typical {major} majors? 8. How often did you study with other students in {your old major}? Do you think you were more or less connected to your classmates than a typical student in {your old major}? What about in {major}?
Gender and Race Questions	*1. Roughly speaking, what was the track level of most of your high school math & science classes [ie., AP, IB, honors, regular, gifted, etc]? a. what percent of students were female? b. what, if anything, did the gender composition of your HS science [& math] convey or signal to you in terms of becoming a STEM major? c. did its gender composition affect your comfort level in the class?* *2. Roughly speaking, what percent of students in your high school math and science classes were like you in terms of race?* *a. what, if anything, did the racial mix of your HS science [& math] classes signal/convey to you in terms of becoming a STEM major?* *b. did its racial composition affect your comfort level in the class?* *3. What is your best "guessimate" of your high school's racial composition? [i.e., diverse, majority white, majority, black, really integrated, etc]* 4. Roughly, what percent of students are in your major are like you in terms of gender? What percent of students were like you in terms of gender in your current major? What about gender in the major you *left*? 5. In terms of race? {for both major and left major} 6. Do you think the experience of pursuing a {your major and then your dropped major} major is different for men and women? If so how?

	7. Do you think the experience of pursuing a {your major, followed by your switched major} major is different for people of different races? If so how?
Final Question (s)	1. We are interested in learning about why people major or don't major in science, technology, engineering, and mathematics. Is there anything else along these lines that we have not asked about that we should have? 2. Thank them for participating and remind them to send in their vendor information form.

APPENDIX C

Avoiders Interview Protocol
February 26, 2013

Warm-Up	• Thank you for agreeing to be interviewed by our team. • I am _____. {say a little about yourself, i.e. where you are working, what your role is student/faculty/ what field you are in, etc.) • Confirm the respondent's name. Tell them you won't use the name again in order to assure anonymity. • We are interested in the factors that influence how people choose their college majors. • Press record. • Give them a chance to ask questions about the process. • Get verbal consent: "You have read the information in this consent form. You have had the chance to ask questions about this study, and those questions have been answered to your satisfaction. You are at least 18 years of age, and you agree to participate in this research project. You understand that your verbal acknowledgement indicates your informed consent." • Mention the respondent's number (i.e., you are respondent #2).
General Questions about Majors	3. Currently you are a senior at {your school} and you are majoring in {your major}. Correct? 4. *If they are a double major* a. *Why did you decide to double major?* b. *Which major do you consider to be your primary major?* *From this point forward consider their primary major to be their major unless they have one STEM and one non-STEM major. In that*

	case, consider them a STEM major and ask questions based on that major 5. We are interested in hearing the story of how you came to major in {your major}. Thinking back over the course of your life, what contributed to your becoming a {your major} major? 4. What do you think was the most influential factor in your decision to major in {your major}? 5. When did you first know you would major in {your major}? 6. Did you have any career/life plans in mind when you chose {your major}? *If yes*: • What were the reasons behind your career plans? • Did you see this major as fitting in with these plans? If so, how? *If not: then go on to question #7:* 7. What kind of career/life plans have you made since you decided to major in {your major}? • Did you see this major as fitting in with these plans? If so, how? • *If planning a career in science* … what about a career in science appeals/does not appeal to you? • *If not planning a career in science* …. Assuming you had the qualifications to do it, what aspects of a job related to science would appeal to you? 8. How did you come to attend {your current school}? 9. What other majors did you consider? Why did you not pursue a major in those areas? 10. Are you happy with your decision to major in {your major}? Would you pick a different major if you could start as a freshman again? (if so why and what major would you pick?) 11. Has your ability to pay, or the way you pay, for your college education impacted what you majored in? 12. Did you ever consider a major in science, mathematics or engineering? *If yes*

