ABSTRACT

GUY, BREONTE STEPHAN. Persistence of African American Men in Science: Exploring the Influence of Scientist Identity, Mentoring, and Campus Climate. (Under the direction of committee co-chairs Mary B. Wyer and Denis O. Gray).

The scant literature on persistence of African American males in science typically takes a deficits-based approach to encapsulate the myriad reasons this population is so often underrepresented. Scientist Identity, Mentoring, and Campus Climate have, individually, been found to be related to the persistence of African American students. However, the unified impact of these three variables on the persistence of African American students with science interests has not been evaluated, and the relationship between the variables, the students' gender, and markers of academic achievment have not been previously investigated. The current study takes a strenths-based approach to evaluating the relationship between Scientist Identity, Mentoring, and Campus climate with a population of African American students with science interests who were studying at six Minority Serving Institutions and Predominatly White Institutions in the Southern United States. Multiple regression analyses were conducted to determine the impact of Scientist Identity, Mentoring, and Campus Climate on Intention to Persist of African American males. The results indicate that Scientist Identity predicts Intention to Persist, and that gender, academic performance, and instution type moderate the relationship between Scientist Identity and Intention to Persist. These results lend credence to the emerging notion that, for African American men studying science, generating a greater depth and breadth of understanding of the factors that lead to persistence will aid in the development of best practices for supporting persistence among this perpetually underrepresented population.

Persistence of African American Men in Science: Exploring the Influence of Scientist Identity, Mentoring, and Campus Climate

by
Breonte Stephan Guy

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APPROVED BY:

Pamela P. Martin, Ph.D.	Marc A. Grimmet, Ph.D.
Denis O. Gray, Ph.D. Co-Chair of Advisory Committee	Mary B. Wyer, Ph.D. Co-Chair of Advisory Committee

DEDICATION

This work is dedicated to the life and memory of my late grandparents, Steptoe D. and Geneva E. Bush. They are my guiding lights, and my continuing inspiration to work hard and expect great outcomes in the face of any adversity. They gave me the tools of will and determination, and they instilled in me a strong sense of morality. Their impact on my life is immeasurable, and I intend to pay forward the lessons that they so capably, generously, and lovingly taught me. I will always honor their legacy, because my accomplishments are but a reflection of their love, their dedication, and their steadfast belief that I could do anything to which I set my mind.

BIOGRAPHY

Breonte S. Guy was born in Anniston, Alabama. Upon graduating from Walter Wellborn High School, he went on to study Psychology at the University of Alabama (UA) in Tuscaloosa, Alabama. In the spring of 2001, Breonte received his bachelor's degree in Psychology from UA. Under the guidance of Jane Berry, Ph.D., Breonte began his master's degree in Experimental Psychology at The University of Richmond (UR) in Richmond, Virginia. He graduated from UR in the spring of 2003. Breonte entered the doctoral program in Developmental Psychology at North Carolina State University the following fall. After two years in the Developmental Psychology program, Breonte made a lateral move into the Psychology in the Public Interest program at NCSU. Under the guidance of Mary Wyer, Ph.D., Breonte developed a strong interest in persistence of African American men in science, and he has spent the past several years cultivating that interest and developing a program of research aimed at increasing the representation of African American men in STEM.

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INTRODUCTION

More students are seeking undergraduate degrees than ever before (NSF, 2012), but high rates of attrition from undergraduate degree programs underscore individuals' struggles to persist. Tinto (1993) argued that the "continuing exodus" from tertiary education signaled societal, financial, occupational, and individual-level failures with far-reaching effects. Institutions that are not successfully matriculating students are at risk for reduced financial resources and diversity, both of which erode the educational environment. The Organization for Economic Cooperation and Development (OECD) recently ranked the United States as 15th in international educational performance by both quantity and retention of students. This is in contrast to the 2nd rank position that the U.S. has held in previous years (Callan, 2006). This low OECD ranking highlights an imperative that the U.S. be more competitive in the global education market, particularly in science, technology, engineering, and mathematics (STEM[1]), which are fields that are critical for economic growth and development (Palmer et. al., 2010).

Trends in student attrition are providing evidence of an expanding problem for American universities, and researchers are highly motivated to develop theory-based investigations in an attempt to conceptualize retention, to provide a clearer picture of the weight and magnitude of attrition, and to construct practical interventions and retention models that institutions can implement at the systemic level. Lotkowski et al. found that

[1] The terms "STEM" and "science" will be used in this document as they appear in the source material cited.

between the years of 1994 and 2001, only 55% of all undergraduates who began their educations at four-year institutions had completed their degree within six years. American College Testing (ACT, 2001; ACT, 2012) reported that at four-year public universities, less than half of American college students who began their studies had successfully completed them within a five year window, with only 41.8% of students persisting to degree completion. The graduation rate at private colleges was higher, with a 55.1% degree completion rate. The most current data from ACT (2012) indicates that national persistence to degree rates at two-year public institutions is only 25.4%. At two- year private institutions the number increases to 51.4%. Four-year public institution persistence to degree rates have *decreased* in the last decade, and are now only 36.6%. The graduation rate at private colleges remains significantly higher at 54.7%. These figures contrast with ACT's 1983 report, which placed the graduation rate at four-year public institutions at 52.2% and 59.5% for private institutions. These statistics reinforce other investigations which maintain that time-to-degree rates are also lagging (Lotkowski, Robbins, and Noeth, 2004).

In the second edition of his edited volume *College Student Retention: Formula for Student Success* (2005), Alan Seidman and his contributors argued that retention rates had indeed failed to improve over the past twenty years due to a myriad of reasons (e.g., measurement of persistence, how finances relate to persistence, pre-college preparation and achievement, etc.). In the final chapter of his edited volume, Siedman provided a persuasive model of student success for institutions to follow. "The Seidman Retention Formula" – which is embedded "The Seidman Success Model" – rests on the idea that retention is dependent upon the early identification of students who need attention, and then providing

early, intensive, and continuous intervention practices for those students. In accomplishing the goal of increased student retention, Seidman suggested that programs (i.e., financial aid, career services, internships, etc.), administrators, and faculty members all played a critical role in the personal and academic success of student populations that were deemed at-risk. Siedman's work makes the case that if retention efforts are not strengthened, at-risk students could face a daunting challenge in beating the odds, which are in some ways stacked against them. Because the U.S. public education market is both a business and a global commodity, and because there is an imperative to produce a highly qualified and globally competitive American workforce, the implementation of practical, theoretically sound, and empirically-based interventions is a pressing concern.

Educational persistence is also related to employment opportunity. Unemployment rates, particularly among African Americans[2] with a high school diploma (or less), are significantly higher than for those holding a bachelor's degree, and this has been true for at least two decades (U.S. Department of Education, 2001; 2013) Labor Force statistics, for citizens aged sixteen years and above, indicate a significant increase in the unemployment rate for Blacks or African Americans, particularly between January of 2007 (7.9%) and January of 2010 (16.5%). These numbers are in contrast to smaller increases in the White unemployment rate (from 4.2% to 8.8%) and the Hispanic or Latino unemployment rate (from 5.8% to 12.7%) for the same three-year time period (US Department of Labor, 2013) .

[2] The terms "African American" and/or "Black" are used as per source material cited.

Current income by race and education census data indicate that synthetic work-life earnings[3] for African Americans with a high-school diploma are about $1.3 million, with a bachelors $2.1 million, and with an advanced or professional degree from $2.5 to $3.5 million dollars (Julian & Kominski, 2011). Degree attainment, in other words, has a significant and tangible influence on employment and earnings.

There is a dramatic need for interventions if higher education is to provide equal educational opportunity to African Americans. Between the years of 1977 and 1993 only 6% of Ph.D.s were awarded to African Americans. Between 1994 and 2004, the number of African American Ph.D.s did increase slightly, and *The Journal of Blacks in Higher Education*'s "News and Views" column (Journal of Blacsk in Higher Education, http://www.jbhe.com/news_views/50_black_doctoraldegrees.html) reported that, in 2004, African Americans earned 7.1% of all Ph.D.'s awarded, which was the highest number of awards to African Americans to date. The data for African Americans in the sciences is less encouraging. The article reports that in "2004, 2,100 doctorates were awarded by universities in the United States in the fields of mathematical statistics, botany, optics physics, human and animal pathology, zoology, astrophysics, geometry, geophysics and seismology, general mathematics, nuclear physics, astronomy, marine sciences, nuclear engineering, polymer and plastics engineering, veterinary medicine, topology, hydrology and water resources, animal nutrition, wildlife/range management, number theory, fisheries science and management, atmospheric dynamics, engineering physics, paleontology, plant physiology, general

[3] The Synthetic Work-Life Earning Estimate is an approximation of a full-time, year-round workers income generating potential between 25 and 64 years of age.

atmospheric science, mathematical operations research, endocrinology, metallurgical engineering, meteorology, ocean engineering, poultry science, stratigraphy and sedimentation, wood science, polymer physics, acoustics, mineralogy and petrology, bacteriology, logic, ceramics science engineering, animal breeding and genetics, computing theory and practice, and mining and mineral engineering. *Not one of these 2,100 doctoral degrees went to an African American."*

Because a doctorate is a prerequisite for a faculty position, African American students beginning their postsecondary education may be hard pressed to find African American faculty members who have successfully secured tenure-track positions who could be models for their own professional trajectories.

The U.S. Department of Education's latest report on faculty positions at American colleges and universities indicated that in 2009 there were only 13,750 total tenured black faculty members, representing 4.6% of the almost 300,000 total tenured faculty members (Knapp, Kelly-Reid, and Ginder, 2010). National Science Foundation (Burrelli, 2011) data showed that African Americans make up 4% of the 221,000 positions held by science, engineering, and health-related faculty members. Furthermore, in contrast to other racial/ethnic groups, African American faculty with science, engineering, and health-related doctoral degrees are less likely to be employed at high research activity universities (RUHs). Scientific professionals are among the most highly educated and respected members of the academic workforce (Palmer et. al., 2006), and the National Science Foundation (2004), the American Association for the Advancement of Science (2008), and the National Academies of Science (2007) have all called for increased diversity in STEM education and workforce.

However, African Americans remain decidedly underrepresented on both fronts (Maton, Hrabowski, and Freeman, 2004; NSF, 2012).

Historically black colleges and universities (HBCUs) have played an important role in addressing underrepresentation. These institutions provide students with a rich selection of role models of academic success, which researchers such as Knapp, Kelly-Reid, and Ginder, (2010) have identified as particularly critical for degree completion and professional advancement. These institutions also reported higher student graduation rates in STEM (Clewell, Cohen, Deterding, and Tsui, 2010). The ability of HBCUs to successfully matriculate high percentages of STEM graduates, paired with their overall higher graduation rates than predominantly white institutions, makes a compelling argument for their continued importance in developing future African American STEM degree holders and faculty members.

Attitudes about science and academic preparation prior to postsecondary education are two factors that have been identified as strong predictors for choosing STEM majors (Tai, Liu, Maltese, & Fan, 2006). The literature has often posited that African American students are especially vulnerable to negative attitudes about science, they are inadequately prepared for postsecondary science majors, and that White males are the normative reference group for STEM majors (Buck, Clark, Leslie-Pelecky, Lu, & Cerda-Lizarraga, 2008). However, Riegle-Crumb and King (2010) suggested that there have been mixed results for determining how African American students' attitudes lead to choice of major. Though some studies show a clear relationship between attitudes and subsequent choice of major, other studies find that African American students' attitudes about science (particularly among African

American females, who often report positive attitudes regarding science) are not congruent with their subsequent major choice (Riegle-Crumb & King, 2010).

One factor in the cultural backdrop that could be contributing to a disinterest in science majors is stereotyping. Stereotypes of scientists affect African American students' educational experiences from start to finish, as students' stereotypes about scientists are well established at an early age. Chambers (1983) used the Draw-a-Scientist Test (DAST) to explore the age by which young children hold stereotypes regarding scientists. The DAST requires the students to simply draw a scientist on a blank piece of paper. Chambers found that by the time young children reach the second grade, they hold relatively concrete perceptions of what exactly constitutes being a scientist. To them, scientists were somewhat reclusive and spent much of their time bent on world domination, manipulating hazardous chemicals, or simply holding out hope that their experimentation will lead them towards some form of Eureka. White males represent a normative for STEM, with most of these children seeing scientists as white men who wear lab coats, are balding, and have beards. These childhood stereotypes may have long-term educational effects, particularly for African American students. There is evidence that African American students who display an interest in science disengage from science because of the myriad science stereotypes (Powell, 1990). It has also been suggested that African American students, when they are exposed to quality educational experiences and have access to knowledgeable mentors that facilitate an interest in mathematics and science, may be more likely to later pursue STEM degrees than those who have not had this exposure and experience (Maton, Hrabowski, & Schmitt, 2000).

Despite the general underrepresentation of African American students in postsecondary education, and the dearth of faculty role models and mentors for underrepresented students, African American women are faring better than African American men in STEM education. In fact, African American women are completing high school degrees, entering college, and progressing to graduate school at higher rates than are African American men (U. S. Department of Education, 1998; Wildes, 2000; NSF, 2012), which suggests that the gender gap in African American degree attainment is steadily widening. Downer-Assaf (1995) found that the gender gap between African American males and females taking math courses was significant. By measuring persistence by the number of math courses completed, the study found that of the 93% of African American men and women who took math courses during their initial high school year, only 36% of the men as opposed to 47% of the women continued to take math courses up until graduation. The percentage of bachelor's degrees in engineering awarded to African Americans has increased steadily in the last two decades, but the percentages of those degrees awarded to women and men show an interesting pattern (NSF, 2012). Although there are roughly three times as many African American men as women receiving engineering degrees, African American women earned a larger percentage of degrees awarded to all African American students (26.1%) than White women earned among all White students (16.4%; NSF, 2012).

With these statistics in mind, the current investigation sought to explore factors at the intersection of race and gender, such that within-group, cross-sex comparisons might lend some deeper insight into African American science degree attainment. Three levels of influence on African American men pursuing STEM degrees have been distilled from the

literature: (a) the individual level, or "microsystem", (b) relationships between microsystems and contexts, or the "mesosystem", and (c) influential social experiences that the individual does not have immediate control over or which are prevalent in the culture that the individual primarily identifies with, or the "macrosystem". These three levels of influence were extracted from Uri Bronfenbrenner's (1979, 1993) Ecological Systems Model, which posits that human behavior develops as a function of the dynamic interactions between the individual, the environment, and proximal processes over time.

The microsystem has received the majority of attention in the literature, primarily because it speaks to the immediate setting within which the individual lives as well as interactions and influences from family, cohorts, neighbors, and schools. The mesosystem speaks to exchanges between microsystems, or the interactions between the individuals' immediate family, cohorts, neighbors, and schools (e.g., a child's school grades might be negatively impacted by in-home parental conflict or divorce). Bronfenbrenner's macrosystem speaks to the cultural context of the individual, such that influence emerges from cultural attitudes and ideologies (e.g., ethnicity, religious affiliations, and political beliefs). These three levels of influence grounded the current investigation by providing theoretical structure, as it is posited that defining the interactions between individuals and their setting, context, and culture, in order to provide a more fully developed picture of the individual and their contextual fit with science education.

Because of the well-documented history of educational inequity, a consideration of setting, context, and culture are important factors for understanding persistence among African American students. At the microsystem level of influence, the current study sought

to better understand how African American students viewed their skills and abilities in relation to those skills and abilities that they attribute to scientists (i.e., their scientist identity), and how the "fit" relates to their intention to persist in science.

For the current study, the mesosystem of influence related to how academic support -- the connections between self and others -- affected persistence, such that mentoring experiences might have lent structure and stability for African American students to persist in their academic achievement/degree attainment goals. The macrosystem level of influence explores cultural context (campus climate), which may be particularly relevant for underrepresented students studying at schools with less inclusive campus climates. For example, African American men studying on predominantly African American college campuses may evaluate their campus environment as more inclusive than do African American men studying at predominantly white college campuses. Each of these three areas of research -- scientist identity, mentoring, and campus climate -- have received considerable attention individually, but the current study explores their combined contribution to persistence, with a particular eye towards developing best practices for encouraging and retaining talented young African American men in science.

Significant Trends and Key Variables

Trends in science education, particularly over the past two decades, signal a widening disparity in persistence for African American undergraduate students relative to their European American counterparts (Palmer et. al., 2010). Although a variety of programs have been implemented to increase the pool of highly-trained African American scientists, these efforts have had limited success. The time period between the early 1970s to the mid-1980s

was marked by a slight reduction in educational disparities, particularly among African American students, but such gains have waxed and waned in more recent years (Jencks, 1998; Jencks & Philips, 1998; Blickenstaff, 2005; Riegle-Crumb & King, 2010). One argument is that there was an influx of relatively effective intervention programs that have not made the lasting impact on overall patterns of minority underrepresentation that were projected (Haycock, 2001), but an exact explanation for the negative trends remains elusive.

Much of the research on underrepresented groups assumes that women are underrepresented relative to men. This is not always the case, as African American men are not only disproportionately less likely to graduate high school than African American women, but the gap in such graduation rates between African American men and women is more than double that of any other minority group (Wilds, 2000). Although women typically outnumber men on most co-educational college campuses, more African American women than men are entering, being retained, and receiving STEM-related degrees from these institutions (Campbell et al., 1998). African American women, as opposed to African American men, constitute a majority of newly conferred science and engineering advanced degrees (NSF, 2004; NSF, 2012). Most major colleges and universities have implemented general programs that address the concerns of retaining African Americans and other minority students (Reichert and Absher, 1997). However, there have been relatively few recruitment and retention programs that are specifically directed at African American men (Freeman, 1997).

How an individual views his or her self as a scientist may play a key role in persistence from a microlevel perspective. Research on scientist stereotypes suggests that

children have formulated a stereotype regarding scientists by the time they have reached the second grade (Chambers, 1983). Identity is defined as a congruent set of normative ideologies and values shared by the individual and the larger community (House, 1981). Having an identity that is incongruent with that larger community would require an individual to negotiate barriers that others do not need to confront. For instance, Brickhouse (2001) suggested that gendered identity formation may be incongruent with scientist identity. For women, the development of a scientist identity could be mitigated by the fact that they must bridge the gap between their gender (which they have developed over many years) and their desire to become a scientist (which, without early intervention, will seem foreign and require the learning of a new set of norms). This concept is elaborated by Settles (2004) who argued that some identities are core (e.g., gender and race) and core identities may both enable and constrain women by virtue of leaving them vulnerable to interference from other identities that are held as being equally important. For African American male students, similarly, the stereotype of scientists as white males may seem to preclude and, thus, inhibit their interest and academic success in science.

Branscombe and colleagues (1999) argued that holding a central identity mitigates the relationship between negative psychological outcomes and discrimination for African Americans. Thus, scientist identity may be especially useful in determining the extent to which African American students can benefit from a strong, positive identity as scientists per se, providing them with a better chance of coping with the demands of a STEM-related academic environment.

Mentoring programs have received considerable attention as a means of encouraging the participation of African American science students. The goal of such mentoring programs is to provide the student with a network of qualified professionals or advanced students who are available to field questions, as well as to help empower the student to develop his or her own campus connections. Mentoring has a mesosystem level of involvement, such that the relationships between the mentor and protégé are of paramount importance to enhancing a protégé's microlevel scientist identity and macrolevel campus experience. As such, the mentor/protégé relationship is one that may be pivotal in increasing African American students' intention to persist. The vast majority of mentoring programs in higher education, however, have not been systematically evaluated to demonstrate their effectiveness empirically and have relied on flawed designs (Campbell and Campbell, 1997; Lunsford, 2007). Where there is empirical data, results are mixed. For some students, mentoring programs appear to be helpful. Whether the program's success depends on individual level or macro level factors is unclear.

Improving the representation of African American men in science may also require institution-wide efforts to cultivate a climate supportive of diversity. Simmons and Thurgood (1995) noted that educational authorities have taken a "laissez-faire" stance on the facilitation of student/campus interactions, maintaining that students are capable of working through the challenges of finding their way in a new environment and making progress that is self-directed (Hurtado et. al., 1998). However, the lack of programmatic attention within university administration leaves students vulnerable to isolation in the larger campus environment and also limits the effects of faculty members' individual attempts to shape the

larger campus diversity climate (Hurtado et. al., 1998). Hurtado et. al., (1998) argues that student success in a university environment is contingent upon the racial environment of the campus. A positive campus climate will be grounded in four elements: (a) representation of diversity among administrators, faculty, and students, (b) a curriculum that is grounded in the historical relevance and contemporary contributions of people of color, (c) systematic programs that are aimed at the inclusion and retention of students of color and, (d) a university-wide commitment to maintaining the presence and success of administrators, faculty, and students of color. Hurtado et. al. (1998) suggests that a campus' climate becomes progressively more negative with the absence of these four elements. The current investigation seeks to explore the relationship between persistence (as measured by commitment to a science career), scientist identity, mentoring, and campus climate, so that a greater breadth of information might be gained from assessing each factor in relation to the other.

Objectives of This Study

The immediate goal of the current investigation was to examine how African American undergraduate students' scientist identity, mentoring, and campus climate were linked to intentions to persist in science. Within that context, the study aimed to (a) call attention to the academic persistence of African American undergraduate science students in general, and (b) to determine the unique factors that contribute to the persistence of African American men studying science. Three major research questions emerged: 1.) Do scientist identity, mentoring, and campus climate have direct effects on persistence for African Americans, and are their combined effects on persistence greater than their individual

effects? 2.) Do gender and academic achievement moderate these effects? 3.) Does attendance at a Minority Serving Institution or a Predominantly White Institution moderate these effects?

LITERATURE REVIEW

Major Models of Educational Persistence

Many foundational theories have been posited to explain the processes of persistence through college science education, but the major contemporary theme among researchers in this field centers on defining a method by which best practices in recruitment and retention of underrepresented women and minorities might be implemented, rather than focusing on deficits and perpetuating racialized narratives (Brown, 2000; May & Chubin, 2003; Tester, Scott, Hatfield, Decker, & Swimmer, 2004; Burke & Mattis, 2007). The barriers to persistence literature generally falls into six broadly defined areas, including academic preparation (Adelman, 2004; Pascarella and Terenzini, 1991, Tyson et. al., 2007), self-efficacy/confidence (White-Brahmia & Etkina, 2004), unrealistic expectations (White-Brahmia & Etkina, 2004), community disengagement (Seidman, 2005), environmental alienation (Carter, 2006), and financial needs (Seidman, 2005). Best practices in engaging communities of color to persist in STEM related degree programs at the university level include preparation (i.e., acquiring necessary knowledge, skills, and habits), access (i.e., the chance to put those habits into practice), motivation (i.e., cultivating self-confidence and steadily progressing, d) financial assistance, e) academic and cultural support services, and f) social integration (i.e., feeling welcomed in the chosen field of study; National Academies, 2011).

