

ABSTRACT

JENKINS, FELYSHA L'AUQUERA. Career Commitment and African American Women in Undergraduate STEM Majors: The Role of Science-Math Self-Efficacy, Department Climate, and Campus Climate at the Intersection of Race and Gender. (Under the direction of committee chair Mary B. Wyer).

Despite the odds, African American women are achieving some success in science, technology, engineering, and mathematics (STEM). However, a dearth of empirical evidence exists on the mechanisms that contribute to their persistence. This study contributes to understanding how African American women are successful in obtaining baccalaureate degrees in the sciences. Specifically, through surveying students from multiple institutions of higher education, including Historically Black Colleges and Universities (HBCUs) and Predominately White Institutions (PWIs), the study examined how African American undergraduate women's self-efficacy, gender, race/ethnicity, department climate, and campus climate interact to promote career commitment. This project focused on a population at the crossroads of race and gender in STEM: African American women obtaining undergraduate degrees.

Participants (N = 670) were African American (N = 375) and European American (N = 295) women and men enrolled in four universities in North Carolina (two PWIs, two HBCUs). Multiple regression analyses were used to examine the data. Results demonstrated that being a STEM major was the biggest predictor of career commitment across race and gender. For women with STEM majors, science/math self-efficacy emerged as the primary predictor of career commitment and perceptions of gender equality in one's major department were especially important for African American women. These results can be used to inform educational policy about training faculty members in classroom and campus

climate issues. The results may also be useful to those designing interventions, to address issues of science/math self-efficacy of students who plan to pursue STEM careers after graduation.

Career Commitment and African American Women in Undergraduate STEM Majors:
The Role of Science/Math Self-Efficacy, Department Climate, and Campus Climate
at the Intersection of Race and Gender

by
Felysha L. Jenkins

A dissertation submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

Psychology

Raleigh, North Carolina

2012

APPROVED BY:

Mary B. Wyer, Ph.D.
Committee Chair

Craig C. Brookins, Ph.D.

Tuere A. Bowles, Ph.D.

Jason C. Allaire, Ph.D.

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DEDICATION

To my beloved grandmother, Jessie Queen Smith, who always supported my love of reading, helped ground me and raise me, and who left me with the sweetest memories. You are always in my dreams. I love you and I miss you.

BIOGRAPHY

Felysha Jenkins was born in Chattanooga, TN to the late Samuel B. Jenkins and Ms. Carolyn Y. Jenkins. She obtained her undergraduate degree in psychology from the University of the South in Sewanee, TN. While an undergraduate student, she took an interest in African American studies and has followed that interest. After graduating, she worked for Dana Corporation as a human resources representative until deciding to return to school to pursue her graduate education. She enrolled at Wake Forest University in Winston-Salem, NC and earned her Master's degree in psychology. Felysha continued her education at North Carolina State University in the area of Psychology in the Public Interest.

Felysha has always held an interest in addressing the inequities faced by African Americans and women. She was able to combine her interests with her dissertation by examining the conditions of African American women in STEM.

ACKNOWLEDGMENTS

I would like to extend my deepest gratitude to everyone who has supported me on this journey to my Ph.D. because “life ain’t been no crystal stair” as Langston Hughes said.

Dr. Mary B. Wyer, my advisor and committee chair, thank you for your unwavering support in me and my project and thank you for all of the knowledge you have given me about the status of women in our world. It’s more than enough to make me dangerous and I plan to do something about it. Drs. Craig C. Brookins, Tuere A. Bowles, and Jason C. Allaire, thank you for the contribution of your time and expertise and for propelling me forward with your ideas and improvements for my final product.

I am especially grateful to each university, professor, lecturer, dean and administrator who responded favorably to my request for participants and so graciously encouraged students to take my survey. I could not have done it without you. Although I cannot thank each of you individually, I am extremely grateful to the more than 900 undergraduate students who took the time to respond to the items on the survey. Without your responses, there would be no dissertation. I also extend a very special thank you to the African American women in STEM who are succeeding, despite the obstacles. You remain an encouragement to me.

In addition, there are numerous people I must thank for the role they played in this process. Nicky Hamilton, she encouraged me many, many years ago to take the leap to graduate school; thank you for believing in me when I did not. The department of psychology at Wake Forest University, the friends and colleagues I met there, and especially my advisor, Dr. Charles Richman, spirited me forward to NC State with the academic and personal

encouragement I needed to continue the ascent for the doctoral degree. My officemates past, Anisha Mahesh Nix, Diane Ryan, and Jennifer Schneider, and my officemates present, Breonte Guy and Jameta Barlow, have been instrumental with their mentoring, support, and advice. Andrea Lloyd, Avril Smart, Athena Gibbs, Niambi Hall-Campbell, Alison Baker, and Dawn Henderson have surrounded me with their love and friendship and I am grateful for them. Becky Siceloff and Erin Banks thank you for remaining my constant cheerleaders and for pulling me and pushing me across the finish line. Thank you, Office of the Graduate School, for your emotional and financial support. I have never worked with such a great group of people.

To my family, especially my momma and my sisters: thank you for the prayers, your words of encouragement, and for “standing in the gap” when the days were long and difficult. To my nieces and nephews, thank you for all your hugs and kisses, your stories, and being the characters that each of you are. You have always been my little, and now, not so little, beacons of light. I love each of you, dearly.

Robert Hodge, thank you for keeping me sane and reminding me that I would successfully defend my dissertation and you were right!

Finally, to B.M., I can’t thank you enough for helping me find the light at the end of the tunnel.

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Career Commitment and African American Women in Undergraduate Sciences: The Role of
Science/Math Self-Efficacy, Department Climate, and Campus Climate

INTRODUCTION

There are multiple reasons to improve the representation of African American women in science. Science, technology, engineering, and mathematics (STEM) careers are high-status, high-paying jobs (Hanson, 1996; Hanson, 2007; Johnson, Brown, Carlone, & Cuevas, 2011; Pascarella & Terenzini, 2005; Smyth & McArdle, 2004; Staniec, 2004). Unequal access to prestigious and better-paying jobs has negative economic consequences for African American women. Although 60% of African American women were in the workforce in 2000 (McKinnon & Bennett, 2005), only a smaller number of African American women were represented in STEM fields (NSF, 2011). African American women represented less than 1% of degree-holding engineers in 2006 and only 1.8% of computer and information scientists in the same year (NSF, 2011). The average annual income for African American women was \$30,264 in 2009 (BLS, 2010). In contrast, the average annual income for computer scientists was \$76,290 in 2009 (BLS, 2009). According to Lewis and Oh (2008), despite the large gap in pay between African American women and European American men in STEM fields, the disparity in pay is even greater in non-STEM fields. These findings suggest that higher-paying STEM jobs can contribute to closing the economic gap and increasing opportunities for African American women to express their talents to the fullest.

Innovation in STEM

In addition to improving the economic status of African American women, a need exists for innovation in STEM given international competition and the increasingly global economy (NGA, 2008). China and India are rapidly developing nations which are becoming

stronger competitors in the race for global leadership (Chang, Han, & Saenz, 2008; NGA, 2008). Lagging innovation in STEM fields means that the U.S. is falling behind other countries when the U.S. has long been a leader (Hanson, 1996; Seymour & Hewitt, 1997). To maintain the position as a world leader, the U.S. must find a way to attract or retain more individuals, especially women, in the science pipeline.

Growing STEM Workforce

Almost half of the fastest growing occupations in the U.S. are in STEM fields and STEM education is thus increasingly important for the United States economy and workforce (NGA, 2008). With many STEM workers reaching the age of retirement, others will be needed to take their place (Burke, Mattis, & Elgar, 2007). Because the U.S. workforce in general, and the scientific workforce in particular, are becoming increasingly diverse, this is an opportune time to ensure the full participation of all people in STEM fields.

The multiple reasons that demand the improvement in the representation of African American women converge here. There is a general lack of research on African American women in STEM. Because of the dearth of research that exists at the intersection of race and gender for African American women in the sciences, there are no specific approaches to address their underrepresentation. This study is designed to begin that work. A study of African American women in STEM will provide information about the unique conditions at the intersection of race and gender.

Persistence and Attrition Models

Models of persistence and attrition exist but none of these models are specific to African American women who are attempting to obtain their degrees in STEM. Perhaps a model does not exist because of the relatively small numbers of African American women in

the sciences, but those numbers are unlikely to increase if the condition of African American women in the sciences continues to receive inadequate attention.

There have been efforts to hypothesize why African American women are such a small percentage of degree earners in STEM. Some posit that African American women are inadequately prepared academically for obtaining a degree in the sciences, so low persistence is to be expected (Daempfle, 2003). Others posit that women, in general, are not obtaining degrees in STEM because their aptitude or lack of interest in science (Ceci & Williams, 2010). Other research indicates that more African Americans would succeed if only they would try harder so that they would be more competitive academically (Russell & Atwater, 2005). However, the university, department, and individual make unique contributions that help explain the patterns that are observed when examining the persistence and attrition rates of African American women in STEM.

There is limited research on the underrepresentation of African American women in STEM and fewer still focus on models for success. The handful of studies that do focus on success are grounded on a deficit model that assumes individuals' successes or failures rest on an individuals' skills and abilities without reference to their social and historical contexts (Ceci & Williams, 2010). Similarly, some models of success assume that what works for European American women also works for African American women (Barker, 2001).

However, the factors at play for African-American women in STEM are unclear. Career commitment may be key to increasing the representation of African American women in the sciences. Based on a broad reading of relevant qualitative and quantitative research, this proposed study hypothesizes that science/math self-efficacy, major, department climate, campus climate, and gender and ethnicity each make a unique contribution to career

commitment. Science/math self-efficacy influences one's perception of whether or not she has what it takes to be successful in the sciences. Having higher science/math self-efficacy may help her stay in the STEM fields while lower science/math self-efficacy might have the opposite effect. The major of the individual also plausibly has an effect on career commitment in STEM. For those who are STEM majors, their commitment to a future career may be measurably high. Campus climate is external to the individual and influences one's interpretation of her environment. If it is pleasant and positive, she may be encouraged to persist in her STEM career, but if it is hostile and prejudiced, she may be more likely to pursue another, more supportive, career choice. If she is in a STEM department that is supportive and accessible, she may be more likely to stay than if her department is intimidating and unsupportive. Gender and race/ethnicity arguably have an interactive effect on career commitment but the significance of the interaction is unclear. The current study seeks to explore the gaps in the literature by exploring links among/between these factors.

LITERATURE REVIEW

Social Cognitive Career Theory

Social Cognitive Career Theory (SCCT) is a widely utilized approach to understanding factors related to career choice and is organized around the relationship between environmental, individual, and behavioral variables (Lent et al., 2005). The theory purports that multiple aspects of a student's life influence the career choices that she makes. SCCT differs from other theories because it includes aspects that are individual and environmental. Therefore, a student's performance hinges on internal or individual variables, such as self-efficacy, as well as external or environmental variables such as campus climate. Furthermore, SCCT has been used extensively to examine the career choice behaviors of underrepresented groups in STEM (Lent et al., 2005).

Problem Statement

Though the reasons for the underrepresentation of African American women in STEM are likely to be multi-layered and complex, there are several plausible theories. Some argue that attrition rates are especially high among African American STEM majors, others that African Americans are not interested in STEM, and still others that African Americans are not trying hard enough in comparison to other ethnic groups (Clewell & Campbell, 2002; Daempfle, 2003; Fisher, 2007). It is striking that these theories rely on a "deficit model" that implicitly reasserts the notion that African American women are deficient, rather than talented, able, and motivated. A more equitable (and accurate) approach would be to look beyond the individual level to multiple levels of analyses to explore how it is African American women succeed in completing their degrees. Cultural context, university setting,

and individuals' psychological strengths each likely make unique contributions to the persistence rates of African American women in STEM (Hanson, 2007).

There are African American women who aspire to obtain their undergraduate degrees in science, technology, engineering, and/or mathematics. In 2007, approximately 38% of science and engineering degrees were awarded to women; 3% of them were awarded to African American women (NSF, 2010). This study will contribute to understanding why those who are enrolled in STEM degree programs can persist despite the obstacles and barriers they must confront. Specifically, through surveying students from multiple institutions of higher education, including Historically Black Colleges and Universities (HBCUs) and Predominately White Institutions (PWIs), this study examines how African American undergraduate women's science/math self-efficacy, major, department climate, campus climate, gender, and ethnicity combine to promote career commitment in STEM. Substantial information exists on the circumstances of women, in general, in science, technology, engineering and mathematics (STEM) and on increasing minority representation in STEM. However, there is a paucity of research at the crossroads of race and gender in STEM. This project will focus on a population at that crossroads: African American women obtaining STEM degrees.

Double Jeopardy and Intersectionality

African American women have been subjected to what social scientists commonly have termed "double jeopardy." Double jeopardy is when one is a member of a twice stigmatized group; in this instance, one by race, the other by gender (Malcolm, 1976). As put by Anna Julia Cooper, a woman who was born a slave and later earned her Ph.D., African American women are "confronted by both a woman question and a race problem" (as cited

by King, 1988). Because there is a paucity of information specific to African American women in STEM, this study begins by distilling results based on what is known about women in STEM, what is known about African Americans in STEM, and what is known about African American women, in general. When studies address inequalities in STEM, they are likely to address it from the perspective of women or they combine multiple minority groups into one group. Rarely do studies investigate or examine data specific to African American women. In studies that include African American women, it is often a small portion of the story and limited to a few paragraphs (e.g., Hanson, *Lost Talent*).

Focusing on African American women nonetheless may complicate how researchers understand gender and race dynamics in STEM. As a twice stigmatized group, in theory, African American women should never outnumber African American men in any male-dominated STEM field. However, African American women outnumber African American men in Chemistry, Agricultural, and Biological Sciences and have done so for at least a decade (NSF, 2010).

Levin, Sinclair, Veniegas, and Taylor (2002) conducted a study to examine the validity of the double jeopardy hypothesis. The participants were 687 students from a large university on the West coast. The participants were asked about general discrimination against themselves and against their “group.” They found that men and women of color responded similarly in their expectations of general personal/group discrimination. These results do not support the double jeopardy hypothesis. In review, double jeopardy hypothesizes that women of color would report more discrimination than their male counterparts because the women of color are members of twice-stigmatized groups. Since

the women of color reported results similar to the men of color, it suggests that the additive nature of double jeopardy is not operating.

In contrast to double jeopardy is the concept of intersectionality. Intersectionality refers to the concept that identities can overlap such that one is fully female while also being fully African American (Cole, 2009). In essence, the two cannot be separated and must be examined as a distinct whole (Greenman & Xie, 2008). Greenman and Xie (2008) point out that whereas double jeopardy relies on the additivity of discrete categories, intersectionality does not. Therefore, it is essential to investigate the experiences of African American women in science instead of relying on what is known about African Americans in science or women in science.

Settles (2006) conducted a study to examine intersectionality with a group of African American women. There were 89 participants from 31 institutions who were part of a larger pool of undergraduates and graduate science students. Participants were recruited via mail and email. The participants completed a survey about the importance of their identities as African Americans and as women, along with measures that assessed their psychological well-being, the extent that being a woman was in conflict with being African American and vice versa, and a measure designed to assess any perceived rewards or difficulties associated with being an African American woman. Results indicated that women enrolled in HBCUs reported higher self-esteem than women at PWIs. It may be that there exists a relationship between self-esteem and campus climate such that being at a HBCU may be positively related to having higher self-esteem, as well. Settles also found that the participants rated their identities as African American women higher than their identities of being either

African Americans or being women, indicating support for the idea that their identities exist at the intersection of race and gender not merely identifying themselves as one or the other.

Persistence

Research on persistence has defined it in multiple ways. Persistence includes remaining at a college or university until graduation (Wintre & Bowers, 2007), retention at a college or university from semester to semester (Brown, et al., 2008), stopping out for a time but re-enrolling (Bean & Metzner, 1985), dropping out of a college or university and enrolling in another, or staying at one school but changing majors. Although one is not persisting in a particular major, he or she is persisting toward a degree. This project focused on intention to persist toward degree completion and working toward an advanced degree or toward a career as a scientist.

Grandy has done work examining the circumstances of African American students and under what conditions the students are successful. Grandy (1998) conducted a study to examine the performance and aspirations of high-ability minority students. The participants were 2,557 minority (Native American, African American, Hispanic and Asian American students) students. The survey data were collected three times over the course of five years. Of particular interest, Grandy found that women were less likely to persist in science and engineering despite having better grades than males at each point along the way to a baccalaureate degree, demonstrating that something other than academic achievement is responsible for women leaving the sciences. Grandy also found that women reported wanting a “service” oriented career, which reinforces the notion that science and engineering are not considered service careers and are thus less likely to attract and retain women in their ranks. In terms of commitment to science and engineering, Grandy found that the sophomore year,

in general, best predicted commitment three years later and accounted for 56% of the variance for the students' outcome statuses. Additionally, Grandy found that departmental conditions positively influenced students when there were staff dedicated to the needs of minority students.

A strength of Grandy's (1998) study is that it included information on minority populations in the sciences for many points, disaggregated the data by gender to demonstrate how male and female populations may differ in science and engineering. However, Grandy did not disaggregate the data by race, which leads one to speculate about any racial differences that might exist between the multiple, non-majority, groups.

Women and persistence. Less than 40 years ago, men earned the majority of bachelor's degrees obtained in the United States (Snyder, Dillow, & Hoffman, 2008). Over the years the number of women obtaining baccalaureate degrees began to outnumber men, such that women accounted for 57% of baccalaureate degrees awarded for academic year 2007-2008 (NCES, 2010). To examine why such a stark difference in degrees awarded occurs, Conger and Long (2010) conducted a study using data from 11 public, Florida universities from 2002-2003 and five universities in Texas. Each of the Texas universities was observed for one academic year and the years spanned from 1998-2001. There were more than 42,000 participants in the study. Conger and Long found that women enrolled in a greater number of courses and outperformed the men in the courses taken. They postulated that the women were more persistent due to the type of courses they chose. For example, students in the Liberal Arts were said to take easier courses than students in STEM which made it easier for them to persist in comparison to STEM fields which have more "difficult" courses.