	• Which field of science did you consider? • What experiences encouraged/discouraged you to consider this major? • Why did you not consider other fields such as biology/physics/computer science/electrical engineering? *If no* • Why did you *not* consider a science, math or engineering major?
Interest in Science	4. How interested were you in science when you were very young? What contributed to this interest or lack of interest? *a. {If not mentioned} How did your family influence your interest?* *b. {If not mentioned} How did your experiences at school influence your interest?* *c. {If not mentioned} Did you have any experiences outside of school or the home that influenced your interest, such as camps or summer programs related to science?* 5. How did that interest level change as you went through middle and high school? Explain. 6. Since you started college, has your interest in science in general and your major (if a science major) increased/decreased? If so, what do you think contributed to this shift?
Pedagogical Experiences and Interactions with Teachers	11. Did you take more math and/or science classes in HS than what was required for graduation? Why or why not? (i.e. personal interest, external expectations from family, society, college admissions, etc.) 12. Did you enjoy your math classes in HS? Why or why not? 13. Did you enjoy your science classes in HS? Why or why not? 14. Do you feel your HS math classes were taught well? Why or why not? 15. Do you feel your HS science classes were taught well? Why or why not? *16. If not mentioned for (4) and (5) above follow with* *a. Do you think your math and science teachers in high school were interested in teaching? Explain.*

	b. *Do you think your math and science teachers cared about you and your learning? Explain.* i. *Probe (if necessary): could you provide an example of one-on-one interaction that made it seem like one of them cared about you and your learning?* c. *To what extent did your math and science teachers lecture vs. use more active approaches such as, encouraging student discussion, cooperative learning and hands on activities?* i. *Would you have preferred a different emphasis?* d. *Did any of your math and science teachers stand out as being very influential in your choice of major, positively or negatively, why?* 17. Have you taken any science classes in college? Why or why not? 18. Did you enjoy the science classes you took in college? 19. Do you feel your college math /science classes were taught well? Why or why not? *20. If not mentioned for (8) and (9) above follow with* a. *Do you think your science instructors at college enjoyed and were interested in teaching? Explain.* b. *Do you think your science instructors cared about you and your learning? Explain.* c. *To what extent did your math and science teachers lecture vs. use more active approaches such as, encouraging student discussion, cooperative learning and hands on activities?* i. *Would you have preferred a different emphasis?*
Identity and Confidence Issues	1. Do you feel you have the ability to complete a math/science major as well as other people if you chose to? Have your feelings about your ability to do math/science changed over time? If so what led to these changes?

	2. How do you think your math/science teachers in HS viewed your ability to do science? Did they think you are more or less able that you thought you were? 3. How do you think your peers view your ability to do math/science? Did they think you are more or less able that you thought you were? 4. Think about your high school science and math courses. a. Did you feel like you belonged? Did you ever feel out of place? Explain. b. How often did you study with other students in the course? c. Do you think you were more or less connected to your classmates than a typical student in the course? 5. Think about your college science and math courses. a. Did you feel like you belonged? Did you ever feel out of place? Explain. b. How often did you study with other students in the course? c. Do you think you were more or less connected to your classmates than a typical student in the course?
Gender and Race Questions	1. *Roughly speaking, what was the track level of most of your high school math & science classes [ie., AP, IB, honors, regular, gifted, etc]? a. what percent of students were female? b. what, if anything, did the gender composition of your HS science [& math] convey or signal to you in terms of becoming a STEM major? c. did its gender composition affect your comfort level in the class?* 2. *Roughly speaking, what percent of students in your high school math and science classes were like you in terms of race?* *a. what, if anything, did the racial mix of your HS science [& math] classes signal/convey to you in terms of becoming a STEM major?* *b. did its racial composition affect your comfort level in the class?* 3. *What is your best "guessimate" of your high school's racial composition? [i.e., diverse, majority white, majority, black, really integrated, etc]* 4. Roughly, what percent of students who are in your current major are

	like you in terms of gender? What about in STEM {or considered/intended STEM major, if they had one}. 5. In terms of race? (for both their major and (either STEM or a specific STEM major they considered if possible) 6. Do you think the experience of pursuing a {your major, followed by STEM or a specific STEM major they considered} major is different for men and women? If so how? 7. Do you think the experience of pursuing a {your major followed by STEM or a specific STEM major they considered} major is different for people of different races? If so how?
Final Question (s)	1. We are interested in learning about why people major or don't major in science, technology, engineering, and mathematics. Is there anything else along these lines that we have not asked about that we should have? 2. Thank them for participating and remind them to send in their vendor information form.