Longstanding theories about college persistence have informed research for decades. Tinto's Student Integration Model (1975) and Bean's (1982a & 1982b) Student Attrition Model serve as the most comprehensive and widely cited assessments of college persistence that have been provided by the literature thus far. Both models have been supported by empirical studies of student persistence across disciplines and institutions (Cabrera, Nora, and Castaneda, 1993; Mallette and Cabrera, 1991; Pascarella & Terenzini, 1976; Pascarella, Terenzini, & Wolfle, 1986). Cabrera, Nora, and Castaneda (1993) even suggest that the two models, although distinct in many ways, are easily merged to increase our ability to address the problem of student persistence.

Tinto's Model of Student Integration

Although the previously discussed work primarily emphasizes the paths to students persisting in their academic programs, it is also important to understand why students leave. Spady (1970) proposed that social integration stemmed from two factors: 1.) Academic Success, such that grades are an extrinsic reward, while academic growth and development are intrinsic rewards that lead to "normative congruence" between the student and his or her academic environment. 2.) "Friendship Support" or the ability of a student to establish meaningful connections with other students, faculty, or staff. In an extension of Spady's (1970 and 1971) work on college dropouts, Tinto (1975) suggested that the intricate and complex processes associated with a student's decision to not complete the degree were inadequately addressed in the literature. Specifically, both Spady (1970 and 1971) and Tinto (1975) argued that the wealth of research on college dropout rates relied heavily upon descriptive information, rather than theoretically driven questions. Individual-level student

factors, rather than broader ecological factors and institutional characteristics, had received the bulk of attention in the general literature. This insight holds true today, as represented by the best practices laid out by the National Academies Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline (2011), such that increasing completion rates of underrepresented minorities stems from both academic integration into a welcoming college environment and academic support factors. The rationale for focusing on individual-level factors, particularly in light of the constellation of factors that likely play a role in student engagement and attrition, has not always been clear. In an attempt to develop a broader perspective, Tinto developed a comprehensive predictive model of student persistence (Pascarella and Terenzini, 2005). Tinto's model asserted that student background characteristics such as race, gender, and family socioeconomic status interact with their commitment to goal completion. This interaction, as well as the inclusion of family, socio-economic, and individual-level factors, has remained one of the more important advances in educational persistence research (Pascarella and Terenzini, 2005).

Understanding student attrition across time and academic setting is integral to enhancing our understanding of best practices for retaining students (Elkins, Braxton, and James, 2000). Facing estimates as high as three fourths of all college dropouts leaving at some point during the first year, Tinto (1987) suggested that scholars, practitioners, and advisors must focus heavily on the early stages of a student's academic involvement or risk losing them at the beginning of their post-secondary educations. Though Tinto's model of student integration is broadly cited, critics charge that it lacks empirical internal consistency (Braxton, Sullivan, and Johnson, 1997). Further, some researchers have argued that the

model is not adequate for explaining the persistence rates of minority populations (Tierney, 1992; Tinto, 2007), who leave at disproportionate numbers, because it was developed with a primarily European American population. Braxton, Sullivan, and Johnson (1997) argue that the model is basically good, but that the theory framing it is too narrowly focused to address issues confronting at-risk populations.

For instance, Tierney (1992) posits that Tinto's model is heavily rooted in the early works of anthropologist Arnold Van Gennep (Elkins, Braxton, and James, 2000). Van Gennep asserted that there were three discrete rites of passage that delineated the transition of an individual from one culture to another: a) separation, b) transition, and c) incorporation. Extrapolating these stages for use with college communities, Tinto (1987 and 1993) suggests that separation, to college students, represents a breaking away from family and community familiarities and transitioning into being a new member of the college community. He also suggests that an inability to successfully navigate this transition may be one reason for high first year dropout rates, and an inability to incorporate the new community will lead to dissatisfaction with the college environment. Tierney (1992) argues that the use of anthropological rites of passage may not translate to minority populations if they are leaving an entirely different culture and entering another, more bourgeois, set of circumstances that they may not have been especially prepared to enter.

Bean's Model of Student Attrition

Bean (1982 a and b) suggests an extension to the Student Integration Model that posits attrition of students from universities can be thought of in the same way that work organizations consider turn-over. The student's persistence in their program of study is

dependent upon their behavioral intentions to remain in the program. These intentions are shaped by the institutional environment, such that external factors associated with the university are related to the students' beliefs. Such beliefs are then reflected in the students' attitudes. Thus, the attitudes that the student holds shapes their behavioral intentions. Attrition is, then, the result of a dynamic interchange between the students' internal and external motivations.

Bean's Student Attrition model also posited that it is the opposing ends of the freshman year that are most likely impacted, and that relevant background factors and goal-directed behaviors, along with academic performance measures of the student, will have influenced the students' persistence at end of the first academic year. As such, the guiding premises of the Student Attrition Model are that the student's fit with the institution, the student's intention to persist in the program, as well as other non-intellectual barriers to persistence all impact the likelihood of dropping out. Bean and Vesper (1990) extended this work by provided a method of addressing college persistence rates that was highly focused on institutional and other external factors. Their variables were separated into distinct categories: a) organizational, b) personal, or c) environmental. This allowed background information to be gathered on freshmen students upon entering the institution, while researchers could then gather external institutional information in the meantime. Bean and Vesper found that the bulk of variance explained in dropout rates could be attributed to six organizational, personal, and background variables. In Bean and Vesper's (1990) study, academic performance alone was not sufficiently predictive of persistence. This highlights the need to consider increasing the breadth and depth of investigations into models of student

attrition, and, thus, an appreciation of the complexity of the attrition might lead to a better understanding of attrition.

African American Male Achievement and Academic Degree Attainment

Much of the literature on African American male achievement and degree completion paints an austere portrait of troubled, disenfranchised, uneducable, dysfunctional, endangered and dangerous people (Davis, 2003; Kunjufu, 2001; Parham and McDavis, 1987; Noguera, 2003; Strayhorn, 2008). Such characterizations of African American men clearly portray them as outside the boundaries of educational attainment, and they underwrite prominent stereotype-laden social narratives (Harper, 2006; Palmer et. al. 2010). Overcoming educational disparities, particularly with a backdrop of such racialized narratives, poses many challenges for African American male students.

The backdrop issues are apparent early in the academic pipeline (Davis, 2003; Howard-Hamilton, 1997). Kunjufu (1993) suggests that teacher expectations for their students are of primary importance to cultivating a successful learning environment. He found that regardless of their academic potential, teachers are more likely to consider African American males who are from lower socio-economic status households as "at risk" students. During primary and secondary education, educators (both teachers and guidance counselors) are disproportionately more likely to impose low expectations for higher education onto African American male students than onto European American male students (Epps, 1995; Moore et al., 2008). African American males also receive a disproportionate amount of disciplinary action relative to European American males, including in-school and out-of-school suspensions as well as expulsions (Palmer et. al., 2010).

It even has been suggested that some schools have embraced the idea that academic prospects for African American males *should* be low, and these schools have made it expected and permissible for teachers to undermine the academic achievement of these students (Anderson, 1990). Steele (1992) posits that when educators hold lowered expectations, and actively undermine the academic potential of African American males with those low expectations, what they are actually manipulating is the student's sense of worth, self-esteem, and potential for positive identity development. Such threats to identity development, and how persistence is impacted by threats to identity development, are core aspects of the current investigation. As the current investigation postulates, it is this threat to positive identity development, grounded in a socio-historical context of oppression, which might play a pivotal role in African American male persistence in science education.

A Reconceptualization of African American Male Achievement

In response to the persistent reiteration of findings that emphasize barriers to African American male students' academic achievement and persistence to degree completion, some researchers are now challenging the deficits-based approach to the achievement gap. On the forefront of this line of theory and research is Shaun Harper, whose article "Reconceptualizing Reactive Policy Responses to Black Male College Achievement: Implications for a National Study" (2006) calls for a shift in how researchers and policy makers contribute to understanding African American achievement. Harper argues that a focus on African American male underachievement only serves to magnify deficits instead of recognizing strengths. As a result, there is a distinct lack of information regarding what happens when African American male students do, indeed, achieve their academic goals.

Harper (2010) maintains that in order to develop a model of African American student success, researchers must focus on ability and achievement indicators. Using data from 219 African American male undergraduate students at over forty colleges across twenty states, with differing institutional types (e.g., HBCUs and PWIs, both private and public), his National Black Male College Achievement (NBMCA) study focused on African American students who held grade point averages (GPAs) above 3.0, had earned a substantial number of honors and accolades, and were considered to be leaders on their respective campuses -- high achieving African American male students. The goal of the NBMCA was to identify the unique traits of successful African American male undergraduate students (many of which were from economically depressed neighborhoods, broken homes, and had inadequate academic preparation). Using a series of in-depth, open-ended questions, he found that these high achieving African American male students had been exposed to quality pre-college educational experiences that led to choosing STEM majors (e.g., summer bridge programs), they had made good connections with like-race peers, and they also had taken advantage of organizations that fostered networking/interconnectivity and undergraduate learning opportunities that solidified their interest in STEM.

Scientist Identity

Researchers in other arenas are also shifting the focus from deficits and barriers to strengths to emphasize the variety of students' abilities in what is termed "multiple dimensions of identity". This emphasis includes not only cognitive abilities, but also identities, intentions, and perceptions (Warren, Ogonowski, and Pothier, 2005, Nasir, Rosebery, Warren and Lee, 2006; Strayhorn, 2008). For example, Nasir et al. (2006)

suggested that pathways to science learning, particularly for those individuals who might not fully adhere to the traditional construct of "scientist", might be best navigated in an "everyday learning environment" rather than a traditional lab setting. As such, non-traditional science learners are provided with the opportunity to display strengths that might not be fully recognized in a more traditional science environment (e.g., a laboratory). In developing their science skills in this non-traditional environment, access to science is widened and non-traditional science students are allowed to cultivate a more coherent science identity. Strayhorn (2008) posits that African American male students at PWIs lack the necessary access to supportive interactions outside of their same-race peer group, and that these interactions are critical for developing a sense of belonging. The development of such a sense of belonging in science is plausibly a necessary precursor to educational persistence for African American men – particularly those who study at PWI campuses. Warren, Ogonowski, and Pothier (2005) define such continuity for minorities as "ways of conceptualizing, representing and evaluating their lived experiences… as generative resources in learning new ideas and traditions of inquiry" (p. 122). In other words, altering the traditional science discourse (e.g., making it more applicable to their lived experiences) is a valid method of engaging minority students. This approach also allows the non-traditional student to further develop a sense of belonging in science, and, thus, shrinks the gap between self and image of scientists, such that a lived experience that does not fit the traditional science narrative can be made applicable and relevant.

Although there is relatively scant information that is directly related to the specific scientist identity of African Americans, there has been a call for deeper investigation into the

processes by which African American scientist identity is formed. Carlone and Johnson (2007) argued that research about African American persistence in science-related degree programs falls short on several important fronts. 1). There is a lack of theoretical foundation upon which to develop good studies. 2). The primarily phenomenological data that is available does not adequately capture distinctive elements in the experiences of African American men who do persist. 3). There is a clear disconnect in the literature between a focus on environmental factors and a focus on individual agency. Carone and Johnson (2007) proposed that identity is an empirically valid and promising approach to understanding the factors that lead to African American students' success in science.

Identity is defined as a congruent set of normative ideologies and values between the individual and the larger community in which they are striving to become a participant (House, 1981). Problems with identity formation become apparent when conflicts between two or more competing communities cause a breakdown in a person's ability to successfully navigate one or all identities that they must assume (e.g., the identity of "mother" often conflicts with the identity of "career woman"). Although there are benefits to holding multiple identities and being a part of multiple communities, such that social, economic, and other specific skill sets are all enhanced, the constellation of communities that one belongs to might also lead to confusion regarding which one best fits the individual's life goals and aspirations (Settles, 2004). For African American male students, this suggests that their "scientist identity" would emerge in an educational context that may (or may not) be optimal for meeting the demands of science education and persistence.

Much of the work related to science identity stems from the literature on "leaking science pipelines" for women. However, Xie and Shauman (2003) suggested that this metaphor for attrition fails to access other important life course transitional phases that might render women less likely to persist in science degree programs. Their study used a multidimensional, multivariate approach to looking at demographic data that had been gathered from numerous longitudinal studies. Their life course perspective suggests that transitional phases are interdependent between competing communities (e.g., work, family, and education), thus the leaking science pipeline does not stand independently as a sole cause for attrition. Rather, many factors over the life course work in tandem to produce either a successful matriculation through science degree programs or attrition from such programs. Further, Xie and Shauman also suggested that although women are more likely to enter degree programs in the biological sciences, they are less likely to pursue careers in the biological sciences than are women who study other majors such as engineering. In other words, career persistence differed by field in their study.

Most important to the current study, Xie and Shauman posited that a major factor for women who have families was a lack of other examples of women with families who have been successful. The incongruence of cultural perceptions of "woman as scientist" and "woman as mother or wife," for example, has been said to create tensions that reduce commitment to the "woman as scientist" role (Brickhouse, 2001). Settles (2004) similarly explores how a scientist identity emerges in the context of competing identities. The goal of Settles' study was to determine if identity interference (i.e., problems with executing two identities) was related to negative outcomes in measures of academic performance and

psychological wellbeing, as well as to determine if identity centrality was a buffer for negative outcomes for women. There was support for the hypothesis that the divide between women and science identity did cause interference, thus leading to lower academic performance and well-being scores.

Early work about educating African Americans argued that the content of coursework in the sciences creates "interference" in students' interest in learning the material and thus in their academic performance. In his 1933 analysis of approaches to racial equality in mathematics educational pedagogy, Woodson argued that education for minority students should not be built solely on the experience of math's White forefathers. He called this traditional approach to mathematics education "foreign pedagogy," highlighting the extent to which African American students in particular would not find a fit with methods to which they have no cultural ties. This concern with the effects of instructors and content on persistence is still very relevant today. Oyserman, Gant, and Ager (1995) posited a multilevel, socially contextualized model of African American student persistence, reporting on four separate studies they conducted. Their research was based on the premise that because students formulate a myriad of possible selves and because those selves may not match with the student's potential long-term academic/professional self, students may forgo potential avenues for academic achievement based on that mismatch.

Using 118 undergraduate psychology students from Wayne State University, Oyserman, Gant, and Anger measured "Possible Selves" as a socially contextualized identity in answers to open-ended and closed-ended questions. They found that Black students did not significantly differ from White students in how they matched on pairs of possible selves, and

that their identity development was (unlike White students) more correlated with collectivism rather than individualism. A sense of collective identity, i.e. identity based on sense of group membership -- eschewing individualism -- was more salient for Black students than White students. For White students, individualism, Protestant work ethic, and balanced "possible selves" was paramount in determining achievement potential. In their second study, Oyserman, Gant and Anger (1995) examined gendered aspects of identity among African American students, and they built a model that predicted that there would be a strong relationship between academic achievement, identities, and "awareness of racism" among young African American women and men. The second study addressed a sample of 146 African American 7th and 8th grade students from inner city schools in Detroit, Michigan. Open-ended questions were used to assess the students' African American identity over 8 categories: 1) Connectedness, 2) Vision/Responsibility, 3) Racism, 4) Everyday behaviors/coping strategies, 5) Being male/female African American, 6) Awareness of problems, limitations, 7) Achievement/Attainments, and 8) Disengagement. These 8 categories were condensed into three factors: 1) Connectedness, 2) Racism, and 3) Achievement as an African American. The Racism factor did correlate to a measure of self-esteem; however, Achievement as an African American correlated with Connectedness. The primary findings of this sub-study were that differences between how African American male and female identities are conceptualized in regards to achievement do differ, such that girls tended to focus on the impact of the "limitations of being female" whereas boys focused on the "advantages of being male". More specifically, females were more significantly influenced by their sense of achievement and how racism impacts it than were males,

suggesting that the socially contextualized model was a better fit for the females in their sample. However, boys were more likely to aspire to achieve for achievements' sake, whereas girls saw achievement as a means to employment security. This suggests that African American males and females have different methods of conceptualizing their social contexts, and that their persistence behaviors might be different based on the divergent perspectives.

The third study in Oyserman, Gant, and Anger (1995) focused on how student identity was impacted by having successful academic models, which, as stated earlier, has been shown to be significantly related to persistence outcomes of underrepresented students. A total of 55 students from the previous sample were asked "How likely is it that you will be successful in school next year?" One group was primed with a paragraph regarding the researchers' interest in individuals the student knows who are doing well in school, and the other group was primed with a question asking them about someone they feel is doing poorly in school. Both groups were asked how they were similar to and different from their respective positive or negative prime. What they found was that gender and context seem to impact how the students felt about what was possible for themselves in the future. The researchers conclude that African American males "scan the social environment for information about self" as a protection from negative feedback, whereas African American female students scan their environments to determine how similar or different they are from their surroundings. The researchers suggest that females are more interdependent while males are more constrained by their identity as "self" (e.g., protecting "self" from negative feedback).

A fourth study in Oyserman, Gant, and Anger (1995) was conducted to examine possible selves, school performance, and gender among 55 middle school students. This study examined the relationship between identity and academic performance among 8th graders, and hypothesized that the balance between expected possible selves and "to-be-avoided" possible selves might provide scaffolding for academic persistence. "Balanced possible selves" refer to the extent to which a person's expectations are tempered by fear of not meeting those expectations, and the goal of this study was to determine the extent to which congruence between expectations and fears of negative outcomes had an impact on school/academic performance. The researchers used four measures of academic performance, such that GPA, the California Achievement Test (math and English sub-scales), and a 5-item persistence measure were employed to measure school achievement. The researchers found that males were significantly less likely to view themselves in a balanced context, whereas females tended to have more balanced perceptions of their possible selves (which also had a positive impact on their academic performance measures). Further, females view themselves in a congruent manner with their teachers, such that both groups' perceptions followed that females were more highly motivated and capable of academic achievement.

In summary, these studies make a distinction between male and female identity development, and they also offer some insight into how that identity development leads to disparate academic achievement and persistence for African American males and females. Further, these studies exemplify the complexity of the relationship between the student, the academic environment, expectations (both intrinsic and extrinsic), and how incongruence in identity might pose barriers to persistence. These studies thus informed the current

investigation by confirming that a critical eye toward parsing out differences in how African American men and women self-identify, and how that identity might impact academic performance and achievement, is an important component in understanding the factors leading to persistence for this population.

Mentoring

Mentoring programs have drawn considerable attention and support as one strategy to increase participation of African American men, but these programs yield mixed results (Marabel, 1999). African American mentoring initiatives tend to rely on formal, unidirectional partnerships that are grounded in the role-model/protégé paradigm, and evaluations are often directed at demonstrating a program's overall success in relation to immediate outcomes such as improvement in test-taking skills, GPA, or increased interest in a particular field of study rather than evaluating the effectiveness of the program in improving the educational outcomes for participants (Marabel, 1999; Van Aken, Watford, and Medina-Borja, 1999). Further, much of the literature has struggled to define what constructs best represent the prototype of a mentor. The development of scales that assess the core qualities of mentoring has become an important factor in understanding the impact that mentors have in cultivating successful relationships with their protégés. Nora and Crisp's (2007, 2008, and 2009) College Student Mentoring Scale (CSMS). The CSMS sprang from earlier work which sought to define the constructs within which college level mentoring was most efficacious, such that the performance of mentors was shown to reach a level of efficacy that was both consistent with previous estimates in the literature and adhered to definitions set forth by that previous literature. For example, previous mentoring literature

spanned from delineating functions and roles (Jacobi, 1991), to taking a more phenomenological approach by reviewing the constructs of what make a mentor efficacious (Roberts, 2000), to the distinction between "technical" and "alternative" or "formal" vs. "informal" mentoring (Mullen, 2005; Henry, Bruland, & Sano-Franchini, 2011). Nora and Crisp (2008), however, took a more empirical stance on validating the major constructs of mentoring, and this lends a very much needed and promising extension to the prior body of mentoring research because of its potential for measuring, isolating, and operationalizing these constructs. Using a stratified random sample of 351 college students, Nora and Crisp found four major latent constructs which best described or encapsulated "mentoring", thus emerging as a second order construct in and of itself: 1). Psychological and emotional support, 2). Goal-setting support and career paths, 3). Subject knowledge support, and 4). Fitting the specifications of being a role model.

Traditional investigations of mentoring have typically focused on finding answers to questions surrounding the definition of mentoring, the manner by which students are being mentored, and, less frequently, the impact that such mentoring will have on the academic success of students (Wallace, Able, and Ropers-Huilman, 2000). Because such investigations are often a-theoretical in nature, and because there is a distinct dearth of empirical literature regarding specific outcomes of mentoring initiatives (Lunsford, 2007), the current investigation lends an important contribution to the extant body of literature in that it aims to provide an empirically based assessment of how positive mentoring experiences contribute to a commitment to persist in a science career. Although there are limited empirical investigations that focus on the mentoring of African American men in STEM specifically,

there are hosts of mentoring programs that purport to demonstrate the effectiveness of mentoring for African American students in general. The qualitative approach is the dominant form of research design in these program evaluations.

Wallace, Abel, and Ropers-Huilman (2000) investigated the effectiveness of the TriS (i.e., Student Support Services) mentorship initiative for minority students at several major universities. The U. S. Department of Education's Office of Higher Education developed the TRiS program in the late 1960s as a method of combating the underrepresentation of low-income and first-generation students. The program is still in effect today. However, the program evolved to incorporate a strong focus on mentoring initiatives as well. These effort aims to ensure students' persistence and success in myriad college majors. Further, the TRiS program places strong emphasis on the degree of formal and informal interaction between mentors and protégés, thus incorporating directed curriculum and relaxed interactions as a form of overall mentorship.