Another study that found gender differences in persistence was Noble, Flynn, Lee and Hilton (2007). Although their emphasis was on participation in a residential program, gender differences were apparent. Noble et al. investigated the persistence of students during their first-year of college through the use of an intervention program. The longitudinal study (1998-2001) was designed to determine if graduation rates could be improved through participation in the program and to find out what effect participation in the program would have on the students' grade point averages (GPAs). The participants were a sample of first-year students at the University of South Alabama taken from entering cohorts over a four year time span. The participants were 2,915 students who were either enrolled in the Entering Students at South Engaging in New College Experiences (ESSENCE) residential program or a control group not enrolled in the program. Women were in the majority ranging from 56-75% of the participants depending on the cohort. The study was conducted to determine if retention rates differed for students in the program compared to a control group of students who were not in the program. Results indicated that even after controlling for their American College Testing (ACT) score, whether or not they lived on campus and whether they were involved in the intervention program or not, women continued to have higher GPAs. As for persistence, women were more than twice as likely to graduate within four years than were men. Grade point average, alone, predicted persistence but it accounted for very little of the variance explained. The study was strengthened by the existence of a control group of students who were not participants of the intervention. Overall, the results indicated that the intervention was beneficial to students in increasing persistence for all students.

Although there are similarities across gender and race concerning persistence for undergraduate students, some factors are more important for women than they are for men. Leppel (2002) used data from the Beginning Postsecondary Students (BPS) survey data collected in 1990 by the NCES to investigate differences in persistence for men and women. There were 5,384 participants almost equally divided between men and women. She examined social integration and academic performance. Persistence was measured by including only the students who were enrolled for the academic year, 1990-1991. Overall, the women had a 93.3% persistence rate compared to the men's 92.3% persistence rate. Leppel also found that men had higher predicted "social integration" scores than did women and contended that too much social integration had a negative effect on persistence for men. Regarding academic performance, Leppel found that women with predicted heavy social integration also had higher predicted GPAs than those who were not very involved, indicating that involvement had a positive effect on grade point average (GPA) for women.

Though performance measures such as GPA, are often thought to be an important predictor of persistence when gender and race are considered together, studies show mixed results. Leppel conducted analyses to compare the predicted GPAs for African American and European American students. She found that the predicted GPA for African Americans was lower than the predicted GPA for European Americans. However, when examining persistence rates, Leppel found that African American women had higher persistence rates than European American women. She asserted that the difference may be attributed to the greater motivation of African American women and their belief that they have little hope for employment advancement without a bachelor's degree. Though her assertion may be plausible, she provides no evidence for this account.

African Americans and persistence. African Americans are more likely to persist at HBCUs than at PWIs (Pascarella and Terenzini, 2005). This appears to be the result of an indirect relationship between persistence and campus climate, rather than persistence and academic influences (Astin et al., 1996; Pascarella & Terenzini, 2005). For instance, according to Grandy (1998) having a staff dedicated to the needs of minority students increases persistence at PWIs to the extent that such dedication is pervasive at HBCUs, persistence would be boosted by an overall positive climate for success.

Other researchers have investigated the persistence of African American students at PWIs and HBCUs. Kim and Conrad (2006) conducted a study to determine what, if any, differences existed in persistence for African American students attending an HBCU versus a PWI. The data were taken from the Cooperative Institutional Research Program (CIRP). The 941 participants were first surveyed in 1985 and were contacted again nine years later in 1994. Kim and Conrad examined interactions with faculty, high school GPA, Scholastic Aptitude Test (SAT) scores, and initial degree aspirations, etc. At the institutional level they examined college type, i.e., did the student attend an HBCU or a PWI? Results indicated that HBCUs and PWIs graduated a similar percentage of students despite the HBCUs operating with fewer resources and enrolling students with less preparation for college. The study also found that women were more likely to graduate than men were, although they did not offer an explanation for this finding. Furthermore, they found that African American students had more interactions with their faculty at HBCUs than African American students at PWIs, supporting the finding of Pascarella and Terenzini (2005) that faculty interactions encourage persistence.

Similarly, Zea, Reisen, Beil, and Caplan, (1997) conducted a study to examine the persistence of minority and European American students at a PWI. The minority students consisted of African American students, Hispanic students, and Native American students. The participants were first year students at a private university in the Northeast. The participants were divided into two categories, minority and nonminority. Zea et al. (1997) examined differences between the participants based on their social integration (i.e., number of dates per month) and academic integration (i.e., the number of academic clubs to which one belongs). They found that academic integration and social integration were almost equally important to minority and European American students whereas academic integration was not as important to European American students. Zea et al. (1997) combined the three minority groups in their analyses and did not disaggregate the data by gender so it is difficult to make any additional judgments about gender or racial group differences.

Rice and Alford (1989) conducted a study to analyze the retention and attrition of African American students at a Research I and PWI university. They collected data from students enrolled at the university and also students who had recently decided not to return to the university. Most of the respondents of the retention portion of the survey were juniors or seniors. Fifty-seven percent of the non-returning students were in good academic standing at the time of their departure, indicating that something other than academic achievement was responsible for their decision to leave the university. This study offers some insight as to why African American students might leave a PWI. According to Rice and Alford, isolation from other African Americans was ranked very low (four percent) on the list of reasons as to why students left the university. For students who stayed, they rated their contact with other African American students as fair to poor. In other words, although students did not report

isolation from other African American students as the reason they left the university, the students who remained at the institution had very little contact with other African American students. Social integration did not appear to be responsible for the students' persistence which is counter to Tinto's (1975) argument. The researchers disaggregated the attrition results by gender and found no gender differences in why the students chose to leave the university.

In the retention survey, the respondents were very positive in the rating of their university's reputation in their specific major. However, the survey did not identify which students left based on their dissatisfaction with their major or if their major was a STEM major. Additionally, Rice and Alford did not look at students who transferred from one major to another (perhaps because it is difficult to track). They only counted students who dropped out completely. Thus the role that major and department may play in persistence was not addressed.

In sum, research has shown the impact of variables such as HBCU attendance, PWI attendance, faculty interactions, peer interactions and departmental conditions at colleges and universities on student persistence. However, what strengthens the persistence of students appears to vary across race and gender (Grandy, 1998; Noble et al., 2007; Pascarella & Terenzini, 2005). Taken together, the research findings suggest that women who attend HBCUs and PWIs with supportive climates may be more successful in STEM fields than African American women from less supportive campuses. Incorporating a theoretical approach provides a foundation on which to build additional research.

Theoretical Foundations

Although many researchers have contributed information on attrition and persistence for college students, there are two bodies of research that deserve special attention. The first is Tinto's Student Integration Model and the second is Bean and Metzner's (1985) Student Attrition Model, both of which focus on attrition.

Tinto's Student Integration Model

Pre-entry characteristics. According to Tinto, there are pre-entry characteristics that students bring to college with them. Among them are individual attitudes, family background, and pre-college schooling. Students enter with a certain amount of goal commitment, which is the commitment one has to obtain a baccalaureate degree, and institutional commitment, which refers to one's loyalty to the university. Each of these is then shaped by their academic systems while enrolled in the institution. If one is low in institutional commitment or goal commitment, it can lead to dropping out (Tinto, 1975).

Social and academic integration. According to Tinto, when the student is properly integrated into the environment, the student will be more likely to persist than if she or he were not involved in any extracurricular activities. According to Tinto, persistence is more likely to be achieved when the student is integrated into the community both academically and socially (Tinto, 1975). Academic integration is strengthened by grade performance and intellectual development whereas social integration is strengthened by peer and faculty interactions. Social integration can have an inverse effect if it is too high. Instead of encouraging persistence it can encourage attrition if a student is so involved in social activities that academic endeavors begin to suffer.

Criticisms of Tinto. A criticism of Tinto's model is that he focuses on middle class, European American, male students (Canada Report, 2003). In addition, his theory is not specific to those in the sciences where plausibly the lab environments provide unique opportunities for social integration or isolation. Although Tinto has information in his theory which might be appropriate for African American students in the sciences, the theory needs expansions to apply to diverse populations and the unique circumstances of their group histories. For instance, Tinto focuses on the inadequacies the individual may bring to the table without fully addressing institutional contexts that encourage some groups of students to leave while assisting others to stay.

Bean and Metzner's Student Attrition Model

Bean and Metzner (1985) share some essential components with Tinto in how they account for student attrition. As Tinto does, Bean and Metzner assume that the causes of attrition are multi-faceted and interactive (Cabrera, Nora, & Castaneda, 1993). Additionally, both theories hypothesize that precollege characteristics influence academic success (Cabrera, Nora, & Castaneda, 1993). Finally, both theories call attention to the importance of the student and the institution matching one another (Cabrera, Nora, & Castaneda, 1993).

In contrast to Tinto (1975), whose theory does not address race or gender, Bean and Metzner outline that race and gender are defining variables for students entering college. Bean and Metzner (1985) also emphasize that the external environment of nontraditional students makes it difficult for them to persist, in contrast to Tinto, who emphasizes the importance of social integration. Bean and Metzner focus on environmental factors such as family approval of the institution or friends' encouragement to stay, which are missing for

Tinto (1975). Therefore, Bean and Metzner's theory may be able to account for campus climate as an environmental factor, whereas Tinto's theory could not.

Criticisms of Bean and Metzner

A criticism of Bean and Metzner (1985) is that they focus on nontraditional students, such as those who are commuters or older than the traditional student. However, students of color and women are also placed in the nontraditional student categories. Whereas Tinto is silent on differences in attrition for women or students of color, Bean and Metzner argue that differences between subpopulations are to be expected and explored. However, they do not examine what the differences in the subpopulations might be. Instead, they assert that their model is flexible and can accommodate the examination of subgroup differences. Since neither Tinto's model nor Bean and Metzner's model can fully account for attrition, a hybrid of the two theories appears to be the best method to examine persistence.

Academic Achievement

Grades are important to persistence such that those who have good grades are more likely to persist than others (Adelman, 1999; Pascarella & Terenzini, 2005). Though grades influence persistence they do not fully account for the differences that are seen between students who persist and students who leave STEM fields (Seymour & Hewitt, 1997). First year achievement is important to persistence such that students who make better grades are more likely to make it to their second year of college (Suresh, 2006). This holds over time for students and when controlling for other events such as financial aid, how selective the university is, and hours worked to name a few (Pascarella & Terenzini, 2005).

Allen (1992) pointed out how focusing on race complicates the study of academic achievement, arguing that the needs of African American students are similar, but not

identical to the needs of the majority students on campus. Allen launched a series of survey-based studies to explore the similarities and differences between African American students on HBCU campuses and those on PWI campuses (Allen, 1992). The surveys requested information such as demographics, peer relationships, faculty relationships and academic achievement. The findings indicated that positive relationships with faculty were positively correlated with academic success. Allen also found that students with positive peer relationships were more likely to be socially involved at their universities. However, his study did not extend to those in the sciences.

Fries-Britt and Turner (2002) also examined the academic experiences of African American students at an HBCU campus and a PWI campus. The participants were 34 (19 from HBCU and 15 from PWI) students who were either juniors or seniors at their universities. Fries-Britt and Turner used interviews and focus groups to collect data from the students. They generated two themes from their results: 1) social and emotional experiences and 2) the cultivation or dispersion of energy. Students at the HBCU reported a more positive campus climate and favorable interactions with peers whereas the students at the PWI reported feeling a lack of support. However, the science students at the PWI reported that they felt more support in their science classes than they experienced in their non-science classes. It should be noted that the PWI used in this study also had a large representation of African-American students due to the university's efforts to design programs to retain African-American students. Additional results of the first theme, involvement in campus activities, demonstrated that the students at the PWI were not as socially integrated into the campus as the students at the HBCU. The students at the PWI mentioned that they focused on their studies instead of social activities and that activities geared toward the African

American students were patronizing. In contrast, the students at the HBCU did not report a lack of social engagements geared toward them neither did they report that their social activities detracted from their studies.

The second theme, cultivation or dispersion of energy, revealed that African American students on HBCU campuses felt energized by their campus events and the integration of Black History in their courses, whereas the African American students at the PWI reported feeling tired from being seen as the “expert” on everything dealing with African Americans for their European American peers. Fries-Britt and Turner (2002) concluded that the achievement of African American students would increase by identifying the best practices from HBCUs and PWIs and instituting them at both types of universities.

Students have other ways of looking at academic achievement outside of grades. Carson (2009) examined the academic achievement of African American students who were enrolled in a PWI. Carson conducted a qualitative study with 16 participants. They were interviewed using a semi-structured approach to gain information about their views on their academic achievement. Results indicated that the students reported looking at their achievement in terms of persisting from semester to semester rather than in terms of the grades they earned in their courses. Holding the belief that persistence from semester to semester is more important than grades may partially account for the lower grades that African Americans have in comparison to their European American counterparts. However, further testing should be done on a larger sample size to replicate the finding.

The research findings demonstrate that grades are important but they, alone, cannot predict who will stay and who will leave the sciences. Fries-Britt and Turner (2002) found that the level of social integration influenced achievement but their findings could not

explain the success of some students in comparison to other students. Similarly, Carson (2009) found that grades were less important to a group of African American students than was persisting from semester to semester. The data clearly demonstrate that grades are not the primary predictor of success but questions remain about the importance of other factors such as social integration in determining success for African American women in STEM fields.

Career Commitment

Career commitment has been examined several ways. In some instances, the focus is on actual outcomes, such as studies that take a retrospective or longitudinal approach to verify if students choose careers within STEM after graduation from baccalaureate programs (Barker, 2001.) Another body of research looks at expectations, such as examining if students plan to enter STEM fields upon graduation while they are still in their undergraduate programs (Farmer & Chung, 1995; Nauta, Epperson, & Kahn, 1998). Barker (2001) provided a sociological definition of career commitment as a global construct that centers on the type of work one does, regardless of the title the particular job or workplace might carry. The purpose of the study was to examine how gender influenced career commitment. Instead of having participants who were students, Barker conducted a retrospective study with individuals who were already in engineering careers. The participants completed surveys regarding the engineering type, their involvement in their careers, their manifest needs, workplace experiences, and career commitment and satisfaction. The participants were 187 (101 women, 86 men) who were alumni of a university in the northeast of the United States. To find out whether career commitment, career involvement, and career success (to name a few variables) differed by gender, a regression analysis was used. Results

indicated that there was no difference in overall commitment based on gender, but there were numerous underlying differences that support the notion of a chilly climate for women in the sciences. For example, women were statistically more likely to report mistaken job identity (e.g., being mistaken for the administrative assistant rather than an engineer), being the token woman, hearing patronizing remarks, and seeing men promoted more frequently.

Results are suggestive about adults' career commitment, and clearly demonstrate gender differences in workplace experiences. However, the study has limited applicability to understanding how gender and race may together influence career commitment. It is also unclear if findings in engineering profession are applicable to other STEM fields.

Multiple definitions have been used to describe career commitment. One body of research asserts that career commitment is a multidimensional concept. Carson and Bedian (1994) devised a three-prong approach to career commitment that is comprised of "career identity," "career planning" and "career resilience." They defined "career identity" as developing an emotional attachment with the career, "career planning" as setting goals to achieve the career, and "career resilience" as maintaining one's desire to remain in the career even when obstacles present themselves. In this model, career commitment describes the extent to which one plans to continue in the career that she has chosen (Kidd & Green, 2006). Kidd and Green's (2006) results indicated that salary appeared to be more important to men than women but on the issue of the three-pronged approach to career commitment, there appeared to be a small, yet significant relationship indicating that women were less committed to their careers than men in the areas of career planning and career identity. However, there was no consistent difference between men and women as it

relates to career resilience. The findings suggest that men and women may be similar in their career commitment, once their careers have been chosen and they have worked in the field, but in the trend of most studies, it was silent on how race and gender may combine to influence the commitment one makes to her chosen career.

Another body of research suggests that career commitment is best defined as a global construct based on one's feelings toward her career or how she envisions the path of a certain career (Barker, 2001; Blau, 1985; Chusmir, 1982; Mowday, Steers, & Porter, 1979). Continuing in that vein, other researchers described it as the extent to which one considers the attainment of a given career (Super & Chula, 1976; Farmer & Chung, 1995), the type of work one chooses that is specific to a field, such as becoming a scientist or a mathematician (Barker, 2001), or simply staying within a job family for an extended amount of time (Lyons, 1971). For example, Blau (1985) describes it as how one thinks about her profession, but this provides a limited scope as it does not include any aspirations or goals that are tangible ways of demonstrating career commitment.

Career commitment has been linked to job commitment (Colarelli & Bishop, 1990), organizational commitment (Colarelli & Bishop, 1990; Goulet & Singh, 2002), and career resilience (Kidd & Green, 2006). However, one study contends that career commitment is a distinct variable which may correlate with the aforementioned variables but certainly measures a separate construct. Job commitment refers to one's commitment to a particular job but may not include one's career. Organizational commitment refers to being loyal to the entity one works for, but it does not address the job one may have within the company or

corporation. Colarelli and Bishop (1990) found that career commitment was a distinct variable when compared to organizational commitment or job commitment.

Colarelli and Bishop (1990) conducted a study to compare career commitment among a group of chemists and students working towards their MBAs while employed. There were 426 participants (216 women/210 men) in their survey. The survey included two career commitment scales. Each had been modified from an organizational commitment scale where “career” had been substituted for “organizational” commitment. The two scales differed in that the first scale mirrored the authors’ affective concept of career commitment. The researchers did not explain why they chose the second scale but it included questions based on items asking under what circumstances one would change his/her career. Results revealed a strong correlation between the two measures of career commitment administered by the researchers. They also conducted a factor analysis on the career commitment and organizational commitment measures and two distinct factors emerged, one that aligned with career commitment and the other aligning with organizational commitment. The major strength of this article is that the participants were those in a professional field (chemists) and a managerial field (MBA students with full-time jobs), allowing an opportunity to compare career commitment between the two fields, one in STEM and the other in business. The men and women in the study did not differ in their commitment to their profession. Keeping in mind that the participants were those who were already working in their fields, the results seem to suggest that the women in this sample have overcome barriers that were presented to them earlier in their careers and they now have a sense of security about their careers that may have been absent earlier in the pipeline. Whether there may be gender differences among younger participants i.e., students early in their training in these fields, is unclear.

One study designed to determine if career commitment to engineering differed between men and women found no gender differences in career commitment but found that when children were included in the equation for career commitment, that career commitment went up for people with fewer children (Barker, 2001). While Barker was able to capture the perspective of men and women several years after graduating from their undergraduate programs and analyzed whether the individuals stayed in the engineering field or if they chose to leave it, the study did not cover individuals who chose fields outside of engineering.