As such, their study examined the mentor/protégé relationship for TriS mentors and minority students. The goal of the study was to see if formal mentoring (defined as guided curriculum and mandated meetings) was as effective to students as informal (unscripted/uncontrolled interactions between mentors and protégés). The investigators used qualitative methods, specifically open-ended questions, to assess the degree to which students felt that they were adequately mentored by the TRiS program, as well as their level of desire to persist and succeed in their academic programs. They found that the majority of the students that they interviewed felt that the formal mentoring was adequate, but a significant portion of the students interviewed felt that informal relationships between

mentors and themselves would provide valuable social connections that would aid in the process of integrating into college life.

The limitations of the Wallace, Abel, and Ropers-Huilman (2000) study center on three major aspects: a) lack of control over mentor/protégé matching, b) lack of availability to informal interaction for all students, and c) adhesion to hierarchical, unidirectional model of mentoring. Because the students who enter TRiS programs are randomly assigned to whichever counselor/mentor is available, there is no method of matching by gender or race. Further, many of the students included in the study had been mentored by numerous TRiS staff. It has been suggested that matching by race, and almost certainly by gender, are important factors in ensuring the success of a mentoring relationship (Lee, 1999). Another shortcoming of the study is the lack of availability to informal interactions for all students. As most of the students interviewed had been switched from mentor to mentor, and because the mentors were not mandated to provide any sort of outside support to the students, the degree to which they were exposed to informal interactions with their mentors was quite limited. Finally, the program utilized for the design of the study follows the traditional hierarchical model of mentoring that renders the protégé at the bottom of a unidirectional chain of mentors.

One potential method of ensuring that students do have informal access to their mentors is to provide peer-mentoring initiatives. Such peer mentoring provides an accessible source of formal and informal interaction, social support, and also potentially benefits both the mentor and the protégé (Brawer, 1996). Good, Halpin, and Halpin (2000) examined peer mentors academic development and the extent to which their ability to integrate into their

academic environment was aided by being placed in the position of mentor. The study focused on 19 upper-level undergraduate African American students who were assigned as mentors to as many incoming freshmen engineering students. The role of these mentors was both formal and informal in approach. The formal aspect of the peer mentorship was that they engaged in structured curriculum, problem solving workshops, math and science labs, and tutoring sessions, whereas the informal aspects centered on the peer mentors' and protégés' meal sharing, movie dates, and home and apartment study sessions. Such informal interactions were built into the program's goals, and provided a balance between social/academic integration and formal knowledge-building sessions.

The Good, Halpin and Halpin (2000) study used an innovative form of weekly qualitative data collection spanning one year, such that the peer mentors were instructed to post structured weekly bulletins to an online journal. The content of these journal entries was to chiefly focus on student, personal, and organizational development. The peers' grade point averages were also collected in an effort to track their academic growth over the course of the year. The journals were content analyzed and three areas of academic growth emerged: a) improved study skills (endorsed by 70% of peer mentors), b) understanding of engineering concepts (50% endorsement), and c) enhanced critical thinking (27% endorsement). Three areas of personal growth also emerged from the content analysis: a) responsibility and leadership, b) ease of social interaction, and c) self-satisfaction (all endorsed by more than 90% of peer mentors). These findings suggest that providing a structure not only to formal, but also informal interactions may play a vital role in enhancing the mentor/protégé relationship. Although Good, Halpin and Halpin (2000) used peer mentors, the universal

principle that emerges is that mentors' availability to the protégé is clearly beneficial to both individuals. Further, the program's focus on academic as well as personal growth sets it apart from other mentoring initiatives that solely center on the overall success of the implementation of the program itself. This study provided an innovative approach to mentoring, and there was an overwhelming endorsement of personal and academic improvements by the peer mentors. However, not all the interactions among students and mentors (i.e., those not structured into the program) were measured. As peer mentors are of similar age to their protégés, it is plausible that the relationships that were forged by the mentoring paradigm extended outside the confines of the original initiative. Thus, it becomes difficult to parse out the effects of mentoring from the potential social support benefits that resulted from increased social integration into a community of students with similar backgrounds and interests.

The success of faculty mentorship for minority students has been demonstrated by Campbell and Campbell (1997). Their mentorship intervention also integrated the use of academic performance measures and time-to-degree. Campbell and Campbell posited that mentoring initiatives are, actually, seldom theoretically driven. Rather, such initiatives are more interested in developing forms of mentoring and uncovering the correlational consequences of those forms. The authors also argue that traditional mentoring intervention evaluations are much more concerned with the extent to which the intervention has been successful as measured by participants' perceptions of self-growth. The authors sought to provide a springboard from which theoretical constructs could become less akin to what they termed an "empirical dustbowls (p. 728)" in mentoring research. Rather than directly testing

theoretical models themselves, their study sought to assess the degree to which mentoring improved academic outcomes and persistence through completion of undergraduate degrees.

The mentoring initiative of the Campbell and Campbell (1987) study centered on providing both structured and unstructured opportunities for the students and mentors to interact, as well as offering faculty mentors the opportunity to further their commitment to their protégés by providing students with funding to support research and attend conferences. The study used a sample of 339 undergraduate students (predominately minority students) who were matched to other students at the university that were not a part of the study for comparisons. The total matched sample was 678. Ten percent of the faculty at the university where the study was held (n =126) agreed to participate, each working with between one and four protégés. The study spanned three years with data points collected in three waves (i.e., at the end of each academic year). The dependent variables were academic achievement (i.e., GPA at baseline, first, and second semester) and retention as measured by the students' enrollment or withdrawal by the spring semester of the final year of the intervention. The authors hypothesized that the mentored students would have improved academic performance and complete more credit hours over three years than those students who were not mentored. The study also hypothesized that the retention rates of mentored students would be higher than those students not involved in the intervention. Further, it was hypothesized that academic performance and persistence would not be related to the race or gender of the mentor or protégé, thus implying that mentors of any race or gender may be successfully matched with protégés of any race or gender.

The data were analyzed in a series of t-tests. The results indicated that the first hypothesis was supported, such that mentored students did have better academic outcomes (i.e., higher GPAs) and also completed more credit hours than did the non-mentored students over the three years. Further, the study found that the rate of persistence through graduation for the mentored students was double that of those students who were not mentored. Thus, the magnitude of academic improvement and persistence were related. Gender matching the mentors and protégés did not result in increased academic improvements or persistence, although there were gains in the academic outcomes of those mentor/protégé pairs they were not increased by matching. This would suggest that mentoring is beneficial regardless of the method or vessel through which the initiative is enacted.

The strengths of this study lie in the study's integration of academic outcomes and persistence measures, but also in its use of both formal and informal routes of enhancing the mentor/protégé relationship. The study does an exceptional job of attempting to debunk some of the commonly held myths regarding mentoring, such as the effectiveness of the program in increasing internal outcomes is more important than academic outcome measures. However, it could be argued that the study's weakness stems from its lack of randomization of the participants into conditions. By relying on matching, or matched pairs, of the participating students to those students who chose not to participate, the study neglects certain characteristics of self-selection (e.g., motivation) that may have skewed the balance of academic performance and persistence outcomes in negative ways. That being said, the Campbell and Campbell study provided a trailblazing approach in calling for better conceptualization of the implementation of mentoring initiatives through the help of

theoretical frameworks, and also highlighted the importance of more rigorous design and analytical strategies to approaching the problem of persistence.

Campus Climate

Tinto's (1975) model of student attrition suggested that there are four overarching areas of primary concern, such that a) the students' family backgrounds b), the student's early educational experiences, c) on campus student interactions, and d) the student's personal attitudes and perceptions. Tinto's model has been tapped by a wide variety of studies to compare education outcomes by race. This literature indicated that there was a positive relationship between supportive student environments and persistence outcomes as defined within the context of minority serving institutions (MSIs; Fleming, 1990). However, in the context of a predominantly White university, the social isolation from other African Americans, the inability to culturally integrate, and the pervasive tone of racial inequity pose significant obstacles to successful matriculation through such degree programs (Guloyan, 1986). Helm, Sedlacek, and Prieto (1998) found that there was a significant, positive relationship between a student's perceptions of fair treatment by other students and instructors and "Overall Satisfaction" with their university community as well as their comfort level in "Cross-Cultural Situations". However, high perceptions of racial tension and lack of support were associated with low overall satisfaction.

African American students' educational outcomes appear to be related to the diversity composition of the campus itself. Some have argued that African American students at predominantly White universities are confronted with a host of challenges for which many have not been adequately prepared. For instance, Ehrlich (1990 and 1992) found that African

American students reported a disproportionate amount of verbal discrimination on predominantly White campuses. Even those students who did not report such verbal abuse did, however, indicate that they had peers who had experienced them. How much students are affected by such hostility may depend on their personal backgrounds. Mannan, Charleston, and Saghafi (1986) suggest that students who arrive at on predominantly White campuses from formative educations spent in predominantly White preparatory schools are less affected by racially hostile campus climates. However, most African American students come from formative educations and communities in which they are, indeed, the majority (Allen, 1985; Guloyan, 1986).

Hurtado, Milem, Clayton-Pedersen, and Allen (1998) provided a four-dimensional framework to conceptualize racism as it pertains to the campus climate: 1) the institutions legacy of inclusion; 2) proportionate representation of diversity; 3) between group perceptions and attitudes; and 4) intergroup relations on the campus. In this model, the campus climate for diversity is dependent upon the interaction of these four factors. The importance of the Hurtado, Milem, Clayton-Pedersen, and Allen (1998) model has been confirmed by subsequent studies, particularily in relation to the proportionate representation of diversity. In contrast, other researchers have looked at psychosocial dynamics within academic settings to explore the importance of campus climate for educational outcomes.

Some researchers have argued that active forms of learning (i.e., cooperative learning, presentations, group projects, student-led evaluations of other students' work, and independent learning) are effective methods of providing minority students with a more culturally appropriate form of academic preparation. This also provides students from

varying academic and community backgrounds with opportunities to interact at the classroom level – thus enhancing the feel of a supportive and cooperative learning environment (Johnson and Johnson, 1985 and 1986; Milem and Wakai, 1996; and Slavin 1987).

The importance of these techniques for minority students is linked to their status as "institutional outsiders" (as coined by Merton, 1948), because "outsiders" are more likely to craft research agendas that are most relevant to their particular minority groups, as well as to create novel solutions to hypothesized problems. When such outsiders enter the faculty ranks, they are more likely to be aware of certain classroom dynamics than are faculty who have majority status. Theorists such as Patricia Hill Collins (1997) suggest that the importance of "commonality of experiences and perspectives" (one factor associated with Feminist Standpoint Theory[4]) may account for "outsiders'" novel approach to hypothesizing and creating solutions to problems, such that individuals who share a common background of inequity tend to develop a greater depth of understanding of those who share their common background.

Faculty likeness (race/gender) is an important factor that influences academic success. In a review of research findings, Milem and Astin (1993) and Milem & Wakai (1996) found that active learning environments are most likely to be used by women and

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[4]Feminist Standpoint Theory posits that a "Standpoint" develops when an individual recognizes and then challenges the social norms, cultural values, and power inequities that advance subordination and oppression in the dominant cultural discourse. Power is reclaimed by recognizing that distinct forms of knowledge are acquired by members of a particular group.

minority faculty members. Minority faculty members also more readily accept and practice student-centered approaches to learning that "warm" the campus climate (Kozma, Belle, and Williams, 1978; Milem and Astin, 1993, & Milem and Wakai, 1996). While minority faculty members clearly contribute to diversity on campus, they also are subject to biased perceptions based on race. Smith and Anderson's (2005) investigation of student preconceptions of professors found that European American men saw their minority professors as being less qualified and as being more biased than professors of European ancestry. Indeed, student ratings of faculty effectiveness are lower for faculty from ethnic minority backgrounds than for European American faculty (Smith & Anderson, 2005; Hamermesh & Parker, 2005; Smith, 2007). These research findings about minority faculty at PWIs suggest that students who are "outsiders" may face climate issues on PWI campuses.

Minority Serving Institutions produce a considerable portion of newly conferred STEM degrees, and the Journal of Blacks in Higher Education (Anonymous, 2008) states that (a) women are more effectively promoting degree attainment in STEM fields, (b) of the top twenty African American STEM degree producing universities, all but three are MSIs (c), in 2004, MSIs conferred 22% of all bachelor's degrees to African American students, but produced 30% of bachelor's degrees in STEM fields and (d), African American women represented 33% of MSI bachelor's degrees in STEM, whereas African American men represented 26% of MSI bachelor's degrees in STEM[5]. Sudents who attend Minority Serving Institutions rate their academic and social integration into the scientific academic

[5] Anonymous (2008). "Black colleges and universities are graduating an increasing Share of African Americans who Earn Ph.D.s in mathematics and science." *The Journal of Blacks in Higher Education, 61*, p.35.

environment to be positive (Hurtado et al., 2009). Researchers have argued that one reason students rate their experiences at MSIs so highly is because they perceive their social and psychological interactions with MSI faculty, staff, and peers to be positive (Allen, 1992). In comparison, at PWIs, minority students identify access to resources as critical to positive experiences (Allen, 1992). Outcalt and Skewes-Cox's (2002) review of the relevant literature states that students at MSIs enjoy a sense of community on their campus, as well as having more positive peer-to-peer interactions. These positive social and academic interactions are a hallmark of the MSI educational experience, and the positive social climate that MSIs foster is one important factor in their ability to produce high numbers of underrepresented minority bachelor's degree earners in science (Huang, Taddese, & Walter, 2000; Provasnik & Shafer, 2004; NSF, 2012). In fact, from 1998 to 2004, of the top 15 universities for retaining and graduating underrepresented minority students in the sciences, only two were not MSIs (Chew, 2004; Hurtado, Cabrera, Lin, & Espinosa, 2009).

Summary of the Literature Review

The literature on underrepresented minority students studying science paints a mixed picture of both academic achievement markers and persistence rates. For some models of achievement, early academic preparation and performance are key factors, although some empirical studies have found that underrepresented minority students are as prepared for, and interested in, the undergraduate science curriculum as are White students. Models of educational persistence suggest that both external and internal motivations are key factors to persistence for underrepresented minority students in science. In overview, empirical findings do suggest that a student's positive identification with (and achievement in) science,

positive mentoring experiences, and emersion in an inclusive academic environment may all contribute to persistence. These three areas have, individually, been found to influence the persistence of underrepresented minorities, but their combined impact had not been evaluated prior to the current investigation. Thus, in an effort to better understand the individual and combined influence of these three broad areas on the persistence of African American students in science, the current investigation takes a strengths-based approach to uncovering the unique and unified contribution of these three factors to the persistence of African American students, particularly African American men, studying science.

Restating the Objectives and Aims of the Current Study

The current investigation explored the relationship between three independent variables (i.e., scientist identity, mentoring, and campus climate) on one dependent variable (i.e., intention to persist). Specifically, the goal of this examination was to determine the unique and combined contribution of these variables to the persistence of African American undergraduate science students. The study aimed to address three general research questions regarding persistence among African American science students: 1). Do scientist identity, mentoring, and campus climate have direct effects on intentions to persist, and, are their combined effects on intention to persist greater than their individual effects? 2). Does gender and academic achievement moderate the impact of the independent variables on the dependent variable? 3.) Does attendance at a Minority Serving Institution or a Predominantly White Institution moderate the impact of the independent variables on the dependent variable?

METHOD

Research Questions and Hypotheses

Research Question #1 explored the relationships between intention to persist, scientist identity, at the individual and group levels. To this end, linear multiple regressions were implemented to test the following hypotheses:

> H 1.1: Scientist identity predicts intention to persist through STEM educational programs, such that a highly congruent scientist identity will be related to stronger intentions to persist.
>
> H 1.2: The students' mentoring experiences predict their intention to persist, such that more positive mentoring experiences will be related to stronger intentions to persist.
>
> H 1.3: Campus climate predicts intention to persist, such that more positive assessments of campus climate are related to stronger intentions to persist.
>
> H 1.4: Scientist identity, campus climate, and mentoring combined will better predict intention to persist than do each individually.

Research Question #2 explored student characteristics which, based on the literature, may moderate the relationship between the independent variables and intention to persist. These variables are gender and academic achievement. A moderated multiple regression analysis was implemented in order to test two hypotheses.

H 2.1 Gender moderates the relationship between the independent variables and intention to persist, such that the independent variables better predict intentions to persist for women than for men.

H 2.2 Academic performance moderates the relationship between the independent variables and intention to persist, such that the independent variables better predict intentions to persist for higher achieving students than for lower achieving students.

In attempting to devise a model of student persistence based on scientist identity, mentoring, and campus climate, the current study investigated the relationship between institutional setting and persistence. Research Question #3 centered on differences between students' experiences at Minority Serving Institutions (MSIs) and students' experiences at Predominantly White Institutions (PWIs), to explore the extent to which the independent variables are moderated by the type of institution the students attend. Moderated multiple regression analyses were used to explore these relationships.

H 3.1: Institutional type moderates the relationships between the independent variables and intention to persist, such that students at MSIs have stronger intentions to persist than students attending PWIs.

H 3.2: Institutional type will moderate the relationship between the independent variables and intention to persist after controlling for academic performance, such that academic performance has less influence on MSI

students' intentions to persist than it does on PWI students' intentions to persist.

Design

The current investigation was a cross-sectional predictive analysis of the impact of three independent variables (i.e., scientist identity, mentoring, and campus climate) on an independent variable (i.e., intention to persist). The data were collected from six four-year colleges/universities in North Carolina between February and October of 2012. In an effort to gain access to student participants, cooperating faculty members at each of the universities were identified between March of 2010 and August of 2012. These faculty members were recruited via calls, emails, personal meetings, and snowball recruitment by already confirmed cooperating faculty members. Institutional Review Board (IRB) approval was secured at the base university in February of 2012, and IRB approvals at the universities of cooperating faculty members were secured as these faculty members confirmed their participation. As per individual campus IRB guidelines, cooperating faculty members were allowed to provide incentives to encourage their students to participate (e.g., extra credit). However, these incentives were left solely to the discretion of the cooperating faculty members, and no incentive was provided by the researcher. Cooperating faculty members were also allowed to recruit participants at their discretion, utilizing any method that they choose to recruit their particular sub-populations of students (e.g., flyers, emails, attachments to online assignment boards, and, in certain cases, the primary investigator traveled to the university to present in-class recruitment presentations). Cooperating faculty members had a two-week window

within which to initiate their recruitment efforts and they were instructed to encourage their students to complete the survey within a two-week period after that initiation date.

Because the current investigation sought to determine the impact of science identity, mentoring, and campus climate on intentions to persist among *science* students, science, engineering, technology, and mathematics-related courses were oversampled, such that they represented 53.7% of the courses sampled. That said, participants representing a range of courses, fields of study, and interests were sampled, and non-science participants represented 22.2% of the courses sampled. Another 24.1% of participants sampled represented those students with undecided majors. The degree plans of these students are unknown. (See Table 1 for a complete breakdown of Universities and courses sampled).

The instrument was a web-based 135 item survey that took approximately twenty minutes to complete. Participation was voluntary. A link to the survey was provided in a recruitment script that was dispersed to each of the cooperating faculty members. This recruitment script also provided a brief introduction to the purpose of the study, a declaration on the storage and protection of collected data, a statement assuring that participation was completely voluntary, and the primary investigator's contact information. Students were instructed to complete the survey within two weeks, but, because the primary investigator had no access to the students' individual contact information, no reminders to adhere to the two-week window were sent out and data collected after the two-week window had closed was included in the analyses.

Table 1

Universities and Classes Sampled

Characteristics	Sample
North Carolina Agricultural and Technical University (NC A&T)	9.0%
North Carolina Central University (NCCU)	41.3%
North Carolina State University (NCSU)	36.8%
Shaw University	5.8%
St. Augustine's College	.8%
University of North Carolina	6.3%
	100%

Courses	
Agricultural and Life Sciences	19.0%
Physical Science and Math	7.4%
Engineering	13.5%
Education	18.0%
Humanities	4.2%
Social Sciences	13.8%
Undecided	24.1%
	100%

Participants

Data were collected from a total of 413 students. Eighteen students' data were removed due to a conspicuous lack of variance in responses (e.g., answering 1 for all responses), ten students' data were removed because they identified as a race other than African American, and seven students data were removed because they chose not to complete the study. A total of 378 students are represented in the current investigation. Response rates for this study are virtually impossible to determine, as the primary investigator had little to no control over the direct recruitment of students, thus knowledge of the exact number of students who were recruited as opposed to completed the survey was impaired.

Demographic information was obtained at the beginning and end of the survey instrument (i.e., the first eight questions and the final three questions). All participants self-identified as African American (100%). The sample was composed of exactly 50% women and 50% men, thus both genders were equally represented. A majority of this study's participants were either in their first or second year of study (79.9%), and only 5.8% of the sample had already began their third or fourth year of study by the time they completed the survey. Although no information on the weighting of grade point averages (GPA) was collected, 62.4% of the sample self-reported a high school GPA of 3.0 and above. Of those students self-reporting a GPA of 3.0 and above, 32% self-reported a GPA above 3.5. A majority of participants self-reported above average Scholastic Assessment Test (SAT; Kobrin, Patterson, Shaw, Mattern, & Barbuti, 2008) scores for writing (59%), math (66.3%), and reading (65.7%; See table 2 for a complete breakdown of the relevant demographic information). These GPA and SAT markers of achievement suggest that the sample has a

large representation of high-achieving African American students, which might be attributed to the oversampling science-related courses.

Table 2

Respondent Characteristics

Characteristics	Sample
Gender	
Female	50.0%
Male	50.0%
Ethnicity	
African American/Black	100%
Years at University	
<1	41.0%
1<2	38.9%
2<3	14.3%
3<4	3.2%
4<5	2.6%
*High School GPA	
<2.0	0.5%
2.0 – 2.5	8.7%
2.5 – 3.0	28.8%
3.0 – 3.5	30.4%
>3.5	32.0%
Scholastic Assessment Test (SAT)	
Writing	
200 – 300	1.6%
300 – 400	6.9%
400 – 500	32.5%
500 – 600	37.3%
600 – 700	17.7%
700 – 800	4.0%
Math	
200 – 300	0.8%
300 – 400	9.0%
400 – 500	23.8%
500 – 600	34.9%
600 – 700	24.3%
700 – 800	7.1%
Reading	
200 – 300	2.1%
300 – 400	5.8%
400 – 500	26.5%
500 – 600	39.2%
600 – 700	22.0%
700 – 800	4.5%

*High School GPA scale was not obtained (i.e., weighted v. unweighted).

Measures

Items from four pre-existing scales and instruments were used to assess the relationship between scientist identity, mentoring, campus climate and intentions to persist. The working title for the newly constructed composite scale was *The Scientist Identity, Mentoring, Climate, and Educational Persistence* (SIMC-EP) instrument. The SIMC-EP included 135 items from the Stereotypes of Scientists scale (SOS; Wyer, Schneider, Nassar-McMillan, & Oliver-Hoyo, 2010), the College Student Mentoring scale (CSMS; Nora & Crisp, 2007), the Undergraduate Campus Climate survey (UCC; Whelchel, 2011), and the Career Intentions in Science scale (CIS; Nassar-McMillan, Wyer, Schneider, & Oliver-Hoyo, 2012). Demographic and academic achievement information was also collected. Items also included participants' (1) university of attendance, their (2) birth year, their (3) grade point averages (GPA; weighted and unweighted), their (4) Scholastic Assessment Test (SAT; writing, math, and critical reading) scores, their (5) American College Testing (ACT) scores, their (6) primary major or area of study. Further, information regarding the students' (7) length of time at their university, (8) gender, and their (9) race/ethnicity. See Appendix 1 for all items and the complete questionnaire.

Independent Variables

Scientist Identity: To assess the participants' scientist identity, this investigation created a new measure, drawing from an available stereotypes scale to measure students' preconceptions about scientists and then matching paired responses about students' sense of self in order to distill a scientist identity score. This involved two steps: (1) factor analyses of

students' responses to the Stereotypes of Scientists (SOS; Wyer, Schneider, Nassar-McMillan, & Oliver-Hoyo, 2010) scale items to generate a study-specific stereotypes scale, and (2) calculating a scientist identity score by comparing responses to each scale item to the related "self" item.

Analyses of the Stereotypes of Scientists Scale

The SOS was developed from a survey of undergraduate students from science, technology, engineering, and mathematics (STEM) and non-STEM courses at a large Research 1 university in the Southeastern United States between 2008 and 2010 (n = 1, 106). The twenty-two item scale was distilled from exploratory factor analyses of 56 original items. The final scale reflects two distinct factors: 1.) Professional Competencies (13 items; Cronbach's Alpha [Cronbach, 1951] = .84), and 2.) Interpersonal Competencies (9 items; Cronbach's Alpha =. 77). Examples of item stems include: When I think about scientists, I think that they" with response options such as "Know a lot about the latest discoveries" or "Have fun with colleagues at work") and from a "self" perspective (e.g., "When I think about myself, I: Know a lot about the latest discoveries" or "When I think about myself, I: Have fun with colleagues at work"). Several items in the SOS are negatively worded (e.g., "When I think about scientists, I think that they are: *Insecure*"), and these items were reverse coded in analyses. The SOS is six-point Likert-type response scale ranging from 1 ("Strongly Disagree") to 6 ("Strongly Agree"). The scale is designed to capture students' preconceptions of scientists' professional and interpersonal capabilities and activities.

The SOS scale has demonstrated reliability and validity, as findings have been replicated in studies with different samples (Mahesh 2009; Schneider 2010) and demonstrate that positive stereotypes are linked to being a STEM major (Ryder-Burge 2010; Schneider 2010). However, previous studies were developed with a primarily European American sample of college students studying at large public PWIs (i.e., in Schneider (2010), the study population was 79% European American, 8% African American, 6% Asian American or Asian, 2% Latino American or Hispanic, and 1% Native American or American Indian. Thus for this investigation, a series of exploratory factor analyses were first performed to determine if the two-factor construct would emerge for the fully African American sample of PWI and MSI students. An initial Bartlette's Test of Sphericity (χ^2 [231] = 2061.47, $p <$ .001) and the Kaiser-Meyer-Oklin test of sampling adequacy (KMO = .87) both confirmed that responses to the 22 items in the SOS displayed sufficient common variance for the factor analysis to proceed (Tabachnick & Findell, 2001).

As with the SOS scale, factor loadings less than .40 were considered to be an adequate and conservative cutoff point. Loadings less than .40 were suppressed in the current factor analyses. An unconstrained principle component factor analysis (PCA) with Varimax rotation of the 22 items in the SOS scale was initiated, using SPSS 19, in an iterative sequence.

Five factors with limited practical or theoretical construct validity emerged from the initial exploratory factor analysis, as the 22 items loaded across five factors (see Table 3). Only the first of the five factors had a robust Cronbach's Alpha (M = 4.99, α = .84). In order

to find the best fit of scale items for this study, a sequence of factor analyses systematically forced a reduction in the number of factors, using orthogonal rotation (Abdi and Williams 2010) to force four factors (Table 4), then three factors (Table 5). At this point, the Cronbach's Alpha for the first factor was acceptable (M = 4.93, α = .85), but the other two factors had unacceptable alphas. Three of the twenty-two items failed to sufficiently load among the three forced factors, so those items were removed and the three-factor model was ran again (see Table 6). Again, only one factor had an acceptable Cronbach's Alpha (M = 4.88, α = .86). The analysis was run again, only this time limiting the number of factors to two. As had previously been the case, the resulting factor analysis only had one robust factor with thirteen items (M = 4.88, α = .86), and the item "Insecure" fell out of the model due to a low factor loading (see Table 7). After dropping the "Insecure" variable, and re-running the model, the variable "Out of Touch" also fell out of the model because it loaded on two factors. The item was removed and the model was re-run. The same course of action was taken an additional three times (see Tables 8, 9, and 10) before all items loaded on one of two factors. However, a strong Cronbach's Alpha only appeared for one factor (M = 4.90, α = .85). At this point it became relatively clear that, for this particular population of African American students, only one factor would emerge. The PCA was forced to one factor, and four more items dropped out of the model due to low loadings (see Table 11). The final PCA represented twelve of the original twenty-two items, and displayed a strong Cronbach's Alpha (M = 4.90, α = .85). The resulting items all loaded cleanly and logically, as each item clearly represented the "Professional Competencies" factor of the original SOS (Wyer, et. al., 2010).

Scientist Identity Score

After analyzing the factor structure of the scale, the next step was to determine the congruence between students' stereotypes of scientists and their self-evaluation for parallel items. For instance, the stereotype of scientist item stem read: "When I think about scientists, I think that they are…" and the parallel item read: "When I think about myself, I think that I am…." This crucial step provided a measure of the participants' "science identity" by comparing the stereotypes of scientists responses with their "self" evaluations, transforming the two parallel sets of responses into an average congruence score between "self" (e.g., When I think about myself, I think that I am: Competent) and "scientists" (When I think about scientists, I think that they are: Competent) items. More specifically, the data for all the items that loaded on the Professional Competencies factor were copied into a Microsoft Excel data sheet. The participants' "self" scores were then subtracted from their "scientists" scores. Some students reported higher "self" evaluations than "scientist" evaluations (i.e. they reported their competencies to be higher than those of scientists). Indeed, there were 2253 instances of overestimating "self" in relation to "scientists" found in the 4536 calculations[6]. This represented 49% of the self-scientists calculations. A negative-to-zero transformation was implemented to adjust for these overestimations and to provide a clearer picture of the congruence between participants' "self" and "scientists" responses. The instances of overestimation were transformed into zero base scores. The items were then

[6] There were 12 self-scientist items. Those 12 items, multiplied by the 378 participants, equates to 4536 calculations. Virtually half (49%) of the 4536 calculations resulted in overestimation of "self" in comparison to "scientists".

averaged, and the resulting average deviation between “self” and “scientists” became the measure of congruence between “self” and “scientists” for each study participant, For the scientist identity measure, the smaller an average deviation the greater the congruence between “self” and “scientists.” Thus, low congruence scores equate to higher scientist identity.

Table 3

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of Stereotypes of Scientists Scale (SOS; Wyer, Nassar-McMillan, Oliver-Hoyo, and Schneider, 2010): Unconstrained Model

		Factor Loadings				
Item	Mean	1	2	3	4	5
Fun With Colleagues	3.73				**.80**	
Maintain Friendships	4.27				**.77**	
Latest Discovery Knowledge	4.92	**.52**		**.45**		
*Have Few Friends	4.00					**.54**
*Out of Touch	4.04					**.70**
Equipment Knowledge	4.44			**.69**		
Careful with Equipment	4.86			**.63**		
Have Happy Marriages	3.81			**.56**		
Competitive	4.85		**.54**			
Cooperative	4.45		**.75**			
Independent	4.96		**.58**			
Work Oriented	5.08	**.51**				
Family Oriented	4.11		**.53**			
Tech. Competence	4.94	**.50**				
Competent	5.00	**.65**				
Self-Confidence	4.82	**.54**				
*Insecure	3.87					**.72**
Collaborative	4.71		**.42**			
Highly Focused	5.13	**.62**				
Learn New Equipment	5.00	**.70**				
Especially Intelligent	5.07	**.76**				
Logical	5.01	**.59**				
Scale Means	4.60	4.99	4.61	4.50	4.00	3.97
Cronbach's Alpha	.84	.84	.66	.63	.63	.42
Item Total	22	9	5	4	2	3

*Items are reverse scored; Loadings less than .40 are suppressed

Table 4

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of Stereotypes of Scientists Scale (SOS; Wyer, Nassar-McMillan, Oliver-Hoyo, and Schneider, 2010): Four Forced Factors

	Factor Loadings			
Item	1	2	3	4
Fun With Colleagues			**.75**	
Maintain Friendships			**.72**	
Latest Discovery Knowledge		**.59**		
*Have Few Friends				**.547**
*Out of Touch				**.69**
Equipment Knowledge		**.67**		
Careful with Equipment		**.67**		
Have Happy Marriages		**.49**		
Competitive	**.60**			
Cooperative	**.48**			
Independent	**.54**			
Work Oriented	**.59**			
Family Oriented			**.49**	
Tech. Competence	**.56**			
Competent	**.56**			
Self-Confidence	**.51**			
*Insecure				**.71**
Collaborative	**.57**			
Highly Focused	**.66**			
Learn New Equipment	**.61**			
Especially Intelligent	**.64**			
Logical	**.58**			
Scale Means	4.91	4.50	4.04	3.97
Cronbach's Alpha	.85	.63	.57	.42
Item Total	12	4	3	3

*Items are reverse scored; Loadings less than .40 are suppressed

Table 5

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of Career Stereotypes of Scientists Scale (SOS; Wyer, Nassar-McMillan, Oliver-Hoyo, and Schneider, 2010): Three Forced Factors

	Factor Loadings		
Item	1	2	3
Fun With Colleagues		**.61**	
Maintain Friendships		**.65**	
Latest Discovery Knowledge	**.63**		
*Have Few Friends		**.45**	
*Out of Touch			**.52**
Equipment Knowledge	**.60**		
Careful with Equipment	**.57**		
Have Happy Marriages	--	--	--
Competitive	**.46**		
Cooperative		**.45**	
Independent	--	--	--
Work Oriented	**.52**		
Family Oriented		**.59**	
Tech. Competence	**.64**		
Competent	**.57**		
Self-Confidence	--	--	--
*Insecure			**.73**
Collaborative		**.44**	
Highly Focused	**.65**		
Learn New Equipment	**.65**		
Especially Intelligent	**.70**		
Logical	**.68**		
Scale Means	4.93	4.21	3.95
Cronbach's Alpha	.85	.60	.36
Item Total	11	6	2

*Items are reverse scored; Loadings less than .40 are suppressed

Table 6

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of Stereotypes of Scientists Scale (SOS; Wyer, Nassar-McMillan, Oliver-Hoyo, and Schneider, 2010): Removing Non-Loading Items with Three Forced Factors

	Factor Loadings		
Item	1	2	3
Fun With Colleagues		**.74**	
Maintain Friendships		**.73**	
Latest Discovery Knowledge	**.60**		
*Have Few Friends			**.51**
*Out of Touch			**.67**
Equipment Knowledge	**.54**		
Careful with Equipment	**.52**		
Competitive	**.53**		
Cooperative	**.42**		
Work Oriented	**.58**		
Family Oriented		**.57**	
Tech. Competence	**.67**		
Competent	**.61**		
*Insecure			**.76**
Collaborative	**.41**		
Highly Focused	**.69**		
Learn New Equipment	**.68**		
Especially Intelligent	**.73**		
Logical	**.70**		
Scale Means	4.88	4.04	3.97
Cronbach's Alpha	.86	.58	.42
Item Total	13	3	3

*Items are reverse scored; Loadings less than .40 are suppressed

Table 7

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of Stereotypes of Scientists Scale (SOS; Wyer, Nassar-McMillan, Oliver-Hoyo, and Schneider, 2010): Two Forced Factors

	Factor Loadings	
Item	1	2
Fun With Colleagues		**.56**
Maintain Friendships		**.54**
Latest Discovery Knowledge	**.57**	
*Have Few Friends		**.62**
*Out of Touch		**.42**
Equipment Knowledge	**.51**	
Careful with Equipment	**.52**	
Competitive	**.57**	
Cooperative	**.45**	
Work Oriented	**.61**	
Family Oriented		**.47**
Tech. Competence	**.70**	
Competent	**.61**	
*Insecure	**--**	**--**
Collaborative	**.45**	
Highly Focused	**.68**	
Learn New Equipment	**.70**	
Especially Intelligent	**.73**	
Logical	**.70**	
Scale Means	4.88	4.03
Cronbach's Alpha	.86	.47
Item Total	13	5

*Items are reverse scored; Loadings less than .40 are suppressed

Table 8

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of Stereotypes of Scientists Scale (SOS; Wyer, Nassar-McMillan, Oliver-Hoyo, and Schneider, 2010): Removing Non-Loading Item with Two Forced Factors

	Factor Loadings	
Item	1	2
Fun With Colleagues		**.57**
Maintain Friendships		**.54**
Latest Discovery Knowledge	**.57**	
*Have Few Friends		**.60**
*Out of Touch	**--**	**--**
Equipment Knowledge	**.51**	
Careful with Equipment	**.54**	
Competitive	**.59**	
Cooperative	**.51**	
Work Oriented	**.60**	
Family Oriented		**.45**
Tech. Competence	**.72**	
Competent	**.61**	
Collaborative	**.50**	
Highly Focused	**.67**	
Learn New Equipment	**.66**	
Especially Intelligent	**.68**	
Logical	**.67**	
Scale Means	4.88	4.03
Cronbach's Alpha	.86	.53
Item Total	13	4

*Items are reverse scored; Loadings less than .40 are suppressed

Table 9

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of Stereotypes of Scientists Scale (SOS; Wyer, Nassar-McMillan, Oliver-Hoyo, and Schneider, 2010): Removing Non-Loading Item with Two Forced Factors

	Factor Loadings	
Item	1	2
Fun With Colleagues		**.68**
Maintain Friendships		**.67**
Latest Discovery Knowledge	**.58**	
*Have Few Friends		**.52**
Equipment Knowledge	**.51**	
Careful with Equipment	**.50**	
Competitive	**.53**	
Cooperative		**.40**
Work Oriented	**.58**	
Family Oriented		**.59**
Tech. Competence	**.67**	
Competent	**.60**	
Collaborative	**--**	**--**
Highly Focused	**.69**	
Learn New Equipment	**.70**	
Especially Intelligent	**.75**	
Logical	**.71**	
Scale Means	4.93	4.11
Cronbach's Alpha	.85	.55
Item Total	11	5

*Items are reverse scored; Loadings less than .40 are suppressed

Table 10

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of Stereotypes of Scientists Scale (SOS; Wyer, Nassar-McMillan, Oliver-Hoyo, and Schneider, 2010): Removing Non-Loading Item with Two Forced Factors

	Factor Loadings	
Item	1	2
Fun With Colleagues		**.71**
Maintain Friendships		**.69**
Latest Discovery Knowledge	**.59**	
*Have Few Friends		**.51**
Equipment Knowledge	**.52**	
Careful with Equipment	**.51**	
Competitive	**.54**	
Cooperative	**40**	
Work Oriented	**.60**	
Family Oriented		**.57**
Tech. Competence	**.68**	
Competent	**.61**	
Highly Focused	**.69**	
Learn New Equipment	**.70**	
Especially Intelligent	**.75**	
Logical	**.71**	
Scale Means	4.90	4.03
Cronbach's Alpha	.85	.53
Item Total	12	4

*Items are reverse scored; Loadings less than .40 are suppressed

Table 11

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of Stereotypes of Scientists Scale (SOS; Wyer, Nassar-McMillan, Oliver-Hoyo, and Schneider, 2010): One Forced Factor

	Factor Loadings
Item	1
Fun With Colleagues	**--**
Maintain Friendships	**--**
Latest Discovery Knowledge	**.59**
*Have Few Friends	**--**
Equipment Knowledge	**.52**
Careful with Equipment	**.51**
Competitive	**.54**
Cooperative	**40**
Work Oriented	**.60**
Family Oriented	**--**
Tech. Competence	**.68**
Competent	**.61**
Highly Focused	**.69**
Learn New Equipment	**.70**
Especially Intelligent	**.75**
Logical	**.71**
Scale Means	4.90
Cronbach's Alpha	.85
Item Total	16

*Items are reverse scored; Loadings less than .40 are suppressed

Table 12

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of Stereotypes of Scientists Scale (SOS; Wyer, Nassar-McMillan, Oliver-Hoyo, and Schneider, 2010): Final Scale

	Factor Loadings
Item	1
Latest Discovery Knowledge	**.59**
Equipment Knowledge	**.52**
Careful with Equipment	**.51**
Competitive	**.54**
Cooperative	**40**
Work Oriented	**.60**
Tech. Competence	**.68**
Competent	**.61**
Highly Focused	**.69**
Learn New Equipment	**.70**
Especially Intelligent	**.75**
Logical	**.71**
Scale Means	4.90
Cronbach's Alpha	.85
Item Total	12

Factor loadings have been rounded; Loadings less than .40 are suppressed

Mentoring: A derivation of the College Student Mentoring Scale (CSMS; Nora and Crisp, 2007; Crisp, 2009, Crisp & Cruz, 2010) was used to assess the participants' mentoring experiences. The CSMS sprang from early theoretical works in the fields of primary and secondary education, psychology, and business (Crisp & Cruz, 2010). The work was grounded in the premise that, for undergraduate college students, there are four distinct (yet highly interrelated) ways by which perceptions of mentoring experiences are shaped: 1.) Psychological and Emotional Support (8 items), 2.) Degree and Career Support (6 items), 3.) Academic Subject Knowledge Support (5 items), and 4.) Existence of a Role Model (6 items). The CSMS included a total of 25 items, and 19 of 25 items were selected for their applicability to the current study. These nineteen items reflect the four dimensions of the CSMS[7]. The CSMS items were adapted for use with a 6-point Likert-type scale for interpretive convenience in relation to other measures in the current study. Response categories ranged from 1 "Strongly Agree" to 6 "Strongly Disagree."

The 2010 Crisp and Cruz confirmatory analysis of the CSMS is particularly relevant to the current investigation, because the measure was validated on a sample of Hispanic American students studying at a large doctoral degree granting Hispanic Serving Institution located in the South. Their sample consisted of 363 participants, roughly equal in numbers of women (54%) and men (46%). However, the ethnic distribution of the sample was quite

[7] Since the development of the current use of the CSMS, the scale has been expanded and validated (Holt & Berwise, 2012).

diverse, in that students self-identified as White (42%), Hispanic (42%), African American (8%), Asian American (6%), and Native American or American Indian (<1%). A series of exploratory factor analyses were performed on data in the current investigation in order to determine if the four-factor Crisp and Cruz (2010) model could be confirmed with a population of exclusively African American students. The resulting Bartlette's Test of Sphericity (χ^2 [171] = 2712.93, $p < .001$) and the Kaiser-Meyer-Oklin test of sampling adequacy (KMO = .93) both confirmed that the CSMS items display sufficient common variance for the factor analysis (Tabachnick & Findell, 2001) to proceed.

An unconstrained principal component factor analysis with Varimax rotation of the nineteen CSMS items that were used for the current study was run for the participants who indicated that they had an intact mentoring relationship on campus.[8] Factor loadings less than .40 were suppressed for this analysis. Unlike Crisp and Cruz (2010), who confirmed a four-structure model with their sample, the unconstrained PCA on the current sample of African American students initially resulted in a two factor model with numerous double-loading items. Crisp and Cruz (2010) do note that there is a high degree of interrelatedness among the mentoring variables, and this might explain why their model and the current model are so

[8] Of the 378 participants included in the analyses of the current investigation, 124 (32.8%) reported having a mentor and 254 (67.2%) reported that they did not have a mentor. Although the percentage of students reporting a lack of a mentor seems high, previous literature suggests that "mentor" is often poorly defined (Lunsford, 2007). In the current investigation, the survey instrument included a definition of mentor as ("someone who you consider to be influential to your academic preparedness. They are likely to be wiser and more learned about your field of study, and will provide you with advice regarding your academic future.")

distinct. Each of the two factors that resulted from the unconstrained model demonstrated a high Cronbach's Alpha (M = 4.88, α = .97 and .95; see Table 13), and all items were retained. However, considering the unusually high occurrence of double loadings and given that previous research had noted a high degree of interrelatedness among the mentoring variables, a PCA with one forced factor was run in order to determine if there was a single underlying factor at play. The single factor model had strong fit indices and retained all nineteen items (M = 4.88, α = .97; see Table 14).