In summary, career commitment can be assessed as a global construct, according to Colarelli and Bishop (1990). It is also known that at least for engineers, a difference in career commitment did not emerge between men and women (Barker, 2001). However, a dearth of information exists concerning African American women in science and career commitment. The paucity of research in this provides an enormous opportunity to explore a wide variety of factors related to career commitment at the intersection of race and gender.

Department Climate

A substantial amount of research on faculty-student interactions exists (Hurtado, Eagan, Tran, Newman, Chang, & Velasco, 2011; Kim & Sax, 2009; Sax, Bryant, & Harper, 2005). Research on faculty-student interactions highlight the positive influences these interactions have on student outcomes such as GPA, persistence, and degree aspirations (Sax et al., 2005). Research on faculty-student interactions has also investigated gender differences and found that women are less likely than men to seek faculty-student interactions (Eagan, Herrera, Garibay, Hurtado, & Chang, 2011; Sax et al., 2005). Though research on faculty-student interactions exists, less is known about the experiences students are having in the major department, in concert with faculty interactions. Department climate

has been neglected in undergraduate research on the underrepresentation of African American women in STEM. Instead, an emphasis has been placed on producing a “critical mass” of women faculty in STEM departments or addressing the experiences of female graduate students in STEM departments (Etzkowitz, Kermelgor, Neuschatz, Uzzi, & Alonzo; 1994; Ferreira, 2003; Maranto & Griffin, 2011; Settles, Cortina, Malley, & Stewart, 2006; Stockard, Greene, Lewis, & Richmond, 2008). Positive interactions with faculty promote persistence (Pascarella & Terenzini, 2005). It may be more beneficial to explore the influence of the department for students in addition to the influence of having female faculty members. Furthermore, *department climate* may vary across departments and colleges of an institution. If so, some departments may be better at retaining African American women in contrast to other departments. It is known that the biological science departments have more women represented in their departments than physical and mathematical sciences do (Ferreira, 2003). Pascarella and Terenzini (2005) hypothesize that grading practices, faculty-student interactions, and faculty accessibility may play a direct role in persistence. The current project includes an examination on how faculty and peers influence persistence and the similarities and differences that are found for women and African Americans as it relates to persistence.

In the absence of faculty interactions outside the classroom it appears that the students’ positive perceptions of faculty are enough to promote persistence (Halpin, 1990; Johnson, 1994; Mallette & Cabrera, 1991; Pascarella & Terenzini, 2005). Positive interactions with faculty are linked to persistence although the causal relationship is unclear. For contact that occurs outside the classroom it is unclear if better students were seeking

these relationships with faculty and they already would be strong persisters or if the contact with the faculty leads to persistence (Kuh & Huh, 2001; Pascarella & Terenzini, 2005).

The influence of peers outweighs the influence of faculty (Bank, Slavings, & Biddle, 1990; Pascarella & Terenzini, 2005). It also appears that peers encourage group homogeneity and discourage group differences (Bank, Slavings, & Biddle, 1990; Pascarella & Terenzini, 2005). If peers are discouraging group differences, they may also be discouraging persistence in the sciences by discouraging their peers to major in subjects which require more stringent demands on their time, as a degree in engineering does. Holland and Eisenhart (1992) found that peers had a strong influence on students; one that may distract students from their career goals.

Campus Climate

Campus climate may be partially responsible for influencing which African American women persist to degree in STEM fields and which do not. Hall and Sandler (1982) coined the term “chilly climate” to describe the environment for women on college campuses. The chilly climate they refer to is the “subtle or overt” ways men and women are treated differently on campus, with preferential treatment given to men (Hall & Sandler, 1982). It can include the campus, in general, and it can be extended to interactions that occur outside the classroom (Solorzano, Ceja, & Yosso, 2000). It is possible for a supportive campus climate to exist outside the classroom but not in the classroom and vice versa. In the classroom the climate can be affected by the instructor, the pedagogy, or other students. The instructor can cause a chilly climate if he or she encourages the men but not the women or asks follow-up questions of the men, but not of the women. If the instructor seems cold or distant, it can also have a negative effect on how women and people of color interpret the

instructor's behavior. Researchers have noted that women and people of color prefer instructors who care about their performance and want them to do well (Seymour & Hewitt, 1997). If the class is taught using the "banking" style where the instructor stands at the front of the class and lectures the students and they are basic receptacles of knowledge, then that may also discourage the educational engagement of female students and people of color (Freire, 1970).

A negative campus-wide climate perception might be created in the form of an "unassuming" remark about a female classmate being enrolled just to find a husband (Hall & Sandler, 1982). It is important to study campus climate in relation to the success of African American women in the sciences because environmental variables may have a strong impact on whether or not an individual succeeds in a baccalaureate program. If students enjoy their campus climate they may be more likely to persist than if they feel unwelcome on their campus.

Indeed, much of the literature on campus climate focusing on underrepresented populations demonstrates this relationship (Locks, Hurtado, Bowman, & Oseguera, 2008). The results have consistently indicated that racism and discrimination influence students' experiences on PWI campuses (Cabrera & Nora, 1994; Cabrera, Nora, Terenzini, Pascarella, & Hagedorn, 1999; Locks, Hurtado, Bowman, & Oseguera, 2008).

While Hall and Sandler (1982) is a classic study, it has been criticized as too reliant on anecdotal reports (Morris, 2003). However, multiple subsequent studies have verified the importance of institutional climate in educational experiences (Hausemann, Schofield, & Woods, 2007; Morris & Daniel, 2008; Rosser, 2003; Rosser 2004;).

In an interesting attempt to challenge these findings, Morris and Daniel (2008) conducted a study with participants from a community college to compare the climate for people in female-dominated majors (e.g., nursing, education) and those who were not. The participants were students at a two-year college (186 men, 217 women). Morris and Daniel used the Perceived Chilly Climate Scale to assess the climate. They analyzed the data by conducting multivariate analyses and assessing correlations. Despite their focus on the effects of underrepresentation on men whatever their majors, they found that women were more likely to report a chilly climate than were men. Although this study was conducted at a community college and not a four-year institution, the results contribute to the growing empirical evidence to support the early insights of Hall and Sandler.

Campus climate for African Americans. Most African American students attending college prior to the 1960s did so at a HBCU due to segregationist laws and precedence (Douglas, 1999). The decision to attend a PWI today may not be an easy one for African American students. African American students attending PWIs report feeling more alienated, isolated, and less welcome than African American students attending HBCUs (Ancis, Sedlacek, & Mohr, 2000).

African Americans attending HBCUs may have advantages that those attending PWIs do not. According to Pascarella and Terenzini, a major advantage is the favorable climate that exists for African American students on HBCU campuses in comparison to the isolation that can occur for them at PWIs. Numerous studies have demonstrated modest to strong results indicating the increased chances of earning a degree at an HBCU in comparison to a PWI (Astin et al., 1996; Allen, 1992).

Perna et al. (2009) have focused on the links between climate and career commitment in STEM. They conducted a study at Spelman College to examine how campus climate influences women who are pursuing STEM careers. The participants were 19 individuals who were either students in STEM fields, faculty or campus administrators. Data were collected through focus groups. Results were analyzed by noting themes that emerged from the focus groups. The four primary themes indicated that 1) the student participants selected Spelman because of the positive reputation it had for producing STEM field graduates, 2) students enrolled with career and occupational aspirations which they maintained during their academic career, 3) there was an acknowledgement of the multiple barriers that women of color face in STEM fields, 4) and some of the potential barriers were reduced because of the positive campus climate. For example, they found that small classes and faculty accessibility positively affected retention in STEM fields. They also found that peer support, faculty encouragement and involvement, undergraduate research opportunities, and academic support services all contributed to the positive campus climate. Perna et al. (2009) investigated the supports and barriers that women may find in STEM fields and noted how supports made positive contributions in helping women obtain bachelor's degrees in STEM fields. However, because of the small sample size, the generalizability of their findings for African-American women across institutional types is unknown.

Cabrera and Nora (1994) found that African-American students reported less sense of belonging than did their European American counterparts at PWIs. It is likely that students who report less of a sense of belonging may be less likely to persist. Sense of belonging has also been used as a proxy measure of social integration on university campuses (Hurtado, Han, Saenz, Espinosa, Cabrera, & Cerna, 2007).

Campus climate and career commitment. Campus climate may influence career commitment in that African American women who interpret their surroundings as supportive and conducive to their success may be more likely to persist than African American women who interpret their environment as hostile and negative.

Cabrera and Nora (1994) conducted a study to determine the perceptions students had about their college campus during their first year of college. The participants were 879 students. African Americans, European Americans, Hispanics and Asian Americans were represented in the participant pool. The university was a PWI. Results indicated that African American students perceived more discrimination on campus than did their peers of other races. Minority students, in general, felt isolated and singled out in their classes. Results provided evidence that African American students are having qualitatively different experiences on PWI campuses than their European American peers.

Social Cognitive Career Theory Core Constructs

According to Lent and Brown (2006) the core constructs of Social Cognitive Career Theory (SCCT) are self-efficacy, goals, outcome expectations, interests, and constraints/supports. Self-efficacy, the belief an individual possesses about her/his ability to accomplish a given task, varies by individual and the task at hand and may mediate academic success (Lent, Brown, & Larkin, 1987; Zimmerman, 2000). In this instance, goals are “one’s determination or intention to pursue a particular course of action” (Lent, Brown, Schmidt, Brenner, Lyons, & Treistman, 2003). For example, goals can be grade-related such as “I want to make an ‘A’ in this course.” Outcome expectations are the likely results of an action or behavior (Lent & Brown, 1996) and are reflected in the following statements, “I will

become an astronaut,” and “I will become a science teacher.” Interests are activities, subjects, etc. that an individual likes such as reading or enjoying math (Bandura, 1982).

Finally, constraints/supports are factors outside of the individual that can affect her success or failure. Social cognitive career theory does not speak directly about campus climate but it does allow for it to be a part of the equation. It says that there are supports and barriers in one’s environment that encourage or discourage one in the sciences. By extension, campus climate can either be a support or a barrier depending on the students’ interpretation of it.

Social Cognitive Career Theory and African-American Students

Some elements of SCCT have been shown to be of particular relevance in understanding the educational choices and outcomes of African-American students. For example, Lent, Brown, and Larkin (1987) examined self-efficacy, interest congruence, and consequence thinking to determine which had the greatest predictive ability. The participants were 105 students who were primarily freshmen and sophomores. Their results indicated that self-efficacy was the best predictor of interest congruence and consequence thinking for college students considering science and technology careers.

In a later study led by Lent and his colleagues (2005), they included students at two historically Black colleges and universities (HBCU) and one predominately White institution (PWI). Four hundred eighty-seven engineering students participated in the study. The students completed five measures which assessed their self-efficacy, engineering outcome expectations, technical interests, social supports and barriers and major choice goals. Their results indicated that self-efficacy was the primary predictor of outcome expectations and major choice goals. Self-efficacy also predicted interests. For students at HBCUs, self-

efficacy was a stronger predictor of interests than it was for students at PWIs. Although women and African American students were strongly represented in this study, unfortunately the analysis did not look at the intersection of gender, race and campus. Instead, the analyses used university as a variable, perhaps with the assumption that HBCU campuses served as a proxy for race.

Another limitation of this study is that their participants were engineering students rather than students from multiple STEM fields. Their study demonstrates that the self-efficacy scale was reliable and valid for engineering majors but its value for students in other fields is as yet untested.

Building on Lent and his colleagues' previous work, Byars-Winston, Estrada, Howard, Davis, and Zalapa (2010) examined SCCT and social cognitive variables on a sample of students of color. The participants were 223 students who self-identified as African American, Latino/a, Native American or Southeast Asian. They were majoring in one of two disciplines: biological sciences or engineering. The participants responded to items for several measures, including academic self-efficacy and perceptions of campus climate. Results indicated that engineering undergraduate students reported higher academic self-efficacy and more positive perceptions of the campus climate in comparison to the biological sciences undergraduate students. Byars-Winston et al. also found that students who had higher self-efficacy scores also perceived their campus climate in a more positive fashion. The researchers postulated that it may be that those with higher self-efficacy may be more positive in general or, perhaps, the positive environment may improve self-efficacy.

Byars-Winston et al. (2010) contributed to the literature a comparison of the differences that may be found within STEM disciplines, in this case, engineering and

biological sciences. Also, all of the participants in the study were non-majority students, which allowed the researchers to investigate whether SCCT was adequate for a non-majority population. Their findings indicate that it is.

Self-Efficacy

Other researchers have focused on gender differences in STEM fields. According to Zeldin, Britner, and Pajares (2008) men and women differ in self-efficacy as it relates to STEM careers. The participants were 10 men who were currently employed in STEM fields, such as a computer consultant or a chemistry professor. Zeldin et al. used an open-ended interview protocol to gather data from the men and a crosscase approach to compare their findings with the results of a previous study on women and self-efficacy beliefs. The findings of the 2008 study indicated that men and women differ in self-efficacy and the pursuit of a career in STEM with women being guided by relational contexts, in that they are guided by their relationships with others more so than are men. Additionally, the women reported social obstacles that the men did not report having, indicating that the women may have been subjected to a less hospitable climate than the men.

Still other researchers have focused on different types of self-efficacy. For example, technical/tinkering self-efficacy was posited as a marker of an individual's likelihood to pursue the sciences. According to Baker, Krause, Yasar, Chell, & Robinson-Kurpius (2007), boys have more experience operating lab equipment (technical) or taking things apart and rebuilding them (tinkering) than do girls because boys are encouraged to do these activities as children. Accordingly, if women were encouraged to operate technical equipment or build things, then they would also be more likely to become engineers and explore careers as scientists (Ayre, Mills, & Slay, 2001).

Another measure that has been put forth is the math self-efficacy scale which measures the students' assessment of their math abilities (Lent, Lopez, & Bieschke, 1991; O'Brien, Martinez-Pons, & Kopala, 1999). The ability to do well in math courses is related to one's performance in the scientific fields (Gwilliam & Betz, 2001; O'Brien, et al., 1999), but math performance cannot fully predict one's performance in STEM fields, nor is math performance equally important across STEM fields as some STEM fields require fewer math courses than others. Additionally, a theoretical framework is lacking for mathematics self-efficacy as an explanatory factor for African American women in science. Mathematics self-efficacy has been linked to women's interest in the sciences but its relationship to career commitment is unclear (O'Brien, et al., 1999).

Another type of self-efficacy that has been examined is science self-efficacy. Gwilliam and Betz (2001) conducted a study about the validity of a science related self-efficacy. The participants were 399 students from an introductory psychology course. The study was conducted with an African American and European American participant pool. Results indicated that the Science/Technical Self-Efficacy was more appropriate for science students than students in the general undergraduate student population. However, the article did not explore how gender and race may interact in predicting science self-efficacy. Plausibly, African American and European American men and women have distinct and different assessments of their scientific ability.

Self-efficacy and careers. Some of the first studies used to explore women's career outcomes also looked at self-efficacy (Betz, 2001; Gwilliam & Betz, 2001; Lent, et al., 1991; Silcox & Cummings, 1999; Taylor, 1983). Some explored career decision-making self-efficacy, others computer self-efficacy, and others math self-efficacy. In more recent years,

researchers focused on more specific definitions of self-efficacy such as science self-efficacy and have linked it to career outcomes, as well.

Self-efficacy may influence the performance of undergraduate students in the sciences. Understanding African-American women's self-efficacy in relation to the sciences may be able to provide us with an important clue to uncovering why African American women are able to achieve success in the sciences. One's self-efficacy may serve as a strong predictor career commitment.

Self-efficacy scales. As mentioned previously, multiple self-efficacy measures have been developed for capturing an individual's self-evaluated proficiency in STEM. The self-efficacy scale for mathematics and the Scientific/Technical Efficacy Scale have both been used to assess self-efficacy. The Scientific/Technical Efficacy Scale is of particular interest because it has been shown to be valid for African American and European American samples. However, one of the problems with the scale is that it does not align with the contextual assessments that it should in order to be a useful scale when using social cognitive career theory (R. W. Lent, personal communication, 2008). Lent and Brown (2006) explained that most current models of measuring self-efficacy do not account for each of the tenets that Social Cognitive Career Theory theoretically addresses. Therefore, the Scientific/Technical Efficacy Scale was not the best scale to use for this study.

Due to the dearth of information on African American women in STEM, the availability of literature that speaks directly to their circumstances is extremely limited. Therefore, it was essential to use information that was found to be valid for groups that though, not identical, may be similar. For example, Zeldin and Pajares (2000) have conducted important research regarding the self-efficacy of women in the sciences. The

purpose of their study was to examine the self-efficacy beliefs of women who were already successful in their STEM-related careers. Zeldin and Pajares (2000) found that self-efficacy was more important for women in STEM fields than for those who had more traditional career paths. Their study was limited in generalizability because of its small sample size (15). Only two of the participants were not European American, and neither of the two minority women were African American. The women's educational backgrounds spanned the gamut from having no formal education beyond high school to having attained a PhD in the sciences. These limitations mean that the results are suggestive and further study is needed to establish their applicability to African American women, and to explore if field differences within the sciences may be at play.

STEM Major Differences

African Americans in STEM have lower completion rates than European Americans in STEM (HERI, 2010). Nonetheless, unlike in other ethnic categories African American women have higher completion rates than African American men (HERI, 2010).

There are differences in completion rates among STEM majors (Chen & Thomas, 2009). Using data from the Beginning Postsecondary Students (BPS) Longitudinal Study, Chen and Thomas examined differences in persistence by STEM field. The students were surveyed first in 1995-1996, again in 1998, and once more in 2001. The BPS study had a sample of approximately 12,000 participants nationwide. Students enrolled in engineering and computer sciences were less likely to attain a bachelor's degree (in six years) than were their peers in other STEM fields, such as biological sciences or the physical sciences. Again, the students in the physical sciences were more likely to earn a degree than their counterparts in engineering or engineering technologies. Only 37% of students who declared a STEM

field as their major graduated with a degree in that major six years out (Chen & Thomas, 2009). Taken together, these numbers demonstrate that the need for examination of STEM fields still exists. Furthermore, the data Chen and Thomas (2009) reported on did not provide information about the intersection of race and gender. However, the overall rate of persistence for African Americans was lower than that of European Americans.