Table 13

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of the College Student Mentoring Scale (Crisp, 2009): Unconstrained Model

		Factor Loadings	
Item	Mean	1	2
Honest Expression	4.97	**.77**	
Emotional Support	4.86	**.76**	
Brainstorming Support	5.05	**.80**	**.40**
Encourages Counseling	4.77	**.43**	**.61**
Coping Strategies	5.00	**.79**	
Confident of Success	5.03	**.87**	
Confidence in Me	5.01	**.85**	
Uninterrupted Meetings	4.72		**.89**
Regular Meetings	4.46		**.90**
Unbiased Feedback	4.81	**.69**	**.51**
Academic Preparation	4.92	**.71**	**.50**
Achievement Strategies	4.94	**.72**	**.46**
Explore Opportunity	4.86	**.60**	**.60**
Academic Objectives	4.88	**.67**	**.55**
Assumption Analysis	4.81	**.75**	
Career Examination	4.92	**.73**	
Life Strategies	4.84	**.66**	**.56**
Goal Competencies	4.97	**.80**	
Willingness to Help	4.90	**.74**	
Scale Mean	4.88	4.91	4.83
Cronbach's Alpha	.97	.97	.95
Item Total	19	17	10

Note. n = 124; Factor loadings are rounded up; Loadings less than .40 are suppressed

Table 14

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of College Student Mentoring Scale (Crisp, 2009): One Forced Factor

	Factor Loadings
Item	1
Honest Expression	**.77**
Emotional Support	**.78**
Brainstorming Support	**.90**
Encourages Counseling	**.69**
Coping Strategies	**.85**
Confident of Success	**.89**
Confident in Me	**.89**
Uninterrupted Meetings	**.72**
Regular Meetings	**.72**
Unbiased Feedback	**.86**
Academic Preparation	**.87**
Achievement Strategies	**.86**
Explore Opportunities	**.83**
Academic Objectives	**.86**
Assumption Analysis	**.84**
Career Examination	**.83**
Life Strategies	**.86**
Goal Competencies	**.87**
Willingness to Help	**.81**
Scale Mean	4.88
Cronbach's Alpha	.97
Item Total	19

Note. n = 124; Factor loadings are rounded up; Loadings less than .40 are suppressed

Campus Climate: The climate survey used in the current analysis was developed to assess attributes/perceptions of students' campus diversity environment. Drawing from the Campus Climate Survey (CCS) of North Carolina State University's (NCSU) Office department of Institutional Planning and Analysis, in cooperation with the Office of Diversity and Inclusion, 51 items were distilled for the current investigation. The CCS (Whelchel, 2011) evolved from an earlier version from 2004, and is used by the university to gather information and perceptions of undergraduate and graduate students' diversity climate. The instrument takes a global perspective on understanding diversity and inclusion, and covers topics ranging from interactions with divergent groups on campus (e.g., women, other racial and sexual minorities, myriad religious groups, etc.) to perceptions of how on-campus diversity climate has shaped their educational experiences. It is used for purposes of institutional self-assessment and policy development.

The full 2011 CCS consists of 200 closed-ended and 6 open-ended questions that are grouped in 8 different categories. The surveyed population included 28, 845 students, of which the vast majority were undergraduates (22,050) and the remainder were graduate students (6,795). The CCS (2011) was only accessible via a secure survey site, and students could only access the survey by signing in with their university-provided authentication information. Factor loadings for the CCS have not been published, thus the current investigation implemented an exploratory factor analysis to determine both the factor structure of the CCS and the quantitative impact on intention to persist. Because the CCS is a large survey that attempts to cover a broad, global perspective of diversity climate (i.e., 200 items), the current investigation distilled the fifty-one questions that dealt exclusively with

campus climate diversity. The Bartlette's Test of Sphericity (χ^2 [1275] = 11168.04, $p < .001$) and the Kaiser-Meyer-Oklin test of sampling adequacy (KMO = .89) both confirmed that the CCS items employed by the current investigation display sufficient common variance for the factor analysis (Tabachnick & Findell, 2001) to proceed.

The fifty-one items drawn from the CCS were run in an unconstrained principal component factor analysis with Varimax rotation. As with the previous two factor analyses for independent variables, all factor loadings less than .40 were suppressed to ensure a conservative estimate of item fit. Four clear factors emerged, reflecting (a) campus support (20 items; $M = 4.84$, $\alpha = .92$), (b) faculty and staff stereotypes (14 items; $M = 2.28$, $\alpha = .94$), (c) respect/relations (11 items; $M = 4.59$, $\alpha = .82$), and (d) student stereotypes (7 items; $M = 3.29$, $\alpha = .88$). All items were retained in the initial exploratory PCA, and the factors were logical and had face validity. All items had loadings about .40, the items clearly loaded on logical factors, and the four factors all displayed good fit (see Table 15).

Table 15

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of the Campus Climate Survey (Whelchel, 2011): Four Forced, Conceptually-Relevant Factors

		Factor Loadings			
Item	Mean	1	2	3	4
Faculty –Student Respect	4.55			**.59**	
Faculty – Minority Respect	4.69			**.70**	
Faculty – Female Respect	4.78			**.59**	
Student –Faculty Respect	4.58			**.57**	
Student –Minority Faculty Respect	4.45			**.68**	
Student –Female Faculty Respect	4.79			**.63**	
Student – LGBT Respect	4.30			**.66**	
Student – Race Relations	465			**.52**	
Student – LGBT Relations	4.18			**.54**	
Campus Support – AA	4.96			**.41**	
Campus Support – Asian	4.62	**.60**			
Campus Support – Latino	4.64	**.62**			
Campus Support – Native	4.72	**.67**			
Campus Support – White	5.05	**.60**			
Campus Support – International	5.06	**.66**			
Campus Support – Female	5.15	**.61**			
Campus Support – Male	5.13	**.60**			
Campus Support – Transgender	4.41	**.50**			
Campus Support – LGB	4.51	**.40**			
Campus Support – Christian	5.05	**.63**			
Campus Support – Jewish	4.78	**.73**			
Campus Support – Muslim	4.53	**.70**			
Campus Support – Non-Christian	4.76	**.72**			
Campus Support – Disability	4.98	**.66**			
Campus Support – Low SES	4.79	**.56**			
Campus Support – Middle SES	5.04	**.66**			
Campus Support – Upper SES	5.18	**.59**			
Campus Support – Non-Traditional	4.90	**.68**			
Campus Support – Parents	4.85	**.78**			
Campus Support – Veterans	4.92	**.67**			
Faculty Stereotype – Disability	2.04		**.68**		
Faculty Stereotype – Gender	2.14		**.69**		
Faculty Stereotype – Immigration	2.14		**.68**		
Faculty Stereotype – Race	2.35		**.56**		
Faculty Stereotype – Religion	2.22		**.61**		
Faculty Stereotype – Sex. Orientation	2.23		**.71**		
Faculty Stereotype – SES	2.15		**.66**		

Continued

Table 15

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of the Campus Climate Survey (Whelchel, 2011): Four Forced, Conceptually-Based Factors

		Factor Loadings			
Item	Mean	1	2	3	4
Staff – Stereotype Disability	2.16		**.79**		
Staff Stereotype – Gender	2.30		**.77**		
Staff Stereotype – Immigration	2.27		**.80**		
Staff Stereotype – Race	2.45		**.77**		
Staff Stereotype – Religion	2.32		**.78**		
Staff Stereotype – Sex. Orientation	2.42		**.77**		
Staff Stereotype – SES	2.31		**.75**		
Student Stereotype – Disability	2.87				**.64**
Student Stereotype – Gender	3.46				**.77**
Student Stereotype – Immigration	3.07				**.75**
Student Stereotype – Race	3.39				**.73**
Student Stereotype – Religion	3.10				**.62**
Student Stereotype – Sex. Orientation	4.06				**.71**
Student Stereotype – SES	3.05				**.67**
Scale Means	3.87	4.84	2.28	4.59	3.29
Cronbach's Alpha	.86	.92	.94	.82	.88
Item Total	51	20	14	11	7

Factor loadings are rounded; Loadings less than .40 are suppressed

Moderators

Gender: The students were asked to identify their gender (male = 0, female = 1).

Academic Performance: Self-reported high school GPA information was collected, but because information regarding the weighting of GPAs was not collected, the GPA measure may not be reliable and is potentially skewed. Thus self-reported Scholastic Assessment Test (SAT; Kobrin, Patterson, Shaw, Mattern, & Barbuti, 2008) scores served as the proxy for academic performance/achievement in the current investigation. This measure has been shown to be a relatively reliable predictor of academic achievement (Kobrin et al., 2008). The SAT has three sections, critical reading (SAT-CR), mathematics (SAT-M), and writing (SAT-W). These scores for each section range from 200 – 900, and the national average for each section is 500[9]. The scores were transposed into either below or above average by using the average SAT cutoff of 500.

Institutional Type: The students were asked to identify their primary university, and the primary investigator then recoded those universities based on their function as a minority serving institution or a primarily white institution (MSI = 0, PWI = 1).

Dependent Variable

[9] The average SAT score centers on the middle value of possible scores, thus a score of roughly 500 or above on each section could be translated to mean that the student has performed better than half of the population taking the exam (Kobrin, Patterson, Shaw, Mattern, & Barbuti, 2008).

Intention to Persist: The students' intentions to persist were measured by the Career Intention in Science Scale (CIS; Nassar-McMillan, Wyer, Schneider & Oliver-Hoyo, 2012). The CIS is composed of twelve items, and has a one-factor structure (α = .98; Nassar-McMillan, et. al., 2012). The CIS employs a six-point, forced choice Likert-type scale ranging from 1 (Very Unlikely) to 6 (Very Likely). The CIS evolved from earlier occupational choice work by Ellis and Herman (1983) that found two dimensions of influence over occupational choice, such that (1) "certainty" reflects students' ambition and (2) "duration" reflects students' short and long-term goals and expectations in science. These two dimensions are embedded in the wording of the CIS, such that questions in the certainty dimension are worded to determine the extent to which it is likely that students will pursue science (e.g., "In your future career, how likely is it that you will: Become a scientist.") and questions that fall along the duration dimension are worded to reflect students' future plans in a science career (e.g., "In your future career, how likely is it that you will: Have a lifelong career in science.").

Because the CIS has not been validated on an African American student population, an exploratory principal component factor analysis was run to determine the fit of the questions to the scale for this population. The Bartlette's Test of Sphericity (χ^2 [66] = 7368.05, $p < .001$) and the Kaiser-Meyer-Oklin test of sampling adequacy (KMO = .96) both confirmed that the CIS items employed by the current investigation display sufficient common variance for the factor analysis (Tabachnick & Findell, 2001) to proceed. High factor loadings ranging from .80 to .96 on the twelve items of the CIS further justified their

inclusion in the scale, and all twelve items loaded on a single factor (M = 3.42, α = .92; see Table 16).

Table 16

Factor Loadings for Principle Component Factor Analysis with Varimax Rotation of the Career Intentions in Science scale (CIS; Wyer, Nassar-McMillan, Oliver-Hoyo, and Schneider, 2010): Unconstrained Model

		Factors
Item	Mean	1
Career Science	3.50	**.94**
Collegiate Training Science	3.86	**.80**
Success Science	3.28	**.94**
Advanced Degree Science	3.34	**.93**
Career Likelihood Science	3.12	**.92**
Ability Science	3.58	**.89**
Advanced Education Science	3.53	**.94**
Degree Attainment Science	3.50	**.93**
Research Science	3.35	**.95**
Graduate School Science	3.20	**.93**
Career Longevity Science	3.33	**.95**
Career Success Science	3.40	**.96**
Scale Means		3.42
Cronbach's Alpha		.98
Item Total		12

Factor loadings are rounded up.

Data Analyses

The data were analyzed using the 19th installation of the Statistical Package for the Social Sciences (SPSS), and the negative-to-zero transformation on self and scientists scores was conducted using Microsoft's Excel. A statistical significance of $p \leq .05$ was used for all analyses. Any negatively worded items were reverse coded. All scales were normally distributed, thus no distribution transformations were required (see Table 17 for a summary of measures).

Table 17

Summary of Measures

Variable	Variance Explained	*M*	*SD*	# of Items	Reliability
1.) Stereotypes of Scientists (SOS)*					
Professional Competencies (Original)	39.18%	4.90	0.68	12	.86
Scientist Identity (Neg.-to-zero Transformed)	39.18%	0.48	0.46	12	.86
2.) College Student Mentoring Scale (CSMS)*					
CSMS Single Factor	68.54%	4.88	0.81	19	.97
3.) Campus Climate Scale (CCS; NCSU)*					
CCS Support	16.39%	4.84	0.66	20	.92
CCS Faculty/Staff Stereotypes	16.02%	2.28	0.98	14	.94
CCS Respect	8.50%	4.59	0.71	11	.82
CCS Student Stereotypes	7.95%	3.29	1.16	7	.88
4.) Career Intentions in Science (CIS)**					
CIS Single Factor	85.29%	3.42	1.57	12	.98

Note. n = 378;
*Items range from 1: Strongly Disagree to 6: Strongly Agree
**Items range from 1: Very Unlikely to 6: Very Likely

RESULTS

Results of the current investigation will be broken down into three major sections: 1) descriptive statistics of all scale items, 2) results of the three research questions and their hypotheses, and 3) exploratory analyses.

Section One: Descriptive Statistics of All Scale Items

This section provides an overview of descriptive information for scales used in study variables, including the Stereotypes of Scientists (SOS) scale, the College Student Mentoring (CSMS) scale, each of the four factors of the North Carolina State University Campus Climate Survey (CCS), and the Career Intentions in Science (CIS) scale. These descriptive results are presented in terms of the percentages of African American students with science interests who either agreed with the items (e.g., who answered "Strongly Agree" or "Agree" for the SOS, CSMS, and CCS) or disagreed (e.g., who answered "Strongly Disagree" or "Disagree"). The same information will be provided for the CIS, with response choices for the CIS of "Very Unlikely" to "Very Likely."

The SOS Items

Previous investigations using the SOS scale have found that items cleanly loaded on one of two factors (i.e., "Professional Competencies" and "Interpersonal Competencies"; (Wyer et. al., 2010; Nassar-McMillan, Wyer, Schneider, & Oliver-Hoyo, 2012). However, only one significant factor manifest for the current investigation (i.e., "Professional Competencies"). The distinction between the previous studies and the current investigation is that the previous studies used multi-ethnic samples with low African American representation (i.e., below 8%), whereas the current investigation used an exclusively African

American sample. Twelve items represented the Professional Competencies factor. Participants' responses on each of the twelve items trended toward high levels of agreement. For instance, on the "Latest Discovery Knowledge" item, 75.1% of respondents either agreed or strongly agreed that scientists "know a lot about the latest discoveries," whereas only 3.8% either disagreed or strongly disagreed. This high degree of affirmation of scientists' professional competencies is in line with previous research (Wyer et. al., 2010; see Table 18 for an item breakdown of percentages of "Strongly Agree" and "Strongly Disagree").

Table 18

Descriptive Statistics by Item for the Stereotypes of Scientists (SOS) Scale

Item	*M*	*SD*	% Strongly Agree	% Strongly Disagree
Professional Competencies	4.90	0.68		
Latest Discovery Knowledge	4.92	1.07	31.2%	1.9%
Equipment Knowledge	4.44	1.25	18.0%	3.4%
Careful with Equipment	4.86	1.20	33.3%	2.1%
Competitive	4.85	1.18	33.1%	2.4%
Cooperative	4.45	1.32	22.8%	4.2%
Work Oriented	5.08	1.03	38.9%	1.9%
Technology Competence	4.94	1.11	35.7%	1.9%
Competent	5.00	1.07	34.9%	2.1%
Highly Focused	5.13	1.02	43.7%	0.5%
Learn New Equipment	5.00	1.02	35.2%	1.6%
Especially Intelligent	5.07	0.99	38.1%	1.1%
Logical	5.01	1.02	34.7%	1.9%

Note. n = 378

Note. The stem for these responses is “When I think about scientists, I think they are:”

The CSMS Items

The initial validation of the College Student Mentoring Scale (CSMS; Crisp, 2009) found a four-factor structure: 1) Psychological and Emotional Support, 2) Degree and Career Support, 3) Academic Subject Knowledge Support, and 4) Existence of a Role Model. African American students were underrepresented in the validation study, such that they accounted for only 3% of the 351 participants who were surveyed (Crisp, 2009). A one-factor structure emerged for the current investigation, which utilized an exclusively African American sample of students. Although the present study includes a larger number of participants than did Crisp (2009), of the 378 students who completed the survey for the current investigation, only 124 students responded affirmatively to having a mentor. Only those students who responded that they had a mentor were included in the validation and analyses of the CSMS for the current investigation. A total of nineteen items reflected the students' mentoring experience. The students' responses trended towards positively affirming their mentoring experiences, and, in line with previous research (Crisp, 2009), students were highly likely to either agree or strongly agree with the CSMS items. For example, 79.3% of students either agree or strongly agree that their mentor "expresses confidence in [their] ability to succeed in pursuit of [their] academic goals" (see Table 19 for a breakdown of percentages of "Strongly Agree" and "Strongly Disagree").

Table 19

Descriptive Statistics by Item for the College Student Mentoring (CSM) Scale

Item	*M*	*SD*	% Strongly Agree	% Strongly Disagree
Mentor Competencies	4.88	0.81		
Honest Expression	4.97	0.98	28.7%	0.8%
Emotional Support	4.86	1.04	28.7%	0.8%
Brainstorming Support	5.05	0.84	30.3%	1.6%
Encourages Counseling	4.77	1.05	25.4%	0.8%
Coping Strategies	5.00	0.92	32.0%	1.6%
Confident of Success	5.03	0.90	31.1%	1.6%
Confident in Me	5.01	0.94	31.4%	3.3%
Uninterrupted Meetings	4.72	1.15	23.1%	2.5%
Regular Meetings	4.46	1.29	21.5%	3.3%
Unbiased Feedback	4.81	1.03	26.4%	0.8%
Academic Preparation	4.92	1.02	28.3%	1.7%
Achievement Strategies	4.94	0.96	27.0%	0.8%
Explore Opportunities	4.86	1.05	27.3%	0.8%
Academic Objectives	4.88	1.02	26.2%	0.8%
Assumption Analysis	4.81	0.95	23.0%	2.5%
Career Examination	4.92	0.98	28.7%	3.3%
Life Strategies	4.84	0.94	22.3%	2.5%
Goal Competencies	4.97	0.88	27.0%	1.6%
Willingness to Help	4.90	1.00	27.9%	0.8%

Note. n = 124

Note. The stem for these responses is “My mentor helps (expresses, encourages, etc.)”

The CCS Items

Support: The Campus Climate Survey (CCS) has been used extensively at North Carolina State University over the past decade. Although no validation of the measure has been published, the factor analysis performed on the measure for the current investigation found four clearly loading and theoretically sounds factors: 1) Support, 2) Faculty/Staff Stereotypes, 3) Respect/Relations, and 4) Student Stereotypes. A total of 20 support items were embedded into the CCS in the current investigation, and there was a clear tendency for students to highly agree that their campus environment was supportive of each racial/ethnic/religious/SES/military subgroup represented in the survey. For instance, 35% of the respondents strongly agreed that their "campus environment is supportive of" male students, whereas only .5% of respondents strongly disagreed with that statement. Similarly, 33.3% highly agreed that their campus environment was supportive of women. Only .3% of participants highly disagreed with women being supported on their campus (see Table 20).

Faculty/Staff Stereotypes: There were a total of 14 items represented in the Faculty/Staff Stereotypes factor of the CCS, with seven items referencing faculty and seven items referencing staff stereotypes. For this factor, participants were more likely to strongly disagree that they have heard faculty or staff at their university make negative, inappropriate, or stereotypical statements related to racial/ethnic/religious/SES/military subgroups. In fact, 39.7% of participants strongly disagreed that they have heard faculty members make negative, inappropriate, or stereotypical statements about immigrants on their campus, and 37.4% of students responded that they strongly disagree to hearing staff members make such statements. Important to the current investigation, 38.1% of students strongly disagreed that

they have heard faculty members make negative, inappropriate, or stereotypical statements about race or ethnicity, whereas only 2.9% of students strongly agreed that they had heard of such statements by faculty members. It should be noted that there was a range of responses, and although 38.1% of students say they have never heard staff make negative racial comments, the spread of responses is such that many students have potentially experienced faculty/staff make negative or inappropriate comments (see Table 21).

Respectful Relations: Nine items in the CCS represented the "Respect/Relations" factor. This factor assessed the faculty and students' level of respect for underrepresented students (i.e., minorities, women, and students who identify as lesbian, gay, bisexual, transgendered, or queer/questioning [LGBTQ]). The final two items reference the participants' interactions or "relations" with students from different racial backgrounds and students who identify as LGBTQ. The trend in responses to this question was towards strong agreement, such that 61.7% of participants affirmed that they either "Agree" or "Strongly Agree" that faculty members at their school respect students from racial/ethnic minority groups. For the student-minority respect item, 55% of participants rated either "Agree" or "Strongly Agree" that students on their campus respect students from racial/ethnic minority groups, whereas 6.9% affirmed that they "Strongly Disagree" that students on their campus respect students from racial/ethnic minority groups (see Table 22).

Student Stereotypes: A total of seven items represented the "Student Stereotypes" factor of the CCS. Similar to the "Faculty/Staff Stereotypes" factor, these seven factors evaluated the extent to which participants had heard students make negative, inappropriate, or stereotypical statements about other students on their college campuses. Similar to the

Faculty/Staff Stereotypes factor, there was a slight trend towards strongly disagreeing that they had heard other students make negative, inappropriate, or stereotypical statements about other students. However, there was far more variability across participant responses to these items compared to others in the CCS. For instance, 17.2% of participants strongly disagreed that they had heard students make negative, inappropriate, or stereotypical statements about other students' race on their college campus, whereas 9.3% strongly agreed, 20.9% agreed, 21.7% mildly agreed, 13.8% mildly disagreed, and 17.2% disagreed that they had heard such statements regarding race (see Table 23).

Table 20

Descriptive Statistics by Item for the Campus Climate Scale (CCS): Support

Item	*M*	*SD*	% Strongly Agree	% Strongly Disagree
Support	4.84	0.66		
Campus Support – Asian	4.62	1.23	21.5%	4.0%
Campus Support – Latino	4.63	1.06	20.4%	1.6%
Campus Support – Native	4.72	1.06	24.1%	1.6%
Campus Support – White	5.04	1.04	38.1%	0.5%
Campus Support – International	5.05	0.89	33.1%	0.5%
Campus Support – Female	5.14	0.78	33.3%	0.3%
Campus Support – Male	5.13	0.85	35.0%	0.5%
Campus Support – Transgender	4.41	1.26	21.7%	4.2%
Campus Support – LGBTQ	4.51	1.21	21.7%	2.6%
Campus Support – Christian	5.05	0.91	32.8%	1.3%
Campus Support – Jewish	4.78	1.08	23.5%	2.4%
Campus Support – Muslim	4.53	1.10	19.0%	2.1%
Campus Support – Non-Christian	4.76	1.07	23.1%	2.4%
Campus Support – Disability	4.98	0.92	29.2%	1.1%
Campus Support – Low SES	4.78	1.11	26.5%	2.1%
Campus Support – Middle SES	5.03	0.93	32.2%	0.8%
Campus Support – Upper SES	5.14	0.95	42.9%	1.3%
Campus Support – Non-Traditional	4.90	1.03	29.4%	1.3%
Campus Support – Parents	4.84	0.97	25.5%	0.8%
Campus Support – Veterans	4.92	0.95	28.0%	1.1%

Note. n = 378

Table 21

Descriptive Statistics by Item for the Campus Climate Scale (CCS): Faculty/Staff Expressing Stereotypes

Item	*M*	*SD*	% Strongly Agree	% Strongly Disagree
Faculty/Staff Stereotypes	2.28	0.99		
Faculty– Disability	2.05	1.13	0.8%	37.8%
Faculty– Gender	2.15	1.16	0.8%	34.2%
Faculty– Immigration	2.16	1.25	1.1%	39.7%
Faculty– Race	2.38	1.44	2.9%	38.1%
Faculty– Religion	2.24	1.29	1.9%	36.8%
Faculty– LGBTQ	2.24	1.24	1.6%	35.2%
Faculty– SES	2.18	1.27	2.4%	38.9%
Staff– Disability	2.17	1.28	2.6%	38.6%
Staff– Gender	2.31	1.34	1.9%	35.2%
Staff– Immigration	2.28	1.35	2.4%	37.4%
Staff– Race	2.45	1.43	2.6%	33.1%
Staff– Religion	2.31	1.39	2.9%	36.6%
Staff– LGBTQ	2.43	1.45	4.0%	34.1%
Staff - SES	2.32	1.35	2.4%	34.1%

Note. n = 378

Note. The stem for these responses was “While at your university, have you heard faculty/staff make negative, inappropriate, or stereotypical statements related to:”

Table 22

Descriptive Statistics by Item for the Campus Climate Scale (CCS): Respectful Relations

Item	*M*	*SD*	% Strongly Agree	% Strongly Disagree
Respect/Relations	4.59	0.71		
Faculty to Students Respect	4.53	1.14	20.6%	1.9%
Faculty to Minorities Respect	4.69	1.07	23.3%	1.6%
Faculty to Women Respect	4.77	1.00	21.7%	1.6%
Student to Faculty Respect	4.57	1.12	18.8%	2.1%
Student to Minorities Respect	4.44	1.19	17.2%	2.9%
Student to Women Respect	4.78	0.92	19.0%	1.1%
Student to LGBTQ Respect	4.30	1.21	14.8%	1.9%
Student to Race Relations	4.64	1.10	19.6%	1.9%
Student to LGBTQ Relations	4.19	1.29	15.3%	4.8%

Note. n = 378

Note. The stem for these responses was "How would you assess the following aspects of the campus diversity climate at your university?:"

Table 23

Descriptive Statistics by Item for the Campus Climate Scale (CCS): Students Expressing Stereotypes

Item	*M*	*SD*	% Strongly Agree	% Strongly Disagree
Students Expressing Stereotypes	3.29	1.16		
Stereotypes about Disability	2.88	1.54	3.7%	24.1%
Stereotypes about Female	3.47	1.62	9.0%	17.5%
Stereotypes about Immigration	3.09	1.59	5.6%	23.0%
Stereotypes about Race	3.40	1.61	9.3%	17.2%
Stereotypes about Religion	3.11	1.55	5.0%	20.9%
Stereotypes about LGBTQ	4.06	1.19	12.2%	2.6%
Stereotypes about SES	3.06	1.55	4.8%	21.7%

Note. n = 378

Note. The stem for these responses was “While at your university, have you heard students mane negative, inappropriate, or stereotypical statements related to:”

The CIS Items

There have been several validations of the Career Intentions in Science (CIS) scale (Mahesh 2009; Schneider, 2010; Jenkins, 2012). These previous investigations using the CIS have found that the scale is reliable and valid, and that the one-factor model for the scale holds up across study populations and that it predicts majoring in STEM. The single factor, Intention to Persist, also held for the current investigation, which focused on African American students. Twelve items were included in one factor. Participants' responses to those twelve items varied across items, such that relatively equal percentages of students responded that they were "Very Likely" to have a career in science as responded that they were "Very Unlikely" to have a career in science. For example, when given the stem "In your future, how likely is it that you will: Complete your degree in science", 17.4% responded very likely, 18.7% responded likely, 15.2% responded mildly likely, 14.7% responded mildly unlikely, 13.6% responded unlikely, and 20.3% responded very unlikely. It should be noted that the percentage of students responding "Very Unlikely" could potentially be reflecting the 22.2% of students in the participant population who identified their major as either Education (18%) or Humanities (4.2%). Also, regardless of their science interests, 24.1% of the population identified their major as "Undecided". In summary, the non-science and undecided majors likely influenced the variability across responses for the CIS items (see Table 24).

Table 24

Descriptive Statistics by Item for the Careers in Science (CIS) Scale

Item	*M*	*SD*	% Very Likely	% Very Unlikely
Intention to Persist	3.41	1.57		
Career in Science	3.50	1.72	14.2%	19.6%
College Training in Science	3.86	1.50	16.3%	7.0%
Success in Science	3.28	1.70	10.7%	21.9%
Advanced Degree in Science	3.34	1.75	13.4%	22.7%
Career Likelihood in Science	3.12	1.66	9.4%	24.1%
Ability in Science	3.58	1.69	15.0%	18.4%
Advanced Education in Science	3.53	1.72	14.7%	18.7%
Degree Attainment in Science	3.50	1.78	17.4%	20.3%
Research in Science	3.35	1.68	11.8%	21.1%
Graduate School in Science	3.20	1.69	12.6%	22.2%
Career Longevity in Science	3.33	1.74	12.8%	22.7%
Career Success in Science	3.40	1.74	13.1%	21.7%

Note. n = 378

Note. The stem for these responses was “In your future, how likely is it that you will:”

Section Two: Results of the Three Research Questions and their Hypotheses

The first step in generating results that assess the relationship between Scientist Identity, Mentoring, the four Campus Climate factors and the dependent variable Intention to Persist (Career Commitment) was to calculate the correlations between and among factors in the primary variables. In the Campus Climate measure, there were moderate positive correlations between Climate Respect and Mentoring ($r = .42$, $p < .01$), between Climate Respect and Climate Support ($r = .53$, $p < .01$), and between Climate Student Stereotypes and Climate Faculty/Staff Stereotypes ($r = .46$, $p < .01$). Other correlations were non-significant or significant but somewhat weaker (see Table 25). The Climate Respect and Mentoring correlation $r(124) = .42$, $p < .01$ indicated that participants with higher Climate Respect scores were also likely to have positive views of their Mentoring experience, whereas the Climate Respect and Climate Support correlation $r(378) = .53$, $p < .01$ suggested that students with high Climate Respect scores also have higher Climate Support scores. The Climate Student Stereotypes and Climate Faculty/Staff Stereotypes correlation $r(378) = .46$, $p < .01$ indicated that students with higher Student Stereotype scores also felt that Faculty/Staff members were more likely to have made inappropriate comments regarding race/ethnicity, gender, or sexual orientation.

The next set of correlations was between the moderating variables, (i.e., gender and academic performance) and the dependent variable (Intention to Persist). There were small, yet significant negative correlations for Academic Performance and Gender ($r = -.12$, $p < .05$) as well as Intention to Persist and Gender ($r = -.24$, $p < .01$), but the correlation between Intention to Persist and Academic Performance was non-significant (see Table 25). The

Academic Performance and Gender correlation $r(378) = -.12$, $p < .05$ suggests that men (coded 0) had somewhat lower measures of Academic Performance than did women (coded 1). The Intention to Persist and Gender correlation $r(378) = -.24$, $p < .01$ indicated a small, yet significant trend towards women having somewhat higher Intention to Persist than did men in the current sample of participants.

Table 25
Correlations between the Independent Variables and the Dependent Variable

Primary Variables	1	2	3	4	5	6	7
1. Scientist Identity	-						
2. Mentoring	-.335**	-					
3. Climate Support	-.340**	.324**	-				
4. Climate Fac./Staff Stereotypes	.097	-.273**	-.240**	-			
5. Climate Respect/Relations	-.379**	.416**	.528**	-.297**	-		
6. Climate Student Stereotypes	-.079	-.233**	-.175**	.463**	-.207**	-	
7. Intention to Persist	-.106*	-.077	.066	.012	.054	.047	-
Moderating Variables	1	2	3				
1. Gender	-						
2. Academic Performance	-.117*	-					
3. Intention to Persist	-.240**	.051	-				

Note. n = 378 for all variables accept Mentoring
Note. n = 124 for Mentoring
**p < .05; **p < .01*

Research Question 1: Do scientist identity, mentoring, and campus climate have direct effects on intention to persist for African Americans?

Hypothesis 1.1: Scientist Identity will predict intention to persist through STEM educational programs, such that a highly congruent scientist identity will be related to stronger intentions to persist.

A simple linear regression was run to determine if Scientist Identity (IV) predicted Intention to Persist (DV). The null hypothesis was that the regression coefficient was equal to 0, such that the regression line lacked a slope. The data were examined for missing items and assumption violations before being analyzed, and there were no significant violations of linearity, independence, or homogeneity of variance. Because of the Negative-to-Zero transformation that was performed to create the measure of Scientist Identity, the measure does have a distinct negative skew. This was expected, as transforming the data so that it had a meaningful zero point caused the data to negatively skew.

The results of the simple linear regression indicated that a small yet significant portion of the variance in Intention to Persist was predicted by Scientist Identity. This result suggested that the students' Scientist Identity score was a good predictor of their Intention to Persist $F(1, 372) = 4.25$, $p = .04$ (see Table 26). The unstandardized slope (b= -.362) and the standardized slope ($\beta = -.106$) were significantly different from the null hypothesis of 0 ($t = -2.06$, $df = 372$, $p < .05$), which indicated that for each unit increase in Science Identity there will be a unit decrease in Intention to Persist (see Figure 1). The Multiple R squared ($R^2 =$

.011) indicated that 1% of the variance in Intention to Persist was accounted for by Scientist Identity[10].

Hypothesis 1.2: The students' Mentoring experiences will be related to strong intentions to persist.

A simple regression analysis on Mentoring (IV) and Intention to Persist (DV) was non-significant $F(1, 120) = .717$, $p = .40$. Mentoring did not predict Intention to Persist for the current population, thus it was not used to test the hypotheses of subsequent research questions.

Hypothesis 1.3: Campus Climate will predict intention to persist, such that a positive assessment of Campus Climate will be related to strong intentions to persist.

The regression analyses on the four Campus Climate factors were all non-significant. Neither Climate Support $F(1, 372) = .1.61$, $p = .20$, Climate Faculty/Staff Stereotypes $F(1, 372) = .05$, $p = .82$, Climate Respect/Relations $F(1, 372) = .1.07$, $p = .30$, nor Climate Student Stereotypes $F(1, 372) = .83$, $p = .36$ were significant predictors of Intention to Persist for the current population. The four factors of the Campus Climate measure were not used to test the hypotheses of subsequent research questions.

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[10] These analyses were run on a heterogeneous sample of both science (53.7%) and non-science (46.3%) majors. However, when the analyses were ran on a sub-sample of science majors (n = 203), the significance for Hypothesis 1.1, 1.2, 1.3, and 1.4 did not change. For science majors, only Scientist Identity predicted Intention to Persist, $F(1, 201) = 5.57$, $p = .01$. The Multiple R squared ($R^2 = .027$) indicated that 3% of the variance in Intention to Persist was accounted for by Scientist Identity for science majors in this sample.

Hypothesis 1.4: Scientist Identity, Mentoring, and Campus Climate combined will better predict intention to persist than do each individually.

Due to lack of direct effects in two of the three variables, this test could not be run. The model was not supported.

Table 26

Linear Regression Predicting Intention to Persist by Scientist Identity: Research Question 1

Variables	*B*	*β*	*p*
Independent Variables			
Scientist Identity	-.362	-.106	*.04
Mentoring***	-.153	-.077	.39
Campus Climate Support	.156	.066	.21
Campus Climate Faculty/Staff Stereotypes	.019	.012	.82
Campus Climate Respect/Relations	.118	.054	.30
Campus Climate Student Stereotypes	.064	.047	.36

Note. n = 378
*p < .05
*** n = 121

Table 27

Multiple Regression Predicting Intention to Persist by Scientist Identity, Mentoring, and Four Factors of Campus Climate: Research Question 1

Variables	*B*	*β*	*p*
Independent Variables			
Scientist Identity	-.333	-.113	.06
Mentoring***	-.363	-.183	.08
Campus Climate Support	-.368	-.165	.15
Campus Climate Faculty/Staff Stereotypes	-.138	-.093	.38
Campus Climate Respect/Relations	.753	.323	**.00
Campus Climate Student Stereotypes	.206	.164	.12

Note. n = 378
*p < .05
**p < .01
*** n = 121

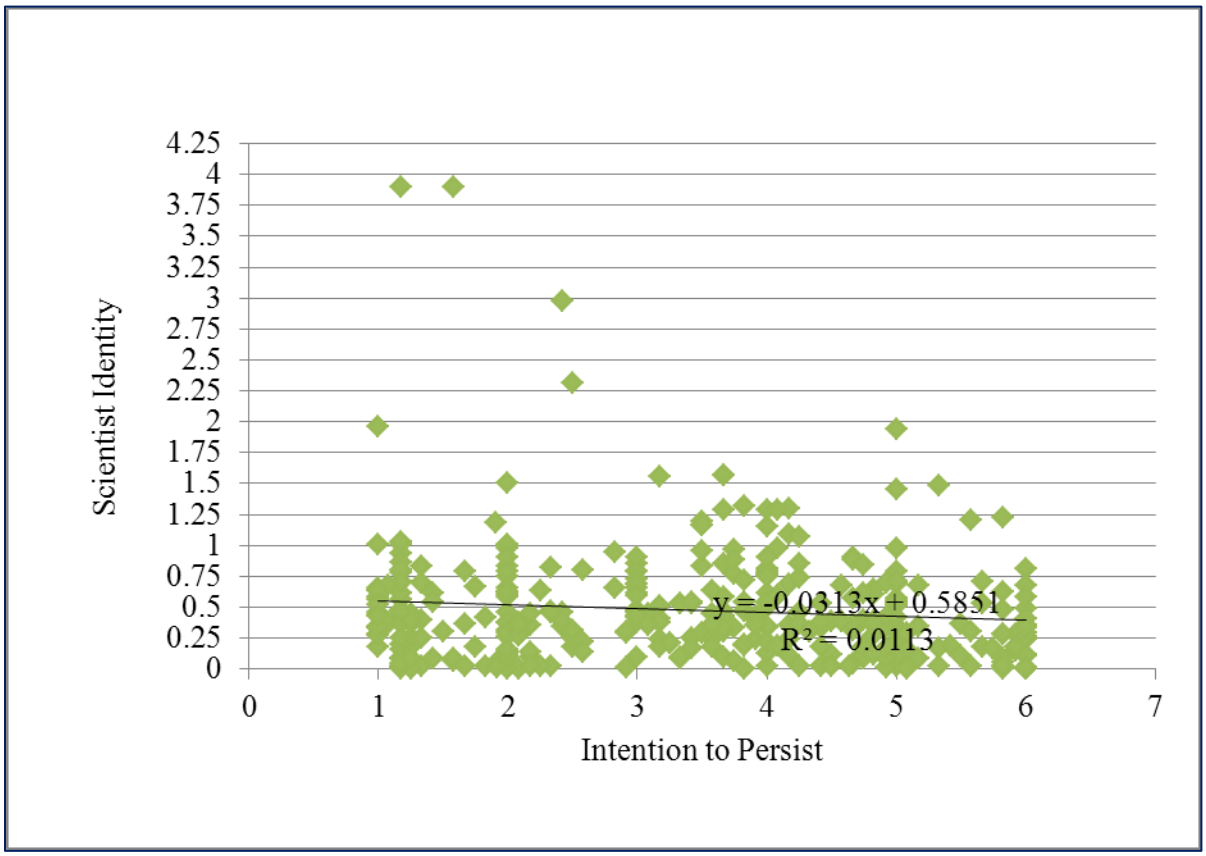

Figure 1: Slope Line of the Scientist Identity by Intention to Persist Regression

Research Question 2: Do gender and academic performance moderate these effects?

Hypothesis 2.1: Gender will moderate the relationship between the independent variables and intention to persist, such that the model will better predicts intention to persist for women than for men.

A gender moderated linear regression between Scientist Identity and Intention to Persist was run. The null hypothesis was that the regression coefficient would be equal to 0, such that there would be no slope. The data were examined for missing items and assumption violations before being analyzed, and there were no significant violations of linearity, independence, or homogeneity of variance. However, because of the Negative-to-Zero transformation that was performed to create the measure of Scientist Identity, the measure does have a distinct negative skew. This was expected, as transforming the data so that it had a meaningful zero point caused the negative skew.

The gender moderated multiple regression had two continuous variables (i.e., Scientist Identity and Intention to Persist) and one categorical variable (i.e., gender). The result of the regression indicated that the effects of Scientist Identity on Intention to Persist were dependent upon gender $F(1, 371) = 13.63$, $p = .00$. To determine the impact of gender on Scientist Identity, the data file was split by gender (men = 0 and women = 1). The regression was run again. The results of the split file regressions indicated that the model was significant for men $F(1, 185) = 5.05$, $p = .03$. However, the model was non-significant for women $F(1, 185) = .57$, $p = .45$. The unstandardized slope for men (b = -.556) and the standardized slope ($\beta = -.163$) were both significantly different from the null hypothesis of 0 ($t = 25.31$, $df = 185$, $p < .05$), which indicated that, among men, for each unit increase in

Science Identity there will be a unit decrease in Intention to Persist. The Multiple R squared (R^2 = .027) indicated that nearly 3% of the variance in men's Intention to Persist was accounted for by Scientist Identity.

Hypothesis 2.2: Academic Performance/Achievement will moderate the relationship between independent variables and intention to persist, such that the model will better predict intentions to persist for those with high academic performance than for those with low academic performance.

An Academic Performance moderated linear regression between Scientist Identity and Intention to Persist was run. The null hypothesis was that the regression coefficient would be equal to 0, such that there would be no discernible slope for the model. The data were examined for missing items and assumption violations before being analyzed. There were no significant violations of linearity, independence, or homogeneity of variance. As was the case for all hypotheses using the Scientist Identity scale, the Negative-to-Zero transformation caused the data to be negatively skewed in a planned and predictable way, so no action was taken to make the item normally distributed.

The Academic Performance moderated multiple regression had two continuous variables (i.e., Scientist Identity and Intention to Persist) and one categorical variable (i.e., Academic Performance). The result of the regression indicated that the effects of Scientist Identity on Intention to Persist were not dependent upon Academic Performance. The model was non-significant, however the effect was approaching significance $F(1, 371) = 2.82$, $p = .06$.

Research Question 3: Does attendance at a Minority Serving Institution (MSI) or a Predominantly White Institution (PWI) moderate these effects?

Hypothesis 3.1: Institutional type moderates the relationship between the independent variables and intention to persist, such that students at MSIs will be more likely to intend to persist than those attending PWIs.

A moderated linear regression with two continuous variables (i.e., Scientist Identity and Intention to Persist) and one categorical variable (i.e., Institutional Type) was run to test the hypothesis. The result of the regression indicated that the effects of Scientist Identity on Intention to Persist were dependent upon Institutional Type $F(1, 371) = 7.11$, $p = .00$. To determine the impact of Institutional Type on Scientist Identity, the data file was split by type (MSI = 0 and PWI = 1). The regression was run a second time. The results of the split file regressions indicated that the model was non-significant yet approached significance for MSIs $F(1, 210) = 3.02$, $p = .08$. The model was non-significant for PWIs $F(1, 160) = 1.78$, $p = .18$.

Hypothesis 3.2: Institutional type moderates the relationship between the independent variables and intention to persist when controlling for academic performance.

Because Hypothesis 3 was unsupported, the moderated linear regression controlling for academic performance was not run.

Section Three: Exploratory Analyses

Considering that the analyses of the current investigation found that Scientist Identity predicted Intention to Persist for African American students, that Gender moderated the effects of Scientist Identity on Intention to Persist, and that Academic Performance

approached significance of moderating the effects of Scientist Identity on Intention to Persist, additional analyses were undertaken to explore the potential for developing a model specific to African American men in STEM. An emerging critique of the racialized narratives that are often associated with African American men suggests the need to focus on the factors that cultivate success among high-achieving African American male students, in order to develop strengths-based research agendas that improve educational achievement for all African American men. Although the results of the current investigation did find that gender moderated the effects of Scientist Identity on Intention to persist, there was no support for hypotheses directed at mentoring experiences or perceptions of the campus climate. However, given the fact that academic performance approached significance in this study, that Institutional Type was found to moderate the relationship between Scientist Identity and Intentions to Persist, and that one factor (Climate Respectful Relations) in the Campus Climate scale was significant in the original model, additional analyses of the data were warranted. The exploratory analyses of the current investigation centered on determining the impact of gender, academic performance and type of institution on African American students' Intention to Persist.

Two exploratory analyses were undertaken to examine: 1) the relationship between Scientist Identity and Intention to Persist for high/low-performing African American men and women; 2) the impact of Scientist Identity, Climate Respectful Relations, and Institution Type on Intention to Persist for high/low-performing African American men.

Exploratory Analysis 1: *The relationship between Scientist Identity and Intention to Persist for high/low-performing African American men*

To explore the relationship between Scientist Identity and Intention to Persist for high-performing African American men, a linear regression with one IV (Scientist Identity) and one DV (Intention to Persist) was run. Before running the linear regression, the data were split into high-performing and low-performing African American students. First, the students' SAT writing, math, and reading scores were averaged. After averaging the SAT scores, the scores were sorted by scores above the SAT national average of 500 (n = 108) and scores below the SAT national average of 500 (n = 270). This became the marker for Academic Performance in the current investigation. The data was then split by the dichotomous Academic Performance scores (0 = Low Performance and 1 = High Performance) as well as the dichotomous gender measure (0 = men and 1 = women). The linear regression was run.