Camp, Gilleland, Pearson, and Putten (2009) conducted a study to find out what differences existed between women who majored in “hard” sciences versus those who majored in “soft” sciences. They distinguished between “hard” and “soft” sciences by the number of quantitative courses needed to complete the curriculum. Therefore, psychology, social sciences, and biological/life sciences were considered to be “soft” sciences in contrast to the physical science, mathematics, engineering, and computer sciences which were considered to be “hard” sciences. The participants were 925 women who were respondents to the Beginning Postsecondary Students Longitudinal Study (BPSL) beginning in 1996 through 2001. The researchers assessed student background characteristics (e.g., career preference, aptitude, values, and aspirations), collegiate experiences (e.g., social/academic integration, peer groups, and major department curriculum), and non-collegiate reference groups (e.g., peers, employers, community organizations). There were almost five times as many women in the “soft” sciences as compared to the “hard” sciences once the outliers were removed (467 v. 100).

Results indicated few differences between women who majored in the “hard” sciences versus those who majored in the “soft” sciences. One of the few differences noted was that women in the “hard” sciences had more faculty interactions than women in the “soft” sciences. The researchers hypothesized that women in the “hard” sciences sought more

interaction with faculty because of the difficulty of their courses. However, it is plausible that women in the “hard” sciences were more likely to seek out the faculty regardless of the difficulty of their courses. Students who interact with their instructors are more likely to persist (Kim & Conrad, 2006; Pascarella & Terenzini, 2005). Camp et al. also found that the number of math courses taken was statistically greater for women in “hard” sciences versus those in the “soft” sciences. They concluded that math continues to be a critical filter for those who wish to pursue a degree in STEM fields.

A major strength of the study was its emphasis on women in the sciences and the differences that might be seen between those who choose a life sciences track versus those who pursue the physical sciences. However, no analyses were provided for any racial differences that might be present between the two groups.

Smyth and McArdle (2004) conducted a study to determine the effect of ethnic and gender differences on graduation rates for selective colleges and universities. The data was taken from the Cooperative Institutional Research Program (CIRP). Twenty-three colleges and universities were included in the study which were assessed to be “selective” universities with half of the colleges and universities included in Barron’s Educational Guides. There were 5,047 respondents in the study. The respondents entered college in 1989; however, Smyth and McArdle did not include the number of years allotted to matriculate through college. They assessed differences between the students based on their high school GPA, and SAT math and verbal scores, at the individual level. Using HLM, Smyth and McArdle found that gender and ethnicity accounted for only a small percentage of the variance in SME graduation rates. Instead, their results indicated that differences in SME graduation rates were due to precollege preparation in math and science courses. Smyth and McArdle

collapsed across race such that African American, Hispanic and Native American were combined to create an “underrepresented minority” category. Therefore, if there were differences based on racial category they may have been missed.

Although, Smyth and McArdle addressed institutional selectivity, they did not directly include a measure of the campus’s climate and its impact on student performance. Institutional selectivity refers to the difficulty of getting into a particular university or college. In this study, the universities and colleges were assessed as being highly selective. It is known that STEM majors are more likely to select more selective institutions than non-STEM majors (Chen & Thomas, 2009); however, selectivity should not be assumed to be a proxy measure for how students interpret the climate of their institution. Therefore, the results of Smyth and McArdle’s study must be interpreted with caution in relation to campus climate.

Elliott, Strenta, Adair, Matier, and Scott (1996) conducted a study examining the connection between ethnicity and choosing and leaving science in colleges or universities. Because the subjects came from multiple institutions, Elliott et al. (1996) presented totals in terms of averages across schools. There were approximately 13,000 individuals whose information was included in the survey. Elliott et al. gathered information from the respondent’s high school, standardized test scores, number of math and science courses taken in college and the student’s GPA for science and non-science courses. They found that African American students enter college with strong interest in the sciences but less preparation for it. However, the article did not fully address what happens for African American students who enter the sciences and are fully prepared. Their inclusion of minority students and the disaggregation of the data by minority status is a strength of this study.

However, they did not disaggregate by gender. Without that information, it cannot be determined why students stay or leave the sciences. It leaves the intersection of race and gender unexplored. An additional limitation of the study is that they examined persistence of first-year students into their second year, without including students who were sophomores, juniors, or seniors at the time the study was conducted.

The primary focus of their research was on institutional selectivity and early attrition and persistence into their second year. As mentioned previously, institutional selectivity cannot be assumed to be a proxy measure of campus climate. Therefore this article contributes to the body of knowledge concerning African American students but reveals little about the role of campus climate in persistence and attrition.

Leppel (2001) conducted a study using Beginning Postsecondary Student (BPS) data, a national longitudinal database, to examine how one's major influenced one's persistence. There were 4,947 (2521 female, 2426 male) respondents for this study. Leppel categorized the majors into six disciplines (engineering, health, business, education, arts and sciences, and undecided). The study was conducted with data taken from the student's first year in college, 1989-1990 and persistence was assessed by student's enrollment the following year, 1990-1991. If they were enrolled, they were counted as having persisted. Results indicated that one's major influenced persistence, especially for those who were undecided. For those who were engineering majors, having an engineering major did not appear to influence persistence. She added a caveat that there were only 78 women in the total population, which could mean that different results might occur with a larger sample. In relation to race, Leppel's results indicated that there was a small positive effect for African American women but not for African American men, meaning that African American women were more likely

to persist to their second year in comparison to African American men. Leppel did not include information about science or math courses separate from engineering so no information could be assessed about it. Although her study did not disaggregate the data by race and gender, per se, this study did contribute to the body of knowledge on persistence for African American women and for women in engineering.

In addition, the summarized studies focus their attention on the first year or two of college. Given that the greatest attrition occurs during the first year or two of college (Suresh, 2006), the authors make a significant contribution to the body of knowledge. However, the researchers were more focused on finding reasons for attrition and persistence and less focused on differences within STEM majors, making it difficult to determine why some STEM fields have better persistence rates than others.

Summary

African American women who have chosen majors in the scientific pipeline have made a preliminary decision to pursue science as a career. Once they have made that choice what contributes to their persistence? A patchwork of research findings suggest that self-efficacy, department climate, campus climate, academic major, and race and gender, each likely make a unique contribution to career commitment for African American women in STEM. In order to more precisely understand the career commitment of African American women, researchers must take into account the interaction between the individual, social and institution-level factors that influence career commitment.

Persistence to degree has been the focus of a great deal of research (Lent, Brown, & Larkin, 1986; Pascarella & Terenzini, 2005; Russell & Atwater, 2005; Seymour & Hewitt, 1997). The availability of research on the topic has shown that positive faculty interactions

and peer interactions contribute to persistence for students (Pascarella & Terenzini, 2005). It is also known that African Americans persist under circumstances where they experience a positive campus climate (Allen, 1992). For women, it is known that they are more likely to persist to degree than are men, but the reasons remain unclear (Leppel, 2002).

Previous models have utilized Tinto's (1975) Student Integration Model, designed for European American men, or Bean and Metzner's (1985) Student Attrition Model, designed for less 'traditional' students, such as women and people of color. However, neither of these models can fully address the circumstances regarding African American women in STEM. In contrast, a study that uses a theoretical framework such as the SCCT, which considers the dynamics of the interaction between individual and environmental, may be most applicable for working with African American women. Though this framework provides multiple paths that a study could take, the project focused on self-efficacy and the basics of the multilevel ecological model (i.e., individual, social, and environmental). That is, individual characteristics were examined in concert with environmental factors such as campus climate.

Academic achievement contributes to career commitment for African American women; however, Seymour and Hewitt (1997) found that even high-achieving students were leaving STEM fields for other majors. Therefore, understanding career commitment and the determination of African American women to succeed extends beyond grades and interests. The studies included in this literature review contribute to a body of knowledge about career commitment that is more complicated than academic achievement alone.

Science/Math Self-Efficacy, department climate, campus climate, and academic major may play a role in career commitment. However, there are limitations to the research that has been conducted in this area in particular, as that data is seldom analyzed by race and

gender and research frameworks seldom are multi-level. Instead, most studies have examined race as if it has two categories, European American and non-European American. This type of analysis falls short when more nuanced findings are sought, such as research with African American women as its target population. Furthermore, most of the studies in the literature review have focused on individual characteristics that were not examined in context of the social and the environmental contributions, be they supports or barriers to success.

Numerous studies have been conducted to investigate the role of environmental variables such as campus climate (D'Augelli & Hershberger, 1993; Locks, Hurtado, Bowman, & Oseguera, 2008; Ponterotto, 1990; Rankin & Reason, 2005) but there is a paucity of research in the literature that examines campus climate as it relates to career commitment. Although research suggests that there may be a relationship between self-efficacy, academic major, campus climate, and career commitment, to date, few studies, if any, have examined that relationship at the intersection of race and gender, i.e., in relation to African American women, specifically.

In an effort to fill a gap in the research, this study examined career commitment of undergraduate students, more specifically African American students, in relation to other key variables. The goal was to expand the literature on what is known about African American women who are pursuing degrees in STEM and thereby understanding how to address issues of underrepresentation with attention to the powerful social factors that have shaped educational opportunities in the contemporary U.S. workforce.

METHOD

Research Objective and Hypotheses

The objective of this study was to identify how science/math self-efficacy, academic major, department climate, campus climate, gender and ethnicity come together to influence career commitment for African American women in STEM. Consequently, six major questions were developed:

First, how are gender and race/ethnicity related to academic major?

H1a: Gender is related to academic major such that men are more likely than women to be STEM majors.

H1b: Race/ethnicity is related to major such that European Americans will be more likely than African Americans to be STEM majors.

The second research question examined the relation of gender and race/ethnicity to science/math self-efficacy.

H2a: Gender is related to science/math self-efficacy such that men will report higher science/math self-efficacy than women.

H2b: Race/ethnicity is related to science/math self-efficacy such that European Americans will report higher science/math self-efficacy than African Americans.

The third research question looked at gender and race/ethnicity and how they related to perceptions of *department climate*.

H3a: Gender is related to department climate such that, men will report more positive department climate scores at PWIs and HBCUs than women.

H3b: Ethnicity is related to department climate such that African Americans at PWIs will report less positive department climate scores African Americans than at HBCUs.

The fourth research question looked at gender and race/ethnicity and how they related to perceptions of *campus* climate.

H4a: Gender is related to campus climate such that, men will report more positive campus climate scores at PWIs and HBCUs.

H4b: Ethnicity is related to campus climate such that African Americans at PWIs will report less positive campus climate scores than at HBCUs.

The fifth research question asks how do academic major, science/math self-efficacy, *department climate* and *campus* climate influence females' and African American students' career commitment?

H5a: Career commitment is influenced by gender, major, self-efficacy, department climate and campus climate. In particular, for women in STEM, higher science/math self-efficacy and positive perceptions of *department climate* and *campus* climate will influence career commitment.

H5b: Career commitment is influenced by race/ethnicity, major, self-efficacy, and campus climate. In particular, for African Americans who are STEM majors, higher science/math self-efficacy and positive perceptions of the *department climate* and *campus* climate will influence career commitment.

The sixth research question asks if gender and race/ethnicity vary the impact of academic major, science/math self-efficacy, *department climate* and *campus* climate on career commitment.

H6a: For African American women, gender and race/ethnicity, in interaction, better predict the influence of major, science/math self-efficacy, *department climate* and *campus* climate on career commitment than either gender or race/ethnicity alone.

Design

This study was cross-sectional. The participants were selected from four universities in North Carolina. Data were collected from February through August, 2011.

Internal Review Board (IRB) permission was obtained from each university at which potential participants would be contacted. The method used to gather data varied. An email was sent to faculty members in the STEM majors of participating universities. It was suggested to faculty member that they offer extra credit to their students for participating in the study. In three instances, after making the initial contact, the faculty member allowed the researcher to visit the class to introduce her study and request the students' participation. Cooperating faculty members who offered the incentive credit sent email addresses of the students to the researcher, who contacted the students directly and invited them to participate. The faculty member was provided with a list of those who completed the survey. This information was kept in a separate database from responses and could not be linked to individuals.

As institutional IRB requirements varied and as cooperating faculty had different preferences for how the students were contacted, in more than 12 instances faculty members and/or instructors were provided with a web-link that included an introduction to the study that they then forwarded to the students. Institutional regulations and faculty preferences for student contact were necessarily key to distribution of the survey and thus the process of distributing the survey varied.

It was not possible to determine the response rate for the survey because of the multiple ways in which the survey was distributed to the students. For example, the survey was posted to a message board that went to the entire student population at one university,

but it was seen only by students who checked the message board over the summer. Also, cooperating institutions and faculty made it possible to distribute the survey via several listservs that would otherwise have been unavailable to the researcher, but this limited the ability to calculate a “response rate” since the total group population was unknown.

However, in the period in which survey data was collected, the number of responses increased when faculty offered the incentive. The researcher also used handbills with a link to the survey at one university and participants may have been gained that way. However, it was not possible to determine which, if any, respondents came from this method, or to compare the relative response rates of the various approaches, because there were no items on the survey that asked the participants to disclose how they heard of the survey.

The survey was 74 items and was web-based. It took approximately 15 minutes to complete and participation was completely voluntary. The email introduction included a brief description of the study, a link to the survey, and a description of the incentive or extra credit, when applicable. The online survey included an informed consent statement, from which they could choose to exit or continue the survey. Because the survey was available online, it could be taken at a student’s convenience. When possible, reminder emails were sent to students approximately one week after the initial invitation was sent. Up to five reminders were sent to students. The participants were told that the results would be kept confidential and the participants were informed that the results would only be analyzed in the aggregate. The only requirement for participation was that the student had to be enrolled as an undergraduate student at one of the four universities.

Participants

Data were collected from 1052 students. However, 382 were excluded from the final analysis for varying reasons. One hundred consented to take the survey but did not complete any items. One hundred twenty were excluded because they did not include their race/ethnicity and/or gender. One hundred sixty-two included their ethnicity but identified as other than African American or European American. The remaining 670 were included in the data analyses. The participants ranged in age from 18-57, with an average age of 22 years old and 201 not reporting their birth year.

Undergraduates from four universities and colleges were surveyed. When provided, course information was recorded (see Table 1).

The total number of science and math courses taken overall and taken in the current semester were self-reported. Five students reported taking a total of 35 or more math and science classes and four students reported taking six or more science and math classes for the current semester. To determine if the outliers made a statistical difference, a one-sample *t*-test was conducted. There was no statistically significant difference in the mean scores between the old and new numbers. The original data showed that the average number of classes taken overall was 7.8. After removing the outliers, the new average was 7.5 ($t = .26, p = .80$). For the number of classes taken for the current semester, the average number was 1.98, originally. After removing the outliers, the new mean was 1.94 ($t = .67, p = .51$).

African American women were over-sampled because the primary intention of the survey was to contribute to understanding factors related to career commitment for African American women in STEM. Additionally, African Americans made up more than half of the

participants and African American females were well represented in the study (38.6%; see Table 2).

Table 1

Universities and Classes Sampled

Characteristic	Sample
Universities	
North Carolina Agricultural and Technological University (NC A&T)	2.8%
North Carolina Central University (NCCU)	14.8%
North Carolina State University (NCSU)	78.8%
University of North Carolina at Asheville (UNCA)	3.6%
	100.00%
Total # of universities = 4	
Courses	
Animal Science	3.43%
Education	1.49%
Engineering	4.78%
Mathematics	3.88%
Psychology	9.40%
Women in Science and Engineering (Organization)	2.09%
Women and Gender Studies	9.10%
Unknown	65.82%
	100.00%

Table 2

Characteristics of Respondents

Characteristic	Sample
Gender	
Female	64.6%
Male	35.4%
Academic Major	
Agricultural and Life Sciences	30.4%
Education	12.4%
Engineering	27.8%
Physical and Mathematical Sciences	6.9%
Social Sciences and Humanities	13.6%
STEM Major – Other	3.6%
STEM Major – Unlisted	1.2%
non-STEM – Unlisted	1.9%
Undecided	2.2%
Ethnicity	
European American/Caucasian/White	44%
African American/Black	56%
Years at the University	
1	35.5%
2	22.2%
3	23.6%
4	13.0%
5	4.0%
5+	1.5%
Missing	.1%
Citizenship	
U.S. Citizen	97.9%
Non-U.S. Citizen	1.8%
Did not specify	.3%
Average GPA	
Female	3.12*
Male	3.06*
Combined	3.10*
Science and Math Courses Taken	
Current Semester	1.98
Overall	7.80

Note. Type of GPA scale was not obtained (unweighted v. weighted).*

Measures

Independent variables.

Demographic information. Demographic information was gathered including overall grade point average, race/ethnicity, gender, citizenship status, and birth year. Most of the participants were first-year students (35.5%). However, the combination of second and third year students was 45.8%. Fourth year students were 13.0% of the sample and students in their fifth year or beyond were less than 6% of the sample. See Table 2.

Academic major. The participants in the study came from numerous majors. The majors were divided into two groups: STEM majors and non-STEM majors. The STEM majors were subdivided into five groups: Agricultural and Life Sciences, Engineering, Physical Sciences and Mathematical Sciences, STEM Major (Other) and STEM Major (Unlisted). These groups were chosen based on the representation of majors that were reported by the participants because these are the major colleges at the university that provided the majority of the participants:

- Agricultural and Life Sciences: This category includes majors such as biology, botany, zoology, and animal science
- Engineering: This category includes majors such as civil engineering, computer engineering, electrical engineering, and mechanical engineering.
- Physical and Mathematical Sciences: This category includes chemistry, physics, and statistics.
- STEM (Other): This category includes other STEM majors such as textile engineering, natural resources, textile technology, environmental technology, and clinical laboratory science.

- STEM (Unlisted): This category includes those who indicated they were STEM majors but did not list their major. There were eight who fell into this category.
- Education: This category includes majors such as elementary education, middle grades education, and technology education.
- Social Sciences and Humanities: This category includes majors such as English, Philosophy, political science, psychology and sociology.

Although STEM majors were specifically recruited through science and engineering courses, for comparison purposes not all participants were STEM majors. The participants had a drop-down menu of 37 majors from which to select. Included in the 37 options was an option to specify their major if it was not listed and how majors were coded as STEM or non-STEM (see Appendix A) for a list on how academic majors were coded.

Campus climate. Campus climate was assessed using a scale which focused on perceptions of overt racism. Cabrera and Nora (1994) developed a 10-item scale that has items such as, “I have observed discriminatory words, behaviors or gestures directed at minority students at this institution” and “I have encountered racism while attending this institution.” Response options were on a six-point Likert scale which ranges from one (strongly agree) to six (strongly disagree). In contrast to the other measures in the study, a higher score indicated less positive feelings. A high campus climate score indicated higher dissatisfaction with the campus. Therefore, for the purposes of this study, the items were reverse scored, after data collection, such that higher scores indicated a more positive perception of the campus climate. Having all higher scores indicate more positive perceptions made interpretation of the scores consistent across measures.

The original Campus Climate Scale was designed to test perceptions of prejudice and discrimination and measured four dimensions: Racial/Ethnic Campus Climate; Prejudiced Attitudes of Faculty and Staff; In-Class Discriminatory Experiences, and Alienation. Cabrera and Nora (1994) described Campus Racial/Ethnic Climate as representing “a global perception of prejudice and discrimination based on race and ethnicity. The main characteristic of this dimension rests on a student having witnessed the use of discriminatory words, gestures and behaviors on campus and in the classroom.” (p. 391). Prejudiced Attitudes of Faculty and Staff reflect “students’ perceptions that faculty and college administrators harbor feelings of prejudice toward minorities.” (p. 391-392). In-Class Discriminatory Experiences measure “experiences in the classroom manifested through having been discouraged from participating in class discussions and being singled out in class.” (p. 392). Alienation measures “feelings of not belonging at the institution coupled with feelings that regard the experience of being a student at the institution as unpleasant.” (p. 392).

A principal axis factor analysis with promax rotation was conducted to examine the psychometric properties of the Campus Climate Scale. A robust factor should have at least three items per factor (Costello & Osborne, 2005); however, three of the four factors put forth by Cabrera and Nora (1994) did not in this study (see Table 3). Factor one, Prejudiced Faculty/Class and factor two, Ethnic/Racial Climate, had four items each. Items nine (pleasant experience) and 10 (I belong) were removed because they were the only items that loaded on factor three, Alienation. An additional principal axis components factor analysis with promax rotation was used to determine factor loadings without the Alienation items. The analysis indicated two factors, which accounted for 58.2% of the variance in Campus

Climate. Communalities less than .40 were removed as they can be an indication that that the variable it is designed to measure is not well-represented on the scale or that the variable needs to be further investigated (Costello & Osborne, 2005). The communalities for items seven (discouraged) and eight (singled-out) were below .40 and thus items seven and eight were removed (see Table 4).

The next principal factor analysis with promax rotation included items one through six and represented factor one, Prejudiced Faculty/Class and factor two, Ethnic/Racial Climate. Only two items loaded onto Prejudiced Faculty/Class, but four loaded onto the second factor, Ethnic/Racial Climate (see Table 5). Item two (prejudiced students) loaded onto two factors (Costello & Osborne, 2005) but it was retained to maintain the original structure of the Ethnic/Racial Campus Climate Scale, as designed by Cabrera and Nora (1994). Another exploratory factor analysis with promax rotation was conducted in order to ensure the most parsimonious measure possible. Results indicated one factor with factor loadings ranging from .68 - .76. A Bartlett's Test of Sphericity ($\chi^2 [6] = 861.94, p < .001$) and the Kaiser-Meyer-Olkin (KMO = .80) showed that the common variance was adequate for a factor analysis.

Table 3

First Exploratory Factor Analysis with Promax Rotation of Campus Climate Scale

	Prejudiced Faculty/Class	Ethnic/Racial Climate	Alienation	Communi- nalities
Prejudiced faculty* (5)	.998	-.058	-.073	.870
Prejudiced staff* (6)	.994	-.079	-.032	.870
Singled Out* (8)	.448	.130	.115	.361
Discouraged* (7)	.441	.142	.150	.391
Observed discrimination* (1)	-.062	.813	-.039	.581
Encountered racism (3)	-.086	.812	.010	.586
Negative words* (4)	.191	.601	-.064	.503
Prejudiced students* (2)	.337	.440	.076	.546
Pleasant experience (9)	-.006	-.062	.968	.890
I belong (10)	.013	.023	.796	.658
# of Items per Factor	4	4	2	

Note. n = 670. Factor loadings > .40 are in boldface. *Items were reverse coded.

Table 4

Second Exploratory Factor Analysis with Promax Rotation of Campus Climate Scale

	Prejudiced Faculty/Class	Ethnic/Racial Climate	Communalities
Prejudiced staff* (6)	.980	-.088	.864
Prejudiced faculty* (5)	.963	.093	.851
Discouraged* (7)	.505	.143	.379
Singled Out* (8)	.501	.800	.357
Encountered racism (3)	-.057	.787	.588
Observed discrimination* (1)	-.048	.576	.576
Negative words* (4)	.189	.440	.499
Prejudiced students* (2)	.380	.440	.540
# of Items per Factor	4	4	

Note. n = 670. Factor loadings > .40 are in boldface. *Items were reverse coded.

Table 5

Third Exploratory Factor Analysis with Promax Rotation of Campus Climate Scale

	Prejudiced Faculty/Class	Ethnic/Racial Climate	Communalities
Prejudiced staff* (6)	1.006	-.059	.947
Prejudiced faculty* (5)	.920	.002	.849
Encountered racism (3)	-.079	.808	.585
Observed discrimination* (1)	-.069	.802	.584
Negative words* (4)	.157	.600	.495
Prejudiced students* (2)	.355	.477	.550
# of Items per Factor	2	4	

Note. n = 670. Factor loadings > .40 are in boldface. *Items were reverse coded.

Table 6

Fourth Exploratory Factor Analysis with Promax Rotation of Campus Climate Scale

	Ethnic/Racial Climate	Communalities
Encountered racism (3) Observed discrimination* (1)	.758	.574
Negative words* (4)	.752	.467
Prejudiced students* (2)	.701	.565
# of Items	.683	.491
	4	

Note. n = 670. Factor loadings > .40 are in boldface. *Items were reverse coded.

Department climate. Department climate was assessed using a 28-item scale created by the researcher. The scale was created because the researcher was not able to identify any existing scales which examined the environment of a campus at the departmental level instead of a macro level view of the overall campus climate. Furthermore, in contrast to the scale by Nora and Cabrera (1994), the Department Climate Scale includes an assessment of the student's perception of the department's fairness for students of color and if the department is committed to helping both men and women become successful. The participants' perceptions of the department were important overall to the study but were not captured in the Campus Climate Scale.

The items for the Department Climate Scale were generated based on an adaptation of items from Edman and Brazil (2007). In addition, several items were generated based on Ferreira's (2003) article that examined gender differences in two STEM majors. See Appendix D for the list of items on the Department Climate Scale.

An exploratory factor analysis with principal axis factoring and promax rotation was conducted to determine if the survey represented one scale. Results of the factor analysis indicated the presence of six factors (see Table 7). The items dropped due to low communalities (less than .40) included “I have several close friends” (item 5), “I feel ignored and excluded” (item 17), “Students expect to be mentored by a faculty member” (item 2), “I am being prepared for my future career” (item 4), “I feel comfortable asking for help” (item 20), “The students are competitive with each other” (item 7) and “The faculty members are competitive with each other” (item 28).

Tabachnick and Fidell (2007) recommend that factor loadings of .32 or above can be kept in a factor analysis. However, stringent rules were applied for the Department Climate Scale and factor loadings less than .40 were deleted (Wyer, Schneider, Nassar-McMillan & Oliver-Hoyo, 2010). Six items fell into this category.

The two items that loaded on factor four, Mentorship, “I have a mentor” (item 11) and “I receive a substantial amount of guidance from my mentor” (item 15) were deleted as they were the only two items on the factor. The two items that loaded on factor five, Classes and grades, “My grades reflect the effort I put into my classes” (item 1) and “The grading practices seem fair to me” (item 10) were deleted also as they were the only two items on factor five. The item “The students are competitive with each other” (item 7) was removed because it was the only item that loaded on the sixth factor, Student Competitiveness (Costello & Osborne, 2005; see Table 7). Factors one, Faculty/Staff Approachability, and two, Gender Equality, had at least five items each that had loadings greater than .40. In total, 12 items were dropped from the first analysis and the remaining factor loadings ranged from .41 -.92 (see Table 7).

A second factor analysis using principal axis factoring with promax rotation was conducted without the 12 items that were dropped. The factor analysis yielded two factors, Faculty/Staff Approachability and Gender Equality. The factors that formerly appeared on factor three, Department Atmosphere shifted to factor one or dropped out due to low communalities or low factor loadings. “The environment is supportive and welcoming” (item 13) and “The environment is warm and friendly” (item 16) shifted to factor one. “The climate fosters diversity” (item 21) and “There is a collaborative atmosphere” (item 8) did not load on any factor. “There is someone I can identify as a role model” (item 6) was removed from further analyses due to its low communality. The remaining factor loadings ranged from .57-.90 (see Table 8).

The third factor analysis, a principal axis factoring and promax extraction, indicated two robust factors (see Table 9). A Bartlett’s Test of Sphericity ($\chi^2 [78] = 5382.76, p < .001$) and KMO (KMO=.92) indicated that the items on the scale were adequate for a factor analysis. The remaining factor loadings ranged from .63-.90.

Table 7

First Exploratory Factor Analysis with Promax Rotation of Department Climate Scale

Item	Faculty/Staff Approachability	Gender Equality	Department Atmosphere	Mentorship	Classes and Grades	Student Competitiveness	Communalities
Warm & friendly faculty (23)	.923	-.016	.000	.027	-.100	-.044	.757
Faculty willing to help (24)	.911	.003	-.070	-.004	-.043	.026	.697
Faculty members are sensitive to student needs (25)	.800	.017	.003	.001	.001	.005	.663
The faculty are accessible to me (26)	.773	.030	-.055	-.007	.003	.053	.562
The faculty are interested in my success (27)	.768	.002	-.054	-.018	.128	.155	.646
The academic staff is warm & friendly (22)	.611	-.090	.288	.032	-.018	-.094	.643
They are committed to the success of men (14)	.026	.894	-.234	.068	-.057	.183	.587
Men are treated fairly (18)	-.040	.790	-.102	.040	.092	.021	.569
They are committed to the success of women (9)	-.002	.615	.140	-.041	-.021	.068	.475
They are committed to the success of different ethnic & racial groups (19)	.049	.613	.168	-.032	-.105	-.087	.535
Women are treated fairly (12)	-.011	.564	.144	.071	.005	-.189	.540
The environment is warm & friendly (16)	.193	-.039	.672	.048	-.012	-.012	.660
I feel ignored & excluded (17)	.013	-.100	.647	-.050	.057	-.053	.383
I have several close friends (5)	-.129	-.009	.586	.032	-.056	.314	.292
The environment is supportive & welcoming (13)	.274	.113	.490	.027	-.004	-.013	.662
There is a collaborative atmosphere (8)	.124	.166	.474	-.077	.012	.158	.457
The climate fosters diversity	.107	.236	.460	-.090	-.090	-.023	.437

Table 7 Continued

(21)							
There is someone I can identify as a role model (6)	-.029	-.081	.438	.262	.065	.308	.404
I have a mentor (11)	.005	.046	-.047	.874	-.074	-.039	.715
I receive a lot of guidance from my mentor (15)	.004	.015	.019	.851	.027	-.056	.740
My grades reflect my effort (1)	-.046	-.074	-.006	-.016	.787	.014	.519
Grading practices seem fair to me (10)	.151	.128	.017	.043	.409	-.158	.441
The students are competitive with each other (7)	-.091	-.148	-.127	.109	.078	-.457	.228
Students are treated fairly, regardless of ethnicity, socio-economic status and sexual orientation (3)	.036	.265	.202	-.072	.159	-.251	.414
I feel comfortable asking for help (20)	.258	.024	.336	.053	.048	-.037	.398
Students expect to be mentored by a faculty member (2)	.103	.040	-.089	.184	.112	.025	.078
I am being prepared for my future career (4)	.091	.148	.098	-.028	.363	.233	.354
The faculty members are competitive with each other (28)	-.007	.085	.034	-.034	-.093	-.297	.104
# of Items per Factor	6	5	7	2	2	1	

Note. n = 670. Factor loadings > .40 are in boldface. *Items were reverse coded.

Table 8

Second Exploratory Factor Analysis with Promax Rotation of Department Climate Scale

	Faculty/Staff Approachability	Gender Equality	Communalities
Warm & friendly faculty (23)	.900	-.058	.741
Faculty willing to help (24)	.850	-.059	.657
Faculty members are sensitive to student needs (25)	.813	-.011	.648
The faculty are interested in my success (27)	.794	-.032	.596
The academic staff is warm & friendly (22)	.785	.009	.627
The faculty are accessible to me (26)	.747	-.024	.534
The environment is warm & friendly (16)	.585	.211	.558
The environment is supportive & welcoming (13)	.569	.286	.632
There is a collaborative atmosphere (8)	.385	.300	.399
There is someone I can identify as a role model (6)	.331	.065	.144
Men are treated fairly (18)	-.056	.762	.526
They are committed to the success of men (14)	-.090	.736	.458
They are committed to the success of women (9)	.024	.686	.494
They are committed to the success of different ethnic & racial groups (19)	.061	.680	.524
Women are treated fairly (12)	.090	.626	.479
The climate fosters diversity (21)	.292	.378	.382
# of Items per Factor	8	13	

Note. n = 670. Factor loadings > .40 are in boldface. *Items were reverse coded.

Table 9

Third Exploratory Factor Analysis with Promax Rotation of Department Climate Scale

	Faculty/Staff Approachability	Gender Equality	Communi- nalities
Warm & friendly faculty (23)	.902	-.048	.758
Faculty willing to help (24)	.843	-.042	.665
Faculty members are sensitive to student needs (25)	.807	.002	.653
The academic staff is warm & friendly (22)	.786	.004	.623
The faculty are interested in my success (27)	.779	-.015	.591
The faculty are accessible to me (26)	.741	-.012	.538
The environment is warm & friendly (16)	.585	.194	.535
The environment is supportive & welcoming (13)	.571	.279	.619
Men are treated fairly (18)	-.049	.772	.548
They are committed to the success of men (14)	-.094	.760	.489
They are committed to the success of women (9)	.046	.663	.483
They are committed to the success of different ethnic & racial groups (19)	.101	.634	.498
Women are treated fairly (12)	.108	.621	.489
# of Items per Factor	8	5	

Note. n = 670. Factor loadings > .40 are in boldface. *Items were reverse coded.

Science/math self-efficacy. Science/math self-efficacy was assessed using an adaptation of Witt-Rose's (2003) science self-efficacy scale, specifically designed for students pursuing science and math degrees. It includes items such as, "I am confident I can do well in my science and math courses" and "I don't think I will get good grades in my science and math courses." Response options were on a five-point Likert scale ranging from one (strongly disagree) to six (strongly agree). The Cronbach's Alpha was .89. Due to the

modifications made to the scale, an EFA was conducted to determine if it remained one factor (see Table 10).

The scale produced two factors but only three items loaded onto the second factor. "Compared with other students in my courses, I don't feel like I'm a good student" (item 9), "Compared with other students in my courses, I think I have good study skills" (item 8) and "I don't think I will get a good grade in my math and science courses this semester" were dropped. Additionally, "I think I will receive a C or better in my math and science courses this semester" (item 12), "I feel like I don't know a lot about math and science compared to other students in my courses" (item 7), "I am confident I can do well in the lab portion of my science courses" (item 11), and "I don't think I will be successful in my math and science courses" (item 4) were dropped because of communalities less than .40 (see Table 10). The EFA was re-run and produced one factor with factor loadings ranging from .65 - .85 (see Table 11). A Bartlett's Test of Sphericity ($\chi^2 [21] = 2535.08, p < .001$) and KMO (KMO=.92) indicated that the remaining items were adequate for a factor analysis.

Table 10

First Exploratory Factor Analysis with Promax Rotation of Science/Math Self-Efficacy Scale

	Ability and Effort	Good Grades and Comparisons	Communalities
Ability to learn (3)	.859	-.087	.665
Confident in doing well (1)	.857	-.045	.695
Confident in understanding (5)	.826	-.113	.594
Will perform better than others (2)	.755	.072	.634
Successful through exerting effort (6)	.703	-.108	.424
Confident in explaining to others (14)	.641	.038	.439
Confident on doing well on exams* (10)	.598	.233	.562
I will receive a C or better (12)	.579	.087	.398
Don't know as much compared to other students* (7)	.468	.207	.366
Confident in doing well in lab (11)	.449	-.012	.196
Will be successful in class* (4)	.381	.221	.284
Not a good student compared to others* (9)	-.106	.836	.615
Good study skills compared to others (8)	-.036	.599	.337
I will not get a good grade* (13)	.262	.363	.303
# of Items per Factor	11	3	

Note. n = 670. Factor loadings > .40 are in boldface.

Table 11

Second Exploratory Factor Analysis with Promax Rotation of Science/Math Self-Efficacy Scale

	Science/Math Self-Efficacy	Communalities
Confident in doing well (1)	.848	.719
Will perform better than others (2)	.824	.678
Ability to learn (3)	.799	.638
Confident in understanding (5)	.767	.589
Confident on doing well on exams (10)	.737	.543
Confident in explaining to others (14)	.654	.427
# of Items per Factor	6	

Note. n = 670.

Dependent variable.

Career commitment. Career commitment was assessed using the 12-item Career Commitment scale developed for “Measurement Matters,” a National Science Foundation (NSF) funded research project. The survey includes a stem statement: “How likely is it that you will...” followed by items such as: “Get college training in science” and “Get experience working as a scientist.” Response options were on a six-point Likert scale ranging from one (Very unlikely) to six (Very likely). The items on the scale were summed to create a score for each participant, with a high score indicating high career commitment and a low score indicating low career commitment.

Table 12

Summary of Measures

Variable	Variance Explained	<i>M</i>	<i>SD</i>	# of Items	Reliability
Career Commitment Scale (1-Very Unlikely; 6-Very Likely)	76.32%	3.68	1.59	12	.98
Science/Math Self-Efficacy (1-Strongly Disagree; 5-Strongly Agree)	59.90%	3.94	.67	6	.9
Campus Climate (1-Strongly Agree; 5-Strongly Disagree)*	52.43%	3.52	.95	4	.81
Department Climate					
Faculty/Staff Approachability	50.16%	3.90	.61	8	
Gender Equality (1-Strongly Disagree; 5-Strongly Agree)	7.45%	3.98	.56	5	
	57.61%	3.93	.53	13	.93

Note. n = 670. *These are the reverse scored numbers.

RESULTS

All data analyses were conducted with SPSS 19.0 and AMOS 19.0. A statistical significance of $p < .05$ was used for the analyses, unless otherwise indicated. The negatively worded items were reverse coded. Results section is divided into two sections: 1) the results of the six research hypotheses tests and 2) exploratory analyses.

First, simple correlations were calculated among the measures. Results indicated that the measures were correlated to a varying extent but in expected ways. There was a moderate, positive correlation between the two Department Climate subscales, Faculty/Staff Approachability and Gender Equality ($r = .63, p < .001$), whereas the other measures demonstrated weaker, yet significant correlations (see Table 13).

Table 13

Correlations among Gender, Ethnicity, STEM Major Affiliation, Science/Math Self-Efficacy, Faculty/Staff Approachability, Gender Equality, Career Commitment, Campus Climate

	1	2	3	4	5	6	7
Gender							
Ethnicity	.098*						
STEM_v_non-STEM Major	-.123**	-.001					
Science/Math Self-Efficacy	-.141**	-.134**	.268**				
Faculty/Staff Approachability	-.004	-.110**	-.037	.211**			
Gender Equality	-.017	-.077*	.05	.209**	.634**		
Career Commitment	.032	-.049	.618**	.354**	.126**	.171**	
Campus Climate	-.007	-.296**	.110**	.211**	.489**	.433**	.135**

Note. n = 670.

* $p < .05$. ** $p < .01$. *** $p \leq .001$.

Section One: Results of Research Questions

Research Question 1: *How are gender and race/ethnicity related to academic major?*

A binary logistic regression was conducted to analyze the hypothesis, *Gender is related to academic major such that men are more likely than women to be STEM majors and Race/ethnicity is related to major such that European Americans will be more likely than African Americans to be STEM majors.*

The overall model indicated that STEM majors were correctly identified 67.8% of the time. Though neither the first hypothesis, (H1a), nor the second hypothesis, (H1b) were supported, the results were statistically significant in indicating that women were more likely to be STEM majors than were men, the reverse of the prediction. In fact, the odds of being a STEM major were 1.78 times higher (95% CI = 1.25-2.55, $p < .01$) among women compared to men. For the second hypothesis, there was no statistical difference between the number of African Americans who reported being STEM majors when compared to the number of European Americans who reported being STEM majors (see Table 15). The inferential statistic, Hosmer-Lemeshow (H-L) Goodness-of-fit test, yielded a $\chi^2(2)$ of .16 which was not significant ($p > .05$) indicating that the null hypothesis was a good model fit for the data (Peng, Lee, & Ingersoll, 2002)¹.

¹ The -2 Log likelihood, Cox & Snell R^2 , and Nagelkerke R^2 are not reported because they do not accurately report the proportion of variance explained by the model (Peng et al., 2002).

Table 14

Number of Participants with STEM Majors and non-STEM Majors by Gender and by Ethnicity

Gender by Ethnicity	Academic Major			
	STEM Major (n =454)		non-STEM (n =216)	
	n	%	n	%
African American Female	164	24.36%	94	14.03%
African American Male	90	13.43%	27	4.03%
European American Female	111	16.57%	64	9.55%
European American Male	89	13.43%	31	4.63%

Table 15

Binary Logistic Regression Analysis of Variables Predicting STEM Major by Gender and Ethnicity

Predictor	β	SE β	Wald's χ^2	df	p	e^β (OR)	95% CI
Gender (1= women, 0 = men)	.58	.18	10.09	1	.001**	1.78	1.25-2.55
Ethnicity (1 = Af Am, 0 = Eu Am)	-.05	.17	.09	1	.76	.95	.68-1.32
Constant	.58	.12	2.49	1	.000**	1.78	

Test	χ^2	df	p
Overall model evaluation			
Overall Statistics		2	.01**
Score test (Ethnicity)		1	.99
Score test (Gender)		1	.001***
Goodness-of-fit test			
Hosmer & Lemeshow	.16	2	.97

Note. OR = odds ratio; CI = confidence interval. Af Am = African American; Eu Am = European American
 ** $p < .01$. *** $p \leq .001$.

Research Question 2: *How are gender and race/ethnicity related to science/math self-efficacy?*

An ANOVA was used to test the second hypotheses. Hypothesis 2(a), *Gender is related to science/math self-efficacy such that men will report higher science/math self-efficacy*, was supported. There was a significant difference between men and women on science/math self-efficacy scores with men reporting feeling more efficacious than women ($F [3, 666] = 11.18, p = .001$). Hypothesis 2(b), *Race/ethnicity is related to science/math self-efficacy such that European Americans will report higher science/math self-efficacy scores than African Americans*, was supported ($F [3, 666] = 8.72, p = .003$). European Americans reported feeling more efficacious in science and math courses than African Americans reported.

Research Question 3: *How are gender and race/ethnicity related to perceptions of Department Climate?*

The department scale yielded two subscales; therefore, each subscale appeared in the analysis and a MANOVA was conducted to examine the relationship between department climate and race/ethnicity and gender. The first hypothesis, that African Americans would report less positive perceptions on the Department Climate Scale was supported. There was a main effect of ethnicity for Faculty/Staff Approachability with European Americans reporting more positive scores than African Americans ($F [3, 666] = 6.05, p = .01$). However, Levene's Test of Equality of Error Variances was significant for Faculty/Staff Approachability ($p = .02$). To adjust for this finding, an independent samples Kruskal-Wallis Test was conducted. Results of the Kruskal-Wallis test indicated that the null hypothesis should be rejected, $p = .014$, supporting the initial finding that African

Americans were reporting less positive experiences. Gender Equality was not significant ($F [3, 666] = 2.52, p = .11$), indicating that African Americans and European Americans did not respond differently in regards to their perception of how men and women were treated in their major departments.

There was no main effect of gender for Faculty/Staff Approachability, suggesting that men and women had similar perceptions of the faculty and staff in their major departments ($F [3, 666] = .06, p = .85$). There was no main effect of gender for Gender Equality ($F [3, 666] = .04, p = .85$), demonstrating that men and women did not differ in their perceptions of how men and women were treated in their major department.

Research Question 4: *Gender and race/ethnicity are related to campus climate such that men will report more positive campus climate scores at PWIs and HBCUs and African Americans at PWIs will report less positive campus climate scores than at HBCUs.*

An ANOVA was used to test the hypothesis, *gender is related to campus climate such that men will report more positive campus climate scores.* It was not supported ($F [3, 666] = .22, p = .64$). There was no gender difference in perceptions of campus climate.

A one-way ANOVA was conducted to test the hypothesis, *race/ethnicity is related to campus climate such that African Americans at PWIs will report less positive campus climate scores than African Americans at HBCUs.* Only African Americans were included in this analysis. The number of European Americans at HBCUs was minimal (8) in this sample but they were excluded although their responses were not likely to have changed the results. The hypothesis was supported ($F [1, 373] = 10.17, p = .002$). African American students at HBCUs reported more positive campus climate scores than African American students at PWIs.

Research Question 5: *Career commitment is predicted by ethnicity, STEM major, science/math self-efficacy, department climate, and campus climate. In particular, for African Americans who are STEM majors, higher science/math self-efficacy and positive perceptions of the department climate and campus climate will predict career commitment.*

A multiple regression was conducted to determine if the model was significant ($F [6, 663] = 85.15, p < .001$). Ethnicity did not predict career commitment. However, the predictors explained 43.5.0% of the variance in undergraduates' Career Commitment scores. Of particular interest is that higher Science/Math Self-Efficacy scores, Faculty/Staff Approachability, and being a STEM major were significant predictors in the model (see Table 16). Gender Equality trended in the direction of significance but did not reach significance ($t = 1.71, p = .09$). Ethnicity and campus climate did not predict career commitment.

Table 16

Multiple Regression Model Predicting Career Commitment by Ethnicity, Science/Math Self-Efficacy, Department Climate, Campus Climate and STEM Major

Variables	<i>B</i>	β	<i>p</i>
Ethnicity (European American = 0, African American = 1)	-.07	-.02	.43
Science/Math Self-Efficacy	.41	.17	.001***
Department Climate			
Faculty/Staff Approachability	.21	.08	.04*
Gender Equality	.18	.07	.08
Campus Climate	-.07	-.04	.20
STEM Major (non-STEM Major = 0, STEM Major = 1)	1.96	.58	.001***
R^2	.43		

Note. N=670.

* $p < .05$. *** $p < .001$.

Research Question 6: *Lastly, for African American women, gender and race/ethnicity, in interaction, better predict the influence of STEM major, science/math self-efficacy, department climate and campus climate on career commitment than either gender or race/ethnicity alone.*

Hypothesis six was not supported. There was no race by gender interaction for African American women; their career commitment did not differ in a unique manner in comparison to African American men, European American men, and European American women. However, the model was significant and accounted for 44.7% of the variance in Career Commitment ($F [8, 661] = 68.54, p < .001$). Higher Science/Math Self-Efficacy scores, Faculty/Staff Approachability, and being a STEM major predicted career commitment. Although not significant, Gender Equality trended in the direction of predicting career commitment (see Table 17).

Table 17

Multiple Regression Model Predicting Career Commitment by Gender by Ethnicity for African American Women, Science/Math Self-Efficacy, Campus Climate, Faculty/Staff Approachability, Gender Equality, and STEM Major Affiliation

Variable	B	SE	β	p
Step 1				
Ethnicity (African American = 1, European American = 0)	-.17	.12	-.05	.17
Gender (1= Women, 0 = Men)	.12	.13	.04	.34
Step 2				
Ethnicity (African American = 1, European American = 0)	-.12	.10	-.04	.21
Gender (1= Women, 0 = Men)	.45	.10	.14	.001***
STEM Major Affiliation (non-STEM Major = 0, STEM Major = 1)	2.01	.10	.59	.001***
Department Climate				
Faculty/Staff Approachability	.21	.10	.08	.04*
Gender Equality	.19	.11	.07	.08
Science/Math Self-Efficacy	.44	.07	.19	.001***
Campus Climate	-.08	.05	-.05	.12
Step 3				
Ethnicity (African American = 1, European American = 0)	-.05	.16	-.02	.74
Gender (1= Women, 0 = Men)	.51	.14	.15	.001***
STEM Major Affiliation (non-STEM Major = 0, STEM Major = 1)	2.01	.10	.59	.001***
Department Climate				
Faculty/Staff Approachability	.2	.10	.08	.04*
Gender Equality	.19	.11	.07	.08
Science/Math Self-Efficacy	.44	.07	.19	.001***
Campus Climate	-.08	.05	-.05	.14
Gender * Ethnicity (African American Women = 1, All Others = 0)	-.11	.19	-.07	.59
R ²	.45			

Note. N=670.

* $p \leq .05$. *** $p \leq .001$.

Section Two: Exploratory Analyses

The analyses conducted in the previous section have lent themselves to additional questions to be addressed in the exploratory analyses section and in further studies.

Because a dearth of information exists on African American women in STEM, this study addresses key variables that research suggests are plausible contributors to the patterns that are seen for African American women who are STEM majors. The research questions in this study primarily compared the responses of STEM majors to non-STEM majors. In doing so, the nature of the comparisons may have suppressed findings that could only be made known through additional analyses. By addressing variability across race and gender, heterogeneity among STEM majors, and dissimilarities across HBCUs and PWIs, interesting and meaningful dynamics specific to African American women in STEM may be revealed.

The exploratory analyses are divided into four sets of analyses. The exploratory analyses addressed such questions. Looking at the data from the perspective of these exploratory analyses could reveal results and relationships between the variables which may lead to a more informed analysis of African American women in STEM majors and Career Commitment. The first set of analyses examines Career Commitment for the four groups of participants in the study: African American women, European American women, African American men and European American men. The second set of analyses looks at differences within the groups of STEM majors, including separate analyses for women in STEM majors. The third set of analyses examines the different types of campuses, HBCUs versus PWIs. The contribution of university type is unclear as only one research question addressed university type. It is possible that other differences follow from the

university type. The fourth set of analyses examined the differences between African American women who are in STEM with African American women who are not in STEM.

Exploratory hypothesis one: Comparisons across ethnicity and gender for career commitment. A regression analysis was conducted for African American women, African American men, European American women and European American men to determine what differences existed across ethnicity and gender in accounting for the variance of Career Commitment for these four populations. These analyses differ from research questions five and six in that they do not include ethnicity or gender in the calculation. Instead they examine Faculty/Staff Approachability, Gender Equality, Science/Math Self-efficacy, Campus Climate, STEM major, and include university type (for African Americans only) in the equation across the groups of participants. Results indicate that the model accounts for a greater percentage of the variance in Career Commitment for European American women than African American men and women or European American men.

Different sets of variables were significant for the each group. Results for European American women suggested that positive perceptions of Faculty/Staff Approachability, higher Science/Math Self-efficacy and being a STEM major were predictors of Career Commitment. For African American women positive perceptions of Gender Equality and being a STEM major were predictors of Career Commitment. In contrast, for African American men, higher Science/Math Self-efficacy and being a STEM major were predictors. Surprisingly, negative perceptions of campus climate, along with higher Science/Math Self-efficacy, and being a STEM major were predictors

for European American men. Being a STEM major was the only variable each group had in common. In fact, it made the biggest contribution for accounting for Career Commitment for each group of students.

After the analyses were conducted for each group of participants, the variance in Career Commitment was compared across groups. The regression model accounted for more than half of the variance in Career Commitment for almost half of the variance in Career Commitment for African American women, (43.5%; see Table 18), 67.8% for European American women (see Table 19), 24.9% for African American men (see Table 20) and 37.6% for European American men (see Table 21).

Table 18

Multiple Regression Model Predicting Career Commitment for African American Women by Faculty/Staff Approachability, Gender Equality, Science/Math Self-Efficacy, Racial/Ethnic Campus Climate, University Type and Academic Major

Variable	<i>B</i>	β	<i>p</i>
Department Climate			
Faculty/Staff Approachability	.02	.01	.90
Gender Equality	.45	.16	.01*
Science/Math Self-Efficacy	.18	.07	.13
Campus Climate	-.13	-.07	.16
University	.01	.00	.97
STEM Major (non-STEM Major = 0, STEM Major = 1)	2.13	.64	
.001***			
R^2	.435		

Note. N=258.

* $p < .05$. *** $p < .001$.

Table 19

Multiple Regression Model Predicting Career Commitment for European American Women by Faculty/Staff Approachability, Gender Equality, Science/Math Self-Efficacy, Racial/Ethnic Campus Climate, University Type and Academic Major

Variable	B	β	p
Department Climate			
Faculty/Staff Approachability	.42	.13	.02*
Gender Equality		-.29	-.10
.06			
Science/Math Self-Efficacy	.74	.31	
.001***			
Campus Climate	.13	.07	.14
STEM Major (non-STEM Major = 0, STEM Major = 1)	2.12	.63	
.001***			
R ²	.678		

Note. N=175. University type was excluded for European American women as only nine attended an HBCU.

* $p < .05$. *** $p < .001$.

Table 20

Multiple Regression Model Predicting Career Commitment for African American Men by Faculty/Staff Approachability, Gender Equality, Science/Math Self-Efficacy, Racial/Ethnic Campus Climate, University Type and Academic Major

Variable	B	β	p
Department Climate			
Faculty/Staff Approachability	.31	.13	.30
Gender Equality	.03	.01	.94
Science/Math Self-Efficacy	.41	.18	.04*
Campus Climate	.03	.02	.81
University	.50	.14	.11
STEM Major (non-STEM Major = 0, STEM Major = 1)	1.48	.40	
.001***			
R ²	.249		

Note. N=120.

* $p < .05$. *** $p < .001$.

Table 21

Multiple Regression Model Predicting Career Commitment for European American Men by Faculty/Staff Approachability, Gender Equality, Science/Math Self-Efficacy, Racial/Ethnic Campus Climate, and Academic Major

Variable	<i>B</i>	β	<i>p</i>
Department Climate			
Faculty/Staff Approachability	.25	.10	.28
Gender Equality	.28	.10	.27
Science/Math Self-Efficacy	.68	.26	
.001***			
Campus Climate	-.28	-.17	.03*
STEM Major (non-STEM Major = 0, STEM Major = 1)	1.88	.56	
.001***			
R^2	.376		

Note. N=117. University type was excluded for European American men as they all attended PWIs.

* $p < .05$. *** $p \leq .001$.

Exploratory hypothesis two: STEM majors only. The focus of this dissertation was African American women in STEM in general. Though this focus set clear parameters for major research questions in the dissertation, the experiences of African American women may differ by STEM major. One topic the study was not able to examine in the six a priori research questions was how do students differ across the STEM fields. Therefore, post hoc analyses were conducted to explore possible fruitful directions for further study.

In the current study, the STEM majors were divided into five broad categories: Life and Agricultural Sciences, Engineering, Physical and Mathematical Sciences, STEM major (Unlisted) and STEM major (Other). In the post hoc analyses, Life and Agricultural Sciences and Engineering were compared on Career Commitment, Campus Climate, Faculty/Staff Approachability, Gender Equality, and Science/Math Self-

Efficacy. Physical and Mathematical Sciences, those in the unlisted and other STEM major fields were excluded due to their relatively small sample sizes (see Table 2). A MANOVA was conducted to determine if differences existed in Career Commitment for Agricultural and Life Sciences majors compared to Engineering majors. Agricultural and Life Sciences majors reported higher Career Commitment than did Engineering majors ($F[5, 384] = 41.78, p < .001$). There were no significant differences between Agricultural and Life Science majors compared to Engineering majors for Faculty/Staff Approachability ($F[5, 384] = 2.34, p = .13$), Gender Equality ($F[5, 384] = .04, p = .85$), or Science/Math Self-Efficacy ($F[5, 384] = .3.69, p = .06$).

Exploratory hypothesis three: Female STEM majors. For women who were STEM majors a multiple regression was conducted to determine what the major predictors of Career Commitment were for them. Results indicated that higher Science/Math Self-Efficacy scores and attending a PWI were predictors of Career Commitment for African American and European American women. A fascinating finding was that neither Department Climate subscale (Faculty/Staff Approachability or Gender Equality) was a significant predictor when examining the responses of women who were STEM majors separate from men who were STEM majors (see Table 22).

Table 22

Multiple Regression Model Predicting Career Commitment for Women STEM Majors by Faculty/Staff Approachability, Gender Equality, Science/Math Self-Efficacy, Campus Climate, University Type, and Ethnicity

Variable	<i>B</i>	β	<i>p</i>
Department Climate			
Faculty/Staff Approachability	.06	.03	.67
Gender Equality	.26	.13	.08
Science/Math Self-Efficacy	.36	.18	.004**
Campus Climate	-.05	-.04	.58
University Type	-.38	-.14	.03*
Ethnicity	-.17	-.07	.27
R^2	.089		

Note. N=274.

* $p < .05$. ** $p < .01$.

A binary logistic regression was conducted to find out if type of STEM major (i.e., Agricultural and Life Sciences or Engineering) could be predicted based on Career Commitment scores. Results showed that Career Commitment was a better predictor for women in the agricultural and life sciences than for women in engineering. Based on participants' career commitment, the model was able to predict accurately participants' major 98.8% of the time when they were Science majors but only 5.1% of the time when they were Engineering majors (see Table 23).

Table 23

Binary Logistic Regression Analysis of Career Commitment Predicting Science or Engineering Major for Women with STEM Majors

Predictor	β	SE β	Wald's χ^2	df	p	e^β (OR)	95% CI
Career Commitment	-.36	.13	9.51	1	.002*	.68	.53-.87
Constant	.63	.56	1.27	1	.26	1.88	

Test	χ^2	df	p
Overall model evaluation			
Overall Statistics		1	.002*
Score test (Career Commitment)		1	.002*
Goodness-of-fit test			
Hosmer & Lemeshow	5.23	1	.73

Note. OR = odds ratio; CI = confidence interval.

** $p < .01$.

Exploratory hypothesis four: HBCU vs. PWI. For University type analyses, European Americans (n=9 females, n=0 males) attending HBCUs were excluded from the analyses as the purpose of the analyses was to determine if African Americans experiences differed based on university type. An ANOVA was conducted to investigate how African American women and men interpret their campuses' climates. Results showed that there was a main effect of gender ($F[7, 367] = 9.27, p < .001$), university ($F[7, 367] = 6.26, p = .01$), and academic major ($F[7, 367] = 11.10, p = .001$). In addition, there was a an interaction for gender by academic major, with STEM majors and women reporting more positive campus climate experiences than their non-STEM major, or men counterparts ($F[7, 367] = 6.70, p = .01$).

DISCUSSION

The purpose of this study was to identify how science/math self-efficacy, academic major, department climate, campus climate, gender and ethnicity come together to influence career commitment for African American women in STEM. Due to scant previous research on the subject, examining how these variables work together was of particular interest. Although there are many studies that have investigated persistence in STEM majors (Daempfle, 2003; Packard, 2005; Suresh, 2006), fewer studies have examined the role of math/science self-efficacy (Witt-Rose, 2003) combined with department climate and campus climate (Cabrera & Nora, 1994; Cabrera et al., 1999; Museus et al., 2008). Furthermore, none have incorporated career commitment beyond graduation at the intersection of ethnicity and gender for African American women. Distillation of disaggregated data has statistical complexities. Examining intersectionality may dilute the very findings that are being sought (Cole, 2009).

The present study was designed to investigate a combination of variables and their effect on STEM majors and Career Commitment for African American women. More specifically, it was designed to address both individual and external factors that influence Career Commitment. Previous research has indicated that internal variables, such as self-efficacy predict persistence for STEM majors (Lent et al., 1987). Likewise, STEM department climates and their effect on persistence have been assessed as environments for graduate education but not from an undergraduate student's perspective (Ferreira, 2003). Campus climate has been linked to persistence (Cabrera & Nora, 1994; Cabrera et al., 1999; Museus et al., 2008) but not in combination with the variables presented here.

In addition to examining internal and external variables, examining the intersection of the data for ethnicity and gender was essential. Racial differences in STEM have been investigated (Grandy, 1998; Russell & Atwater, 2005; Zea, et al., 1997), as have gender differences (Ceci & Williams, 2010; Clewell & Campbell, 2002; Nauta et al., 1998). However, most literature has not unpacked/disentangled racial and gender distinctions. Leaving data in its aggregate form creates a platform for over- or under-estimating the relationships between gender, ethnicity, and key variables as these relate to commitment to STEM careers.

This study investigated six primary research questions. Results indicated one key point; being a STEM major was the strongest predictor of Career Commitment for the participants. The study sample was one in which African American women STEM majors were well represented. African American men and European Americans were also among the respondents in significant enough numbers to make comparisons. The first four a priori research questions were designed to examine how the independent variables were related to ethnicity and gender to build a foundation for the final analyses. First, a relationship between ethnicity and gender and being a STEM major needed to be established to confirm current findings in the literature. The last two research questions were designed to examine the combined influence of the independent variables on career commitment.

Examining Academic Major by Ethnicity and Gender

Based on the literature, the study predicted that ethnicity and gender would be associated with being a STEM major. Previous research has shown that men outnumber women and European Americans outnumber African Americans as STEM majors (Chen & Thomas, 2009; Fouad et al., 2010; Hanson, 2006; Perna et al., 2009).

African American students are better represented as STEM majors in this study than is characteristic of the literature. The researcher was able to extend an invitation to every undergraduate African American student who enrolled in a science course at NCSU during summer 2011. Having access to a substantial number of African American students, coupled with the incentive, may explain the unusually large number of African American women who participated in the study from NCSU.

Examining Science/Math Self-Efficacy and Its Relation to Ethnicity and Gender

Science/Math Self-Efficacy was used to examine differences across ethnicity and gender. Results supported the hypotheses that men would report higher self-efficacy than women. These results confirm consistent gender differences (Betz & Klein, 1996; Ma, 2011; Rittmayer & Beier, 2008; Schunk & Pajares, 2002). In the current study, there was a main effect of gender, confirming in particular Gwilliam and Betz's (2001) findings that men score higher than women on science self-efficacy measures. It should be noted that though men may have higher scores than women on self-efficacy measures, the perceived differences in actual ability may not exist (Rittmayer & Beier, 2008). Men and women may perceive their abilities differently while possessing identical abilities. The problem lies in their interpretation of their ability, with men persisting in STEM because they may consider a "C" as a good grade, while women perceive the same "C" as a poor grade and thus switch to non-STEM majors (Rodgers, 2009).

For ethnicity, less empirical work exists. Extant research has examined self-efficacy for African Americans and European Americans but the research has seldom been conducted in the domain of STEM fields (Bembenutty, 2007; Buchanan & Selmon, 2008). Still, in one

study European Americans have been found to report higher self-efficacy scores when compared to minority populations (Bembenutty, 2007).

In this study, in general, Science/Math Self-Efficacy was high even if the participants were not STEM majors. Though earlier studies linked Science/Math Self-Efficacy to majoring in STEM, the scale was not designed to distinguish STEM majors from non-STEM majors. The scale originally was designed to measure the sense of a “possible self” as a scientist or engineer among college students. High Science/Math Self-Efficacy may be thus a necessary but not sufficient predictor of STEM major choice. An alternative explanation of the study’s results could be that students, regardless of their major, do not have discernible differences in regards to Science/Math Self-Efficacy but some students with high Science/Math Self-Efficacy have chosen non-STEM career paths or *switched to* non-STEM career paths for various reasons. If they are indeed switching out of STEM majors, this supports prior findings that capable women sometimes change majors despite their scientific capabilities (Kokkelenberg & Sinha, 2010; Seymour & Hewitt, 1997).

Examining Department Climate in Relation to Ethnicity and Gender

Faculty/staff approachability. The Department Climate Scale was developed by this study’s investigator to explore if/how students’ major department influence their career commitment. Examining department climate extended the reach of the current study beyond internal factors such as science/math self-efficacy in order to assess the role that conditions external to an individual may play in career commitment. Two subscales emerged from the factor analyses – Faculty/Staff Approachability and Gender Equality. The study found no differences between men and women in relation to Faculty/Staff Approachability, suggesting

that, at least, men and women experience comparable level of comfort though they may enact behaviors that are quite different based on gender norms.

Ethnic differences in Faculty/Staff Approachability could be affecting the career commitment of students in STEM. If students deem the faculty and staff as unapproachable then those same students may be less likely to receive encouragement from their faculty to pursue STEM careers compared to their peers who believe they will have positive interactions with the faculty and staff (Einarson & Clarkberg, 2010).

Gender equality. The current study contributes to the limited research on gender Equality in STEM departments for undergraduate students with the finding that the negative department climates, as reported in Ferraira,(2003) faced by female faculty and graduate students, is not directly influencing undergraduates. The implications are that if African American women perceive a gender equitable climate, then it could positively contribute to their career commitment. In fact, having a perception of gender Equality in their major department was a predictor of career commitment for African American women, but not for African American men or European American women or men.

Examining Campus Climate and Ethnicity and Gender

After the campus climate scale was modified, only racial/ethnic campus climate items remained. Therefore it was not surprising to that find that African American students at PWIs reported less positive perceptions than African American students at HBCUs. These results show an area for improvement for PWIs. Though HBCUs continue to be successful in graduating African American students, 88% of African American college students attend PWIs (NCES, 2009). Therefore it is essential that PWIs continue to address issues of diversity and racial/ethnic campus climate for all of their students.

Previous research has indicated that general campus climate was linked to students' perceptions of racial climate on campus and to their academic performance (Reid and Radhakrishnan, 2003). More specifically, academic performance may suffer when students feel that the racial climate is negative. However, the participants in the current study reported similar GPAs across PWIs and HBCUs but statistically different racial/ethnic campus climate perceptions. Though GPA may be only a rough indicator of academic performance, this study's results suggest that African American students' career commitment in STEM may be resilient in the face of negative campus environments.

In contrast to expectations, men did not report more positive racial/ethnic campus climates than women. This is in opposition to Pascarella and Terenzini (2005). It is likely that the modifications of the scale influenced the results that were obtained. However, it was true that African Americans at HBCUs reported more positive experiences than African American students on PWI campuses. A surprising finding was that campus climate perceptions were statistically more positive for African American STEM majors at HBCUs and PWIs than their non-STEM major counterparts. This was an unexpected finding. Results suggest that non-STEM African American men perceive their campus climates as especially hostile.

Examining the Influence of Ethnicity, STEM Major, Science/Math Self-Efficacy, Department Climate, and Campus Climate

The fifth research question examined the relationship the set of variables had on career commitment, including ethnicity but not gender. The question was designed to establish the foundation of the set of research questions so that ethnicity and gender could be included in the final planned analysis. Science/Math Self-Efficacy scores, Faculty/Staff

Approachability, and being a STEM major were significant predictors with Gender Equality almost reaching significance. Results did not support the hypothesis ethnicity would be significant. Results do support Pascarella and Terenzini's (2005) hypothesis that positive faculty relationships foster positive outcomes. In the case of this study, Faculty/Staff Approachability fosters career commitment but it is unclear for whom and the extent of the contribution.

Examining the Influence of Ethnicity, Gender, STEM Major, Science/Math Self-Efficacy, Department Climate, and Campus Climate

The last research question examined the effect the set of variables had on career commitment, including ethnicity and gender, and the interaction of ethnicity and gender for African American women. As in the previous analysis, higher Science/Math Self-Efficacy scores, Faculty/Staff Approachability, and being a STEM major were significant predictors with Gender Equality almost reaching significance. Results indicated that women were more likely to be STEM majors than men. However, there was no ethnicity by gender interaction, which was contrary to expectations. Previous literature has typically grouped African American women across ethnicity and treated their responses in a monolithic fashion by combining them with other women of color. In this instance, data disaggregation provides evidence instead of assumptions points toward the notion that models predicting career commitment may differ for different cultural/historical groups.

Intersectionality and Double Jeopardy

The results suggest that intersectionality plays a key role in career commitment for African American women in STEM. In particular, the finding of the regression models conducted in the exploratory analyses for each group of participants (African American

women, African American men, European American women, and European American men) showed that the variance accounted for in Career Commitment was different for each group. It was speculated that the model would explain the most variance for African American women; instead, the model accounted for a greater percentage of the variance for European American men. It is unclear why this finding emerged.

Career Commitment

STEM majors represented 69.9% of the participants. Results of the Career Commitment scale demonstrated the expected result that STEM majors have greater commitment to a future career in STEM than those who are not STEM majors. Women who were STEM majors, regardless of ethnicity, reported higher Career Commitment than men who were STEM majors. Also, African American STEM majors reported lower Career Commitment than European Americans, for ethnicity and gender, but when an interaction between ethnicity and gender was sought, there was none. Results indicated a most challenging opportunity for improvement exists for researchers and educator who want to improve research about career commitment for African American students in the science pipeline.

University Type

University type did not predict career commitment for African American students and this finding may be an indication that the PWIs in this study offer an equitable education in terms of career commitment and appear to be improving in their ability to prepare African American students, both women and men, for STEM careers. Though this is an encouraging finding, it should not be interpreted that HBCUs are no longer needed. The impact of

HBCUs continues to be significant for the academic success of African American undergraduate students (Kim & Conrad, 2006; Perna et al., 2009).

Social Cognitive Career Theory

As previous research has indicated, there is a link between self-efficacy and outcome expectations (Lent et al., 2005). This research confirms the link between science/math self-efficacy for female STEM students. However, science/math self-efficacy did not emerge as a factor specific to African American women, as evidenced by the multiple regression model for African American women, only. The results may indicate that science/math self-efficacy is operating for African American women in STEM, but not for African American women who are not in STEM.

Fouad et al. (2010) found that the number of barriers students reported for the sciences from middle school to college decreased over time, while the reverse pattern was seen for engineering. This may be a partial explanation of why more women reported being agricultural and life science majors, fewer were in engineering. If perceived barriers decrease, African American women may remain in a STEM field but be more likely to pursue a career path in the sciences instead of engineering.

Limitations

There are several limitations of the current study. The study is limited to students who attended a university within one state and the results may not be generalizable to undergraduate students in other geographical locations. Furthermore, the study was limited in that the students were surveyed at only one point in time thus the results are not assumed to be causal. Conducting a longitudinal study to examine the career commitment of African American women in STEM would be ideal. Comparisons across time could investigate more

definitively who stays in the STEM pipeline, the careers they choose as opposed to those who demonstrated strong career commitment but later select alternative career paths unrelated to STEM. Likewise, the survey did not capture information about students' pre-college preparation or standardized test scores. Pre-college preparation has been known to be associated with persistence in a STEM major, if not career commitment (Daempfle, 2003; Lent et al., 1987; Suresh, 2006). Likewise, the survey only requested participants to report if they were currently STEM majors, not if the students were formerly STEM majors and switched to a non-STEM major. Being informed about the participant's past STEM major would allow for additional analyses that could detect differences between students who pursue STEM majors then switch to non-STEM majors versus students who remain STEM majors and pursue STEM careers.

STEM majors were oversampled in this study, leaving a smaller sample of non-STEM majors to which comparisons could be made. Perhaps having a larger pool of participants from the humanities and education would have provided a clearer delineation of STEM/non-STEM major differences. One limitation of the findings is the categorization of psychology students. Specifically, in the current student, psychology was categorized as a non-STEM major. Currently, some debate in the science community concerns the proper placement of psychology in research. In fact, the American Psychological Association (APA) at present is working to have psychology recognized as a STEM major (APA, 2010). However, to be consistent with the classification standards used by NSF, psychology was separated from the *STEM* majors and was combined with the social sciences (NSF, 2010).

Notably, the sample included a large number of African American women in STEM. However, the majority of the participants came from one university. In addition, all of the

participants are students in North Carolina. Therefore, the results of the study may not represent students who are not attending universities in the Southeast of the United States.

Furthermore, a greater variety of majors was anticipated so that more exploratory analyses could be conducted to investigate differences within STEM majors. With the limited number of students in some STEM majors these within group analyses could not be conducted.

According to Peng, Lee, and Ingersoll (2002) logistic regression is best conducted with SAS and BMDP LR. SPSS is the least recommended method. Perhaps another statistical software package may have produced different results because they can control for over-sampling, which occurred with this dataset.

Seven Institutional Review Board (IRB) permissions were obtained, however participants were recruited from only four universities due to the difficulty of obtaining faculty cooperation and having limited access to the student populations, making participant recruitment extremely challenging. Additionally, more than half of the students came from one institution. The validity and generalizability of the results may have been improved with the participation of more institutions.

Implications and Future Research

The study provides evidence of differences for African American women at the intersection of race and gender, making it clear that both race and gender should be taken into account when considering the variables that provide the greatest contribution to retaining African American women in STEM. This supports the recent push for disaggregation of the data at the intersection of race and gender (Kim & Sax, 2009; Ohland et al., 2011; Sax et al., 2005) as it has implications for understanding and increasing career commitment in STEM

for African American women. This research contributes to a growing body of knowledge on the unique circumstances for African American undergraduate women in STEM majors. The evidence from this study suggests that African American women are capable of pursuing STEM degrees and that the underrepresentation of African American women may be due to factors other than ability. Therefore, it is important to look beyond ability to external variables such as campus climate and department climate to determine how each contributes to successful outcomes.

The majority of previous department climate research has focused on the experiences of graduate students and faculty members but undergraduates may be affected, as well. Griffith (2010) reported that students and faculty affected the persistence of students, indicating that additional research should explore the effect of peers *in* one's major. Expanding department climate research to undergraduate students may provide promising insight on the role of the department in career commitment.

The Department Climate Scale used in the current study underwent significant alterations before the data could be analyzed. Thirteen items were removed through the exploratory factor analyses. Among them were items which addressed mentoring, role models, and peer influences, all of which have been linked to positive student outcomes (Kokkelenberg & Sinha; Packard, 2005; Pascarella & Terenzini, 2005)². For example, two items loaded on the mentorship factor but were deleted because it is customary to have at least four items per scale in factor analyses. Two more items which pertained to grades were removed for the same reason. Hence, the factor analysis indicated that there was a relationship within each set of deleted items. Future studies could include additional items

² It should be understood that the removal of multiple items from an exploratory analysis does not imply poor quality; the item may be relevant in a capacity separate from the factor analysis.

addressing mentorship and grades to determine if the removed items could be developed into stronger subscales. The results could be analyzed to determine if the findings have implications for STEM majors beyond the current findings.

In reference to the Science/Math Self-Efficacy scale, one finding of particular interest was the similarity scores for STEM and non-STEM majors. One plausible explanation for the similarity in scores between the two groups is that the current study's population was significantly different from the one which the Science/Math Self-Efficacy scale was developed. The scale was originally designed for students pursuing science and math degrees but the modifications made to the scale which increased the amount of variance explained by the scale, may have consequently produced results that do not clearly differentiate STEM from non-STEM majors.

Due to the dearth of information available on African American undergraduate women in STEM, more qualitative and mixed-method studies should be conducted which can ask more nuanced questions that reveal the voice of African American women students and their experiences in STEM majors (Settles et al., 2007). Additionally, qualitative research is apt to make specific groups the central focus of the study and less likely to command a comparison group whose existence puts African American women in the place of the "other." Taken together, previous and future scholarship can be used to inform policy and can lead to pedagogical improvements in the classroom, improved diversity at the university level, and increased support from government agencies such as the National Science Foundation and the National Institutes of Health.

Conclusion

The study's results firmly contrast to findings that assert that African American women are not interested in, prepared for, or committed to STEM majors and careers. Results also suggest that science/math self-efficacy may not be as useful as widely assumed in distinguishing STEM majors from non-STEM majors. Study results also suggest that group-level analyses may over- and/or under- estimate the salience of gender and ethnicity for STEM majors, depending on the group. Additionally, the findings of the study indicate that a new measure of department climate may provide additional insight into students' experiences in their majors.

In past studies, African American women have been primarily disregarded and so a study at the intersection of ethnicity and gender was needed. This study addresses the gap in research concerning undergraduate African American women and their commitment to a future career in STEM. It is apparent that examining ethnicity and gender alone cannot illuminate existing, yet concealed variations at the intersection of race and gender. The density of the data suggests that researchers interested in intersectionality must also find better ways to address this area of research (Harnois, 2010; Shields, 2008).

Alternative explanations for the success that African American women are experiencing in the sciences may be influences such as social support, mentoring, research experiences, to name a few, which have all been shown to be indicators of persistence to graduation. However, other studies have not measured commitment to a science career.

Continued improvements in STEM majors are fundamental if the STEM career trajectory for African American women is to be enhanced. Existing interventions must be evaluated to determine their effectiveness and best practices should be shared. Universities

should persist in making strides to provide all students with the tools they need to succeed in STEM fields beyond their undergraduate years.

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APPENDIX

Appendix A

Academic Major Classification

Agricultural and Life Sciences*

Agricultural
 Animal Science
 Applied Nutrition
 Biochemistry
 Biological Sciences
 Biology
 Botany
 Fisheries, Wildlife & Conservation
 Food Science
 Nutrition/Nutrition Science
 Horticultural Science
 Microbiology
 Nursing
 Zoology

Education**

Biology Secondary Education
 Business and Marketing Education
 Elementary Education
 General Studies Education
 History Education
 Middle Grades Education
 Physical Education
 Public Health Education
 School Administration
 Science Education
 Technology Education

Engineering*

Aerospace Engineering
 Biological Engineering
 Biomedical Engineering
 Chemical Engineering
 Civil Engineering
 Computer Engineering
 Computer Information Systems
 Computer Science
 Electronics, Computer, & Information
 Electrical Engineering
 Geomatics Engineering
 Industrial Engineering

Appendix A Continued

Information Technology
Mechanical Engineering
Nuclear Engineering
Textile Engineering

Humanities & Social Sciences**

Anthropology
Communication
Criminal Justice/Criminology
English
International Affairs/International Studies
Philosophy
Political Science
Pre-Professional
Psychology
Public Relations
Social Work
Sociology
Spanish
Women and Gender Studies

Physical & Mathematical *

Atmospheric Sciences
Chemistry
Environmental Studies
Environmental Technology
Mathematics
Meteorology
Physics
Polymer and Color Chemistry

Other(non-STEM)**

Art & Design
Athletic Training
Business
Exercise Sports Science
Fashion and Textiles Management
Graphic Design
Textiles

Appendix A Continued

Other (STEM)**

Architecture
Clinical Laboratory Science
Textile Technology
Natural Resources

Undecided Major**

Unlisted STEM*

* Coded as STEM Major

**Coded as non-STEM Major

Appendix B

Science/Math Self-Efficacy Scale

Witt-Rose (2003) - Revised

We are interested in your beliefs about your abilities in math and science courses. Please rate to what extent you agree with the following statements using a scale ranging from "Strongly Disagree" to "Strongly Agree."

1. I am confident that I can do well in my math and science courses.

Strongly Disagree Disagree Neutral Agree Strongly Agree

2. I think I will do as well or better than other students in my math and science courses.

Strongly Disagree Disagree Neutral Agree Strongly Agree

3. I am confident I have the ability to learn the material in my math and science courses.

Strongly Disagree Disagree Neutral Agree Strongly Agree

4. I don't think I will be successful in my math and science courses.*

Strongly Disagree Disagree Neutral Agree Strongly Agree

5. I am confident that I can understand the topics taught in my math and science courses.

Strongly Disagree Disagree Neutral Agree Strongly Agree

6. I believe that if I exert enough effort, I will be successful in my math and science courses.

Strongly Disagree Disagree Neutral Agree Strongly Agree

7. I feel like I don't know a lot about math and science compared to other students in my courses.*

Strongly Disagree Disagree Neutral Agree Strongly Agree

8. Compared with other students in my courses, I think I have good study skills.

Strongly Disagree Disagree Neutral Agree Strongly Agree

9. Compared with other students in my courses, I don't feel like I'm a good student.*

Strongly Disagree Disagree Neutral Agree Strongly Agree

10. I am confident I can do well on the lecture exams in my math and science courses.

Strongly Disagree Disagree Neutral Agree Strongly Agree

11. I am confident I can do well in the lab portion of my science courses.

Strongly Disagree Disagree Neutral Agree Strongly Agree

12. I think I will receive a C or better in my math and science courses this semester.

Strongly Disagree Disagree Neutral Agree Strongly Agree

13. I don't think I will get a good grade in my math and science courses this semester.*

Strongly Disagree Disagree Neutral Agree Strongly Agree

14. I am confident that I could explain something learned in my math and science courses to another person.

Strongly Disagree Disagree Neutral Agree Strongly Agree

*Notes a reverse scored item.

Appendix C

Career Commitment
(Careers in Science)

We are interested in your observations about yourself and the kind of work you like to do.

Now, please rate how LIKELY it is that you will take the following career steps, using a scale ranging from "Very Unlikely" to "Very Likely."

IN YOUR FUTURE CAREER, HOW LIKELY IS IT THAT YOU WILL:

1. Get college training in science?

Very Unlikely Unlikely Mildly Unlikely Mildly Likely Likely Very Likely

2. Get experience working as a scientist?

Very Unlikely Unlikely Mildly Unlikely Mildly Likely Likely Very Likely

3. Be a successful scientist?

Very Unlikely Unlikely Mildly Unlikely Mildly Likely Likely Very Likely

4. Get an advanced degree in the sciences?

Very Unlikely Unlikely Mildly Unlikely Mildly Likely Likely Very Likely

5. Become a scientist?

Very Unlikely Unlikely Mildly Unlikely Mildly Likely Likely Very Likely

6. Have the ability to become a scientist?

Very Unlikely Unlikely Mildly Unlikely Mildly Likely Likely Very Likely

7. Take advanced courses in science?

Very Unlikely Unlikely Mildly Unlikely Mildly Likely Likely Very Likely

8. Complete your degree in science?

Very Unlikely Unlikely Mildly Unlikely Mildly Likely Likely Very Likely

9. Do advanced research in science?

Very Unlikely Unlikely Mildly Unlikely Mildly Likely Likely Very Likely

10. Apply to graduate programs in science?

Very Unlikely Unlikely Mildly Unlikely Mildly Likely Likely Very Likely

11. Have a lifelong career in science?

Very Unlikely Unlikely Mildly Unlikely Mildly Likely Likely Very Likely

12. Have a very successful career in science?

Very Unlikely Unlikely Mildly Unlikely Mildly Likely Likely Very Likely

Appendix D

Department Climate Scale

We would like to understand more about your thoughts concerning the department in which you major. If you have more than one major, just consider one. Please rate to what extent you agree with the following statements using a scale ranging from “Strongly Disagree to “Strongly Agree.”

IN MY MAJOR DEPARTMENT:

1. My grades reflect the effort I put into my classes.

Strongly Disagree Disagree Neutral Agree Strongly Agree

2. Students expect to be mentored by a faculty member.

Strongly Disagree Disagree Neutral Agree Strongly Agree

3. Students are treated fairly, regardless of ethnicity, socio-economic status and sexual orientation.

Strongly Disagree Disagree Neutral Agree Strongly Agree

4. I am being prepared for my future career.

Strongly Disagree Disagree Neutral Agree Strongly Agree

5. I have several close friends.

Strongly Disagree Disagree Neutral Agree Strongly Agree

6. There is someone I can identify as a role model.

Strongly Disagree Disagree Neutral Agree Strongly Agree

7. The students are competitive with each other.

Strongly Disagree Disagree Neutral Agree Strongly Agree

8. There is a collaborative atmosphere.

Strongly Disagree Disagree Neutral Agree Strongly Agree

9. They are committed to the success of women.

Strongly Disagree Disagree Neutral Agree Strongly Agree

10. The grading practices seem fair to me.

Strongly Disagree Disagree Neutral Agree Strongly Agree

11. I have a mentor.

Strongly Disagree Disagree Neutral Agree Strongly Agree

12. Women are treated fairly.

Strongly Disagree Disagree Neutral Agree Strongly Agree

13. The environment is supportive and welcoming.

Strongly Disagree Disagree Neutral Agree Strongly Agree

14. They are committed to the success of men.

Strongly Disagree Disagree Neutral Agree Strongly Agree

15. I receive a substantial amount of guidance from my mentor.

Strongly Disagree Disagree Neutral Agree Strongly Agree

16. The environment can be described as warm and friendly.

Strongly Disagree Disagree Neutral Agree Strongly Agree

17. I feel ignored and excluded.

Strongly Disagree Disagree Neutral Agree Strongly Agree

18. Men are treated fairly.

Strongly Disagree Disagree Neutral Agree Strongly Agree

19. They are committed to the success of different ethnic and racial groups.

Strongly Disagree Disagree Neutral Agree Strongly Agree

20. I feel comfortable asking for help.

Strongly Disagree Disagree Neutral Agree Strongly Agree

21. The climate fosters diversity.

Strongly Disagree Disagree Neutral Agree Strongly Agree

22. The ACADEMIC STAFF is warm and friendly.

Strongly Disagree Disagree Neutral Agree Strongly Agree

23. The faculty members are warm and friendly.

Strongly Disagree Disagree Neutral Agree Strongly Agree

24. The faculty members are willing to help me.

Strongly Disagree Disagree Neutral Agree Strongly Agree

25. The faculty members are sensitive to the needs of all students.

Strongly Disagree Disagree Neutral Agree Strongly Agree

26. The faculty members are accessible to me.

Strongly Disagree Disagree Neutral Agree Strongly Agree

27. The faculty members are interested in my success.

Strongly Disagree Disagree Neutral Agree Strongly Agree

28. The faculty members are competitive with each other.

Strongly Disagree Disagree Neutral Agree Strongly Agree

Appendix E

Campus Climate
(Cabrera & Nora, 1994)

1. I have observed discriminatory words, behaviors or gestures directed at minority students at this institution.

Strongly Disagree Disagree Neutral Agree Strongly Agree

2. I feel there is a general atmosphere of prejudice among students.

Strongly Disagree Disagree Neutral Agree Strongly Agree

3. I have encountered racism while attending this institution.

Strongly Disagree Disagree Neutral Agree Strongly Agree

4. I have heard negative words about people of my own race or ethnicity while attending classes.

Strongly Disagree Disagree Neutral Agree Strongly Agree

5. I feel there is a general atmosphere of prejudice among FACULTY at this institution.

Strongly Disagree Disagree Neutral Agree Strongly Agree

6. I feel there is a general atmosphere of prejudice among ACADEMIC STAFF at this institution.

Strongly Disagree Disagree Neutral Agree Strongly Agree

7. I have been discouraged from participating in class discussions.

Strongly Disagree Disagree Neutral Agree Strongly Agree

8. I have been singled out in class and treated differently than other students.

Strongly Disagree Disagree Neutral Agree Strongly Agree

9. Being a student at this institution is a pleasant experience.

- Strongly Disagree Disagree Neutral Agree Strongly Agree

10. I feel I belong at this institution.

- Strongly Disagree Disagree Neutral Agree Strongly Agree

Appendix F

Course History

1. Since starting college, approximately how many math and science courses have you completed?

2. How many math and science courses are you enrolled in this semester?

3. 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:

4. What is the profession you currently plan on seeking upon graduation:

5. The number of years you have been at this institution:

6. Please specify your overall Grade Point

Appendix G
Demographics

Please specify the following:

1. Gender
 - Female
 - Male

2. Citizenship
 - Non-U.S.
 - U.S.

3. Ethnicity:
 - Latino American/Hispanic
 - Native American/Alaskan Native/Pacific Islander
 - Asian American/Asian
 - African American/Black
 - European American/Caucasian/White
 - Other (Please specify):

4. Please specify your birth year:

Appendix H

Informed Consent – No Incentive

Dear Student:

You are invited to participate in a National Science Foundation (NSF) sponsored research study to explore students' perceptions of scientists and science. We believe this survey will produce valuable information for students, universities, and government policy makers. The results of this study will be used to make general recommendations about enhancing the classroom and career opportunities that U.S. universities provide to students.

Your participation in this study is completely voluntary. The survey will take about 15-20 minutes to complete. By taking the survey, you will be giving your consent to include your responses in the final results. If you complete the survey by the deadline you can possibly receive extra credit in your affiliated class. Only students who complete the study can receive extra credit, as offered by the instructor.

The survey will ask questions about your experiences as a student and your major department's climate. Because these questions may ask you to evaluate your current department, you should take care to complete the survey on a private computer and to close out of the web browser when exiting the survey.

This course is one of several that are included in the NSF study. Your survey results cannot be linked to your course id or email address. Your completed survey will be kept in strict confidence, since we cannot identify individual responses. Identities will be collected but not associated with responses. I have used your email address to send the survey to you. However, your responses are not connected to your identity. The data sheet that contains all the responses does not request your identity. We will analyze our findings only for all students surveyed or in some small groupings (for example, students planning to go on to graduate school). A general summary of the study results will be made available to the public in 2012.

If you have any questions about the survey or have any problems completing the survey, please do not hesitate to contact Felysha Jenkins at fljenkin@ncsu.edu or by phone at (919) 515-1347.

The deadline for survey completion is: ***Month Day, Year***

Thank you for your cooperation and we look forward to your participation!

Felysha Jenkins
fljenkin@ncsu.edu
(919) 515-1347

PARTICIPANT'S STATEMENT OF INFORMED CONSENT:

If you agree with the following statement and wish to participate in the study, please click on the circle in front of "I agree" below. If you do not agree, simply close your browser.

"I am at least 18 years of age, have read and understand the explanation provided to me and voluntarily agree to participate in this study."

PRINT THIS "INFORMED CONSENT" PAGE FOR FUTURE REFERENCE

Appendix I

Informed Consent – Incentive

Dear Student:

You are invited to participate in a National Science Foundation (NSF) sponsored research study to explore students' perceptions of scientists and science. We believe this survey will produce valuable information for students, universities, and government policy makers. The results of this study will be used to make general recommendations about enhancing the classroom and career opportunities that U.S. universities provide to students.

Your participation in this study is completely voluntary. The survey will take about 15-20 minutes to complete. By taking the survey, you will be giving your consent to include your responses in the final results. If you complete the survey by the deadline you can possibly receive extra credit in your affiliated class. Only students who complete the study can receive extra credit, as offered by the instructor.

The survey will ask questions about your experiences as a student and your major department's climate. Because these questions may ask you to evaluate your current department, you should take care to complete the survey on a private computer and to close out of the web browser when exiting the survey.

This course is one of several that are included in the NSF study. Your survey results cannot be linked to your course id or email address. Your completed survey will be kept in strict confidence, since we cannot identify individual responses. Identities will be collected but not associated with responses. I have used your email address to send the survey to you. However, your responses are not connected to your identity. The data sheet that contains all the responses does not request your identity. We will analyze our findings only for all students surveyed or in some small groupings (for example, students planning to go on to graduate school). A general summary of the study results will be made available to the public in 2012.

You have the opportunity to enter a random drawing for one of four \$25 gift cards at the conclusion of the survey. If you would like to enter the special drawing, please record/write down the special code on the last page of the survey and send it to me in a separate email. Your email to me in no way will be linked to your responses on the survey. After all data has been collected, four random drawings will be conducted and the winners will be contacted via email. At that time, I will request addresses **only from the winners** and will mail the gift cards to them.

If you have any questions about the survey or have any problems completing the survey, please do not hesitate to contact Felysha Jenkins at fjenkin@ncsu.edu or by phone at (919) 515-1347.

The deadline for survey completion is: *Month Day, Year*

Thank you for your cooperation and we look forward to your participation!

Felysha Jenkins
fjenkin@ncsu.edu
(919) 515-1347

PARTICIPANT'S STATEMENT OF INFORMED CONSENT:

If you agree with the following statement and wish to participate in the study, please click on the circle in front of "I agree" below. If you do not agree, simply close your browser.

"I am at least 18 years of age, have read and understand the explanation provided to me and voluntarily agree to participate in this study."

PRINT THIS "INFORMED CONSENT" PAGE FOR FUTURE REFERENCE
National Science Foundation, Division of Science Resources Statistics. 2011. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2011*. Special Report NSF 11-309. Arlington, VA. Available at <http://www.nsf.gov/statistics/wmpd/>.

Appendix J

Letter to Faculty

My name is Felysha Jenkins and I am a doctoral candidate at NC State in the Department of Psychology. I am currently working on an NSF-funded project researching the experiences of African American students in the science career trajectory. Part of my research involves surveying undergraduate students' perceptions of themselves and their perceptions of science, technology, engineering, and mathematics (STEM) courses.

A local and national sample of participants will be invited to take the survey via a secure website. Ideally, there will be 600-800 participants in the study with an oversampling of African American women. Eligibility to participate is defined as enrollment in courses offered by faculty who have volunteered to cooperate in data collection. Therefore no one will be excluded based on race or gender.

I'm contacting you to ask if you would be willing to encourage students in your courses this spring semester to complete my web-based survey. Those who volunteer to participate will be provided with a website address and link to participate in the survey. They will be presented with a statement regarding their consent to the conditions of use of the data, and they will be told that participation is voluntary and that they may quit at any time. The survey items request information about their math/science self-efficacy, campus climate, and department climate.

The survey takes no more than 20 minutes to finish and can be done at a student's convenience. If you are willing to allow your students to participate in the study or if you have questions about the project, please contact me. My information is below.

Best regards,
Felysha Jenkins, M.A.
Doctoral Candidate

Tel: (919) 515-1347
Fax: (919) 515-2873