The results of the simple linear regression indicated that, for low-performing African American men, a significant portion of the variance in Intention to Persist was predicted by Scientist Identity. This result indicated that Scientist Identity was a good predictor of Intention to Persist for low-performing African American men $F(1, 42) = 9.44$, $p = .00$. The unstandardized slope (b = -.955) and the standardized slope (β = -.428) were both significantly different from the null hypothesis of 0 ($t = -3.07$, $df = 42$, $p < .01$; see Table 28 and Figure 2), which suggested that, for low-performing African American men in this sample, for each unit increase in Scientist Identity there was a unit decrease in Intention to Persist. In other words, larger incongruence between a student's perceptions of self and scientists equates to lower intentions to persist. The Multiple R squared ($R^2 = .18$) indicated that, for low-performing African American men in the current sample, about 18% of the

variance in Intention to Persist was accounted for by Scientist Identity. It should be noted that this effect was non-significant for high-performing African American men $F(1, 141) = .02$, $p = .88$, for low-performing African American women $F(1, 61) = .1.36$, $p = .25$, and for high-performing African American women in the current participant population $F(1, 122) = .001$, $p = .98$ (see Figure 3).

Table 28

Multiple Regression Predicting Intention to Persist by Scientist Identity and Climate Respectful Relations based on High/Low-Performing African American men: Exploratory Analysis2

	B		*β*		*p*	
Variables	High	Low	High	Low	High	Low
Independent Variables						
Scientist Identity	-.030	.174	-.007	.078	.94	.70
Climate Respectful Relations	.085	1.07	.036	.650	.68	**.00

Note. n = 43
**p < .01

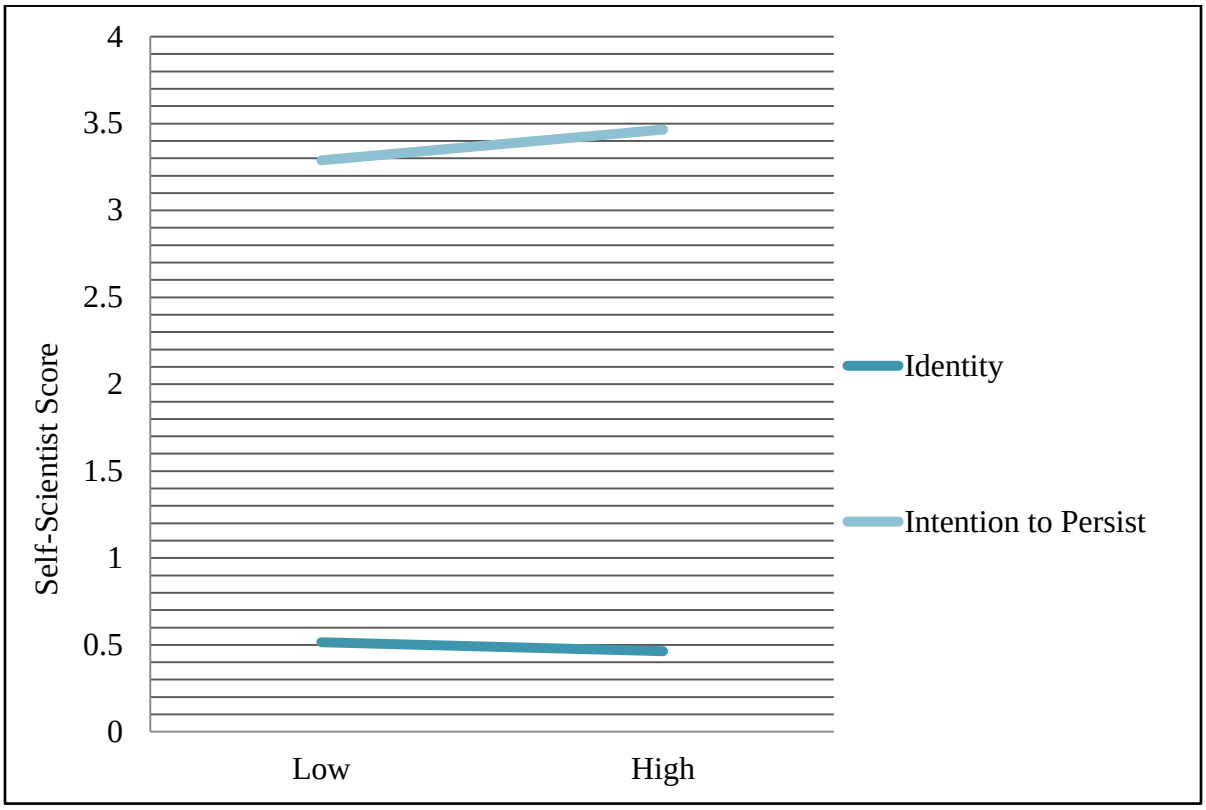

Figure 2: Exploratory Regression for High/Low Performing Students' Scientist Identity by Intention to Persist

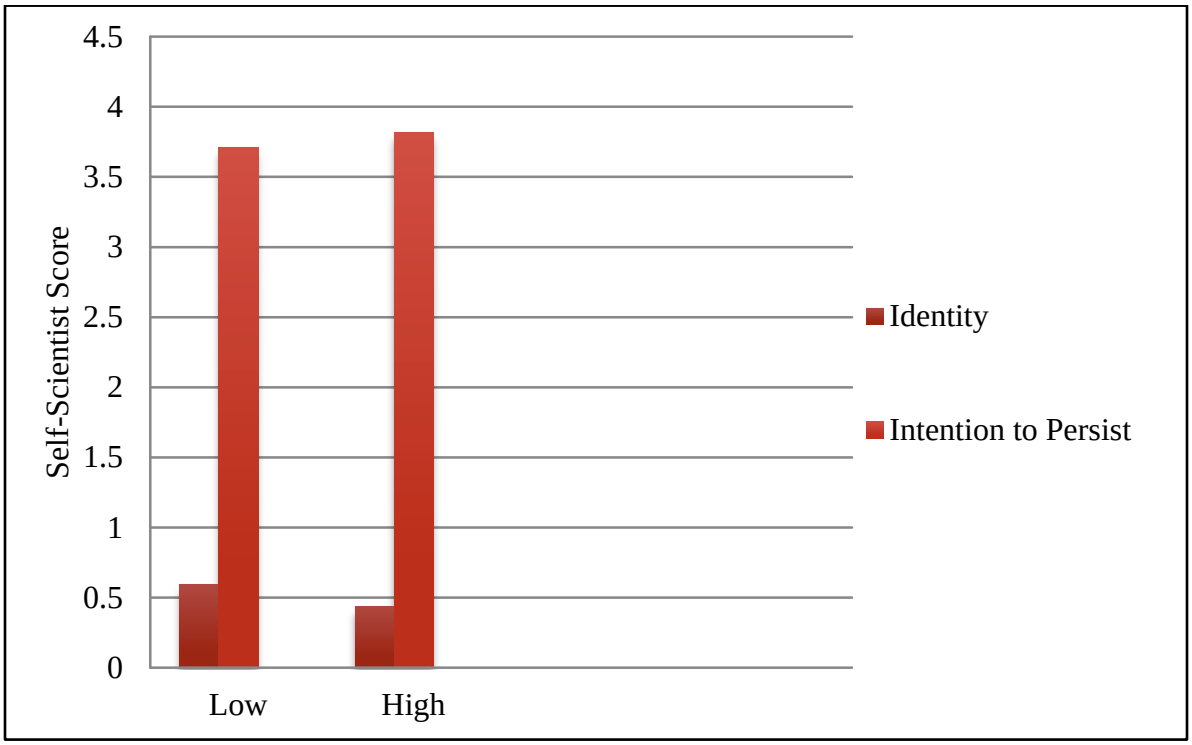

Figure 3: Exploratory Regression for High/Low Performing Men's Scientist Identity by Intention to Persist

Exploratory Analysis 2: *Examining the impact of Scientist Identity, Climate Respectful Relations, and Institution Type on Intention to Persist for high/low-performing African American men*

A multiple linear regression was initially run to determine the influence of Scientist Identity and Climate Respectful Relations on Intention to Persist for high/low-performing African American men. The data file was split by gender (i.e., men and women) and academic performance (i.e., high and low-performance). The results of the multiple linear regression indicated that, for African American men, a significant portion of the variance in Intention to Persist was predicted by Climate Respectful Relations. Scientist Identity became non-significant. Climate Respectful Relations was a good predictor of Intention to Persist for low-performing African American men $F(2, 41) = 11.02$, $p = .00$. The unstandardized slope (b = .1.07) and the standardized slope (β = .650) were both significantly different from the null hypothesis of 0 ($t = 3.24$, $df = 42$, $p < .01$), which suggested that, for low-performing African American men in the current sample, for each unit increase in a Climate Respectful Relations there was a unit increase in Intention to Persist. In other words, low-performing students who experience respectful campus climates are more likely to persist despite their academic performance markers. The multiple R squared ($R^2 = .35$) indicated that, for low-performing African American men in the current sample, about 35% of the variance in Intention to Persist was accounted for by Climate Respectful Relations. This effect was non-significant for high-performing African American men $F(2, 140) = .099$, $p = .91$, for low-performing African American women $F(2, 60) = .821$, $p = .45$, and for high-performing African American women $F(2, 121) = .150$, $p = .86$.

Because Institutional Type approached significance in earlier analyses, the data file was further divided into Institutional Type (MSI and PWI) to determine the influence of campus environment. A multiple regression with two IVs (i.e., Scientist Identity and Climate Respectful Relations) and one DV (Intention to Persist) was run. The results of the multiple linear regression indicated that, for low-performing African American men studying at PWIs, a significant portion of the variance in Intention to Persist was predicted by Climate Respectful Relations. Scientist Identity was non-significant in this model. Climate Respectful Relations was a good predictor of Intention to Persist for low-performing African American men studying at PWIs $F(2, 12) = 24.87$, $p = .00$ (see Table 29). The unstandardized slope (b = 1.41) and the standardized slope (β = .807) were significantly different from the null hypothesis of 0 ($t = 5.30$, $df = 12$, $p < .01$), suggesting that, for low-performing African American men studying at PWI campuses, for each unit increase in Climate Respectful Relations there was a unit increase in Intention to Persist. The Multiple R squared ($R^2 = .81$) indicated that, for low-performing African American men studying at PWIs, about 81% of the variance in Intention to Persist was accounted for by Climate Respectful Relations. This effect was non-significant for high-performing African American men studying at PWIs $F(2, 87) = .474$, $p = .62$, for low-performing African American men studying at MSIs $F(2, 26) = .3.43$, $p = .48$, for high-performing African American men studying at MSIs $F(2, 50) = 1.68$, $p = .20$, for low-performing African American women studying at PWIs $F(2, 11) = 1.00$, $p = .40$, and for high-performing African American women studying at PWIs $F(2, 40) = 1.01$, $p = .37$, or low-performing women studying at MSIs $F(2, 46) = .889$, $p = .42$, and, finally, the

result was non-significant for high-performing African American women studying at MSIs $F(2, 78) = 250$, $p = .78$.

Summary of Results from the Exploratory Analyses

The exploratory analyses of the current investigation were designed to build upon the information attained during the analyses of the primary research questions and hypotheses. The first exploratory analysis explored the relationship between Scientist Identity and Intention to Persist for high/low-performing African American men. The results of a linear regression indicated that, for low-performing African American men, 18% of the variance in Intention to Persist was predicted by Scientist Identity. This result was non-significant for high-performing African American men and low and high-performing African American women in the current participant population.

Because the Climate Respectful Relations factor emerged as a significant predictor of Intention to Persist for Hypothesis 1.4, the next step in the exploratory analyses was to examine the impact of Scientist Identity, Climate Respectful Relations, and Institution Type on Intention to Persist for high/low-performing African American men. The results of a linear multiple regression indicated that Climate Respectful Relations was a good predictor of Intention to Persist for low-performing African American men, accounting for 35% of the variance in Intention to Persist. To explore the influence of Institution Type on this model, the data were split by institution type and the model was run a second time. For low-performing African American men studying at PWIs, 81% of the variance in Intention to Persist was accounted for by Climate Respectful Relations.

But for the relatively small cell sizes that resulted from splitting the data file, the ideal next step would have been to examine the impact of Scientist Identity, Climate Respectful Relations, and Institution Type on Intention to Persist for high/low-performing African American men who were either science or non-science majors. An attempt was made to explore this relationship, but cell sizes under 10 posed a major barrier to accurately interpreting the effects. Previous investigations have determined that Scientist Identity accurately predicts science major (Ryder-Burge, 2011), thus the impact of major on Scientist Identity, Climate Respectful Relations, and Intention to Persist is a logical next step for a later investigation.

Table 29

Multiple Regression Predicting Intention to Persist by Scientist Identity and Climate Respectful Relations based on Institutional Type for low-performing African American men:
Exploratory Analysis 2

	B		*β*		*p*	
Variables	MSI	PWI	MSI	PWI	MSI	PWI
Independent Variables						
Scientist Identity	.014	-.482	.007	-.149	.98	.348
Climate Respectful Relations	.747	1.41	.463	.807	.174	**.00

Note. n = 14
**p < .01

DISCUSSION

This discussion summarizes key findings that emerged from the current investigation, reports on the extent to which these findings confirm or challenge extant literature, and explores how these findings might contribute to understanding factors associated with persistence of African American men in science. The discussion also considers plausible explanations for the non-significant results, examines if (or how) the non-significant results might still provide useful information, and proposes methodological adjustments that may result in useful future applications of the current themes and measures. Finally, a discussion of the limitations of the current investigation, as well as suggestions for possible future research directions, will be presented.

The immediate goal of the current investigation was to examine how African American undergraduate students' scientist identity, mentoring experiences, and assessment of the campus climate were linked to their Intentions to Persist in science. The study aimed to (a) call attention to academic persistence of African American undergraduate science students, and (b) to determine the unique factors that contribute to the persistence of African American men studying science. There were three major research questions: 1.) Do scientist identity, mentoring, and campus climate have direct effects on persistence for African Americans, and are their combined effects on persistence greater than their individual effects? 2) Do gender and academic achievement moderate these effects? 3.) Does attendance at a Minority Serving Institution or a Predominantly White Institution moderate these effects?

The study addressed the three primary research questions and found direct effects for one of the three primary independent variables, Scientist Identity, and for one factor in the Campus Climate measure (i.e., Climate Respectful Relations). The results from the Campus Climate scale were unexpected and so not included in the original hypotheses, but will be discussed in the exploratory analyses section. Scientist Identity significantly predicted Intention to Persist. Because only one of the three independent variables was found to directly impact Intention to Persist for the sample of African American students who participated in the investigation, the model proposed by Hypothesis 1.4 was not supported.

Moderation effects, as proposed in Hypotheses 2 and 3 were partially supported, i.e. gender was significant and Institution Type was significant. For the gender moderation, the Multiple R squared (R^2 = .027) indicated that, among men, for each unit increase in Scientist Identity there was a unit decrease in Intention to Persist. This effect was non-significant for women. The impact of Scientist Identity on Intention to Persist was found to be dependent upon intuitional type, which approached significance for but was non-significant for PWIs.

Exploratory analyses expanded upon the findings in two important ways: 1) by exploring the relationships between Scientist Identity and Intention to Persist for high and low-performing African American men, and 2) by examining the impact of Scientist Identity and Climate Respectful Relations on Intention to Persist for African American men studying at MSIs and PWIs.

The results of the exploratory analyses were promising. The first examination of the impact of Scientist Identity on Intention to Persist for high/low-performing African American men found that 18% of the variance in Intention to Persist was predicted by Scientist Identity

for low-performing African American men. The second examination of the impact of Scientist Identity on Intention to Persist for African American men included one significant factor in the Campus Climate scale in the model. In this analysis, the study found that Climate Respectful Relations accounted for 35% of the variance in Intention to Persist. When the data were further split by university type (i.e., MSI and PWI), Climate Respectful Relations was found to account for 81% of the variance in Intention to Persist for low-performing African American men studying at PWIs. Scientist Identity was no longer significant.

Discussion of the Key Findings

Scientist Identity predicted Intention to persist, and accounted for a small yet significant percentage (1%) of the variance in Intention to Persist.

In the literature review, identity was defined as "a congruent set of normative ideologies and values between the individual and the larger community in which they are striving to become a member" (House, 1981). There are significant barriers to forming a congruent scientist identity because of the multiple identities that compete with the identity of "scientist" (Settles, 2004). Some researchers suggest that, for African American students, pathways to science often take culturally-based trajectories, and so for these science learners developing a congruent scientist identity may be especially challenging (Nasir et al., 2006).

The significant Scientist Identity finding of the current investigation contributes to the literature even though the effect is small, since there are so few quantitative studies of science identity that focus on African American students. Carlone and Johnson (2007) have argued that increasing quantitative research on African American students' persistence in

science-related degree programs is of paramount importance, because (a) there is a lack of theoretically sound investigations, (b) the phenomenological approach that many research initiatives takes only provides a surface understanding of the distinct factors that influence Scientist Identity for underrepresented minority students, and (c) the relationship between environmental factors and individual agency needs more clarity.

Other research posits that students invest and withdraw from science depending on their degree of interest in science (Singh, Granville, & Dika, 2002; Xu, Coats, & Davidson, 2012), and science interest has been found to impact future educational decisions and career choices (Krapp, 2000). The significant findings in the current investigation reinforce the Singh, Granville, and Dika (2002) findings, such that science identity is plausibly related to science interests, which predicts persistence.

Scientist Identity was a significant predictor of Intention to Persist for African American men, in particular, as it accounted for a small yet significant percentage (3%) of the variance in African American men's Intention to Persist.

One theme in the literature review is that a significant portion of research on African American men's achievement and degree completion relies on outdated racialized narratives that describe African American men as disenfranchised, uneducable, dysfunctional, endangered and dangerous people (Davis, 2003; Kunjufu, 2001; Parham and McDavis, 1987; Noguera, 2003; Strayhorn, 2008). From this perspective, prominent stereotype-laden social narratives and characterizations of African American men set them apart from European American students who are successful in reaching their educational attainment goals (Harper,

2006; Palmer et. al. 2010). In response to the persistent reiteration of findings that emphasize barriers to African American male students' academic achievement and persistence to degree completion, some researchers are now challenging the deficits-based approach to the achievement gap. For instance, Harper (2010) maintains that in order to develop a model of African American student success, researchers must focus on positive aspects of African American men's abilities and achievement indicators. Yet other researchers suggest that the development of a sense of belonging in science is a necessary precursor to educational persistence for African American men (Strayhorn, 2008).

The current study's finding that Scientist Identity was a significant predictor of Intention to Persist for African American men, and this finding is consistent with contemporary investigations of African American male persistence, in that it suggests that African American men's identity development as scientists may be one critical factor related to their educational persistence outcomes. Current research also suggests that there is a dearth of literature assessing the impact of scientist identity on persistence, especially for African American men's persistence. However, emerging investigations are beginning to contribute to the field of African American identity and the factors that contribute to cultivating that identity. For instance, Hrabowski (2012) suggests that one explanation for the persistently low representation of African American students, in biomedical science particularly, can be explained by the apparent incongruence between the culture of science and the lack of inclusion of African American students' potentially unique contributions to that culture. The significant finding that Scientist Identity predicts Intention to Persist may help to elaborate

Hrabowski's (2012) theory, since the formation of a scientist identity is plausibly related to positive social and academic integration for African American students.

A Climate of Respectful Relations emerged as a significant predictor of Intention to Persist when run in a multiple regression model with Scientist Identity.

The multivariate model that was proposed was non-significant, as scientist identity dropped out of the model. However, Climate Respectful Relations accounted for a significant percentage (11%) of the variance in Intention to Persist. Climate factors related to persistence were examined in the literature review for the current investigation and this finding is consistent with several studies. Ehrlich (1990 and 1992) indicated that African American students reported a disproportionate amount of verbal discrimination on predominantly White campuses. Even those students who did not report such verbal abuse indicated that they had peers who had experienced them. Although robust empirical research in the last twenty years has found that diversity in terms of the proportionate representation of all races on college campuses is linked to structure-level variables (Hurtado et. al, 1998), researchers continue to find that interpersonal relations can be salient for African American students who feel that they are considered "institutional outsiders," that students value having African American faculty members teaching on their campuses (Milem & Astin, 1993; Milem & Wakai, 1996), and that MSIs better serve their educational needs (Huang, Taddese, & Walter, 2000; Provasnik & Shafer, 2004). This study's finding regarding the link between students' exposure to a respectful campus climate and their persistence in science confirms findings in these earlier studies.

Respectful campus climates rely heavily on both diversity and student engagement with the topic of diversity. In fact, research suggests that best practices in campus diversity initiatives require programs and initiatives to promote positive interracial interactions, learning opportunities and cross-race/ethnic engagement (Engberg, 2004; Denson, 2009; Park, Denson, & Bowman, 2012). The result of the current investigation reinforces this literature on best practices, as it points to the critical role that respectful climate relations have in encouraging the educational persistence of African American students.

Scientist Identity was a significant predictor of Intention to Persist for low-performing African American men, accounting for 18% of the variance in Intention to Persist for this group of students.

It has been suggested that some primary schools have embraced the idea that academic prospects for African American males should be low, and these schools have made it expected and permissible for teachers to undermine the academic achievement of male African American students (Anderson, 1990). Such systematically poor methods of educationally engaging African American men often result in low-performance. Specifically, Steele (1992) argued that when educators held lowered expectations, and actively undermined the academic potential of African American men, they lowered students' sense of worth, self-esteem, and potential for positive identity development. However, Harper (2010) argues that a focus on African American male underachievement only serves to magnify deficits instead of recognizing strengths. Research utilizing Harper's paradigm shift is just beginning to emerge, and, as a result, there is a relatively small body of literature that

focuses on African American male students who do achieve their academic goals. For instance, using a sample of over 600 African American students (n = 304 science majors, n = 307 science degree earners), Brown, Henderson, Gray, Donovan, and Sullivan (2013) found that although race was an important factor in their educational experiences, a sense of alignment with the field of science ("Communities of Practice") and their experience of racial microaggressions (i.e., commonplace daily verbal, behavior, and environmental indignities; Sue, Capodilupo, Torino, Holder, Nadal, & Equin, 2007) predicted persistence for African Americans who have successfully completed a science degree. This finding highlights the ubiquitous impact of racial inequity in science, and also suggests that such pervasive inequities in science may discourage the formation of positive science identity for African American students, which may be particularly important for low-performing African American men.

A Climate of Respectful Relations was a significant predictor of Intention to Persist for low-performing African American men, and it accounted for 35% of the variance in Intention to Persist for this group.

A campus climate that includes respectful relations has been linked to successful matriculation through science degree programs (Guloyan, 1986). In fact, Helm, Sedlacek, and Prieto (1998) found that there was a significant, positive relationship between a student's perceptions of fair treatment by other students and instructors and 'Overall Satisfaction' with their university community as well as their comfort level in 'Cross-Cultural Situations'. Mannan, Charleston, and Saghafi (1986) suggested that students who attend predominantly

White campuses with formative educations spent in predominantly White preparatory schools are less affected by racially hostile campus climates. However, most African American students' formative educations, and the communities in which those formative educations were accessed, are majority African American (Allen, 1985; Guloyan, 1986). Thus, an important factor contributing to a respectful campus environment, and to African American students' integration into that respectful environment, is the visibility and accessibility of minority faculty members Torres & Johnson (2013). However, the climate for minority faculty members is often beset with its own set of problems. For instance, students regularly rate faculty from ethnic minority backgrounds as less effective than they rate European American faculty (Smith & Anderson, 2005; Hamermesh & Parker, 2005; Smith, 2007). Nonethess, faculty support and the development of peer-to-peer networks both enhance persistence of African American students' (Shinew & Hibbler, 2002; Costen, Waller, & Wozencroft, 2013). To the extent that faculty support and peer-to-peer networks are related to a respectful campus climate, findings in this study suggest that faculty support and peer-to-peer networks may be especially critical for sustaining the persistence of low-performing African American students.

A Climate of Respectful Relations was a significant predictor of Intention to Persist for low-performing African American men studying at PWI campuses.

Considering the literature on MSI and PWI experiences for African American students, this study included an exploration of the influence of Institutional Type on intention to persist. This study found that students' evaluation of their campus climate as a climate of

respectful relations was a significant predictor of Intention to Persist for low-performing African American men studying at PWI campuses. This variable accounted for 81% of the variance in Intention to Persist for low-performing African American men studying at PWIs. Minority Serving Institutions have a longstanding reputation for producing a considerable portion of STEM degrees conferred (NSF, 2012), and students who attend Minority Serving Institutions rate their academic and social integration into the scientific academic environment to be positive (Denson, 2009). One reason minority students rate their experiences at MSIs as positive is because they perceive their social and psychological interactions with MSI faculty, staff, and peers to be more positive than do students at PWIs (Allen, 1992). These positive social and academic interactions are a hallmark of the MSI educational experience, and the positive social climate that MSIs foster is one important factor in their ability to consistently produce the highest number of underrepresented minority bachelor's degrees in science (Huang, Taddese, & Walter, 2000; Provasnik & Shafer, 2004; NSF, 2012). African American men studying at PWIs, however, may face social isolation, lack of opportunities for social integration, and microagressions that discourage their persistence (Guloyan, 1986; Solorzano, Ceja, & Yosso, 2000; Strayhorn, 2008).

African American students composed 13.1% of undergraduates in 2005, but a much smaller percentage of students at PWIs due perhaps to the fact that a substantial number of African American students chose to attend MSIs (Chronicle of Higher Education, 2007). African American students report that PWIs are often unsupportive environments that are unresponsive to their individualized needs (Fries-Britt, 2001), and that – although PWIs have

increased their commitment to diversity – African American students and faculty report numerous challenges to finding positive cross-race interactions, friendships, and mentorships on PWI campuses (Solorzano, Ceja, & Yosso, 2000; Park, 2012). Taylor, Austin, Perkins, and Edwards (2012) suggest that successful matriculation to degree completion, for African American students, requires engagement in the social and cultural academic environment as well as meeting performance expectations. To the extent that a sense of social integration on campus is linked to a climate of respectful relations, the significance of this study's variable, Climate of Respectful Relations, as a predictor of persistence for African American men on PWI campuses, is consistent with these earlier studies.

Plausible Explanations for the Non-Significant Results

Mentoring did not predict Intention to Persist for the current population, thus it was not used to test the hypotheses of subsequent research questions. The literature reviewed for this study indicated that African American mentoring initiatives tend to rely on formal, unidirectional partnerships that are grounded in the role-model/protégé paradigm. Evaluations are often directed at demonstrating a program's overall success in relation to immediate outcomes such as improvement in test-taking skills or increased interest in a particular field of study rather than evaluating the effectiveness of the program in improving the educational outcomes for participants (Marabel, 1999; Van Aken, Watford, and Medina-Borja, 1999). Further, the literature is inconsistent in defining the constructs that best represent the prototype for "mentor." The Nora and Crisp's (2007, 2008, and 2009) College Student Mentoring Scale (CSMS) that was utilized by the current investigation is one response to the complex issues surrounding defining mentoring best practices. The mentoring

literature is, nonetheless, broad, and concepts related to mentoring span delineating functions and roles (Jacobi, 1991), understand phenomenological complexity by reviewing the constructs of what make a mentor efficacious (Roberts, 2000), and distinguishing between "technical" and "alternative" or "formal" vs. "informal" mentoring (Mullen, 2005; Henry, Bruland, & Sano-Franchini, 2011). The literature has, in general, provided a broad foundation upon which to develop clear interpretations and analyses of mentor/protégé relationships, but it lacks demonstrated empirical coherence.

Current applications of mentoring research see the factor as a component of social adjustment for African American students, and current investigations of mentoring have found that mentoring initiatives aimed at retaining African American men have had significant success (Brooks, Jones, & Burt, 2012). The current investigation did not find a significant relationship between mentoring and intention to persist, perhaps because nearly half of the study population reported not having a mentoring relationship as defined in the survey instrument.

The current investigation also did not find a significant relationship between the additional three variables of the Campus Climate measure (i.e., Climate Support, Climate Faculty/Staff Stereotypes, and Climate Student Stereotypes). These factors were, however, useful to the overall design of the study and added a level of complexity to the design that prior research repeatedly calls for. Further, the descriptive statistics would suggest that the students trended toward having limited experience hearing faculty/staff members make negative racial or stereotypical comments, yet the trend for student stereotypes would suggest that negative commentary regarding race are more prevalent.

Limitations of the Study

The results of the current investigation provide valuable information regarding the impact of Scientist Identity on Intention to Persist. The study benefitted from having measures that have been adequately validated and found to be reliable, and the study makes a contribution to the current understanding of the importance of scientist identity in African American men's persistence in science. The negative-to-zero transformation, one of many potential methods of attaining a meaningful zero, served the current investigation well. Future investigations may consider other methods of accessing the meaningful zero that do not negatively skew the sample. For the current investigation, the model proposed was not supported by the data. Exploratory analyses provided more suggestive findings. Given the limited number of studies that focus on African American students, even these modest findings make a contribution to developing and refining models of persistence for African American students in the sciences. The current investigation was limited by the size of the study population, the heterogeneity of the sample (i.e., 53.7% science majors and 46.3% non-science majors), and the practical and institutional challenges of recruiting voluntary survey participants across multiple campuses where academic majors are differently defined and organized.

Future Directions

The most significant findings of this study relate to the promise of the scientist identity measure and the intentions to persist in science measure. Both appear to be viable measures that can contribute to advancing research about the importance of cultivating a scientist identity, especially for African American men who have relatively low academic

performance histories[11]. Social integration, as a construct, may prove to be a more important contributor to persistence than mentoring experiences *per se.* Relatedly, and given exploratory analyses, factors that contribute to the broad area of "social inclusion" may be at play, including students' evaluation of a climate of respect on their campuses. In addition, in this study's development and evaluation of measures used, the scales included in the survey instrument demonstrated good reliability and construct validity. These may prove more useful in pre- and post- evaluations of programs and interventions than as measures in a cross-sectional study.

Conclusions

The results of the current investigation, though modest, demonstrate that scientist identity does play a role in African American students' persistence in the sciences, particularly among men. Study results could not confirm the importance of mentoring experiences for intention to persist as had been suggested by earlier studies (Harris, 2012; Matthews, 2012) Nor could the study confirm the influence of campus climate (broadly defined) on intentions to persist. However, the significant number of study participants who are high-performing students is perhaps an important and heartening finding for the future of the representation of African Americans in science. The measures in the study instrument

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[11] The measure of academic performance for the current investigation was SAT Writing, Math, and Reading scores. However, future investigations might be well served to include the additional information of GPA (which was not included in the current investigation due to a lack of information regarding the weighting of the students' high school GPAs). Further, attaining a spectrum of academic achievement measures (e.g., GPA, honors, accolades, school and civic engagement) would provide an even greater breadth of useful information.

may also prove useful in developing research to define best practices for engaging students in an inclusive academic science environment, and for developing programs and interventions that address the specific interests and abilities of African American students. Both the National Science Foundation and the National Institutes of Health have recently renewed their commitment to supporting research and programmatic interventions aimed at fostering diversity in STEM, even in uncertain economic times (Hrabowski, 2012). Advancing our knowledge about how African American students develop a scientist identity, and how that identity is linked to persistence, offers us an opportunity to understand and foster educational persistence in STEM fields, cultivate new talent for science, and enhance training and employment opportunities for African Americans.

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APPENDECIES

Appendix A

* **0001: Which university do you primarily attend?**

Please write your answer here:

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* **0002: Please specify your birth year:** Please write your answer here:

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* **0003: What is your primary major or area of study?**

Please choose the one that is the closest match to your major. Please choose *only one* of the following:

- ☐ Agricultural
- ☐ Animal Sciences
- ☐ Anthropology
- ☐ Biochemistry
- ☐ Biomedical Engineering
- ☐ Biology
- ☐ Botany
- ☐ Business and Marketing Education
- ☐ Chemical Engineering

- [ ] Chemistry
- [ ] Civil Engineering
- [ ] Computer Engineering
- [ ] Computer Science
- [ ] Electrical Engineering
- [ ] Elementary Education
- [ ] English
- [ ] General Studies Education
- [ ] Horticultural Science
- [ ] Industrial Engineering
- [ ] Math Education
- [ ] Mathematics
- [ ] Materials Engineering
- [ ] Mechanical Engineering
- [ ] Microbiology
- [ ] Middle Grades Education
- [ ] Natural Resources
- [ ] Philosophy

- [ ] Physics
- [ ] Political Science
- [ ] Psychology
- [ ] Science Education
- [ ] Sociology
- [ ] Statistics
- [ ] Technology Education
- [ ] Zoology
- [ ] Undecided Major
- [ ] Other not listed area of study

0004: If you selected "Other not listed area of study" above, please specify your primary major or area of sutdy here: Please write your answer here

*** 0005: We are interested in your observations about scientists, including their motivations, priorities, and the kinds of work they do. Please rate to what extent you agree with the following statements using a scale ranging from "Strongly Disagree" to "Strongly Agree."**

When I think about scientists, I think that they:

Please choose the appropriate response for each item:

	Strongly Disagree	Disagree	Mildly Disagree	Mildly Agree	Agree	Strongly Agree
1. Have fun with colleagues at work	☐	☐	☐	☐	☐	☐
2. Maintain friendships with colleagues in other departments	☐	☐	☐	☐	☐	☐
3. Know a lot about the latest discoveries	☐	☐	☐	☐	☐	☐
4. Do not have a lot of friends	☐	☐	☐	☐	☐	☐
5. Are out of touch with what is happening in the world	☐	☐	☐	☐	☐	☐

6. Are the ones who know how equipment works	☐	☐	☐	☐	☐	☐
7. Are careful with expensive instruments	☐	☐	☐	☐	☐	☐
8. Have happy marriages	☐	☐	☐	☐	☐	☐

*** 0006: We are interested in your observations about scientists, including their motivations, priorities, and the kinds of work they do. Please rate to what extent you agree with the following statements using a scale ranging from "Strongly Disagree" to "Strongly Agree."**

When I think about scientists, I think that they are:

Please choose the appropriate response for each item:

	Strongly Disagree	Disagree	Mildly Disagree	Mildly Agree	Agree	Strongly Agree
9. Competitive	☐	☐	☐	☐	☐	☐
10. Cooperative	☐	☐	☐	☐	☐	☐

11. Independent	☐	☐	☐	☐	☐	☐
12. Work oriented	☐	☐	☐	☐	☐	☐
13. Family oriented	☐	☐	☐	☐	☐	☐
14. Technically competent	☐	☐	☐	☐	☐	☐
15. Competent	☐	☐	☐	☐	☐	☐
16. Self-confident	☐	☐	☐	☐	☐	☐
17. Insecure	☐	☐	☐	☐	☐	☐
18. Collaborative	☐	☐	☐	☐	☐	☐
19. Highly focused	☐	☐	☐	☐	☐	☐
20. Able to learn to use new equipment quickly	☐	☐	☐	☐	☐	☐
21. Especially intelligent	☐	☐	☐	☐	☐	☐

22. Logical ☐ ☐ ☐ ☐ ☐ ☐

Section III: Self-Observations

*** 0007: We are interested in your observations about yourself, including your motivations, priorities and the kinds of work that you like to do. Please rate to what extent you agree with the following statements using a scale ranging from "Strongly Disagree" to "Strongly Agree."**

When I think about myself, I:

Please choose the appropriate response for each item:

	Strongly Disagree	Disagree	Mildly Disagree	Mildly Agree	Agree	Strongly Agree
23. Have fun with colleagues at work	☐	☐	☐	☐	☐	☐
24. Maintain friendships with colleagues in other departments	☐	☐	☐	☐	☐	☐

25. Know a lot about the latest discoveries	☐	☐	☐	☐	☐	☐
26. Do not have a lot of friends	☐	☐	☐	☐	☐	☐
27. Are out of touch with what is happening in the wolrd	☐	☐	☐	☐	☐	☐
28. Know how equipment works	☐	☐	☐	☐	☐	☐
29. Am careful with expensive instruments	☐	☐	☐	☐	☐	☐
30. Will have a happy marriage	☐	☐	☐	☐	☐	☐

*** 0008: We are interested in your observations about yourself, including your motivations, priorities and the kinds of work that you like to do. Please rate to what extent you agree with the following statements using a scale ranging from "Strongly Disagree" to "Strongly Agree."**

When I think about myself, I am:

Please choose the appropriate response for each item:

	Strongly Disagree	Disagree	Mildly Disagree	Mildly Agree	Agree	Strongly Agree
31. Competitive	☐	☐	☐	☐	☐	☐
32. Cooperative	☐	☐	☐	☐	☐	☐
33. Independent	☐	☐	☐	☐	☐	☐
34. Work oriented	☐	☐	☐	☐	☐	☐
35. Family oriented	☐	☐	☐	☐	☐	☐
36. Technically competent	☐	☐	☐	☐	☐	☐
37. Competent	☐	☐	☐	☐	☐	☐
38. Self-confident	☐	☐	☐	☐	☐	☐
39. Insecure	☐	☐	☐	☐	☐	☐

40. Collaborative	☐	☐	☐	☐	☐	☐
41. Highly focused	☐	☐	☐	☐	☐	☐
42. Able to learn to use new equipment quickly	☐	☐	☐	☐	☐	☐
43. Especially intelligent	☐	☐	☐	☐	☐	☐
44. Logical	☐	☐	☐	☐	☐	☐

Section IV: Observations of Campus Life * 0009: We are interested in your observations about the racial climate on your university's campus. Please rate to what extent you agree with the following statements using a scale ranging from "Strongly Disagree" to "Strongly Agree." Please choose the appropriate response for each item:

	Strongly Disagree	Disagree	Mildly Disagree	Mildly Agree	Agree	Strongly Agree
45. There is racial conflict on campus.	☐	☐	☐	☐	☐	☐
46. There is	☐	☐	☐	☐	☐	☐

racial/ethnic seperation on campus.						
47. There are interracial tensions in the classroom.	☐	☐	☐	☐	☐	☐
48. I have been exposed to a racist atmosphere in the classroom.	☐	☐	☐	☐	☐	☐
49. I have been exposed to a racist atmosphere outside the classroom.	☐	☐	☐	☐	☐	☐
50. Students are resentful of others whose race/ethnicity is different from their own.	☐	☐	☐	☐	☐	☐
51. I am	☐	☐	☐	☐	☐	☐

comfortable going to see a faculty member of my own race/ethnicity.	☐	☐	☐	☐	☐	☐
52. I am comfortable speaking with others about my racial/ethnic background.	☐	☐	☐	☐	☐	☐
53. I am comfortable being in situations where I am the only person of my racial/ethnic group.	☐	☐	☐	☐	☐	☐
54. I am comfortable saying what I think about racial/ethnic issues.	☐	☐	☐	☐	☐	☐

55. I am comfortable being with people whose racial/ethnic backgrounds are different than my own.	☐	☐	☐	☐	☐	☐
56. I am comfortable being with people whose racial/ethnic backgrounds are the same as my own.	☐	☐	☐	☐	☐	☐
57. Faculty treat me fairly.	☐	☐	☐	☐	☐	☐
58. Teaching assistants treat me fairly.	☐	☐	☐	☐	☐	☐
59. Students treat me fairly.	☐	☐	☐	☐	☐	☐

60. I have often been exposed to a racist atmosphere created by faculty in the classroom. ☐ ☐ ☐ ☐ ☐ ☐

61. I have often been exposed to racist atmosphere created by faculty outside the classroom. ☐ ☐ ☐ ☐ ☐ ☐

62. This university provides an environment for the free and open expression of ideas, opinions, and beliefs. ☐ ☐ ☐ ☐ ☐ ☐

63. Overall, my educational experience at this university has been ☐ ☐ ☐ ☐ ☐ ☐

a rewarding one.

64. I would recommend this university to siblings or friends as a good place to go to college. ☐ ☐ ☐ ☐ ☐ ☐

65. The overall quality of academic programs at this university is excellent. ☐ ☐ ☐ ☐ ☐ ☐

66. I feel as though I belong in the university community. ☐ ☐ ☐ ☐ ☐ ☐

Section V: Observations of Mentoring Experiences

*** 0010: We are interested in your observations about your relationship with your current science mentor on campus. Please rate to what extent you agree with the**

following statements using a scale ranging from "Strongly Disagree" to "Strongly Agree."

My mentor:

Please choose the appropriate response for each item:

	Strongly Disagree	Disagree	Mildly Disagree	Mildly Agree	Agree	Strongly Agree
67. encourages me to express honest feelings.	☐	☐	☐	☐	☐	☐
68. is very supportive when I am emotionally upset.	☐	☐	☐	☐	☐	☐
69. encourages me to use him or her as a sounding board to explore hopes, ideas, and feelings.	☐	☐	☐	☐	☐	☐
70. suggests that I meet with a college	☐	☐	☐	☐	☐	☐

counselor when I have concerns.						
71. helps me develop better coping strategies when my academic goals are not achieved.	☐	☐	☐	☐	☐	☐
72. expresses his or her personal confidence in my ability to succeed in pursuit of my academic goals.	☐	☐	☐	☐	☐	☐
73. expresses confidence in my abilities to achieve my educational goals.	☐	☐	☐	☐	☐	☐
74. meetings arranged to avoid	☐	☐	☐	☐	☐	☐

interruptions.

75. establishes regular schedule of meeting times. ☐ ☐ ☐ ☐ ☐ ☐

76. discusses positive and negative feelings about my ability to succeed. ☐ ☐ ☐ ☐ ☐ ☐

77. encourages me to provide information about my academic preparation. ☐ ☐ ☐ ☐ ☐ ☐

78. assists me in mapping out realistic strategies to achieve my academic goals. ☐ ☐ ☐ ☐ ☐ ☐

79. encourages me to consider other ☐ ☐ ☐ ☐ ☐ ☐

educational opportunities.						
80. helps me explore realistic options and provides guidance on attainable academic objectives.	☐	☐	☐	☐	☐	☐
81. questions my assumptions by guiding me through a realistic appraisal of my ideas and beliefs.	☐	☐	☐	☐	☐	☐
82. helps me carefully examine my career options.	☐	☐	☐	☐	☐	☐
83. encourages me to review my strategies for	☐	☐	☐	☐	☐	☐

managing the changes in my life while pursuing my educational goals.

84. engages in discussions that require me to reflect on competencies needed to achieve my goals.

85. explores the extent I spend time and energy in achieving my educational goals.

86. emphasizes that one of his or her goals is to assist me in reaching my own decisions about my

academic goals.

Section VI: Career Steps

*** 0011: In your future career, how likely is it that you will:**

Please choose the appropriate response for each item:

	Very Unlikely		Mildly Unlikely	Mildly Likely		Very Likely
87. Get college training in science	☐	☐	☐	☐	☐	☐
88. Get experience working as a scientist	☐	☐	☐	☐	☐	☐
89. Be a successful scientist	☐	☐	☐	☐	☐	☐
90. Get an advanced degree	☐	☐	☐	☐	☐	☐

in science						
91. Become a scientist	☐	☐	☐	☐	☐	☐
92. Have the ability to become a scientist	☐	☐	☐	☐	☐	☐
93. Take advanced courses in science	☐	☐	☐	☐	☐	☐
94. Complete your degree in science	☐	☐	☐	☐	☐	☐
95. Do advanced research in science	☐	☐	☐	☐	☐	☐
96. Apply to graduate programs in science	☐	☐	☐	☐	☐	☐
97. Have a lifelong career in	☐	☐	☐	☐	☐	☐

science

98. Have a very

successful career ☐ ☐ ☐ ☐ ☐ ☐

in science

Section VII: Background Information

* **0012: How many years have you been a student at your university?** Please choose *only one* of the following:

- ☐ Less than one year
- ☐ One year to less than two years
- ☐ Two years to less than three years
- ☐ Three years to less than four years
- ☐ Four years to less than five years
- ☐ Five years to less than six years
- ☐ Six years to less than seven years
- ☐ Seven years to less than eight years
- ☐ Eight years to less than nine years
- ☐ Nine or more years

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* **0013: Please specify your gender:** Please choose *only one* of the following:

- ☐ Female
- ☐ Man

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* **0014: Please specify your ethnicity:** Please choose *only one* of the following:

- ☐ African American/Black
- ☐ Asian American /Asian
- ☐ European American/Caucasian/White
- ☐ Latino American/Hispanic
- ☐ Native American/Alaskan Native/Pacific Islander
- ☐ Other

0015: If you chose "Other" for your ethnicity, please specify your ethnicity here: Please write your answer here:

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* **0016: Please specify your martial status:** Please choose *only one* of the following:

- ☐ Single
- ☐ Engaged

- [ ] Married
- [ ] Divorced/Separated
- [ ] Widowed

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* **0017: Please specify your citizenship:** Please choose *only one* of the following:

- [ ] U.S.
- [ ] Non-U.S.

- **0018: Please specify the profession you currently plan on seeking upon graduation:** Please write your answer here: