DISSERTATION

PREDICTIVE FACTORS ASSOCIATED WITH ETHNIC MINORITIES' SELECTION OF COLLEGE ACADEMIC MAJOR: EMPHASIS ON MATHEMATICS AND SCIENCE SELECTION

Submitted by

Willie Mellion

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY WILLIE MELLION ENTITLED PREDICTIVE FACTORS ASSOCIATED WITH ETHNIC MINORITES' SELECTION OF COLLEGE ACADEMIC MAJOR: EMPHASIS ON MATHEMATICS AND SCIENCE SELECTION BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

Committee on Graduate work

W. Lee Wilke

George A. Morgan

Advisor: Gene W. Gloeckner

Co-Advisor: Timothy G. Davies

Interim Director: Carole Makela

ABSTRACT OF DISSERTATION

PREDICTIVE FACTORS ASSOCIATED WITH ETHNIC MINORITES' SELECTION OF COLLEGE ACADEMIC MAJOR: EMPHASIS ON MATHEMATICS AND SCIENCE SELECTION

The percentages of African American undergraduate students entering college continues to rise or remain consistent but, the number of African American students who choose to major in STEM related fields remains below that of Asian or White students. The review of literature reports that African American students displayed an initial interest in STEM fields but more often than not chooses college academic majors in non-STEM fields.

This research study examined the factors that affect African American undergraduate students' choice of college academic major (STEM versus Non-STEM). Multiple factors were examined to see if there were differences between students who choose to switch academic majors and those who do not. This study also examined if there are any predictive factors that lead students to choose STEM academic majors.

The participants were Southern University Agricultural and Mechanical College, undergraduate students (N= 238) classified as juniors or seniors, enrolled in the spring semester 2008.

An independent sample *t*-test did not reveal any statistically significant differences between students who switched majors' verus students who did not switch majors on 13 factors that might influence a student's choice of major.

Two by two factorial ANOVAs revealed statistically significant results between gender on the variables desire to help others through research or practice, desire to teach, mathematics grades, science grades, and advance placement/gifted talented classes took in high school. Statistically significant results were found between major on desire to attend graduate school, desire to attend professional school, desire for a high salary, desire to help others through research or practice, job stability, opportunity for more scholarships, science perception, mathematics grades, and advanced placement/gifted talented classes took in high school. The interaction between gender and major yielded statistically significant results for interest in discipline or field, father's education, and science grades.

Discriminate analysis revealed that high school preparation contributed most in predicting choosing a STEM college major.

A *t*-test revealed a statistically significant difference between students who took calculus, physics, and trigonometry and participated in a STEM club in high school with selection of a STEM major.

Willie Mellion
School of Education
Colorado State University
Fort Collins, CO 80523
Spring 2010

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CHAPTER 1: INTRODUCTION

The American dream lies at the very heart of United States cultural ethos. At the center of this ideal is the emphatic conviction that, in this society, education opens the doors to success (Allen, Teranishi, Dinwiddle, & Gonzales, 2000). Education also has had a distinctively important role as the social right that secures access to the "American Dream," now understood in terms of material prosperity and occupancy of those social roles (which typically have substantial educational prerequisites) that maximize economic opportunity (Callan, 2004). The belief that even the poorest citizens can achieve greatness with talent and hard work is one of the United States' most cherished cultural trends (Hochschild, 1995). In a society that offers little else in the way of a welfare state and where poverty is the almost inevitable fate of the poorly educated, the quality of the state-sponsored schooling takes on a momentous personal importance for parents and children (Callan, 2004).

Allen, et al. (2000) further stated that African Americans have embraced this viewpoint that talent is equated with educational attainment to the extreme. Dating back when slaves were forbidden to learn to read and write under threat of death or physical harm, African Americans have invested education with mythical qualities, holding it up as both hope and salvation for the future (Allen, et al., 2000). Yet no matter how much education African Americans have achieved, they still have suffered discrimination based on skin color. Nevertheless, African Americans have continued to crave and embrace education as the ultimate solution (Allen, & Jewell, 1995). Despite the paradox of societal stereotypes depicting African Americans as lazy, ignorant, and mentally inferior-even as the nation developed history's most elaborate system of institutional barriers intent

on denying African Americans opportunities for schooling African Americans continued to value and pursue education (Allen, et al., 2000).

Statement of the Research Problem

In today's global, technology-driven economy, there is a strong need to invest in human resources and the infrastructure for science, technology, engineering, and mathematics (STEM) education (Okogbaa, Das, Martin-Vega, Centero, Otieno, & Nanduri, 2006). This concern has led to federal policies developed to improve and accelerate STEM education at all levels. From a slightly different dimension, globalization presents exciting opportunities and challenges. However, globalization cannot be embraced without being committed to valuing and affirming cultural diversity in much broader context. The United States' ability to maintain its leadership position now and in the future will require world views that recognize the richness of cultural and human diversity. That is, the talents and wealth of experiences from its entire citizenry must be nurtured and utilized (Okogbaa et al., 2006).

Greater and better use of the diverse human resources of the United States is a national imperative. The under representation of ethnic minorities in STEM related fields is an indicator that the United States has failed to recognize and develop fully the human resources of our diverse population. The United States ability to maintain a position of global leadership depends on its ability and willingness to recognize, stimulate, and develop the capacities of all segments of society and to acknowledge the needs of those currently under represented.

Americans must improve the quality of education and significantly increase the participation of ethnic minority students. Griffin (1990) stated that if minority students and workers are not encouraged and adequately prepared in science, mathematics, and technology, then the United States position as a technological leader will be in jeopardy. For economic, scientific, and democratic reasons citizens of the United States have an obligation to include all populations in the

scientific work force and in shaping scientific policy for the future (Campbell, Denes, & Morrison, 2000).

The impact on society from ethnic minority involvement in science is also important. Racial and cultural differences of minority scientists affect decisions on what scientific problems to address and the ways that the problems are approached (Blockus, 2000). Blockus (2000) further stated that without increased involvement in science, there will not be enough educated and experienced people of color to discuss science policies or influence the direction of research. As a growing population group, it will be important for ethnic minorities to have an input on science and health related issues, which will directly affect their quality of life (Blockus, 2000).

Significance of the Study

While the choice of college academic major is one of the most pivotal decisions that African American students make as they enter college, studies examining the choice of major by race reveal that African American students are more likely than White students to major in education, the humanities, and the social sciences. All three are fields that offer lower incomes to college graduates than the natural and technical fields (Goyette & Mullen, 2006). Men have traditionally concentrated into fields such as business, engineering, chemistry, and physics, while women have studied education, humanities, nursing, and psychology (Goyette & Mullen 2006). The lack of the underrepresented ethnic minority groups and females in STEM fields has led to a greater focus on approaches to increase the representation of these groups.

Purpose of the Study

This research study added new insight to the knowledge base regarding the types of factors that affect African American undergraduate students who chose to pursue an STEM academic major. It also provides information about the types of factors that affect African American undergraduate students who chose not to pursue a STEM academic major. Analysis of

these perceptions may inform policy related to African American students, achievement in STEM fields, and what factors determine their majors.

Research Questions

The specific research questions addressed in this study are:

Research Question One

Is there a difference between students who switched college academic majors and those who did not and their (a) interest in discipline or field, (b) desire to attend graduate school, (c) desire to attend professional school, (d) desire for a high salary, (e) desire to complete research or practice, (f) desire to teach, (g) desire to please parents, (h) job stability, (i) opportunity for more scholarships, (j) highest level mother education, (k) highest level father education, (l) quality of counseling in high school, (m) high school preparation for STEM major, (n) mathematics perception, (o) science perception (p) parental social economic status, (q) high school mathematics background, (r) high school science background, (s) grades in high school mathematics, (t) grades in high school science classes, (u) gifted and talented/ advanced placement classes, (v) satisfaction with department?

Research Question Two

Is there a difference between gender on (a) interest in discipline or field , (b) desire to attend graduate school, (c) desire to attend professional school, (d) desire for a high salary, (e) desire to complete research or practice, (f) desire to teach, (g) desire to please parents, (h) job stability,(i) opportunity for more scholarships, (j) highest level mother education, (k) highest level father education, (l) quality of counseling in high school, (m) high school preparation, (n) mathematics perception, (o) science perception, (p) parental social economic status, (q) grades in high school mathematics, (r) grades in high school science classes, (s) gifted and talented/ advanced placement classes, (t) satisfaction with department?

Research Question Three

Is there a difference between major on (a) interest in discipline or field , (b) desired to attend graduate school, (c) desire to attend professional school, (d) desire for a high salary, (e) desire to complete research or practice, (f) desire to teach, (g) desire to please parents, (h) job stability,(i) opportunity for more scholarships,(j) highest level mother education, (k) highest level father education,(l) quality of counseling in high school, (m) high school preparation, (n) mathematics perception, (o) science perception, (p) parental social economic status, (q) grades in high school mathematics, (r) grades in high school science classes, (s) gifted and talented/ advanced placement classes, (t) satisfaction with department?

Research Question Four

Is there an interaction between gender and major on (a) interest in discipline or field , (b) desire to attend graduate school, (c) desire to attend professional school, (d) desire for a high salary,(e) desire to complete research or practice, (f) desire to teach, (g) desire to please parents, (h) job stability,(i) opportunity for more scholarships,(j) highest level mother education, (k) highest level father education, (l) quality of counseling in high school, (m) high school preparation, (n) mathematics perception, (o) science perception, (p) parental social economic status, (q) grades in high school mathematics,(r) grades in high school science classes, (s) gifted and talented/ advanced placement classes, (t) satisfaction with department?

Research Question Five

Is there a combination of factors tested above that will predict STEM enrollment?

Research Question Six

Is there an association between students who took calculus, physics, trigonometry, and participated in a STEM Club while in high school with major?

Definitions of Terms

For the purpose of this study, the following definitions apply:

African American - an American of African ancestry having origins in any of the Black racial groups of Africa (except those of Hispanic origin).

Historically Black Colleges and Universities (HCBUs) - institutions of higher learning, which were established specifically for the education of African Americans during times of racial segregation and continue to serve a predominantly African American student population.

Latino/Hispanic American - an American of Hispanic or Latin American ancestry having origins in Mexico, Puerto Rico, Cuba, Central or South America, or in other Spanish cultures regardless of race.

Majority - the racial group that historically has access to power in the United States institutions, typically European (White) Americans.

Minority - the racial or ethnic groups that have been historically under represented in the United States, typically Asian Americans, African Americans, Hispanic/Latino, and Native Americans.

Native Americans - an American having origins in any of the original peoples of North American or Hawaii, and who maintains cultural identification through tribal affiliation or community recognition.

Predominantly White Institutions (PWIs) - institutions of higher learning that do not carry a Historically Black College or University designation and serve a majority student population .

Science related careers – identified as careers requiring a minimum of a bachelor's degree in science and involving a significant amount of science as part of the job description.

Delimitation

According to Creswell (1994, p. 110) delimitations "establish boundaries and narrow the scope of the study." The following delimitation was made with respect to this study research. This research was limited to African American undergraduate students. The survey was delimited to current students enrolled at Southern University A. & M., Baton Rouge, Louisiana. This study was limited to students that have completed at least 60 credit hours of course work.

Limitations

According to Creswell (1994, p. 110) limitations "identify potential weaknesses of the study." The written survey format may have limited the quality and quantity of responses provided by the students. Purposeful sampling limits the ability to generalize the data of the study.

Researcher's Perspective

As I examined my educational experiences, I realized early on that I always have had an interest in science. Childhood unscientific experiments using random materials found around the house that evolved into actually completing scientific experiments in high school and college. Science has led me on a challenging and interesting path that took me from Southern University A. & M. in Baton Rouge, Louisiana, to Colorado State University in Fort Collins, Colorado.

I was accepted into a graduate program in Reproductive Physiology at Colorado State University and this is where I realized my previous academic preparation did not prepare me for this program. I honestly can say that some of my lack of preparation was due to my own short comings as a student, and I have had to take full responsibility for my actions. However, there were aspects of my academic preparation that I had no control over, the educational content in the

Louisiana K-12 school system. To be more specific, the schools that served in the African American communities.

I attended Scotlandville Middle School in East Baton Rouge Parish, located in a predominately African American neighborhood. An interesting fact regarding the two years I was at Scotlandville Middle was the school only had one set of books for each class. Students were not assigned their own text books to take home to use for homework assignments and studying. Granted, not having a set of assigned books appeared to be a wonderful idea for me as a teenager but, what I learned in middle school directly impacted most aspects of my high school education.

The high school I attended was Istrouma High, also in East Baton Rouge Parish. I realized early on that I had to take responsibility for the courses that I took in high school. My initial high school course schedule was not challenging and I seemed to randomly placed into courses based on the middle school that I attended. I took it upon myself to meet with my high school counselor and change my course schedule to more advanced and challenging courses. This gave me an opportunity to take Advanced English, Literature, Mathematics, and Science courses. Had I not taken charge of my high school education I would have been like the countless others with whom I went to high school, disenfranchised students who took the courses that they were assigned to take.

My first college academic major was Electrical Engineering; I selected engineering because I had a family member who previously had graduated in that field. After two years, I realized that engineering was not the science that interested me and changed majors. I switched to Animal Science and realized that this was the science that I was interested in.

Unknowingly, my decision to switch college academic majors directly affected my future. My success in Animal Science provided me the opportunity to attend graduate school at Colorado State University. At CSU I have had success and have experienced failure; it was this failure that

forced me to switch from physiology to education. My thought process was I would be able to marry my science background with education.

My collective educational experiences led me to wonder if my experiences were unique just to me or if other African American students experience similar challenges. I do not want to give the impression that I was not supported in my graduate studies at Colorado State, but when you are the only African American student in a program, without a solid background you can feel marginalized and alone.

CHAPTER 2: REVIEW OF LITERATURE

The review of literature in this study covers eight aspects: (a) African American Students K-12 mathematical and science educational trends, (b) gender, (c) socioeconomic status, (d) counseling and ethnic minorities, (e) faculty, role models, and mentors, (f) career choices, (g) educational contributions of historically black colleges and universities, (h) issues related to college attendance and choice among African Americans.

African American Student's K – 12 Mathematical and Science Educational Trends

African American students typically have not done well in mathematics and science at the elementary, middle, or high school levels. In the year 2000, National Assessment of Educational Progress (NAEP) data for mathematics for grades 4, 8, and 12 indicated that although there have been some improvements noted since 1990, White students have higher scores on average than African American and Hispanics, and the gap between subgroups have remained constant (Brand, Glasson, & Green, 2006; NAEP, 2000a). Likewise, the science data of the NAEP (2000b) revealed similar findings (Brand et al., 2006). For students in grades 4, 8, and 12, White students were reported as having higher science scores on average than African American and Hispanic, and the large gaps between subgroups have remained constant since 1996 (Brand, et al., 2006).

Some have argued that African American children's poor mathematics performance is the result of a discontinuity that exists between students' home language and the perceived "precision" of mathematics and mathematical language (Orr, 1987). Tobias (1988) referred to students as being either "insiders" or "outsiders" in mathematics and science classrooms. According to Tobias, the insiders are those who take for granted that they will do well in mathematics and science and are willing to tackle the subjects within the framework of the established school curriculum. These

students identify more with the presentation of Western mathematics and science, because much of what is represented resembles their own subculture (Brand et al., 2006). On the other hand, the outsiders are those students, particularly African Americans, who are unsure about their ability to be successful due to their lack of identity with school mathematics and science subcultures.

Others have suggested that the content of school mathematics is so divorced from African American students' everyday experiences that it appears irrelevant (Tate, 1994). According to Atwater and Riley (1993), African American students are estranged from mathematics and science due to reinforcement of the mono-cultural, Eurocentric underpinnings of Western science.

However, few have situated the mathematics and science performance of African American students into the larger context of mathematics and science teaching and learning in U.S. schools. Mathematics teaching in schools emphasizes repetition; drill; convergent, right answered thinking; and predictability (Ladson-Billings, 1997). Ladson-Billings stated that students are asked to perform similar tasks over and over. They rarely are asked to challenge the "rules" of mathematics. Students rarely are asked how their prior knowledge and experience might support or conflict with school mathematics. Middle-class culture demands efficiency, consensus, abstraction, and rationality (Ladson-Billings, 1997).

Steele (2004) indicated that African American students are more likely to (a) be taught by uncertified and poorly trained teachers, (b) experience corporal punishment and suspensions, (c) encounter an especially distracting peer culture in junior or high school, (d) be tracked into lower academic and special education classes than other students, and (e) go to schools with few or no Advance Placement courses. Furthermore, African American from low income families also must endure the cumulative effects of exposure to community violence, poverty, racism, oppression, and other forms of abuse (Jipguep & Sanders-Phillips, 2003).

Even when African Americans are successful in mathematics and science in the early years, their confidence and interest often decline later on (Hrabowski, 2004; Clewell, Anderson, &Thorpe, 1992). Unfortunately, educators, parents, and peers continue often unknowingly to perpetuate the myth that math and science are "-male" subjects; low expectations and the lack of encouragement and exposure to role models, advanced courses, and careers opportunities reinforce minority students' doubts that they can be successful at higher levels of mathematics and science.

Learned Helplessness

The cultural expectation for ethnic minority groups to perform poorly in mathematics and science is an example of a social-psychological phenomenon referred to as learned helplessness (Powell, 1990). Learned helplessness is a phenomenon containing three components: contingency, cognition, and behavior. Contingency addresses the uncontrollability of the situation. Cognition refers to the attributions that people make regarding their situation or surroundings of which they are a part. Behavior allows individuals to decide whether they will give up or proceed with the obstacle set before them (Firmin, Hwang, Copella, & Clark, 2004; Maier, & Seligman, 1976).

Psychologist have observed that many people, after having failed repeatedly at a designated task, abandon the activity and conclude that they can do nothing in the future to effect a more positive outcome. Upon encountering continuous failure, individuals may stop trying not only in the settings where their failure initially happened but also in other settings where there might be a better chance for success (Powell, 1990). Valas (2001) reported that children who have a history of poor performance are likely to attribute failure to low ability. Moreover, past academic performance also may affect the pattern of attribution indirectly, mediated through academic self-concept. Thus, children who, because of lasting academic under-achievement, perceive

themselves as academically incompetent make attributions that are consistent with this view, i.e. they attribute failure to lack of ability (Marsh, 1984; Marsh, Barnes, Cairns, & Tidman, 1984). Once this learned helplessness syndrome becomes an institutionalized part of the person's psychic make-up, the effects can be extremely deleterious to functional capacity (Powell, 1990). Powell then concluded that this could then lead to emotional problems, motivational disturbances, and negative expectations regarding future performance. This learned helplessness syndrome leads to a defeatist attitude, which can be related to minority students' tendencies to avoid selecting majors in or being directed towards mathematics and science.

Deficiencies

Research is available which documents ethnic minority students' deficiencies in mathematics and science. This may be in part because ethnic minorities generally have received poor preparation in these subjects in the elementary and mid-grade levels. Jacobson (2002) reported White children typically scored near the national average in both reading and mathematics when entering school. However, African-American children score below the national average in those areas and remained there at the end of first grade. Hispanic children entered school and remained at the national average in mathematics, but, significantly below average in reading. However, by the time the Hispanic pupils were finishing first grade, they were closing the gap. Similar research yielded results that living conditions such as over crowding at home and in classrooms also have negative consequences on their performance in mathematics and science. In the mid-grade and high school years, factors such as Powell's learned helplessness syndrome, counselor's inability to suggest and demand that ethnic minority students take mathematics and sciences classes.

The current and past trends are for ethnic minority students to generally subscribe to fewer courses in mathematics and science than White students in high school; they also demonstrate

achievement records below those of White students (Naizer, 1993; Reyes, & Stanic, 1985). Riegle-Crumb (2006) stated that math course-taking patterns are characterized by strong racial and ethnic disparities, such that African American and Latino students take fewer advanced level mathematics courses by the end of high school compared with their White peers. This is an important finding because the number of high school algebra and geometry courses taken by students is the best predictive indicator of scores on standardized mathematics achievements test (Naizer, 1993). Also it seems that many African Americans, as well as other underrepresented minorities, face many problems in mastering mathematics (Fullilove & Treisman, 1990). Anick, Carpenter, and Smith (1981) have stated that that the amount of mathematics studied and the low enrollment in mathematics after grade 10 directly relates to the performance of African American students in mathematics. It also has been stated that African Americans enter college with skill levels in mathematics that place them at considerable disadvantages with Asian students (Fullilove, & Tresiman, 1990; Johnson, 1984; Jones, Burton, & Davenport, 1984).

College Entrance Exams

Many American colleges and universities use standardized admissions test scores and other indicators of precollegiate academic success to decide which applicants should be accepted to undergraduate programs. Test scores such as SAT Mathematics and SAT Verbal scores can be combined with measures of high school academic performance (e.g., high school grade point average or percentile rank) to create a selection index where higher scores relate to higher levels of academic preparation and a greater likelihood of admittance (Culpepper & Davenport, 2009).

Traditionally ethnic minority students have not performed as well on standardized tests compared to White students. According to The College Board (2004) reported significant gains among minority test takers, but the achievement gaps between White students and students from other minority groups persisted. The College Board (2004) reported that 13% of African American

SAT test takers took calculus during high school compared to 27% of White and 43% of Asian American students.

Wimberly and North (2005) stated that American College Testing (ACT) reported that advanced mathematics courses taken in high school are related directly to the probability of success in students' first college mathematics courses.

McLure and McLure (2000) reported that mathematics achievement on the American College Testing (ACT) is directly related to the number of mathematics courses taken. McLure et al., (2000) also stated that not all groups are increasing their mathematics course taking at the same rate. McLure et al., (2000) indicated that students from lower income levels made some gains in the number of advanced mathematics courses taken, but such gains were modest compared to the gains of those in the middle and higher groups.

Ability and Achievement Factors

Academic achievement gaps have existed between African Americans and White students from the onset of efforts to provide education for the prior slaves and their descendants. That gap still exists today though it has not remained unchanged. The 2008 report from the National Assessment of Education Progress (NAEP) shows that the Black-White gap for high school students in reading has narrowed slightly, but it has remained stable for mathematics; and widened for science since 2000.

The achievement gap between African Americans and Whites is longstanding and has received considerable empirical attention and theoretical discussion (Lewis, James, Hancock, & Jackson-Hill, 2008; Kao & Thompson, 2003; Jencks 1972; Miller 1995; Jenks & Phillips 1998). Kao and Thompson (2003) further stated that most contemporary theories about why ethnic groups differ in their educational achievement fall into two general categories. The first is about cultural

orientations of certain ethnic groups promote/discourage academic achievement, and the second is about how the structural position of ethnic groups affect the children's parents, peers, and school environments.

About two-thirds of the gap between the academic performance of African Americans and other ethnic/racial groups is due to the cultural factors. African American students reported that they did about four hours of homework a week when they were working their hardest, while White students said that they did double that amount each week and Asian students reported doing 35 hours a week of homework when they were working their hardest (Hammer, 2003).

The second argument traces the structural position of ethnic groups, crediting either their time of arrival, the skills migrants brought with them at their time of arrival, the needs of the local economy, or the fit between their skills and their ability to fill certain economic niches, or some combination thereof (Kao & Thompson, 2003).

A third, but much less frequent, line of reasoning credits genetic differences between racial groups in their innate intelligence (Jensen 1969; Herrnstein & Murray, 1994), but most sociologist today dismiss these arguments both for their inherently racist overtones and for the lack of empirical data to support such claims (Kao & Thompson, 2003).

Ethnic Minority Students Test Scores

Research has indicated that the mean IQ scores of ethnic minorities fall within the low average range (Atkinson, 1990). Turkheimer, Haley, Waldron, D'Onofrio, and Gottesman (2003) reported that until recently research had indicated that the "heritability" of IQ, that is, the degree to which genes can explain the differences in IQ scores, completely dominated environmental influences. Turkheimer, et al., (2003) stated that the interaction among genes, environment, and IQ finds that the influence of genes on intelligence is dependent on class. Genes do explain the vast majority of IQ differences among children in wealthier families. But environmental factors not

genetic deficits explain IQ differences among poor minorities. In Turkheimer's, et al., (2003) study, the impact of genes on IQ varied depending on a child's socioeconomic status (SES), a sociological measure that includes household income and other elements of class and social status.

The test scores of African Americans have lagged behind those of Whites in vocabulary, reading, and mathematics for the past 30 years, although this gap is shrinking. The National Assessment of Educational Progress (NAEP) has been testing 17 year olds since 1971; from 1971 to 1996, the African American/White reading gap shrank by almost one half and the mathematics gap almost by one third (Kao & Thompson, 2003; Jencks & Phillip, 1998).

Predictors

Singh, Granville, and Dika (2002) reported that the middle school years, grades five through eight, are a critical period for American students regarding achievement in mathematics and science. Achievement in these subjects in middle school determines high school curricular choices and enrollment in higher level mathematics and science courses. The courses in mathematics and science are sequential, making performance in these subjects in middle school critical for later access to advance courses and success in the full array of mathematics and science courses in high school and beyond (Singh, et. al., 2002).

Mathematical ability has been cited as a determinant in pursing science careers (Goggins & Lindbeck, 1996; Gilmartin, K. J., McLaughlin, D. H., 1976). There is evidence that underrepresentation of minorities in mathematics and science is partially due to differences in levels of developed abilities and achievement needed in these careers (Hill, Petus, & Hedin, 1990). These abilities, which consist primarily of mathematics and science skills and knowledge, are developed before and during high school, and are strong predictors of science careers preferences in high school and college (Gilmartin, McLaughlin, Wise & Rossi, 1976; Petus, Hedin, 1990).

Barrington (2006) has reported that the proportion of students taking advance mathematics has declined from 14.1% (1995) to 11.7% (2004), and intermediate mathematics participation has fallen from 27.2% to 22.6% in the same period. Norton (2007) reported that the number of students studying science, technology, and engineering also saw a significant drop in the same time period. Studies have shown that enrollment in upper-level high school mathematics and science courses, and the pursuit of college majors and careers in these fields is largely a function of the academic ability and mastery that students exhibit (Austin & Panos, 1969; Werts, 1966).

Nicholls et al., (2007) stated that the variables most valuable in identifying students potentially inclined to study a STEM topic include both quantitative measures of academic ability and qualitative measures of interests, attitudes, and personal characteristics. Specifically, quantitative indicators of strong STEM interest include high SAT mathematics scores, high school grade point average, and to a lesser extent SAT verbal scores. Qualitative measures such as self-ratings of mathematical ability, computer skills, and academic ability are good indicators of a STEM orientation while needing remedial mathematics training is a good indicator of a non-STEM orientation.

Gender

Research has shown that girls perform better in school than boys in all major subjects and that they graduate from high school with higher grade point averages than their male peers (Perkins, Kleiner, Roey, & Brown, 2004). Some of the offered explanations for this phenomenon covered boys' discipline problems and their unwillingness to regularly complete their schoolwork and girls' faster adjustment and conformity to school routines (Steinmayr & Spinath, 2008). Girls and boys might achieve differently in relation to their cognitive potential that is they might differ in how their cognitive potential is transferred into school achievement (Duckworth & Seligman, 2006).

Females

Gender is an important determinant of educational decision making. Although in the past few decades women have actually surpassed men in rates of high school completion and college enrollment (Beattie, 2002; Mickelson, 1990, NCSE 2000), women are disproportionately concentrated in the sectors of higher education that yield the smallest economic returns (Arum & Hout 1997).

Researchers from many different fields have generated an impressive body of research over the past two decades that seeks to explain the stubborn gap in STEM fields. Although some of women's under representation in these fields is directly linked to barriers and conflict that they face in the workplace (Strand & Mayfield, 2002; Hanson, 1996; Parelius, 1991), much of the leakage in the STEM "pipeline" occurs long before girls experience adulthood or paid work. In elementary school, girls show less confidence in their science and mathematics abilities and less interest in careers in science and mathematics, which continue to be seen by both girls and boys as largely male domains (Strand & Mayfield, 2002). Although their grades in mathematics and science are consistently higher than those of their male counterparts, teenage girls take fewer advanced mathematics and physical science courses than boys and continue to think of themselves as less capable than boys in those areas (American Association of University Women, 1998; Ginorio, 1995). A primary reason for their loss of interest is that they do not experience science activities and skills in the classroom in the same way that boys do (Thompson, 2003; Kahle & Lakes, 1983). The source of disadvantage for girls includes male-focused examples and illustrations in text books, differential expectations of teachers, disapproval of peers, and the lack of role models (Thompson, 2003; Hardin & Dede, 1978). Other factors include, early play experiences, parents' expectations, family resources, gender proscriptions, media images, and job discrimination are rooted in the home or in the wider society and culture (Strand & Mayfield, 2002).

Strand and Mayfield (2002) further stated that much of the responsibility for the SME gender gap lies with our education system, where "hidden curriculum" perpetuates gender inequalities in mathematics and science courses at every educational level. Much of this hidden curriculum takes the form of differential treatment in the classroom, where boys tend to dominate the discourse and monopolize instructional time, where girls are silenced and their insecurities reinforced (Strand & Mayfield, 2002; Linn & Kessel, 1996), and where teachers' lower expectations for girls' performance in mathematics and science bring about a self-fulfilling prophecy. Another aspect of the hidden curriculum is the content of what is taught. Reliance on military and sports examples; the failure to note the contributions of women to science and technology; and the perpetuation of subtly male-biased assumptions, especially in fields such as biology all serve to reinforce the notion that science and mathematics are male domains (Strand & Mayfield, 2002; Davis & Rosser, 1996).

Some studies have found that girls in all-female high schools take more mathematics courses and demonstrate higher achievement in science and mathematics (Thompson, 2003; Lee & Bryk, 1986; Riordan, 1985). However, even when females take equivalent mathematics course and have the same test scores as males, they are still less likely to be enrolled in mathematic-intensive majors when they reach college. This indicates ongoing gender socialization or constraints (Thompson, 2003; Frehill, 1997). Gender socialization may be affected by the peer environment, the school mission, evidence of role models, and various influences on self concepts (Thompson, 2003).

Males

Over the years many explanations have been given for the under representation of African American males in mathematics, science, and engineering. The rationales range from a variety of factors such as (a) inadequate secondary educational facilities and resources, (b) poor academic

performance in mathematics and science, (c) low expectations from teachers and school counselors regarding their academic abilities, (d) inadequate parental and familial support, and (e) shortage of positive mentors to promote their interest in mathematics, science, and engineering (Moore, Madison-Colmore, & Smith, 2003; Fullilove & Treisman, 1990; Hrabowski & Maton, 1995; Hrabowski & Maton, & Grief, 1998; Hrabowski & Pearson, 1993). Regardless of the reason, Moore (2000b) suggested that the future of African American males, in large measure, is predetermined by their academic performance and experiences at the different school levels (i.e. elementary, secondary, and postsecondary) because each school level serves as a feeder to the next level. Of particular importance is the notion that the early years of education are crucial for preparing for college, especially in mathematics, science, and engineering majors (Moore et al., 2003; Hrabowski, 1991; Hrabowski & Pearson, 1993; Moore, 2000b; Taylor, 1994).

In American society, African American males are often seen as being a part of a group rather than unique individuals (Moore, et al., 2003; Hilliard, 1985). Research, past and present always focuses on the shortcomings of African American students, particularly African American males. These shortcomings include academic failure, behavior problems, low aptitude, and teen pregnancy (Cleveland, 2003). Cleveland (2003) further stated that African American males are oftentimes misdiagnosed by teachers who do not understand the African American culture. As a result, many of these African American males are labeled and placed in special education classes, suspended at higher rates than their White counterparts because of zero tolerance policies, and end up in the prison-industrial complex where there are more African American males in prison than in college (Cleveland, 2003).

The outcome of these perceptions affects the academic development as well as the educational experiences of African American males (Lee & Bailey, 1997). Images of inferiority are communicated to African American males at an early age (Moore et al., 2003). These messages

make it difficult for African American males to adjust in life as well as various social institutions in American society (i.e. higher and postsecondary education) (Moore, et al., 2003). The research literature on African American males attending Predominantly White Institutions (PWIs) clearly illustrates these barriers (Moore, et al., 2003; Davis, 1994, 1998). Moreover, many higher education researchers and scholars have found that constant exposure to negative attitudes, biases, and prejudices has debilitating effects on African American male students' social and emotional growth (Moore, et al., 2003; Ancis, Sedlack, & Mohr, 2000; Flemming, 1984; Herndon & Moore, 2002; Moore, 2000b) as well as on student persistence and graduation rates in PWIs (Moore et al., 2003; Fries-Britt & Turner, 2001; Love, 1993; Moore, 2001).

Educational Attainment of Males and Females

Before 1980, the educational attainment of males was higher than that of females at all educational levels. In the early 1980s females equal males, and by the late 1980s, women surpassed men in terms of completion of a high school education. In 1998, females aged 25 to 29 were somewhat more likely than males to have graduated from high school, 90% of females versus 87% of males.

Among Whites, a clear female majority has emerged since 1995-1996, with the male share of undergraduates dropping from 49% to 46% in 2003-2004. This change is due to a decline in the share of low-income White students who are male, from 48% in 1995-1996 to 44% in 2003-2004. Among Hispanics, the percentage of students age 24 or younger who are male fell from 45% to 43%, due primarily to a drop in the share of low-income students who are male. African American males saw some progress with their share of enrollment rising 37% in 1995-1996 to 40% in 2003-2004, but the gender gap is still largest in this racial group (American Council on Education, 2006).

While the college participation rate of all African American high school graduates held steady at 39.4 % between 1999 and 2000, the number of men dropped about five percentage

points, to 33.8 %, while the number of females rose four percentage points, to 43.9%, according to the 19th annual "Minorities in Higher Education" report covering 1990-2000 and complied by the American Council on Education.

College enrollment rates differ between males and females and among the various racial/ethnic groups. Females are more likely than males, and Whites and Asians are more likely than other racial/ethnic groups, to enroll in college. In 1974, young Whites participated in postsecondary education at a higher rate than both young African Americans, and young Hispanics (38% vs. 26% and 22%, respectively) (Hudson, 2005). Hudson (2005) also stated that from 1974 to 2003, participation rates for all three groups increased; however, the increase in the participation of Whites outpaced that of African Americans and Hispanics.

Socioeconomic Status

Social scientists have shown continued interest in socioeconomic status even though there has never been complete consensus on precisely what it represents (Bradley & Corwyn 2002; Liberatos, Link, & Kelsey 1988; McLoyd, 1997). There has been something of a tug-of-war between proponents of socioeconomic status as representing class (or economic position) and proponents of socioeconomic status as represents social status (or prestige). Coleman (1988) stated that the idea of capital perhaps best embodies the current meaning psychologists hold of socioeconomic status (Entwistle & Astone 1994; Guo & Harris 2000). Capital (resources, assets) has become a favored way of thinking about socioeconomic status because access to financial capital (material resources), human capital (nonmaterial resources such as education), and social capital (resources achieved through social connections) are readily connectible to processes that directly affect well-being. Mueller and Parcel (1981) stated that socioeconomic status describes an individual's or a family's access to or control over some commodities such as wealth, power, and social status. Duncan, Featherman, and Duncan (1972) stated that socioeconomic status

incorporates parental income, parental occupation, and parental education as the three main indicators of socioeconomic status.

Although there is general consensus that income, education, and occupation together represents socioeconomic status better than any of these alone, there is no consensus on how best to composite the set of indicators; whether it works best to examine relations between socioeconomic status and child outcomes using a composite, a statistical procedure that includes each indicator, or each indicator singly; or how best to measure each component (Bradley & Corwyn 2002). White (1982) pointed out that socioeconomic status is assessed by a variety of different combination of variables, which has created ambiguity in interpreting research finds.

Many empirical studies examining the relations among these components found moderate correlations, but more important, these studies showed that the components of socioeconomic status are unique and that each one measures a substantially different aspect of socioeconomic status that should be considered to be separate from others (Sirin, 2005).

Sirin (2005) stated that parental income as an indicator of socioeconomic status reflects the potential for social and economic resources that are available to the student. The second traditional socioeconomic status component, parental education, is considered one of the most stable aspects of socioeconomic status because it is typically established at an early age and tends to remain the same over time. Moreover, parental education is an indicator of parents' income because income and education are highly correlated in the United States. The third traditional socioeconomic status component, occupation, is ranked on the basis of the education and income required to have a particular occupation (Sirin, 2005).

Socioeconomic Status and Academic Achievement

Socioeconomic status is not only directly linked to academic achievement but also indirectly linked to it through multiple interacting systems, including students' racial and ethnic

background, grade level, and school/neighborhood location (Sirin, 2005; Brooks-Gunn & Duncan 1997; Bronfenbrenner & Morris, 1998; Eccles, Lord, & Midgley, 1991; Lerner 1991). For example, family socioeconomic status, which will largely determine the location of the child's neighborhood and school, not only directly provides resources but also indirectly provides "social capital," that is, supportive relationship among structural forces and individuals (i.e., parent-school collaborations) that promote the sharing of societal norms and values, which are necessary to success in school (Sirin, 2005; Coleman, 1988; Dika & Singh, 2002).

Grade Level

The effect of social and economic circumstances on academic achievement may vary by student's grade level (Sirin, 2005; Duncan, Brooks-Gunn, Klebenov, 1995; Lerner, 1991). However, the results from prior studies about the effect on grade or age on the relation between SES and academic achievement are mixed. On the one hand, Coleman et al.'s (1966) study and White's (1982) review showed that as students become older, the correlation between SES and school achievement diminishes. White (1982) provided two possible explanations for the diminishing socioeconomic status effect on academic achievement. First, schools provide equalizing experiences, and thus the longer students stay in the schooling process, the more the impact of family socioeconomic status on student's achievement is diminished. Second, more students from lower socioeconomic status backgrounds drop out of school, thus reducing the magnitude of the correlation (Sirin, 2005). On the other hand, results from longitudinal studies have contradicted White's results, by demonstrating that the gap between low- and high-socioeconomic status students is more likely to remain the same as students get older (Sirin, 2005; Duncan et al., 1994; Walker, Greenwood, Hart, & Carta, 1994), if not widen (Pungello, Kupersmidt, Burchinal, & Paterson, 1996).

Minority Status

Racial and cultural background continues to be a critical factor in academic achievement in the United States. Recent surveys conducted by the National Center for Education Statistics (NCES) indicated that, on average, minority students lagged behind their White peers in terms of academic achievement (U.S. Department of Education, 2000). A number of factors have been suggested to explain the lower academic achievement of minority students, but research indicates three main factors: minorities are more likely to live in low-income households or in single parent families; their parents are likely to have less education; and they often attend under-funded schools (Sirin, 2005). All of these factors are components of socioeconomic status and linked to academic achievement (National Commission on Children, 1991).

Spera, Wentzel, and Matto (2009) suggested that socioeconomic status may serve as a proxy for ethnicity leaving minority parents with fewer resources (e.g., expendable income for books, learning supplies, and educational experiences outside of the classroom) to assist their children . Minority parents, in particular, may work in jobs that provide more rigid work hours (e.g., low wage shift work) and less schedule flexibility or autonomy, leaving little residual time at the end of the day for attention to their children's homework (Rank 2005; Waldfogel 2006).

School Location

The location of schools is closely related to the social and economic conditions of the students (Sirin, 2005). A narrative review of research on school location (U.S. Department of Education, 1996) showed that even after accounting for family socioeconomic status, there appear to be a number of differences between urban, rural, and suburban schools. Data for the National Assessment of Education Progress, for example, indicated that the achievement of children on affluent suburban schools was significantly and consistently higher than that of children in "disadvantaged" urban schools (U.S. Department of Education, 2000).

Parental Education

Parental education is also significantly and positively related to the educational aspirations parents set for their children. Parents with high education levels are more likely to have the educational experience and resources to draw upon when helping their children achieve a college- or graduate-level education (Spera, et al., 2009).

Although some research studies have used income as a measure of socioeconomic status, other studies have focused on parental education. Hearn (1988) found that the social factors of socioeconomic status, such as father's education and mother's education, played a more important role than economic factors, such as family income and family size, with regard to college attendance. Hossler, Braxton, and Cooersmith (1989) indicated that parental education predicts the predisposition stage in higher education choice better than academic skill. Specifically, Ahuna (1993) reported that the students who had at least one parent holding a baccalaureate degree, who were proficient in English, and had families who lived in the United States for at least two generations, accepted their parents' expectations to obtain baccalaureate degree. Lareau (1987) noted that middle-class peoples' positive beliefs about education affect educational attainment. For example, middle-class parents are more like to pay for college tuition or save money for their children's college expense than are parents from lower income groups.

Mathematics and Science Interest

Socioeconomic status has been identified as significant factor affecting the participation of African American in science (Hall, 1999; Hill, Pettus, & Hedin, 1990). Social class appears to be related to both selection of college major and selection of career. Natural science majors tend to be of a higher social class than social science or non-science majors (Hall, 1999; Clark, 1986; Hill, Pettus, & Hedin, 1990; Tilford & Allen 1974). Pearson (1982) found that among African American scientists, the majority had their origins in families where the parents were professionals. Since

African Americans, in general, are over represented in the lower socioeconomic strata of society, the differential participation of this group in science may be more of a function of class than race (Hall, 1999; Pettus, & Hedin, 1990).

Results of data analysis conducted by Peng and Hill (1995) showed that family resources and learning activities are all significantly related to both science and mathematics achievement test scores. Of these variables, parental child communication are relatively more important than poverty status, confirming the previous findings that what a family does is more important to student learning than what a family has (Hall, 1999).

Risk Factors

Students at risk are a major topic of education policy and discussion. Many researchers have focused on describing conditions associated with the statistical risk of undesirable outcomes among individuals who are members of groups characterized by problems such as poverty and social disadvantage. When groups of similar backgrounds are compared, findings indicate that students from families with high socioeconomic status outperform students from low socioeconomic status families; Asian and White students have higher achievement than do African American or Hispanic students; boys perform better than girls (Von Secker, 2004).

One of the most common investigated risk factors is low socioeconomic status. Low achievement is attributed to the paucity of resources available to person of low income, which result from low levels of parental education, low-status parental occupation, large family size, and the absence of one parent (Von Secker, 2004; Luthar, 1991). Empirical findings show that risk factors have a reciprocal relationship with one's social class status (Garmezy, Masten, & Tellegen, 1984; Masten, Garmezy, Tellegen, Pellegrini, Larkin, & Larsen 1988). High socioeconomic status is associated with greater social support fewer school and behavior problems, and greater social competence (Von Secker, 2004). Compared with White students, African American and Latino

students are more likely to come from families of low socioeconomic status, live with one parent, and live in high-poverty neighborhoods. They are more likely to attend inferior schools, and they tend to learn less than do Whites even when they attend the same schools (Goldsmith, 2004; Ainsworth, 2002; Kao, Tienda, & Schneider, 1996; Oaks, 1985; Roscigno, 2000).

However, in one area related to achievement, beliefs, African Americans and Latinos have an advantage over Whites. Certain beliefs, like educational aspirations, occupational expectations, and attitudes towards school, are related to students' achievement (Goldsmith, 2004; Ainsworth-Darnell & Downey, 1998; Dumais, 2002; Portes & Wilson, 1976). Both African Americans and Latinos have higher educational aspiration than do Whites, especially when differences in family SES are taken into account (Goldsmith, 2004; Cheng & Starks, 2002; Kao & Tienda, 1998; Qian & Blair, 1999). African Americans also have higher occupational expectations and more pro-school attitudes than do Whites.

Counseling and Ethnic Minorities

Historical Perspective

The traditional role of the guidance counselor was born after the enormous demographic and economic transitions of the industrial revolution (Parson, 1909). The early guidance profession was as interested in effecting social change as in improving the social and vocational development of individuals (Parson, 1909). As this nation grew so did the often-unwelcome influx of ethnic groups and the growth of industrial urban areas led to widespread poverty and exploitation. This poverty and exploitation led individuals to believe that knowledge of the future options and, to a lesser extent, an awareness of one's own needs would result in less exploitation and greater satisfaction for the individual (Davis, 1914).

Career Counseling

Career counseling is a specialty within the profession of counseling, one that fosters vocational development and work adjustment of individual's life stage by engaging individuals in life planning aimed at the psychosocial integration of an individual's abilities, interest, and goals with the work roles structured by the community and occupations organized by companies (Savickas, 2003). It is characterized by developmental and person-environment fit models that assist a developing and deciding individual to make suitable and viable choices. Career counselors, with a range of training and credentials, are employed in settings as varied as schools, colleges, companies, community agencies, and government offices. As career counselors renovate and innovate their methods and materials for providing career services across the life cycle-including information, academic advising, position coaching, employee assistance, retirement planning, vocational rehabilitation, and organizational consultation (Savickas, 2003).

Expectations for Today's Counselors

The counseling profession today faces a new century characterized by social, demographic, and economic circumstances much like those that gave rise to the profession at the turn of the last century. Since circumstances are similar, counselors have a unique opportunity to incorporate the strengths and avoid the oversights of the profession's early efforts at career guidance. Counselors can facilitate social changes by concertedly focusing on the career development of ethnic minority students or inadvertently maintain status quo of discriminated groups as was done at the turn of the century (Hawks & Muha, 1991).

Counselors must not only engage in career counseling and education, they must be certain that their interventions reach and are appropriate to those who need their services, especially ethnic minority students. Ryan (2003) stated that given the change in demographics, there is an increasing concern that the established theories and practices used in counseling are

problematic since they are based on the experiences of traditional college students (Aragon, 2000; Pascarella & Terenzini, 1998). There is a growing realization that current school counseling services often do not have broad applicability across the range of cultural backgrounds represented by students (Baruth & Manning, 2000; Herring, 1997; Lee, 1995). School counselors are becoming increasingly aware of White American middle class culture, whereas the cultural values of a significant portion of the students with whom they work represent worldwide views whose origins are found in Africa, Asia, Mexico, Central America, the Caribbean, or the Middle East (Herring, 1997; Lee, 1995).

Cultural diversity must be addressed effectively in the provision of comprehensive school counseling programs (Lee, 2001). Three concepts underscore the importance of promoting cultural diversity in school counseling interventions. Theses are access, equity, and educational justice. All students, regardless of their cultural background and heritage, deserve equal access to a quality education (Lee, 2001). School counselors need a different perspective from which to operate if they are going to ensure that students from culturally diverse backgrounds have access to services that promote optimal academic, career, and personal services development (Baruth & Manning, 2000). Students in the elementary and secondary schools also deserve counselors who understand their cultural backgrounds and the effects of culture on learning and development; however, the nature of early adolescence, suggest a particular need for effective multicultural counseling at the middle school level. During early adolescence, boys and girls develop their sense of self-esteem and cultural identities and form opinions of other individuals and cultural groups. Ten-to-fourteen-year-olds also experience age and cultural-related problems—for example, different perceptions among cultural of gender roles and of what constitutes school success—that call for multicultural counseling (Baruth & Manning 2000).

Parental Role

Frequently, middle and upper middle class families' parents start very early to give their children messages about attending college and the necessity of a college education. Parents may discuss their own college attendance and possibilities for college institutions while their children are still in elementary school. Information about college may be filtered to children in informal discussion with their older siblings, other relatives, and adults. During high school, parents may actively assist their children by making college visits, setting up opportunities for the child to talk to college students, buying resource guides, or even employing a private college counselor. The preparation for college by the family begins early, is deliberate, and sequential. The high schools that these students attend are also likely to be supportive, containing special college counselors, supportive peers, materials, and resources. In short, students are surrounded by an expectation that they will attend college and are offered assistance from many sources. Economically disadvantaged, minority gifted students also need early encouragement and exposure, and access to information, yet they are less likely to receive it (Olszewski-Kuilius & Scott, 1992).

Counseling and Socioeconomic Status

Lee and Elkstrom (1987) found that ethnic minorities and poor students were significantly less likely than their affluent counterparts to receive counseling for programs planning. It is common knowledge that students who receive counseling are placed in academic rather than nonacademic or vocational tracks. Access to counseling and academic placement will determine partially the marketability of minority students.

Minority students with diverse cultural backgrounds generally bring to the school a set of behaviors and success expectations that are fostered both at home and in their communities. For many Hispanic students talking about going to college is like talking about going to the moon. Major findings indicate that (1) between 1993 and 1995, White high schools graduates aged 18-24

enrolled in colleges at a rate 9 percentage points higher than African Americans and Hispanics; (2) between 1972 and 1995, the college enrollment rates for Whites aged 18-24 grew 11% and for African Americans 8%; (3) between 1993 and 1995, enrollment rates in two-year institutions were similar for Whites and African American high school graduates and higher for Hispanics; however, both African American and Hispanics were substantially less likely than Whites to be enrolled in a four-year institutions; and (4) enrollment rates for high school graduates aged 25 or older were much lower than for those aged 18-24. Bloch (1989) states that children of Hispanic descent are not exposed to the degree that they should be about early intervention and enrichment programs that could improve their academic success and increase their chances of getting into college. Educators must realize that ethnic minority students from lower socioeconomic status have a different message communicated to them; education is not essential to "making it" in the world. Getting and keeping a "job" is the goal as opposed to choosing and being satisfied with the "career" to which middle socioeconomic status students aspire (McIntosh, 1986). McIntosh later concludes that going beyond the high school diploma is generally seen as an unnecessary waste of time and money. This implies that there has been and still is a lack of proper advisement for children of color not only by counselors, but, parents, teachers, and the community as a whole.

Historically, counselors have focused on children who fit their preconceived notions of success and those that will conform, rather than those who will improve with proper motivation (Hawkins, 1993.) Proper motivation provided by educators, family members, and members of the community seem to increase their chances for success. A teacher's influence is immeasurable; one teacher can be a catalyst for ensuring that a bright youth expands and develops him or herself by attending college.

Dreeben (2002) stated that merit-based selection is a strongly held American value. It requires that decisions allocating students to select academic programs be based on evidence

predicting successful achievement in these academic programs. Archbald, Glutting, and Qian (2009), stated that if African American students' academic achievement scores are lower than those of Whites in middle school, a common pattern, then placement decisions based solely on measureable academic criteria will result in disproportionately low representation of African American students in more advanced courses and academic tracks.

Often, ethnic minorities and the economically disadvantaged, have additional barriers to overcome. There is usually a "high counselor/student ratio and limited access to careers and colleges information," (Atkinson, 1990). In some cases ethnic minorities have one high school counselor who has as few as 500 students and others who have as many as 2,000 (Atkinson, 1990).

In 1969 National Association of College Admission Counselors (NACAC) went on record in support of the needs of "students of color and economically disadvantages" when the association published its "Statement of Guidelines for the Traditionally Underrepresented in Higher Education." For many disadvantaged minority students, especially those whose parents have never attended college, the role of the pre-college advisor in the school-to-college transition is particularly important (Alston, 1993). In situations like this, students become more dependent on the counselor for positive feedback and for information about college choices. Teachers must also realize that there is a disparity between their aspiration and the aspiration of their students. This disparity is generated from socioeconomic class that most teachers come from and their students' socioeconomic class. Teachers should be sensitive to the differences but not be judgmental as if the students' background were deficient.

Faculty, Role Models, and Mentors

Historical Perspective

The word mentor has a unique history. The word is in fact the proper name of a person, Mentor. The story of Mentor is found in Homer's epic Odyssey. The Odyssey is a poem about Odysseus, King of Ithaca, who led the Greek soldiers during the Trojan War. The story goes that Odysseus roamed the countryside for 10 years after the war before reaching home. However, before Odysseus went to war he hired Mentor and entrusted him with the education of his son, Telemachus. Mentor became Telemachus's teacher, counselor, and guide (Brown, Davis, & McClendon, 1999).

Present Day Interpretations

Modern-day discourse employs the word mentor in a number of ways. There are mentors, mentees, mentoring, and mentor (the verb). Recent years have even brought increased research and writing on both the concept and practice of mentoring (Alire, 1997; Anderson & Shannon, 1986; Blackburn, Chapman, & Cameron, 1981; Desjardins, 1993; Donovan, 1990; Friedman, 1992; Merrian, Thomas, & Zeph, 1987; Roche, 1979; Schatzberg-Smith, 1988; Scott, 1992; Van Stone, Nelson, & Niemann, 1994). However, academics and other writers have provided scant data regarding the mentoring of students of color (Blackwell, 1987a, 1987b; Willie, Grady, & Hope, 1991).

Developing a common definition of mentoring that will cover all aspects and all situational contexts has been difficult (Dickey, 1996; Jacobi, 1991; Merriam, 1993; Merriam, Thomas, & Zelph, 1987). In an academic environment, mentoring implies a one-on-one teaching experience that facilitates student's growth and development. An effective mentor provides appropriate support to nurture self-esteem, creates or reveals challenges to promote growth, and assists students in

discovering their vision or long-tern goals. Listening, providing structure, expressing positive expectations, setting tasks, and providing alternative viewpoints and feedback are all behavior components of mentoring (Daloz, 1990). An internship, as defined by Premont (1990), involves one-on-one guidance, facilitating network building, and most importantly, transmission of the culture, shared vales and traditions needed to succeed in the profession. There appears to be a good deal of overlap in the concepts of mentoring and internship, although the goals of the internship seem to be a bit more focused on career enculturation.

Mentoring and the College Student

Mentoring has existed throughout the years in a variety of forms and settings. Although it has been defined differently in the fields of Psychology, Human Development, Human Resource Management, and Education, the overriding purpose of mentoring has been the professional and personal development of an individual (Crawford & Smith, 2005).

Although the preparation of intellectual laborers is officially carried out in college classrooms around the country, the classroom is unable to provide the full range of nuanced knowledge and experiences necessary for individuals who wish to practice certain professions. As such, the concept and practice of mentoring has become paramount. Mentoring is the process by which a novitiate person (student or mentee) is positively socialized by a sagacious person (faculty or mentor) for the purpose of learning the traditions, practices, and frameworks of a profession, association, or organization (Brown et al., 1999).

The positive impact of faculty on the satisfaction and experience of college students has been well documented in general (Brown & Robinson Kurpius, 1997; Eaton & Bean, 1995; Endo & Harpel, 1982; Erkut & Mokros, 1984; Pascrarella, 1980; Pascarella & Terenizi, 1976, 1991; Redmond, 1990) and specifically for science majors (Barnes, 1992; Drew, 1996; Tobias, 1992) and African Americans (Davis, 1991; Nettles & Johnson, 1987). Relationships with faculty contribute to

the predictive validity of academic persistence measures (Pascarella & Terenzini, 1980). Non-classroom interactions with faculty seem to significantly and positively affect the persistence of female students (Nora, Cabrera, Hagedom, Pascarella, 1986). Davis (1991) reported that African American students at PWIs that have good relations with faculty members also have higher academic grades and greater satisfaction with campus life in general. Rodriguez (1993) found that social interactions with faculty was a significant predictor of persistence towards science and engineering degrees for students of color and suggests that social interactions are more important than other forms of " campus involvement" to minority students (p. 135). Rodriguez suggested additional research on the characteristics of social interactions between students and faculty and consideration of race, ethnicity, and gender in regards to faculty interactions relevant to persistence. The specific roles of faculty members in creating an environment of mattering (Schlossberg, 1989) and providing validating experiences for non-traditional students (Rendon, 1994) need to be explored.

Role Models

Role models are important to aspiring young scientist, and particularly so for students of color. Having a parent in science or science related career is associated with persistence towards a science career (Sax, 1994). However, most African American parents are not scientists, and thus there is a need for others to step in and serve as scientific role models (Carter & Helms, 1988). Seventy-eight percent of successful African American female science professionals surveyed indicated that role models were an important influence on their pursuit of science (Clark, 1988). Leggon and Pearson (1997) noted that the availability of role models at Spelman and Bennett Colleges is an important factor to the success of these colleges graduating African American females with science degrees (Blockus, 2000). Rodriguez (1993) reported that having

role models of the same ethnicity/gender was ranked by 44% of the students as the most important option in the Social Dimension of his retention survey.

Relationship Building

The quality of the relationship between students and their professors is of crucial importance in determining satisfaction with the institution. Positive interaction with faculty members facilitates the development of healthy attitudes towards learning and towards the college.

Various studies by Pascarella and Terenzini (1979a, 1979b) highlight the importance of frequent and positive student-faculty contact. In addition, Noel (1976) and Schulman (1976), among others cited the importance of persistence of having a "significant adult" on campus. Grites (1979), proposed that colleges can stimulate an important increase in the number of students by selecting and training a number of special faculty academic advisors. He also points out that recruitment and admissions processes are crucial factors in determining retention, and these academic advisors should become integral parts of those processes as well. According to Grites the academic advisor is the natural resource to make use of both the affective and cognitive determinations cited above. As advisors find out more about students involvement, commitment, and course selections, they will in turn, become significant adults; as they become apprised of and gather certain information about their students, they will be able to provide the kind of assistance needed to improve retention. The academic advisor is an integral component of admission and retention programs, and such a resource should not be left unused, since those who are not working for retention are in fact, working against it.

Academic and Social Contact

Pascarella and Terenzini (1979b) found that the frequency and quality of social contact with faculty correlated more highly to retention for female than for male students, while the

frequency and quality of academic contact with faculty was more highly related to retention for male than for female students.

Student-faculty integration has emerged as a leading factor in student's satisfaction with college in many studies (Beal & Noel, 1980; Terenzini & Pascarella, 1977, 1980) and is now seen as a powerful retention factor. However, the interaction that students' value most continues to be the interaction which occurs outside the classroom (Beal & Noel, 1980; Pascarella, 1980; Terenzini & Pascarella, 1977).

Didion (1996) stated that the dramatic factor influencing minorities and females to pursue and cultivate scientific careers is role models. When students see individuals like themselves succeeding in a scientific career, it is more likely to have an impact on their own goals and aspirations. Females and minorities who become successful biomedical scientists most often had mentors who encouraged them, were supportive, and guided them through the various stages of their careers (Porta, 2002). Mentors and role models are thus immensely important, if not crucial, to the recruitment of females and minorities in biomedical sciences. It is these individuals who can provide the motivation needed to persist in science, because they often overcame the very barriers that women and minority students need to overcome in order to succeed (Porta, 2002). Porta (2002) furthers stated that their stories are varied and each can serve as an example of success.

Although the impact of role models has been documented time and time again, students have few opportunities to meet role models. Exposure of students to women and minority role models is often limited to the faculty at their educational institutions (Porta, 2002). Studies have demonstrated the critical importance of faculty as role models (Finholt 1990; Clewell et al., 1992; Matyas & Haley-Oliphant, 1997). Unfortunately, their numbers are few and students lack other opportunities to encounter women and minority role models with a variety of lifestyles, and

backgrounds, a career strategy that can give students the belief that scientific careers are accessible to people like themselves (Porta, 2002).

Career Choices

Impact for Ethic Minorities

Improving the economic and social conditions for a community or a particular group in the United States has always been linked to education (Bailey, 2003; Locke, 1999). With the advances in technology and the globalization of society, postsecondary education or training is increasingly becoming a must.

Our nation is no longer well served by an educational system that prepares a few to attend college to develop their minds for learned pursuits while the rest are expected only to build their muscles for useful labor. In the twenty-first century, all must meet higher achievement standards in elementary, secondary, and postsecondary schools and thus be better prepared for the challenges of work and citizenship (Bailey, 2003).

Parental Role

A parental influence on the career development of adolescents and young adults has been documented in the research literature. Recent studies have revealed numerous parental factors that have been instrumental in career development, such as concern and encouragement (Blustein, Wallbridge, Friedlander, & Wright, 1991; Fisher & Griggs, 1995; Kenny, 1990; Leung, Wright, & Foster, 1987), attitude and reinforcement patterns (Eisler & Iverson, 1986; Grotevant & Cooper, 1988; Hankin, 1986); expectations (Smith, 1981; Young, 1994); interest and aspirations (Astone & Mclanahan, 1991; Bitner, 1981; Crowder, 1992; Watson, 1986), and role modeling (Eisler & Iverson, 1986; Fisher & Griggs, 1995; Hackett, Esposito, & O'Halloran, 1989). Moore (2006) stated that it is well documented in the research literature that certain interests that a person

holds are usually the products of upbringing, environment, education, and cultural tradition (Berryman, 1983; Hrabowski et al., 2002; Hrabowski et al., 1998).

Although the majority of these studies were conducted with White middle-class individuals, the results have been often times used to make assumptions about the parental influences on the career developments of racial and ethnic minorities in the United States. This has presented a possibly biased view of the particular parental components that may be crucial for the ethnic minority youth (Fisher & Padmawidjaja, 1999).

Little is known about ethnic minority students' perceptions of parental influences or the specific impact parents have on career development factors that could prove valuable to the career preparation of the increasing number of ethnic minority groups in the United States. The limited research in this area has shown that parental influence is important across ethnic groups (Hernandez, 1995; McNair & Brown, 1983), but specific types of parental factors may be more important for one cultural group than another (Kuvlesky, Wright, & Juarez, 1971; Lucas, 1997; Majoribanks, 1991). For example, Moore's (2006) qualitative study examined the factors that were most instrumental in influencing African American males' decisions to pursue engineering as an academic major and career choice. A study (Clayton, Garcia, Underwood, McEndree, & Sheppard, 1993) examining family influences on career development for 8th graders, 12th graders, and community college students (n = 2,118) indicated that Mexican American students (66% of sample) rated parental influences on academic and career decisions higher than did other students. In addition, this study found that the Mexican American parents had higher educational aspirations for their children than they had for themselves.

Early Adolescent Career Goals

Conventional wisdom suggests that plans for postsecondary education and employment are typically not crystallized until high school (Hossler & Maple, 1993). Similarly, the development

of career and lifestyles goals is a process traditionally ascribed to the middle to late college years (Chickering & Reisser, 1993). However, a review of theory and recent research related to education and occupational aspirations revealed that important career development processes may occur well before adolescence (Blackhurst & Wahl, 2000). In fact, tentative college plans may be formed in early elementary school (Ring, 1994), with career preferences evident as early as kindergarten (Trice & King, 1991).

Although the earliest theories of career development largely ignored childhood and adolescence, the importance of early developmental process had gradually and increasingly been acknowledged in the career development literature (Blackhurst & Wahl, 2000). Among the first general theories of occupational choice to include childhood was Ginzberg's (1952) theory, which included two relevant phases: fantasy choice (prior to age 11) and tentative choice (age 11-14). According to Ginzberg, the most important career development process begin in the tentative choice phase, during which children's career aspiration are due almost solely to interest, with little attention to ability or other realistic constraints. Research has supported the assertion that interest plays the major role in the selection and rejection of occupations throughout childhood (Trice & Hughes, 1995), but there is evidence that children's choices may be more stable than Ginzberg postulated, even during the period he labeled fantasy choice. For example, Trice and King (1991) found that kindergartners' career goals were both stable and realistic: 74% gave real careers as their first choice during initial interviews, a figured that increased to 89% 8 months later.

Like Ginzberg, Havighust (1964) theorized that two developmental tasks related to career development take place in childhood and adolescence: identifying with a worker (age 5-10) and developing the habits of industry (age 10-15). Although there are no direct tests of these ideas in the literature, recent research has shown that children may, in fact, identify with the adult workers in their lives (Blackhurst & Wahl, 2000). In particular, children's occupational aspirations are

strongly related to parental occupations, and especially the mother's occupation (Trice & Knapp, 1992). This relationship appears to be mediated by children's perceptions of their parents' job satisfaction, with more children more likely to aspire to the occupation of the parent perceived as most satisfied (Trice & Tillapaugh, 1991).

The potential influence of role modeling and direct, first hand information about career possibilities is further supported by research conducted with children from households in which both parents are unemployed. In a study of kindergarten and first-grade students, Reisman and Banuelos (1984) found that children from families without an employed adult had less developed career fantasies than children from families in which at least one parent was working outside the home.

Academic role in Career Choices

"To be or not to be" is not the question. The question is "How does one become what one wishes to be?" The ongoing process of professional development requires faculty to work with students in building knowledge bases, skills, and behaviors that are deemed successful within the students' chosen vocations. Historically, individuals entered their professions through apprenticeship programs that provided practical, hands-on experiences. However, formal apprenticeship programs are now primarily limited to the preparation of trained workmen and skilled technicians. How, then, are lawyers, doctors, librarians, researchers, and educators to be prepared? They are prepared through informal apprenticeship activities termed mentoring (Brown et al., 1999).

African American college students are over represented in the occupations that generate low incomes such as education, the humanities, and the social sciences (Hall, 1987). It is suggested that ethnic minority students tend to select occupations in which they have had contact with successful role models (Hall, 1987). This has led to the belief or perception of opportunities

for employment in these fields. Another line of reasoning is that they tend to choose college majors that will prepare them to work in the helping profession because ethnic minorities have a cultural orientation and expectation to help others (Hall & Post-Krammer, 1987). Historically, underrepresented groups tend to cluster in fields that are perceived as friendly and where they can exercise their talents fully, without discrimination and with good chance of recognition and rewards. Conversely there has been too few high profile or notable scientists out of the minority community. Without the name-brand scientist educators, employers, and scientist must make science and engineering jobs attractive to ethnic minority groups.

Educational Contributions of Historically Black Colleges and Universities

History and Need

Prior to desegregation, the United States was a divided country by both law and custom. African Americans lived in a society that was separate from the mainstream though they expressed much the same needs as the mainstream (Hines, 1993). After reconstruction, the Second Morrill Act of 1890 federally mandated that states allow African American admittance to educational institutions if separate institutions were not provided (Ferguson, 1984). It was the custom of segregation among other factors, which promoted African Americans to set about the business of developing the skills they would need to prosper after slavery, however. With the aid of philanthropists and missionary societies, they opened schools to educate their people (Anderson, 1988). Normal schools were developed first, followed by intuitions of higher education established as early as 1865 (Whiting, 1991).

Shortly after reconstruction, debates raged as to what curriculum would best serve African American students. Eventually, two major schools of thought emerged, each being championed by an African American leader (Hines, 1993). Booker T. Washington believed that education for African American should predominantly be based around the agricultural and skilled trade

traditions of the South (Woodson, 1990). W. E. B. DuBois believed that education for African Americans should consist of a predominantly liberal arts and teacher training curriculum (Aptheker, 1973). Each man contended that implementation of his type curriculum would provide the greatest assurance that African Americans would rise in status in the United States (Hines, 1993). Whiting (1991) believed that the debate was finally settled by socioeconomics. Whites displaced African Americans in skilled trades and did not allow them to join most trade unions. Thus, African Americans were forced to pursue a liberal arts and teacher education program. The majority of African Americans became professional teachers restricted to teaching African American students (Hines, 1993).

In later years, many of these teachers became the educators and administrators of Black Colleges. In elementary schools, African Americans were forced to use the discarded books of White institutions as a mean of educating their students until they were well versed enough in their respective disciplines to write their own (Anderson, 1988). When the opportunity arose for advanced study, many African American educators and administrators upgraded their skills and returned to their classrooms (Anderson, 1988). Even though the information they taught was sometimes dated, they set high standards for their students (Hines, 1993). They attempted to instill pride and a love of life long learning in their students through the care and attention they provided (Whiting, 1988).

As was true for all disciplines, historically Black colleges and universities were the primary educators of African American science majors prior to desegregation (Pearson & Pearson, 1985). They, unlike many others of the social institutions believe in the inherent ability of their students to perform the task associated with the disciplines (Hines, 1993). It was that steadfast belief (Whiting, 1988) that helped to produce a number of scientists who distinguished themselves in the scientific community as well as the larger society.

Historically Black institutions were founded on the premise of being "separate but equal" to White institutions. This was later expressed in law by the Plessy vs. Ferguson decision rendered throughout the 1930s demonstrated the inherent inequity of the Plessy decision. Though African Americans were paying their share of taxes, their state funded educational institutions were under-funded and incapable of providing the same quality of education as that garnered by Whites (Myers, 1989). Their private institutions were supported by philanthropy and tuition. Since none received large endowments, these schools were under funded as well (Whiting, 1988). Only the African American students who could afford the higher tuition could attend.

The ground swell of legislation undermining Plessy culminated in its overturn by the Brown vs. The Board of Education of Topeka Kansas decision. It was this ruling that declared segregation unconstitutional (Fleming, Gill & Swinton, 1978). Prior to 1955, African American private institutions produced more scientists than African American public institutions. However, between 1965 and 1974, the production of African American scientists was nearly equal between Black public and private institutions (Pearson, 1985). By 1984, the exodus of African American students of all majors from historically Black institutions had resulted in 80% of all African American students attending Predominantly White Institutions (Whiting, 1988).

21st Century HBCUs

At present, both public and private historically Black institutions have inadequate funding and academic resources to educate the number of African American students interested in pursuing science majors in college (Thomas, 1989). The federal government has recognized the necessity of increasing its funding of Historically Black institutions in order to increase the output of science majors. Morris (1979) believed that by doing so, the federal government could indirectly increase the persistence to completion of degree by African American students. Berry and Thompson (1982) noted that while the amount of funding to these institutions has increased

steadily since the 1970's allocations also have been redistributed to increase the amount of funding to the sciences. Although Black students can attend any university of their choosing, they continue in large numbers to select HBCUs. With high ACT and SAT scores and with high grade point average of more than 3.5, African American students are being sought out by many of the prestigious colleges in the nation. These students enrolling in HBCUs have had the option of attending Ivy League colleges and other top universities, but they choose continually to attend HBCUs. Florida Agricultural and Mechanical University, a HBCU, has over the years been competing favorably with Yale and Harvard for more National achievement scholars -- the most academically talented African American students graduating from high school (Mitchell, 2002).

The enrollment of these students in HBCUs indicated that their parents, many of whom were probably educated at one of these institutions, do trust these colleges and universities with the education of their children and expect them to be well educated (Mitchell, 2002).

It would be too simplistic, however, to assume that the rich history of HBCUs is the only reason for their appeal to African American prospective students. Today, as before, HBCUs differ from other four-year colleges in their campus climate. Research suggests that HBCUs provide campus environments designed to nurture African American students (Redd, 1998; Roebuck & Murty, 1993). Curricula at HBCUs include a greater integration of African American history and culture than those at PWIs colleges and universities (Bennett & Xie, 2003). Additionally, African American students are more integrated into campus life at HBCUs than at other colleges and universities; they enjoy closer relationships with faculty and participate more fully in campus organizations and activities (Bennett & Xie, 2003).

Bennett and Xie (2003) further stated that the treatment of African American applicants is the second component of the student-college matching process that differs between other four-year colleges. In practice, colleges and universities set their own admissions policies, thereby

directly shaping the postsecondary opportunity structure for African American. By comparison, the very mission of HBCUs is to educate African Americans, and many HBCUs have admissions policies consistent with this objective (Bennett & Xie, 2003). Given the racial inequalities that exist in elementary and secondary education, these policies allow HBCUs to provide college opportunities to some African Americans who otherwise might not attend college due to their academic weakness in areas typically considered for college admissions (Bennett & Xie, 2003).

Issues related to College Attendance and Choice among African Americans

Throughout the history of the United States' higher education, people of color have been less represented at more selective or private 4-year colleges and universities but highly represented at 2-year colleges, which typically have the fewest resources (Kim, 2004). Specifically, since 1982, although there have been significant enrollment increases for students of color, these have not been distributed evenly in different sectors of institutions by diverse racial groups; the enrollment rate of African American students in the most preferred sector, mainly Research I universities, is significantly lower that that of Asian or Latino students (Kim, 2004).

The concerns these trends elicit are compounded by research results that have been shown that graduates of 4-year institutions have more financial benefits than those who graduate from 2-year institutions (Kim, 2004). Even within the 4-year institution sector, significant gaps in lifetime earnings were found by institutional types and selectivity; graduates from 4-year private institutions and from more prestigious (or higher selectivity) institutions generally enjoy higher salaries than graduates from public or less prestigious institutions, even after controlling for other individual characteristics (Leslie & Brinkman, 1998; Rumberger & Thomas, 1993; Thomas, 2000).

Defining College Choice

The term college choice represents a process that captures the academic, social, economic, and familial influences that shape a child's journey from kindergarten to post-high school

(Smith & Fleming, 2006). Scholars have used sociological, economic, and psychological frameworks to describe and characterize college choice mostly from the perspectives of the high school student (Bowers & Pugh, 1973; Cabrera & La Nasa, 2001). Most of these college choice frameworks are built from the experiences and perspectives of White students. Those that consider parents' perspectives (again, usually White) tend to examine the impact of socioeconomic status and social class and how they affect values and behaviors associated with conditioning their children to appreciate and aspire to college (McDonough, 1994; McDonough, Ventresca, & Outcault, 2000). The most complete of these models disaggregate college choice into a step process or a stage process.

Jackson (1982) used a multistage model to suggest that both sociological and econometric perspectives could be used to describe college choice as a singular, integrated process. Litten (1982) used a similar approach to further distinguish how race, gender, academic ability level, parental education level, and geographic location added layers of complexity to each stage. Following the work of Jackson (1982), Litten (1982) and Hossler and Gallagher (1987) developed a staged model consisted of three time periods: predispositions, search, and choice. Predisposition (K through Grade 8) represents the time that parents help children develop a taste for college education. Search (Grade 9 to 10) is when students (and parents) take an inventory of their needs, values, wants, and limitations and attempt to match them to a larger number of desirable institutions, thereby creating choice sets. During the final stage, choice (Grades 11 to 12), students withdraw somewhat from their parents and rely on peer groups, teachers, counselors, and other sources to arrive at a final college attendance decision.

According to Hossler et al. (1989), the term college choice refers to the decision about whether students would (a) attend higher education, (b) attend a 4-year institution, (c) attend a selective institution, or (d) attend a specific institution over other alternatives (Kim, 2004).

Therefore, in studies of college choice, researchers have used different definitions of college choice: (a) attending higher education versus not (Hagedorn & Fogel, 2001), (b) 4 year versus 2-year institutions (Heller, 1998), (c) public versus private institutions (Hu & Hossler, 2000; Tierney, 1980), (d) higher selectivity versus lower selectivity institutions (Hearn, 1991; Orfield,1992), (e) more expensive versus less expensive institutions (Orfield, 1992), (f) first choice versus lower choice institutions (Chapman & Jackson, 1987; or Hurtado et al., 1997), or (g) "right college" from the choice set (McDonough, Antonio, & Trent, 1997).

African Americans

Bateman and Hossler (1996, p.5) stated "until recently, most of the research on students' college attendance focused on majority students." In many cases, students of color were not specifically involved, nor was ethnicity treated as an independent variable in these particular studies. "As a result, little is actually known about the overall characteristics of African American college students and how these students compare and contrast with other students attending higher education institutions" (Astin, 1990, p.16). Fortunately, new studies have emerged in an effort to understand the enrollment decisions (McDonough, Antonio, & Trent, 1997) and postsecondary educational attainment (Haverman & Wolfe, 1995) of African American students (Hall, 1999; Bateman & Hossler, 1996).

Pitre (2006) did an exploratory study of college choice comparing African American and White ninth grade students' aspiration for college attendance, utilizing the first stage of the Hossler and Gallagher (1987) college choice model as a conceptual framework. The results of this study indicated that African American students' aspirations for college attendance are similar to those of White students, even when other variables are taken into account. Further analysis of the variables related to African American students' aspirations and their propensity for actual college attendance revealed a possible aspirations/achievement paradox (Carter, 2001; Kao & Tienda,

1998) meaning that the aspirations that these African American students displayed were not supported by the type of academic achievement that might lead to college attendance (Pitre, 2006).

Family Wealth

Orr (2003) defined wealth as the value of all assets of a particular family or individual minus any debts owed. Wealth can contribute to the financial capital available to a family. Assets can produce income and or can minimize expenses that may normally come out of a family's earned income (Orr, 2003). Orr further stated that certain types of assets can translate into added income, which can be used to create educational opportunities.

In higher education, wealth confers stunning prerogatives and advantages. Affluent families can sidestep poor-quality public education by sending their children to high-quality private schools. This gives them an advantage for admission to the most prestigious universities. Private real estate wealth, which sets the tax base of a community, also sets the academic quality of a large majority of the nation's local public school systems. Students in these affluent districts, which tend to be predominantly White, invariably have the best teachers, most up-to-date textbooks, and superior academic facilities.

Research on low-income household finances was undertaken by Professor Catherine Montalto of The Ohio State University using 2001 Federal Reserve Board Survey of Consumer Finances data. These data, collected from 2,400 representative U.S. households, represent the most reliable recent information about the financial condition of American individuals and families. The data were collected in 2001 and released in 2003.

This research looked at the poorest one-fifth of Americans by income and compared this group to the rest of Americans. Specifically, comparisons were usually between the typical low-income household and the typical American household (i.e., comparison of median statistics).

The research revealed that the poor are indeed somewhat different than the rest of America. Of course, their median incomes are much lower -- $9,868 compared to $40,088. This gap is greatest among Whites, the married, and the well-educated.

Thirty-six percent of the poor, but only 21% of all Americans, are at least 65 years of age. Also, 27% of the poor, yet only 23% of other Americans, are under the age of 35. Lower-income households are about twice as likely as all American households to be unmarried, African American or Hispanic, and not well-educated (i.e., not have finished high school).

Financial Aid

In recent years, federal financial funding for higher education has been on a steady decline. Between 1980 and 1987, federal support of financial aid programs decreased by 11%, yet, the number of students needing financial aid increased by 20% (Donnelly, 1987). Similarly, Carter and Wilson (1993) reported that the 1990-dollar value of the Pell Grant was one fifth of the value it held in 1975. They also reported that the availability of college work-study programs have decreased by 50 % since 1971. In the absence of financial assistance, even the most motivated individuals may be circumvented from pursuing higher education.

There are 772 four-year colleges and universities in the United States where at least 5 % of the full-time undergraduates are African American. At 299 of those institutions, the graduation rate for Africa American students is under 30%. At 164 of those institutions, the rate is under 20%. At 68 of those institutions, the rate is under 10% (Carey, 2004).

The typical American college or university has a graduation rate gap between African American and White students of over 10 percentage points. A quarter of institutions have a gap of 20 percentage points or more (Carey, 2004).

There are significant gaps for Latino students with as lest 25% of all institutions with at least 5% Latino students have a Latino graduation rate of 30% or less. Similarly, the typical

graduation rate gap for Latino students is 7 percentage point gap or more in a quarter of all institutions (Carey, 2004).

Carey (2004) further states that looking at disaggregated rates for individual colleges and universities show that inside the overall national graduation rate- a low number, in and of itself- there are certain institutions and certain groups of students for whom the odds of successfully getting a degree drop from marginal to slim to almost none.

Summary

Presently, there is no research that has been published that provides a comprehensive description of how ethnic minority students select college academic majors. Studies do exist that attempt to provide researchers with a glimpse into various areas of ethnic minority students' background. With this information researchers speculate with some degree of accuracy about factors that the data dictate are responsible for or prevent most ethnic minority students from selecting agricultural, mathematical, and scientific college academic majors.

Studies have shown that some mathematics and science majors must cope with poor teaching, competitive classrooms, negating curricula, inadequate study help, and little encouragement from faculty (Seymour & Hewitt, 1997; Tobias, 1990, 1992). African American students usually have additional obstacles to overcome in pursuit of a mathematical or science based major. African American students typically come from single parent homes, high poverty areas, limited financial resources, and inadequate education from K – 12.

Research has found that the talent pool of potential scientists; engineers, and mathematicians emerges initially during the elementary school years and peaks before the ninth grade (Berryman, 1983). Numerous studies exist that show that African American students have an early interest in mathematics and science. Conversely, there are studies that indicate that

African American students enter the school system either lacking or very behind in basic reading and mathematical skills.

Ethnic minority students, especially African American males, are tracked from the onset into special needs programs or eventually characterized as a having behavior problems. Some educators invoke a zero tolerance policy which results in these students missing valuable time in the classroom.

. For the ethnic minority students do make it unencumbered into high school, additional variables are encountered and must be overcome. High school academic counselors, tracking students towards vocational careers verses suggesting students take advanced mathematics and science classes. Some ethnic minority students are never exposed to quality role models that express the same phenotype and genotype.

This research study was designed to explore these factors and potentially discover others that may help explain where in the educational chain the links are broken.

CHAPTER 3: METHODOLOGY

In previous chapters, the rationale for examining the factors that affect African American students and their choice of college academic majors were developed. The review of literature revealed numerous factors that independently may contribute to how African American students choose their college academic majors. This study examined these independent factors together to see if there were certain combinations of factors that predict how African American students selected their college academic majors.

This chapter describes the methodology and procedures that were used for collecting and analyzing the data gathered to answer the research questions outlined in Chapter 1. Included in this chapter are the basic research design, descriptions of the population, instrumentation, data collection, and data analysis techniques.

Research Approach and Rationale

This research study was both descriptive and analytical in nature, collecting information about factors that affect the African American students and their choice to either major in STEM related fields or not. Quantitative data were collected via survey questionnaire. Inferential statistics were used to answer these research questions:

Demographic Question

What is the descriptive nature of the student surveyed in the study (e.g., age, class, gender, etc.)

Research Questions

1. Is there a difference between students who switched college academic majors and those who did not on 13 factors that might influence student's decision to choose their major: (a) interest in the discipline or field, (b) desire to go to graduate school, (c) desire to go to professional school (e.g. medical, dental, etc.), (d) desire for a high salary, (e) desire to help others through research or practice, (f) desire to teach, (g) desire to please parent(s), (h) job stability, (i) opportunity for more scholarships and/or fellowships than other majors, (j) High school adequately prepared for agricultural, mathematics, or science related academic major, (k) my high school counselor helped me select me select classes that would prepare me for an agricultural, mathematical or science related academic major, (l) High school adequately prepared for agricultural, mathematics, or science related academic major, and (m) Level of high school counseling.

2. Is there a difference between males and females on (a) interest in discipline or field, (b) desire to go to graduate school, (c) desire to go to professional school (e.g. medical, dental, etc.) (d) desire for a high salary, (e) desire to help others through complete research or practice, (f) desire to teach, (g) desire to please parents, (h) job stability, (i) opportunity for more scholarships and/or fellowships than other majors, (j) highest educational level completed by your mother/guardian, (k) highest educational level competed by your father/guardian, (l) level of high school was high, (m) high school adequately prepared for agricultural, mathematics, or science related academic major,, (n) I find mathematics easy, (o) I find science easy, (p) my family's yearly income is, (q) grades in high school mathematics, (r) grades in high school science classes, (s) gifted and talented/ advanced placement classes, and (t) satisfaction with department?

3. Is there a difference between major on (a) interest in discipline or field, (b) desire to go to graduate school, (c) desire to go to professional school (e.g. medical, dental, etc.) (d) desire for

a high salary, (e) desire to help others through complete research or practice, (f) desire to teach, (g) desire to please parents, (h) job stability, (i) opportunity for more scholarships and/or fellowships than other majors, (j) highest educational level completed by your mother/guardian, (k) highest educational level competed by your father/guardian, (l) level of high school was high, (m) high school adequately prepared for agricultural, mathematics, or science related academic major,, (n) I find mathematics easy, (o) I find science easy, (p) my family's yearly income is, (q) grades in high school mathematics, (r) grades in high school science classes, (s) gifted and talented/ advanced placement classes, and (t) satisfaction with department?

4. Is there an interaction between gender and major on (a) interest in discipline or field, (b) desire to go to graduate school, (c) desire to go to professional school (e.g. medical, dental, etc.) (d) desire for a high salary, (e) desire to help others through complete research or practice, (f) desire to teach, (g) desire to please parents, (h) job stability, (i) opportunity for more scholarships and/or fellowships than other majors, (j) highest educational level completed by your mother/guardian, (k) highest educational level competed by your father/guardian, (l) level of high school was high, (m) high school adequately prepared for agricultural, mathematics, or science related academic major,, (n) I find mathematics easy, (o) I find science easy, (p) my family's yearly income is, (q) grades in high school mathematics, (r) grades in high school science classes, (s) gifted and talented/ advanced placement classes, and (t) satisfaction with department?

5. Is there a combination of factors tested above that will predict STEM enrollment?

6. Is there an association between students who enrolled in calculus, physics, and trigonometry in high school, was a member of a STEM Club in high school and major?

A survey design was used for this research. The purpose of using a survey design was to ask questions of a representative group of respondents, which will allowed the researcher to make inferences about characteristics and attitudes of a larger population (Creswell, 1994; Gliner,

Morgan, & Leech, 2009; Huck & Cormier, 1996; Salant & Dillman, 1994). The survey design was the data collection procedure of choice because of the advantages of less expense of the design, time spent on data collection and analysis, and the ability to make inferences to the larger population (Creswell, 1994; Gliner et al., 2009; Huck & Cormier, 1996). The survey was cross sectional, as the information was collected during one specific semester (Creswell, 1994).

The research approach combined three of the basic quantitative research approaches: the descriptive, the comparative approach using a between groups design classification, and the associational approach (Gliner et al., 2009).

Instrumentation

The survey instrument used in this research was modified from an existing instrument developed by Alfred Hall, from George Mason University in Fairfax, Virginia, for his research dissertation titled *Factors Affecting the Matriculation of African American Undergraduates Students in Science, Mathematics, Engineering, and Technology* (Hall, 1999).

Hall's (1999) research analyzed characteristics of African American undergraduate STEM majors participating in the Alliance for Minority Participation (AMP) program in six different states located in the Southeast region of the United States. These states consisted of Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina.

The questionnaire measured the relationship between the study's independent variables and the dependent variables. The types of items on the questionnaire are close-ended questions with ordered choices. These items are mostly Likert-type items in which close ended statements were made and the respondents were asked to rate their reactions to that statement. The questionnaire is composed of six sections designed to provide information about the participants' opinions and descriptions of factors that may have affected their college academic major selection. The sections are identified as follows (1) Influential Factors, (2) Recruitment Factors, (3) Student

Experiences, (4) Student Perceptions, (5) Demographics, (6) High School Preparation and Achievement (see appendix A).

Population Description

The site of this study was Southern University and Agricultural and Mechanical College, Baton Rouge, Louisiana (SU-BR), which has an enrollment of approximately 12,000 students (Southern University, 2009). The participants were Southern University male and female undergraduate students (N= 238 participants) who were enrolled in the spring semester 2008. The participants were students in 300 or 400 level classes in the College of Agricultural, Family, and Consumer Sciences; College of Arts and Humanities; College of Education; and the College of Science.

Sampling Procedures

Convenience sampling was the method used; the participants were selected by the researcher. Respondents were not selected randomly but by using such factors as accessibility to classes, and instructors' willingness to allow administration of survey instruments.

Data Collection

The researcher submitted the Application to Use Human Subjects form (H-100) to the Human Research Committee (HRC) at Colorado State University (Appendix B) and the Institutional Review Board for Protection of Human Subjects' Application for Initial Review form at Southern University.

The cover letter, student questionnaire (see appendix A), letter to the deans, and the approval of the IRB committee from Southern University, were attached to the H-100 form. The researcher submitted the same information to the IRB at Southern University along with a copy of the approval of the HRC at Colorado State University.

Letters were mailed to the deans of the following colleges: Agricultural, Family, and Consumer Sciences; Arts, and Humanities; Education; Engineering; and Sciences. All deans except the dean from the College of Engineering responded either by letter, email, or verbally giving the researcher permission to contact professors in their departments to potentially use students in their classes.

Undergraduate students who were enrolled in 300 or 400 level courses in the following: departments, the College of Agricultural, Family and Consumer Sciences; Arts and Humanities; Education; and the Sciences were recruited for the study. Prior to administering the instrument for the study, the researcher explained the purpose of the study to prospective participants, their rights to be informed of the results, and their rights to discontinue participation in the study at any time. It also was explained that no one will be obligated to complete the instrument, and anyone interested in participating would do so on a voluntary and willing basis. Participants were asked if they understood the instructions. Questions were addressed and clarification was provided where necessary. For this study, a sample size of n = 238 was obtained.

Data Analysis

Descriptive and inferential statistics were employed to analyze the results of the quantitative data retrieved from the survey questionnaire. All descriptive and inferential statistics were computed with the assistance of PASW Statistics. All of the data retrieved from the survey questionnaire were compiled in a database configured with the PASW Statistics software package. Descriptive statistics were used to describe and interpret demographic information about the participants, their socioeconomic status, and their high school preparation and achievement. Descriptive statistics also were used to describe students' characteristics among the various groups of factors potentially affecting their college major selection. These data are represented in

the form of frequency distributions, tables, and measures of central tendency and variability (range, standard deviations, and normal distributions).

The researcher employed a variety of tests to analyze the data. Depending upon the skewedness of the data, the appropriate statistics were used, e.g. (Independent samples *t*-test, Spearman rho, Mann Whitney U).

The chi-square test was used to determine if significant differences emerged between STEM majors and non-STEM majors among the chosen categorical variables. As Fraenkel and Wallen (1990) stated, the chi-square test provides a nonparametric test of significance appropriate for analyzing data presented in the form of frequency counts. The chi-square test compares frequencies actually observed in a study with expected frequencies to determine levels of significance. Discriminant Analysis was used to determine which variable(s) would provide the best predictor(s) of a STEM major selection. Independent samples *t*-test was used to determine if the two conditions differ significantly on variables.

Gordi and Khamis (2004) reported that when testing several outcome variables simultaneously, many researchers declare a statistically significant result for each test having a *p* value of less than 0.05. A *p* value of less than .01 was used as a more conservative *p* value than normally used in social science research, since there are multiple variables in all the research questions. A p value of less than .05 was used to describe any statistically significant interaction.

CHAPTER FOUR: RESULTS

The purpose of this study was to identify the factors that affect African American students and their choice of college academic majors. The study also identified the students who chose a STEM major and the factors associated with that choice and if there were any specific factors that caused them to switch academic majors. This study also explored why some African American students chose not to major in a STEM related field.

Demographic Information

Table 1 shows students in the sample ranged in age from 19 to 29 years with a mean age of 21.5 years. Majority of the students were either 20 or 21 years old.

Table 1

Age

	Frequency	Percent
19	9	3.8
20	63	26.5
21	60	25.2
22	53	22.3
23	24	10.1
24	21	8.8
25	4	1.7
26	2	.8
27	1	.4
29	1	.4
Total	238	100.0

Table 2 shows 66% of the respondents identified themselves as female; 34% identified themselves as male.

Table 2
Gender

	Frequency	Percent
FEMALES	157	66.0
MALES	81	34.0
Total	238	100.0

Table 3 note that STEM and non-STEM majors were approximately equal with 49.2 % of students indicating that they were STEM majors and 50.8% indicating non-STEM majors.

Table 3
Current Major

	Frequency	Percent
STEM	117	49.2
Non-STEM	121	50.8
Total	238	100.0

Table 4 indicates that majority of the students 76.5% identified their academic classification as Junior and 23.5% as Senior.

Table 4
Academic Classification

	Frequency	Percent
JUNIOR	182	76.5
SENIOR	56	23.5
Total	238	100.0

Table 5 indicates that 92% of the students reported attending full time and 8% of students reported attending part-time.

Table 5
Enrollment Status

	Frequency	Percent
PART TIME	19	8.0
FULL TIME	219	92.0
Total	238	100.0

Table 6 shows the largest group (43.7%) of students indicated their grade point average in the range of 2.5 – 2.99.

Table 6
Grade Point Average

	Frequency	Percent
2.0 - 2.49	19	8.0
2.5 - 2.99	104	43.7
3.0 - 3.49	79	33.2
3.5 -4.0	36	15.1
Total	238	100.0

In Table 7 nearly half, (44.5%) of the students indicated that their mother's highest educational attainment was some college courses completed and 35% had a bachelor's or higher degree.

Table 7
Mother's Education

	Frequency	Percent
LESS THAN HIGH SCHOOL	5	2.1
HIGH SCHOOL GRADUATE	43	18.1
SOME COLLEGE	106	44.5
BACHELOR DEGREE	64	26.9
GRADUATE/PROFESSIONAL	20	8.4
Total	238	100.0

Table 8 shows that 34.5% of the students indicated that their father's highest education attainment was some college courses were completed and 38% had a bachelor's or higher degree.

Table 8
Father's Education

	Frequency	Percent
LESS THAN HIGH SCHOOL	10	4.2
HIGH SCHOOL GRADUATE	56	23.5
SOME COLLEGE	82	34.5
BACHELOR DEGREE	73	30.7
GRADUATE/PROFESSIONAL	17	7.1
Total	238	100.0

A majority of the student indicated that their family income in the range of $20,000 - $74,999 Table 9.

Table 9
Family Income

	Frequency	Percent
LESS THAN $20,000	9	3.8
$20,000 - $49, 999	56	23.5
$50,000 - $74,999	84	35.3
$75,000 - $99,999	24	10.1
$100,000 OR MORE	16	6.7
UNKNOWN	49	20.6
Total	238	100.0

Research Question 1: Who Switched Majors?

Is there a difference between students who switched college academic majors and those who did not on 13 factors that might influence student's decision to choose their major: (a) interest in the discipline or field, (b) desire to go to graduate school, (c) desire to go to professional school (e.g. medical, dental, etc.), (d) desire for a high salary, (e) desire to help others through research or practice, (f) desire to teach, (g) desire to please parent(s), (h) job stability, (i) opportunity for more scholarships and/or fellowships than other majors, (j) High school adequately prepared for agricultural, mathematics, or science related academic major, (k) my high school counselor helped me select me select classes that would prepare me for an agricultural, mathematical or science related academic major, (l) High school adequately prepared for agricultural, mathematics, or science related academic major, and (m) Level of high school counseling.

A *t*-test was used to determine whether the responses to the survey revealed attitudinal differences between students who switched college academic majors and those who chose not to switch academic majors. A p value of less than 0.01 was used as a more conservative p value than normally used in social science research, since there are multiple *t*-tests. Table 10 shows the 3 out 13 *t*-test with the lowest p values; they would have been statistically significant at $p < .05$.

Table 10

Comparison of Students Who Did Not Switch and Those Who Switched Academic Majors on Multiple Variables (n= 201 did not switch, n = 37 who switched) From Highest to Lowest t Values

Variable	M	SD	*t*	*df*	*p*	*d*
Satisfaction with department			2.533	236	.012	.44
Did not switch	4.2687	.64611				
Switched	3.9730	.68664				
Mathematics Background			-2.035	236	.043	-.37
Did not switch	3.2488	.73336				
Switched	3.5135	.69208				
Interest in Discipline			2.029	41.941	.049	.41
Did not switch	4.4677	.73498				
Switched	4.0811	1.11501				

Effect sizes were calculated for p values less than .01

Inspection of the two groups of means did not reveal any statistically significant difference between students who switched academic majors and student who did not switch academic major on the 13 variables tested. However the variable, satisfaction with the department was nearly significant, t =2.533, df = 236, p = .012. The effect size d was approximately .44, which is somewhat smaller than typical. Students who did not switch academic majors had a slightly higher mean than students who switched academic majors for satisfaction with department and interest in discipline or field. Students who did switch had a slightly higher mean for mathematics background.

RQs 2, 3 and 4: Effects of Gender and Type of Major

Research questions 2 through 4 examined differences of the main effect of gender (RQ2), major (RQ3), and the interaction (RQ4) between gender and major related to the 22 factors in each research question. A p value of less than 0.01 was used as a more conservative p value for main effect for gender and major and a p value of less than 0.05 was used for interactions between gender and major.

Factors Influencing Choice of Major

The following 11 variables are factors that might influence the selection or choice of a student's major. Theses research questions ask whether they are more important to males or females and also more important to STEM or non-STEM majors.

Gender and major with interest in discipline or field. The researcher performed a 2 x 2 factorial ANOVA test for interest in their discipline or field as a function of gender, major, and interaction between gender and major. Table 11 answers research questions about gender, major, and interaction between gender and major. There was a statistically significant interaction between gender and major on interest in discipline or field F (1, 234) = 4.29, p = .041. Eta for gender and major was .13, which is smaller than typical effect size. Examination of cell means indicated that female non-STEM majors (M = 4.47) had only .04 points higher mean than female STEM majors (M = 4.43) for interest in discipline or field, but male STEM majors (M = 4.47) had .42 points higher mean than male non-STEM majors (M = 4.06) for interest in discipline or field.

Table 11

*Analysis of Variance for **Interest in Discipline or Field** as a Function of Gender and Major*

Variable and Source	*df*	*MS*	*F*	ρ	η^2
Discipline					
Gender	1	1.800	2.76	.098	.012
Major	1	1.837	2.81	.095	.012
Gender * Major	1	2.761	4.23	.041	.018
Error	234	.653			

The profile plot displays an interaction between gender and major (see Figure 1). The profile plot shows an interaction for males and females; females are constantly positive about their major, but non-STEM males rate their interest lower.

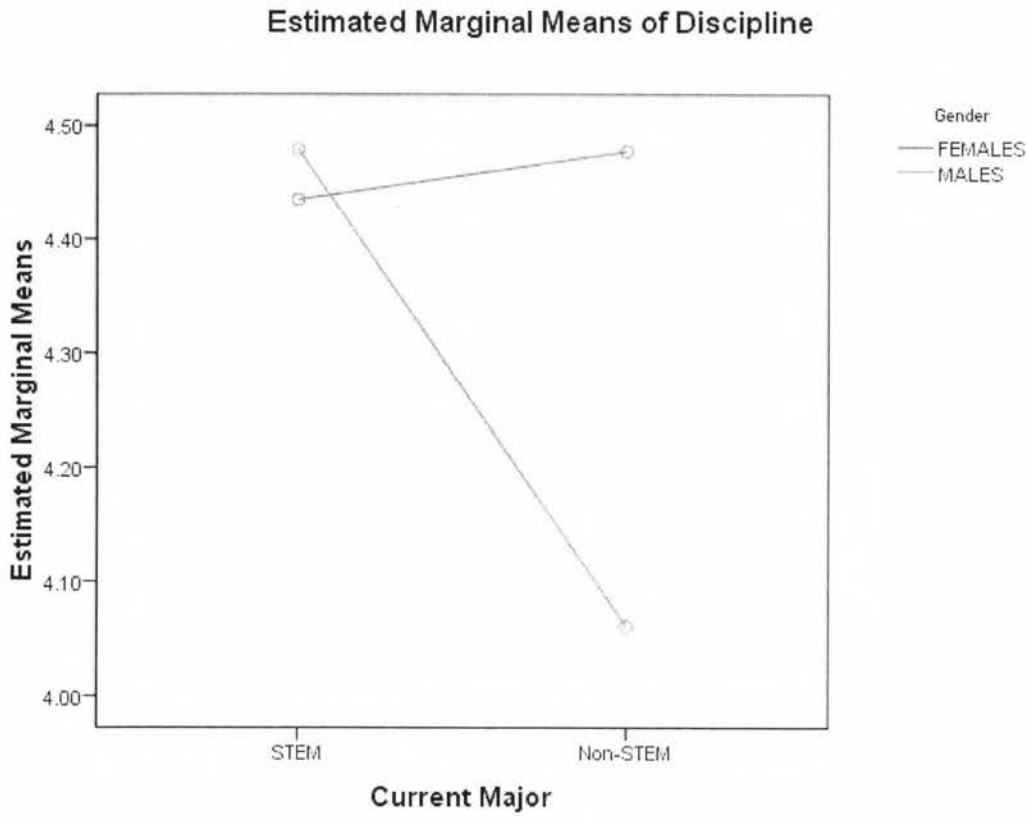

Figure1. Interaction between gender and major on interest in discipline of field

Gender and major with desire to attend graduate school. The researcher performed a 2 x 2 factorial ANOVA test for desire to attend graduate school as a function of gender, major, and interaction between gender and major (Table 12). There was a statistically significant main effect of major on desire to attend graduate school, F (1, 234) = 15.65, $p < .001$. Eta for major was approximately .25, a medium or typical effect size. STEM majors (M = 3.80) had a higher mean than non-STEM majors (M = 3.19).

Table 12

Analysis of Variance for ***Desire to Attend Graduate School*** *as a Function of Gender and Major*

Variable and Source	*df*	*MS*	*F*	ρ	η^2
Graduate School					
Gender	1	1.495	1.10	.295	.005
Major	1	21.235	15.65	.001	.063
Gender * Major	1	.004	.003	.959	.001
Error	234	1.357			

Gender and major with desire to attend professional school. The researcher performed a 2 x 2 factorial ANOVA test for desire to attend professional school as a function of gender, major, and interaction between gender and major (Table 13). There was a statistically significant main effect of major, F (1, 234) = 18.20, $p < .001$. Eta for major was about .27, a medium or typical effect size. STEM majors (M = 3.27) had a .63 points higher mean than non-STEM majors (M = 2.64).

Table 13

Analysis of Variance for ***Desire to Attend Professional School*** *as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Professional School					
Gender	1	1.362	1.11	.294	.005
Major	1	22.374	18.20	.001	.072
Gender * Major	1	.013	.011	.917	.000
Error	234	1.229			

Gender and major with desire for high salary. The researcher performed a 2 x 2 factorial ANOVA test for desire for high salary as a function of gender, major, and interaction between gender and major (Table 14). There was a statistically significant main effect of major on desire for a high salary, F (1, 234) = 23.87, $p < .001$. Eta for major was about .27, a medium or typical effect size. Female STEM majors (M = 4.18) had a .64 points higher mean than female non-STEM major (M = 3.60) on their desire for a high salary. Males STEM majors (M= 3.97)

similarly had a .67 points higher mean than male non-STEM majors (M= 3.24) on their desire for a high salary.

Table 14
Analysis of Variance for ***Desire for a High Salary*** *as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
High Salary					
Gender	1	4.206	4.42	.037	.019
Major	1	22.729	23.87	.001	.093
Gender *Major	1	.295	.310	.578	.001
Error	234	.952			

Gender and major with desire to help others through research or practice. The researcher performed a 2 x 2 factorial ANOVA test for desire to complete research or practice as a function of gender, major, and interaction between gender and major (Table 15). There was a statistically significant main effect of gender on desire to help others through research or practice, F (1, 234) = 6.737, p = .010. Eta for gender was about .16, is somewhat smaller than typical effect size. There was a statistically significant main effect of major on desire to help others through research or practice, F (1, 234) = 27.23, $p < .001$. Eta for major was about .32, a medium or typical effect size. Examination of cell means indicated that STEM majors (M = 3.77) had a .79 points higher mean than non-STEM majors (M = 2.99) and females (M = 3.47) had a .29 points higher mean than males (M = 3.18).

Table 15
Analysis of Variance for ***Desire to Help Others Through Research or Practice*** *as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Research or Practice					
Gender	1	9.325	6.74	.010	.028
Major	1	37.686	27.23	.001	.104
Gender * Major	1	.028	.020	.887	.000
Error	234	1.384			

Gender and major with desire to teach. The researcher performed a 2 x 2 factorial ANOVA test for desire to teach as a function of gender, major, and interaction between gender and major (Table 16). There was a statistically significant main effect of gender on desire to teach, F (1, 234) = 12.919, $p < .001$. Eta for gender was about .22, is a medium or typical effect size. Examination of cell means indicated that female (M = 3.79) had a .61 higher mean than males (M = 3.18).

Table 16
*Analysis of Variance for **Desire to Teach** as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Desire to Teach					
Gender	1	18.940	12.92	.001	.052
Major	1	.193	.132	.717	.001
Gender * Major	1	.231	.157	.692	.001
Error	234	1.466			

Gender and major with desire to please parents. The researcher performed a 2 x 2 factorial ANOVA test for desire to please parents as a function of gender, major, and interaction between gender and major (Table 17). There was not a statistically significant main effect of gender or major on desire to please parents. The interaction between gender and major was not statistically significant. There was, however a marginally statistically significant main effect of gender on desire to please parents, F (1,234) = 5.653, p = .018. Eta for gender was about .15 which is somewhat smaller than typical effect size.

Table 17
*Analysis of Variance for **Desire to Please Parents** as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Please Parents					
Gender	1	6.772	5.65	.018	.024
Major	1	.011	.009	.924	.001
Gender * Major	1	3.898	3.25	.073	.014
Error	234	1.198			

Gender and major with job stability. The researcher performed a 2 x 2 factorial ANOVA test for job stability as a function of gender, major, and interaction between gender and major (Table 18). The main effect of major was statistically significant on job stability, F (1, 234) = 11.555, p = .001. Eta for major was about .22, is a medium or typical effect size. Examination of cell means indicated that STEM majors (M = 4.60) had a .36 points higher mean than non-STEM majors (M = 4.23).

Table 18
*Analysis of Variance for **Job Stability** as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Job Stability					
Gender	1	.092	.138	.711	.001
Major	1	7.694	11.56	.001	.047
Gender * Major	1	.073	.110	.741	.001
Error	234	.666			

Gender and major with opportunity for more scholarships than other majors. The researcher performed a 2 x 2 factorial ANOVA test for opportunity for more scholarships as a function of gender, major, and interaction between gender and major and (Table 19). The main effect of major was significant on opportunity for more scholarships than other majors, F (1, 234) = 36.95, $p < .001$. Eta for gender was about .37, is a large or larger than typical effect size. Examination of cell means indicated that STEM majors (M = 3.24) had a 1.15 points higher mean than non-STEM majors (M = 2.09).

Table 19
*Analysis of Variance for **Opportunity For More Scholarships** as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Scholarship					
Gender	1	7.671	4.71	.031	.020
Major	1	60.146	36.95	.001	.136
Gender * Major	1	.204	.125	.723	.001
Error	234	1.628			

Gender and major with highest educational level completed by your mother/guardian. The researcher performed a 2 x 2 factorial ANOVA test for highest educational level completed by your mother/guardian as a function of gender, major, and interaction between gender and major (Table 20). There was not a significant main effect of gender or major on mother's education. The interaction between gender and major on mother's education was not significant. Thus, mother's education does not seem to be an important factor influencing students to choose a STEM vs. non-STEM major.

Table 20
*Analysis of Variance for **Mother's Education** as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Mother's Education					
Gender	1	.546	.666	.415	.003
Major	1	.192	.234	.629	.001
Gender * Major	1	2.513	3.063	.081	.013
Error	234	.820			

Gender and major with highest educational level completed by your father/guardian. The researcher performed a 2 x 2 factorial ANOVA test for highest level of father's education as a function of gender, major, and interaction between gender and major (Table 21). There was a statistically significant interaction between gender and major on the variable father's education, F (1, 234) = 5.821, p = .017. Eta for the interaction of gender and major was about .15, which is a small or smaller than typical effect size. Examination of cell means indicated that that female STEM majors (M = 3.31) had a .24 points higher mean than female non-STEM majors (M = 3.07) on father's education. However, male non-STEM majors (M = 3.28) had a .42 points higher mean than STEM majors (M = 2.25), on father's education. Overall non-STEM majors had a .004 points higher mean than STEM majors, which indicates no overall difference in father's education for STEM and non-STEM majors.

Table 21

Analysis of Variance for ***Father's Education*** *as a Function of Gender and Major*

Variable and source	df	*MS*	*F*	ρ	η^2
Father's Education					
Gender	1	.957	.991	.320	.004
Major	1	.417	.432	.512	.002
Gender * Major	1	5.621	5.821	.017	.024
Error	234	.966			

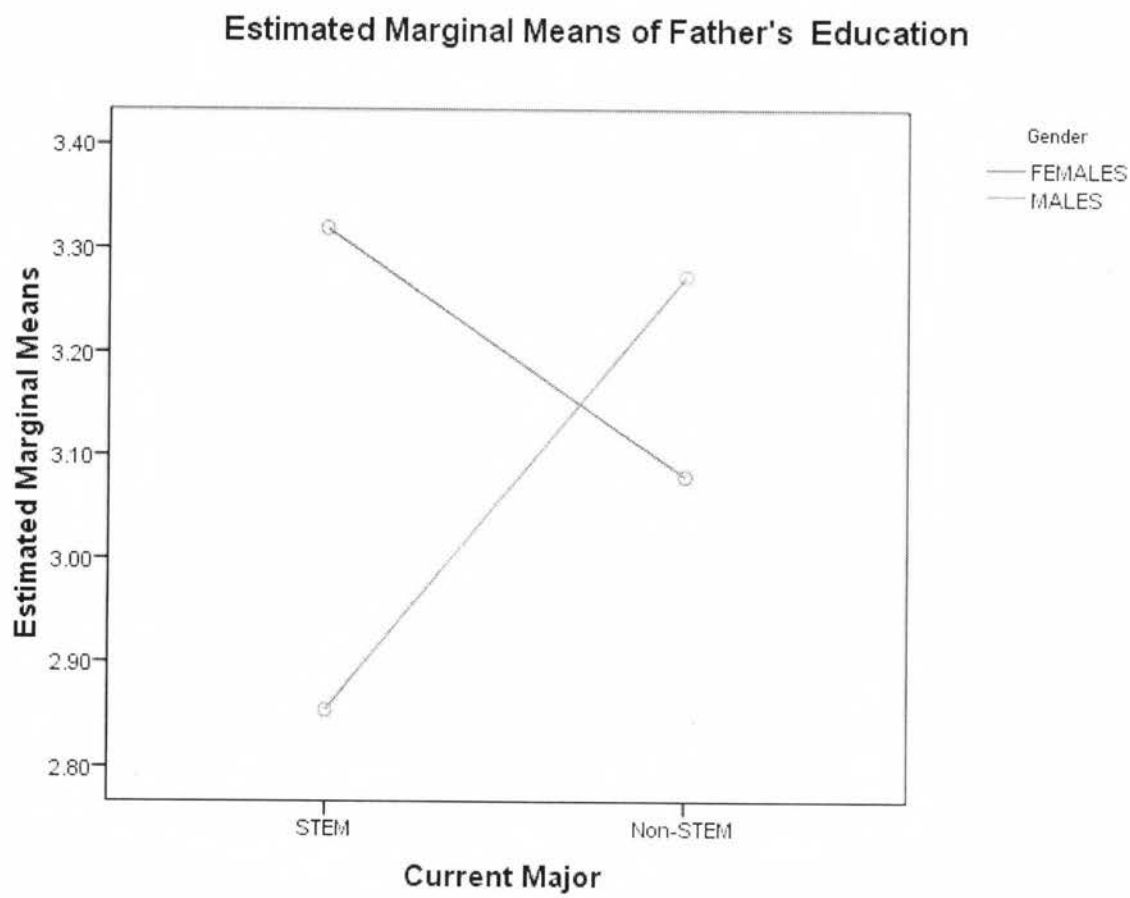

Figure 2. Interaction between gender and major on father's education

The profile plot (see Figure 2) for the interaction between gender and major indicates that female STEM majors had a higher mean on the variable Father's Education than male STEM majors. However, male non-STEM majors had a higher mean on the variable Father's Education

than female Non-STEM majors. The significant interaction between gender and major is shown by the profile plot.

Gender and major with my level of high school counseling was high. The researcher performed a 2 x 2 factorial ANOVA test for level or quality of high school counseling as a function of gender, major, and interaction between gender and major (Table 22). There was not a statistically significant main effect of gender or major on the variable level of counseling. The interaction between gender and major was not statistically significant. Thus, level of high school counseling doesn't seem to influence selection of a STEM vs. non-STEM major.

Table 22
*Analysis of Variance for **Level of Counseling** as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Gender	1	.517	.497	.482	.002
Major	1	4.992	4.80	.029	.020
Gender * Major	1	.279	.268	.605	.001
Error	234	1.040			

Gender and major with high school preparation. The researcher performed a 2 x 2 factorial ANOVA test for adequacy high school preparation as a function of gender, major, and interaction between gender and major (Table 23). There was not a statistically significant main effect of gender or major on high school preparation. The interaction between gender and major was not statistically significant.

Table 23
*Analysis of Variance for **High School Preparation** as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
High School Preparation					
Gender	1	4.146	4.98	.027	.021
Major	1	5.395	6.48	.012	.027
Gender * Major	1	.016	.019	.891	.000
Error	234	.832			

Student Perceptions and Background

Following six analysis were done to see gender or major (STEM vs. Non-STEM) might influence students perception of how easy they find mathematics and science; and whether students with different backgrounds differ in terms of genders and whether they choose a STEM major or not.

Gender and major with I find mathematics to be easy. The researcher performed a 2 x 2 factorial ANOVA test for mathematics perception (i.e., how easy they find mathematics) as a function of gender, major, and interaction between gender and major (Table 24). Surprisingly, there was not a statistically significant main effect of gender or major on the variable mathematics perception. The males and females made similar ratings on finding mathematics easy. Like wise, STEM and non-STEM majors did not differ on this variable. There was not a statistically significant interaction between gender and major on perception of mathematics.

Table 24
*Analysis of Variance for **Mathematics Perception** as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Mathematics Perception					
Gender	1	2.440	2.68	.103	.011
Major	1	1.806	1.98	.161	.008
Gender * Major	1	2.191	2.40	.122	.010
Error	234	.911			

Gender and major with I find science easy. The researcher performed a 2 x 2 factorial ANOVA test for science perception (i.e., how easy they find science) as a function of gender, major, and interaction between gender and major (Table 25). Not surprisingly, the main effect of major on science perception was statistically significant, F (1, 234) = 12.212, p = .001. Eta for the effect of major was .22, which is a medium effect size. Examination of cell means indicated that

STEM majors (M = 4.17) had a .49 higher mean than non-STEM majors (M = 3.68). Thus, STEM majors find science easier.

Table 25
*Analysis of Variance for **Science Perception** as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Perceptions Science					
Gender	1	2.028	2.32	.129	.010
Major	1	10.674	12.21	.001	.050
Gender * Major	1	2.351	2.69	.102	.011
Error	234	.874			

Gender and major with parental social economics status. The researcher performed a 2 x 2 factorial ANOVA test for parental social economic status as a function of gender, major, and interaction between gender and major (Table 26). There were no significant main effects or interaction between gender and major on parental SES.

Table 26
*Analysis of Variance for **Parental SES** as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Family SES					
Gender	1	1.590	.691	.407	.003
Major	1	7.059	3.07	.081	.013
Gender * Major	1	5.158	2.24	.136	.009
Error	234	2.302			

Gender and major with mathematics grades. The researcher performed a 2 x 2 factorial ANOVA test for mathematics' grades in high school as a function of gender, major, and interaction between gender and major (Table 27). There was a statistically significant main effect of gender on mathematics grades, F (1, 234) = 18.151, $p < .001$. Eta for the effect of gender was .27, which is a medium to typical effect size. The main effect of major on mathematics grades was statistically significant, F (1, 234) = 10.857, $p = .001$. Eta for the effect of major was .21, which is a medium to typical effect size. Examination of cell means indicated that that female STEM majors

(M = 5.88) had a .65 points higher mean than female non-STEM majors (M = 5.22) on mathematics grades. Male STEM majors (M = 5.08) had a .32 points higher mean than non-STEM majors (M = 4.75) on mathematics grades. STEM majors (M = 5.55) had a .46 points higher mean than non-STEM majors (M = 5.09) on mathematics grades. Thus, overall STEM majors and females had higher mathematics grades.

Table 27

Analysis of Variance for ***Mathematics Grades*** *as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Mathematics Grades					
Gender	1	20.963	18.15	.001	.072
Major	1	12.539	10.86	.001	.044
Gender *Major	1	1.423	1.232	.268	.005
Error	234	1.155			

Gender and major with science grades. The researcher performed a 2 x 2 factorial ANOVA test for science grades in high school as a function of gender, major, and interaction between gender and major (Table 28). There was a statistically significant main effect of gender science grades, F (1, 234) = 7.273, p = .008. Eta for the effect of gender was .17, which is somewhat smaller than typical effect size. There was a statistically significant interaction between gender and major on science grades, F (1, 234) = 4.773, p = .030. Eta for the interaction effect of gender and major was .14, which is a small or smaller than typical effect size. Examination of cell means indicated that STEM majors (M = 5.90) had a .36 points higher (but not significantly higher) mean than non-STEM majors (M = 5.54), and females (M = 5.85) had a .40 points higher mean than males (M = 5.45).

Table 28

Analysis of Variance for ***Science Grades*** *as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
Science Grades					
Gender	1	10.006	7.27	.008	.030
Major	1	4.934	3.59	.059	.015
Gender * Major	1	6.567	4.77	.030	.030
Error	234	1.376			

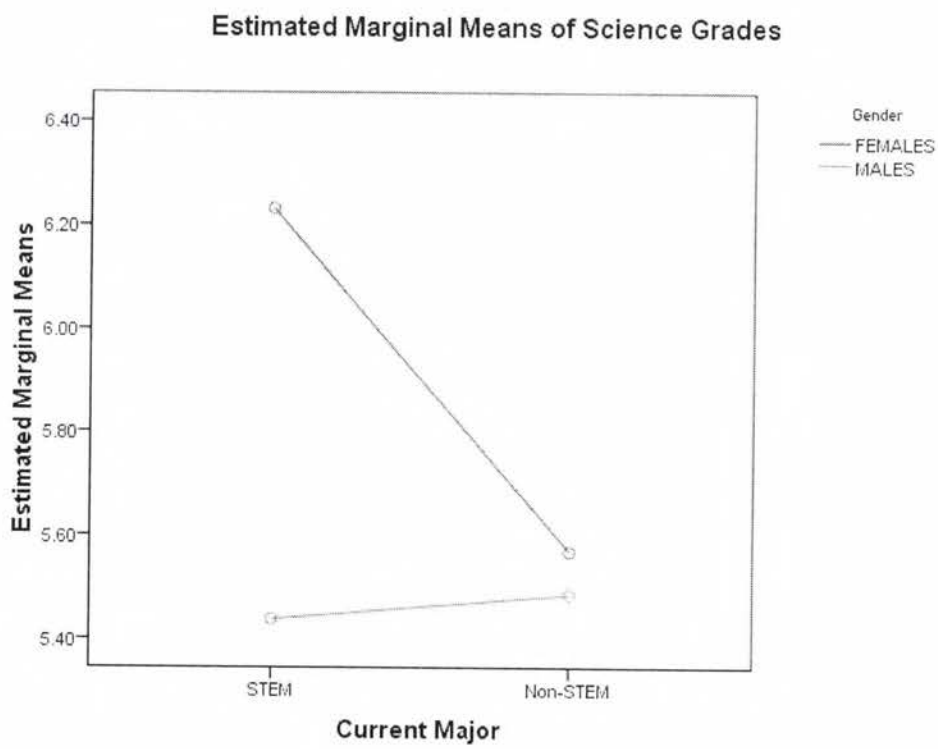

Figure3. Interaction between gender and major on science grades

The profile plot (see Figure 3) for the interaction between gender and major indicates that female STEM majors had a higher mean on the variable science grades than male STEM majors. However, female non-STEM majors had similar means on the variable science grades to male non-STEM majors. The profile plot shows an ordinal interaction for females and males (Gliner, et al., 2009).

Gender and major with advanced placement/gifted talented courses. The researcher performed a 2 x 2 factorial ANOVA test for whether or not the students took any advance placement/gifted talented courses in high school as a function of gender, major, and interaction between gender and major and (Table 29). There was a statistically significant main effect of gender on advance placement/gifted talented courses taken, F (1, 234) = 7.047, p = .008. Eta for the effect of gender was .17, which is somewhat smaller than typical effect size. The main effect of major on advance placement/gifted talented courses taken was statistically significant, F (1, 234) = 10.806, p = .001. Eta for the effect of major was .21, which is close to a typical effect size. Examination of cell means indicated that female STEM majors (M = 1.39) had a .27 points higher mean than female non-STEM majors (M = 1.12) on advance placement and gifted and talented courses taken. Male STEM majors (M = 1.16) had a .17 points higher mean than non-STEM majors (M = 1.00) on advance placement and gifted and talented courses taken. STEM majors (M = 1.29) had a .21 points higher mean than non-STEM majors (M = 1.09), and overall females were more likely to have taken advanced placement courses in high school.

Table 29

Analysis of Variance for ***Advance Placement/Gifted Talented Course Taken*** *as a Function of Gender and Major*

Variable and source	*df*	*MS*	*F*	ρ	η^2
AP/GT					
Gender	1	1.588	7.05	.008	.029
Major	1	2.435	10.81	.001	.044
Gender *Major	1	.129	.572	.450	.002
Error	234	.225			

Research Question 5: Predicting Enrollment as a STEM Major

Is there a combination of factors tested above that will predict STEM major enrollment? Discriminate analysis was conducted to assess whether these predictors, interest in the discipline or field, desire to attend graduate school, desire to attend professional school, desire for high salary, desire to help others through research or practice, desire to teach, desire to please parents, job stability, opportunity for more scholarships, STEM Club membership, my high school counselor helped me select classes that would prepare me for an agricultural, mathematics or science related academic major, highest educational level completed by your mother/guardian, highest educational level completed by your father/guardian, quality of counseling in high school, high school preparation, mathematics perception, science perception, grades in high school mathematics, grades in high school science classes, high school physics, calculus, and trigonometry courses, and gifted and talented/ advanced placement classes could distinguish those who chose STEM majors from those who chose non-STEM majors. Wilks' lambda was significant, $\lambda = .40$, $\chi^2 = 203.9$, $p < .001$, which indicates that the model including these variables was able to significantly discriminate the two groups. Table 30 presents the standardized function coefficients, which suggest that high school preparation, science background, science perception, job stability, and STEM Club membership, contribute most to distinguishing those who chose STEM majors from non-STEM majors, using these predictors. The classification results show that the model correctly predicts 86% of those who chose STEM majors and 94% of those who chose a non-STEM major.

Table 30
Standard Function Coefficients and Correlation Coefficients

Standardized Function Coefficients		Correlations between variables and discriminant function	
High School Prepared for STEM Major	0.687	High School Prepared for STEM	0.687
Science Background	0.543	Science Background	0.315
Science Is Easy	0.491	Science Is Easy	0.215
Job Stability	0.328	Job Stability	0.185
STEM Club	0.302	STEM Club Membership	0.454
Desire for a High Salary	0.274	Desire for a High Salary	0.251
Mathematics Background	0.232	Mathematics Background	0.325
Opportunity for More Scholarship	0.215	Opportunity for More Scholarship	0.368
Calculus	0.175	Calculus	0.245
Desire to go to Graduate School	0.125	Desire to go to Graduate School	0.217
Trigonometry	0.112	Trigonometry	0.283
Desire to Help Others	0.100	Desire to Help Others	0.272
High School Level of Counseling	0.083	High School Level of Counseling	0.129
Desire to go to Professional School	0.022	Desire to go to Professional School	0.233
Mathematics Grades	-0.034	Mathematics grades	0.168
Father's Education	-0.039	Father's Education	-0.022
Desire to Teach	-0.039	Desire to Teach	-0.055
Desire to Please Parents	-0.055	Desire to Please Parents	0.019
Physics	-0.650	Physics	0.271
AP/GT	-0.081	AP/GT	0.178
High School Ed	-0.106	High School Ed	0.129
Interest in Discipline or Field	-0.124	Interest in Discipline or Field	0.045
Mother Education	-0.128	Mother Education	0.053
Science Grades	-0.251	Science Grades	0.123
Mathematic Is Easy	-0.269	Mathematic Is Easy	0.095
HS Counselor Selected Classes	-0.316	HS Counselor Selected Classes	0.118

A second discriminant analysis was completed using the factors determined by the previous discriminant analysis as the best predictors of STEM enrollment. The factors identified were high school education preparation, science background, science perception, job stability and STEM club membership. Wilks' lambda was significant, $\lambda = .55$, $\chi^2 = 140.47$, $p < .001$, which indicates that the model including these variables was able to significantly discriminate the two groups. Table 31 presents the standard function coefficients, which suggest that high school education prepared for STEM major, science background, and science is easy contributed most to distinguishing those who choose STEM majors from non-STEM majors, using these predictors. The results indicated that the best predictor of STEM major selection is a student's level of high

school preparation. The classification results show that the model correctly predicts 77% of those who chose STEM majors and 87% of those who chose non-STEM majors.

Table 31
Standard Function Coefficients and Correlation Coefficients

Standardized Function Coefficients		Correlations between variables and discriminant function	
High School Prepared for STEM Major	0.785	High School Prepared for STEM Major	0.925
Science Background	0.254	Science Background	0.424
Science Perception	0.178	Science Is Easy	0.290
Job Stability	0.132	Job Stability	0.250
STEM Club	0.084	STEM Club	0.611

Research Question 6

Is there an association between students who took calculus, physics, or trigonometry, or participated in a STEM Club while in high school with type of major selected?

Seventy-six percent of STEM majors (n = 89) indicated that they did not take calculus, 96% of non-STEM majors (n = 116) also indicated that they did not take calculus; conversely 24% of STEM majors (n = 28) indicated taking calculus, 4% of non-STEM majors (n = 5) indicated taking calculus. Table 33 shows that the cross-tabulation of students who took calculus with major indicated a significant Pearson chi-square ($\chi^2 = 19.53$, $df = 1$, N = 238, $p < .001$). STEM majors are more likely than non-STEM majors to have taken calculus. Phi, which indicates the strength of association between the two variables, is -.286 and, thus, the effect size is considered to be medium.

Table 32

Chi-square Analysis of Current Major Among Students Who Took Calculus, Physics, Trigonometry and STEM Club Membership

Variable	Current Major		$\chi 2$	*p*
	STEM	non-STEM		
Calculus			19.53	< .001
Enrolled	28	5		
Did not Enroll	89	116		
Physics			23.46	< .001
Enrolled	52	19		
Did not Enroll	65	102		
Trigonometry			25.43	< .001
Enrolled	51	17		
Did not Enroll	66	104		
STEM Club			55.99	< .001
Yes	70	16		
No	47	105		

Fifty-six percent of STEM majors (n = 65) indicated that they did not take physics, 61.1% of non-STEM majors (n = 102) also indicated that they did not take physics; conversely 44% of STEM majors (n = 52) indicated taking physics, 16% of non-STEM majors (n = 19) indicated taking physics. Table 33 shows that the cross-tabulation of students who took physics with major which indicated a significant Pearson chi-square ($\chi^2 = 23.48$, $df = 1$, N = 238, $p < .001$). STEM majors were more likely than non-STEM majors to take physics. Phi, which indicates the strength of association between the two variables, is -.314 and, thus, the effect size is considered to be medium or typical.

Fifty-six percent of STEM majors (n = 66) indicated that they did not take trigonometry, 86% of non-STEM majors (n = 104) also indicated did not take trigonometry, 44% of STEM majors (n = 51) indicated that they did take trigonometry, 14% of non-STEM majors (n = 17) indicated that they did take trigonometry. Table 33 shows that the cross-tabulation of students who took

trigonometry with major indicated a significant Pearson chi-square ($\chi 2 = 25.43$, $df = 1$, N = 238, $p <$ 001). Phi, which indicates the strength of association between the two variables, is .327 and, thus, the effect size is considered to large.

Forty percent of STEM majors (n = 47) indicated that they did not participate in a STEM Clubs, 87% of non-STEM majors (n = 105) indicated that they did not participate in a STEM Clubs, 60% of STEM majors (n = 70) indicated participation in a STEM Clubs, 13% of non-STEM majors (n = 16) indicated participation in STEM Clubs. Table 33 shows that the cross-tabulation of students who participated in STEM Clubs with major which indicated a significant Pearson chi-square ($\chi^2 = 55.99$, $df = 1$, N = 238, $p < .001$). STEM majors were more likely to have participated in a STEM Club than non-STEM majors. Phi, which indicates the strength of association between the two variables, is -.485 and, thus, the effect size is considered to be large.

Table 32 is the chi-square analysis of students who took calculus, physics, trigonometry, and participated in a STEM Club while in high school. The total percentage of students who reported taking calculus was 14% (n = 33). The percentage of students who reported taking physics was 30% (n = 71). The percentage of students who reported taking trigonometry was 29% (n = 68). The percentage of student who reported participating in a STEM Club was 36% (n = 86).

Additional Findings

Although not one of the original research questions, the researcher found that this additional information might provide valuable information into why students switch college academic majors. This additional research question is numbered as research question seven.

Research Question 7

Is there a difference between genders on: (a) support from advisor, (b) support of professors, (c) support of teaching assistants, (d) support of administrators, (e) support other

students, (f) visit with professors, (g) visit with professors, (h) satisfaction with department, (i) satisfaction with program, (j) satisfaction with faculty, (k) satisfaction with academic performance, (l) satisfaction with intellectual development, (m) satisfaction with social life, (n) satisfaction economics circumstances, and (p) prospects for future employment?

A *t*-test was used to determine whether the responses to the survey revealed attitudinal differences between genders. A *p* value of less than 0.01 was used as a more conservative *p* value than normally used in social science research, since there are multiple *t*-tests. For the variable satisfaction with academic performance, $t = 3.872$, $df = 236$, $p = .001$. Female students were more likely than males to be satisfied with their academic performance. The effect size *d* is approximately .50, which according to Cohen is a medium or typical. For the variable satisfaction with faculty, $t = 2.858$, $df = 236$, $p = .005$. Female students were more likely than males to be satisfied with the faculty. The effect size *d* is approximately .38, a somewhat smaller than typical. For the variable satisfaction with economic circumstances, $t = 2.754$, $df = 236$, $p = .006$. Female students were more likely than males to be satisfied with their economic circumstances. The effect size *d* is approximately .37 a somewhat smaller than typical.

Table 33 *Comparison of Gender on Multiple Variables (n= 157 females, n =81 males)*

Variable	*M*	*SD*	*t*	*df*	*p*	*d*
Satisfaction academic performance			3.872	236	.001	.50
FEMALES	4.5350	.63578				
MALES	4.1605	.82850				
Satisfaction with faculty			2.858	236	.005	.38
FEMALES	4.2930	.73608				
MALES	4.0000	.77460				
Satisfaction economics circumstances			2.754	236	.006	.37
FEMALES	3.7580	1.02783				
MALES	3.3704	1.03010				

Effect sizes were calculated for p values less than .01

Summary of Results

Table 34 shows each research question, the statistically analysis, and the statistically significant results if applicable.

Table 34 Summary of Research Question, Statistical Analysis, and Results

Research Questions	Statistic	variable	*p*	*effect size*	Higher Mean
RQ1: Is there a difference between students who switched college academic majors and those who did not in regard to their:	Independent Sample *t*-test	none significant	-	-	-
RQ2: Is there a difference between genders on:	2x2 ANOVA	Desire to Help Others	.010	S	Female
		Desire to Teach	.010	M	Female
		Mathematics Grades	.001	M	Female
		Science Grades	.008	S	Female
		AP/GT	.008	S	Female
RQ3: Is there a difference between STEM and non-STEM majors on:	2x2 ANOVA	Graduate School	.001	M	STEM
		Professional School	.001	M	STEM
		High Salary	.001	M	STEM
		Research or Practice	.001	M	STEM
		Job Stability	.001	M	STEM
		More Scholarship	.001	L	STEM
		Science Perception	.001	M	STEM
		Mathematics Grades	.001	M	STEM
		AP/GT	.001	M	STEM
RQ4: Is there an interaction between gender and major:	2x2 ANOVA	Discipline or Field	.041	S	a
		Father's Education	.017	S	b
		Science Grades	.030	S	c
RQ5: Is there a combination of factors tested above that will predict STEM enrollment?	Discriminate Analysis	Prepared for STEM			
RQ6: Is there an association between students who took calculus, physics, and trigonometry and participated in a STEM Club while in high school with type of major selected?	Chi-square	Calculus	.001	M	STEM
		Physics	.001	M	STEM
		Trigonometry	.001	M	STEM
		STEM Club	.001	L	STEM
RQ7: Is there a difference between gender on:	Independent Sample *t*-test	Academic Performance	.001	M	Females
		Faculty	.005	M	Females
		Economic Circumstances	.006	M	Females

Note, S = small or smaller than typical, M = medium or typical, L = Large or larger than typical

CHAPTER 5: SUMMARY, DISCUSSION, and RECCOMENDATION

The primary purpose of this study was to determine what factors affect African American students and their choice of college academic majors. It was also the intent of this study to investigate what factors are related to students switching academic majors. The data were obtained from a survey designed to explore the individual factors on students' reasons for choosing academic majors and students' reasons for changing academic majors.

Context of the Study

The site of this study was Southern University and Agriculture and Mechanical College located in Baton Rouge, La. Southern University was established in 1880 as a school of higher learning for "colored" people. The Second Morrill Act of 1891 allowed Southern University to reorganize as a land-grant institution, with separate divisions for agriculture and mechanical arts.

Southern University (2008) had a total enrollment of 7,669 students (NCES 2009). Full time undergraduate students comprised 89% (n = 6,453) of the student body population. Whereas, part time undergraduate students equaled 11% (n = 239) of the student body population. Female students equaled 61% (n = 4,082) and males equaled 39% (n = 2,371). Majority of the undergraduate students were residents of Louisiana (75%).

STEM majors or degrees as defined by the Classification of Instructional Programs (CIP) are areas of study that fall into science, technology, engineering, or mathematics (NCES; CIP 2008). For the purpose of this study all majors were classified as either STEM or non-STEM based on the CIP. This study did not have any students who identified their academic major as engineering or technology.

A sample of 238 students (157 females and 81 males) in various majors participated in this empirical study. Of these students, 182 identified their current academic level as juniors and 56 students identified their current academic classification as seniors. Data were collected from a questionnaire developed by Alfred Hall for his dissertation and modified by the researcher.

Summary of Research Question 1 Findings

An independent samples *t*-test was used to evaluate if there was any difference between students who switched academic majors and those who did not switch academic majors on multiple variables. The data analyses showed that students who switched academic majors were not statistically significant from students who did not switch academic major on all variables. However, satisfaction with the department was nearly statistically significant at $p < .01$, for students who did not switch academic majors. Students who did not switch academic majors had a higher mean than students who switched academic majors on satisfaction with department.

Discussion of Research Question 1

Subtonik and Steiner (1993) student surveyed 38 females and 60 males who participated in a Science Talent Search, they found that male participants who left STEM cited reasons such as poor instruction, unappealing lifestyle, and a developing interest in other areas outside of STEM as reasons for leaving. Female participants left for different reasons, including their perceptions of crowed, impersonal classes and objections to lifestyle they had witnessed in laboratories.

According to the NCES (2002) study, approximately 27% of African American students change majors. My research results indicated that approximately 15% of students changed majors. These results are somewhat lower than the national average for African American students. My expectation for this research question was a higher percentage of students would have reported changing their college academic majors. The nurturing environment that African

American students receive at HBCUs is a possible explanation for my results being lower than national average. Hall's (1999) study revealed that 58% of the students surveyed indicated that they did not consider switching majors or leaving their institution. Of the students who did think about switching only 10.4% thought about switching to a non-STEM major.

Summary of Gender and Major with Interest in Discipline or Field

This survey question asked, the following was a major influence in my decision to choose my college academic major. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major. The research findings indicated there was not a statistically significant main effect for gender and interest in discipline or field. There was not a statistically significant main effect for major and interest in discipline or field. The research findings indicate that there is a statistically significant interaction between gender and major on interest in discipline or field.

Discussion of Gender and Major with Interest in Discipline or Field

The findings of this study did not yield a statistically significant main effect for gender and interest in discipline or field. The literature reviewed in this area did not support my research findings. Lubinski and Benbow (2001) suggest that preferences and attitudes may play an important role in determining whether females select STEM majors, and even in determining which STEM fields' males and females enter. Allard (2006) reported that gender is significantly related to the choice of college major. Allard (2006) further stated that females and males appear to gravitate in different proportions towards different major categories. Females and males may pick college courses, and even majors, which reflect the distribution of females and males in those professions.

My results did not yield a statistically significant main effect for major and interest in discipline or field. The literature reviewed in this area did not support my findings from this research study. National Science Foundation (2008) report stated that males and females select

different types of STEM majors, as males chose computer science, engineering, mathematics, and physics/astronomy more frequently than females.

My research findings indicated there was a statistically significant interaction between gender and major on the variable interest in discipline or field. The research reviewed supported these findings. Trusty (2002) stated that students choosing STEM majors indicated that the number of mathematics and sciences courses enrolled in high school were positively associated with students choosing STEM degrees in college. A study by Ware, Steckler, and Lesserman (1985) stated the factors that affected female students to major in science in college are high paternal education level, very high SAT Mathematics scores, and strong desire for control, prestige, and influence. For males, high grades in freshmen sciences and pre-college science major intentions were positively associated with a major declaration in STEM, while paternal education level had a negative relationship.

Summary of Gender and Major with Desire to Attend Graduate School

This survey question asked, the following was a major influence in my decision to choose my college academic major. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on desire to attend graduate school. There was not a statistically significant main effect on gender on desire to attend graduate school. There was however, a statistically significant main effect of major on desire to attend graduate school. There was not a statistically significant interaction between gender and major on desire to attend graduate school.

Discussion of Gender and Major with Desire to Attend Graduate School

The results from this research study showed that there was not a significant main effect on gender for desire to attend graduate school. These results do not agree with other reported literature which indicated that gender and major are statistically significant factors in a students'

desire to attend graduate school. McCormack (2005) reported that enrollment in graduate programs at American universities increased in 2004; this increase was due to more female and minority students entering graduate programs. Females, who make up 57% of the students attending graduate schools, were largely responsible for the growth, with a 3% increase enrollment in 2004. Men, meanwhile, increased their enrollment in graduate programs numbers by only1%.

The results indicated that there was a significant main effect of major on desire to attend graduate school. The literature reviewed supports the researcher's findings; according to the Council of Graduate School (2007) report, about 50% of African American, 44% of Latino, and 41% of Native American graduate students were enrolled in business and education. Engineering, physical science, and biological sciences accounted for comparatively lower shares of under-represented minorities. Only 9% of African Americans, 12% of Native Americans, and 13% of Latinos were enrolled in these fields.

There was not a statistically significant interaction between gender and major on desire to attend graduate school. The literature reviewed does not support this research finding. According to the Council on Graduate School (2007) graduate enrollment differed markedly by gender, in business, 58% of the students were male, while 75% of those studying education were female. In the field of engineering, physical sciences, and business, collectively, accounted for 49% of total male enrollment, while the fields that enroll the highest shares of women (health sciences, public administration and services, and education) accounted for 50% of total female graduate students.

Summary of Gender and Major with Desire to Attend Professional School

This survey question asked, the following was a major influence in my decision to choose my college academic major. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on desire to attend professional school. There was a statistically significant main effect of gender on desire to attend

professional school. There was not a statistically significant main effect of major on desire to attend professional school. There was not a statistically significant interaction between gender and major on desire to attend professional school.

Discussion of Gender and Major with Desire to Attend Professional School

The current research findings indicated that there was a significant main effect on gender and desire to attend professional school which supports the current literature examining African American students and their desire to attend professional school. According to the U.S. Department of Education, National Center for Education Statistics; and Current Population Survey (2002) women account for nearly half of all enrollments into professional school programs. As reported by *The Journal of Blacks in Higher Education*, African American women make up more than 50% of the African American student body at all the nation's 11 highest ranked law schools.

My research findings indicated that there was not a significant main effect of major on desire to attend professional school which does not support the literature on major and desire to attend professional school. According to *The Journal of Blacks in Higher Education* (2005) from 2002 to 2004 the number of African Americans applying to medical school increased from 2,855 to 3,004.

My research results revealed that there was not a significant interaction between gender and major on desire to attend graduate school. These findings are not supported by the literature reviewed on African Americans and their desire to attend professional schools. According to *The Journal of Blacks in Higher Education* (2004) in 2001, 3,306 African American women earned professional degrees, about 61% of all such degrees awarded to African American compared to 2,110 African American men which were awarded professional degrees.

Summary of Gender and Major with Desire for a High Salary

This survey question asked, the following was a major influence in my decision to choose my college academic major. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on desire for a high salary. There was a statistically significant main effect of gender on desire for a high salary. There was a statistically significant main effect of major on desire for a high salary. There was not a statistically significant interaction between gender and major on desire for a high salary.

Discussion of Gender and Major with Desire for High Salary

Free, Brown, and Clifford (2007) studied differences by race and gender in expected starting salaries for bachelor degree recipients in Connecticut. Using the National Association of Colleges and Employers' (NACE) *Salary Survey* data, which provided the average starting salaries offered nationally to bachelor recipients in 69 different majors. Free et al., compared their results to the 65 majors offered in Connecticut, which revealed that the cumulative percentages of women graduates in the six lowest-paying majors was 20.88% compared to 8.6% for men, with women having a higher percentage of graduates in each of these majors. In contrast, the cumulative percentages of men in each of the six highest-paying majors were more than three times that for women.

Polachek (1978) found that students who place high value on money were more likely to major in business and engineering while students interested in social development were more likely to major in the social sciences than in humanities. The literature supports or agrees with Lips (2001) research with college students that demonstrated that men are more likely to choose a career based on salary earning potential while women are more likely to choose a career where they can enjoy their work and have an influence on other people but not be as highly paid. Green's (1992) research speculated that men, regardless of socioeconomic background, are likely to be

motivated by money and status in their choice of major, and women depending on their financial security were willing to explore majors not directly related to securing a job.

Summary of Gender and Major with Desire to Help Others through Research and or Practice

This survey question asked, the following was a major influence in my decision to choose my college academic major. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on desire to complete research or practice. There was a significant main effect of gender on desire to help others through research or practice. There was a significant main effect of major on desire to help others through research or practice. There was not a statistically significant interaction between gender and major on desire to help others through research or practice.

Discussion of Gender and Major with Desire to Complete Research or Practice

The literature reviewed agrees with my research findings that gender was highly predictive of desire to complete research or practice. Carroll and Brayfield (2007) study examined gender career aspiration of first year law students. Carroll and Brayfield (2007) reported that the majority of both males and females respondents decided to go to law school sometime after graduating from college. Their reasoning for going to law school was to get a practical and flexible degree. Wilder (2007) found that women were significantly more likely than men to work in public interest law (77% women verse 23% men), non-profit (70% women and 30% men); legal services or as public defenders (63% verse 37% of men) and in educational institutions (61% women verse 39% men).

As reported by The Journal of Blacks in Higher Education (2004) African American women make up nearly three quarters of all African American students at Morehouse Medical College and two thirds of the African American dental students at Howard University. The only area where

African American women are not making up the majority of African American students enrolled is at the highest ranked business schools. This study agreed with the literature reviewed.

Summary of Gender and Major with Desire to Teach

This survey question asked, the following was a major influence in my decision to choose my college academic major. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on desire to teach. There was a significant main effect of gender on desire to teach. There was not a significant main effect of major on desire to teach. There was not a statistically significant interaction between gender and major on desire to teach.

Discussion of Gender and Major with Desire to Teach

The results of this research study showed that there was a significant main effect on gender on desire to teach. One reason for the significant findings may be that African Americans select traditional working environments such as education.

The literature reviewed agrees with the research findings. Witherspoon and Speight (2009) study explored African American interest and self-efficacy beliefs in career choice. The results from Witherspoon and Speight study indicated that African American women's interest in traditional occupations was significantly higher than men's interest in traditional occupations.

Henke, Chen, Geis, and Knepper (2000), in a longitudinal study of more than 11,000 college graduates from the class of 1992-1993, in the Baccalaureate and Beyond, found that women were more likely than men to enter the teaching pipeline (i.e., to have taught in a school, to have become certified to teach, to have applied for a teaching position, or to be considering teaching).

The research results from this study revealed that major had a significant main effect on desire to teach. The literature reviewed agrees with my research findings. Guariono, Santibanez,

and Daley, (2006), in their review of recent empirical literature found that four studies concluded that college graduates with the highest levels of measured ability tend not to go into teaching, and two of these studies found that holds primarily for elementary school teachers rather than secondary school teachers. Henke et al. (2000) also stated that graduates whose college entrance examination scores fell in the top quartile were less likely than those in the bottom quartile to enter the teaching pipeline.

Summary of Gender and Major with Desire to Please Parents

This survey question asked, the following was a major influence in my decision to choose my college academic major. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on desire to please parents. There was a significant main effect of gender on desire to please parents. The main effect of major on desire to please parents was not significant. There was not a statistically significant interaction between gender and major on the variable desire to please parents.

Discussion of Gender and Major with Desire to Please Parents

Green and Parker (1965) stated that males, if their relationship with either mother or father was perceived as being warm, protecting, and tangibly rewarding then males gravitate towards person occupations. Cold, negative and punishing parents seem to have little effect upon their son's occupational orientation. For females, it is a dynamically negative father and a more passively negative mother who affects the daughters' orientation towards non-person occupations. Warm, loving parents seem to have little effect upon the females' occupational choice.

Ferry, Fouad, and Smith (2000) stated that emotional warmth and encouragement from parents at an early age can directly influence achievement in mathematics and science courses and hence, overall career aspiration. O'Brien, Friedman, Tipton, and Linn (2000) suggested that attachment to father may become more influential once a young women enters college and the

women with a strong attachment to fathers may tend to choose career paths that more fully use their abilities. This research study findings indicated that there was a significant main effect on desire to please parents and choice of academic major which agrees with the current literature. .

Summary of Gender and Major with Job Stability

This survey question asked, the following was a major influence in my decision to choose my college academic major. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on job stability. The main effect of gender on job stability was not significant. There was a significant main effect of major on job stability. There was not a statistically significant interaction between gender and major on the variable job stability.

Discussion of Gender and Major with Job Stability

My research results indicated that there was not a significant main effect on gender on the variable job stability; these results are not supported by the literature reviewed. Joy (2006) study using data from the National Center for Educational Statistics, Baccalaureate and Beyond Longitudinal study 1993/94 (B&B) found that when choosing a first-job, men were more interested than women in receiving a higher starting salary and in greater potential salary increases. Women were more interested in having time for other endeavors. Men were also 5% more likely than women to have changed their state of residence from college to the labor market.

The literature reviewed does not support the non significant finding from this study on the variable major on job stability. Folbre and Badgett (2003) stated that women may select occupations not only because they desire to do caring types of work but also because these occupations are considered more feminine than other types of occupations, and therefore may be perceived as enhancing their chances in the marriage market. Joy (2006) stated that some college majors are closely linked to occupations while others are not. In the health care and engineering

fields, for example, graduates more often than not choose these majors with a particular occupation or career track in mind. Joy (2006) furthered stated that where the link to major is weaker, variation in student's choice of occupation is much wider.

Summary of Gender and Major with Opportunity for Scholarships and/or Fellowships than Other Majors

This survey question asked, the following was a major influence in my decision to choose my college academic major. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on opportunity for more scholarships. The main effect of gender on opportunity for more scholarships was significant. There was a significant main effect of major on opportunity for more scholarships. There was not a statistically significant interaction between gender and major on opportunity for more scholarships.

Discussion of Gender and Major with Opportunity for Scholarships and/or Fellowships than Other Majors

Much of the current literature on opportunities for more scholarships, deals with states that choose to offer merit based scholarship programs for students to attend in-state universities. The literature discussed the impact of merit based financial aid on enrollment for in-state institutions, states spending more money on merit based scholarship programs verses need based financial aid programs, and the ability of an institution to raise tuition pricing and how that potentially offsets merit based scholarships cost. To qualify for most merit based programs students are expected to have a certain grade point average graduating from high school, make a specific score on a standardized college entrance examination and maintain a prescribed grade point average.

Louisiana has merit based scholarship program called the Taylor Opportunity Program for Students (TOPS). The TOPS is available for all students that choose to attend a specific in-state

college, university or technical college who has met the minimum requirements to be eligible to receive the TOPS award. TOPS eligibility is based on previous academic performance and standardized test scores. For the 2007-2008 academic year, (academic year when research was conducted) 603 Southern University A & M College students participated in this program (LOFSA, 2009). My research findings indicated there was a significant main effect for both gender and major which agrees with the research literature reviewed.

Summary of Gender and Major with Mother's Education

This survey question asked, what is the highest educational level completed by your mother/guardian? A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on mother's education. There was not a significant main effect of gender on mother's education. The main effect of major on mother's education was not significant. There was not a significant interaction between gender and major on mother's education.

Discussion of Gender and Major with Mother's Education

The current research findings did not yield a significant main effect for gender, major, or interaction between gender and major. These finding are not supported by the literature reviewed that examines mother's education and its influence on a student's academic major selection. Simpson (2003) study examined the maternal influences on the choice of academic major. Simpson (2003) concluded that mother's occupational prestige appears to encourage pursuit of technical majors and works through high school, mothers who are house wives remain a robust determinant of choice of major with a direct effect on choice of major, even after the addition of high school and academic preparation.

Majority of the respondents (n = 106) in this study indicated that their mother's highest level of education was some college. This leads me to believe that these students' mothers

probably encourage or suggested that a college education was important to their future but may not have suggested a specific major.

Summary of gender and Major with Father's Education

This survey question asked, what is the highest educational level completed by your father/guardian? A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on father's education.

There was not a statistically significant main effect of gender on the variable father's education. The main effect of major on father's education was not statistically significant. There was a statistically significant interaction between gender and major on the variable father's education.

Discussion of Gender and Major with Father's Education

Although my research findings did not find a significant main effect on gender and major there was a statistical significant interaction between gender and major on father's education. The significant finding is supported by the literature reviewed that examines the effects of father's education on choice of academic major. Leppel, Williams, and Waldauer (2001) stated that female students whose fathers are in professional or executive occupations are more likely to choose the sciences and engineering or health related fields. Leppel et al., said that male students whose fathers are in professional or executive occupations are more likely to choose the humanities and social sciences.

Summary of Gender and Major with Level of Counseling

This survey question asked, my level of high school counseling was high. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on level of counseling. There was not a statistically significant main effect of gender on the variable level of counseling. The main effect of major on

level of counseling was statistically significant. There was not a statistically significant interaction between gender and major on level of counseling.

Discussion of Gender and Major with Level of Counseling

Mahoney and Merritt (1993) study reported that a higher proportion of African American high school seniors than White high school seniors, both male and women considered counselors to be important in helping them make their educational and vocational plans. The study further states that African American men, were more likely to use school counseling services to overcome academic weakness than White men, and when they used them African American students generally found them to be more helpful.

Sonaike (2007) stated that counselor's ethnicity greatly influences the choices of student's college and academic majors. This was more prominent with male students than with female students. Also, counselor's gender influenced the choices of student's colleges and majors. Male Hispanic students tended to prefer male counselors more than male Asian and African American students. Students that rated their level of counseling to be high tended to choose STEM majors.

Summary of Gender and Major with High School Preparation

This survey question asked, my high school education adequately prepared me for the rigorous nature of an agricultural, mathematical or science related academic major. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major high school preparation. There was a statistically significant main effect of gender on high school preparation. The main effect of major on high school preparation was statistically significant. There was not a statistically significant interaction between gender and major on high school preparation.

Discussion of Gender and Major with High School Preparation

Tyson, Lee, Borman, and Hanson (2007) reported that women generally complete higher level course slightly more often than men, and there are few differences on course taking at the highest levels. Around 25% of both women and men take physics and more men take chemistry II or physics II even though it is a small number. Mathematics shows similar trends, as 22.8% of women take calculus or advance II courses compared to 19.1% of men. Men are more likely to take advance II and calculus III at 8% compared to 7.4%.

Adelman (1999) identified a "toolbox" of high school courses considered crucial in preparing a student for postsecondary participation, including mathematics, science and foreign language. Those whose high school curricula include advance levels of these courses tended to perform better in college, net of high school grades or standardized test scores. Students who study higher levels of mathematics in high school are also disproportionately likely to enter a doctoral degree-granting institution (Adelman, Daniel, Berkovitz, and Owings, 2003). Adelman et al., stated that students whose highest level of mathematics in high school as at the trigonometry, precalculus, or calculus level had bachelor's degree completion rates about 60% for students who completed a calculus course in high school, the bachelor's degree competition rate was 83%.

The significant findings for gender and major are supported by the literature cited. The respondents that participated in this research study revealed comparable calculus, physics, and advance mathematics/trigonometry course completion percentages with the cited literature.

Summary of Gender and Major with Mathematics Perception

This survey question asked, I find mathematic to be easy. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on mathematics perception. There was not a statistically significant main effect

of gender on the variable mathematics perception. The main effect of major on mathematics perception was not statistically significant.

Discussion of Gender and Major with Mathematics Perception

The results of this research study did not indicate a significant main effect on gender, major, or an interaction between gender and major. This is not supported by the literature reviewed on mathematics perception. Furner and Duffy (2002) stated that 93% of Americans feel negatively about their past mathematics education and more than two-thirds of U.S. adults are estimated to have math-related fear. Steen (1999) found that most U.S. students leave high school with far below even the minimum expectations for mathematics understanding and literacy.

Summary of Gender and Major with Science Perception

This survey question asked, I find science to be easy. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on science perception. There was not a statistically significant main effect of gender on science perception. The main effect of major on science perception was statistically significant. There was not a statistically significant interaction between gender and major on science perception.

Discussion of Gender and Major with Science Perception

The research findings did not yield a significant main effect for gender, which is not supported by the current literature on science perception. Research indicates that female high school students feel less confident than male students about their abilities and likelihood of success in physical science and engineering professions, but feel more confident in health related professions that rely heavily on training in the biological sciences and in business and managerial positions that rely on applied mathematics skills (Bae and Smith, 1996).

The non-significant results for gender on the variable science perception were somewhat surprising; HBCUs produce more African American engineers and scientist than traditional majority colleges and universities. The research results revealed that 27 percent of females who participated in this study took physics, which according to pervious cited literature is comparable to national averages. The percentages for males who took physics were also comparable to the previously cited literature.

The main effect of major was significant and was supported by the literature. Udo, Ramsey, and Mallow (2004) stated that science anxiety acts as a career filter, preventing students from entering certain fields because they fear enrolling in prerequisite science courses. Jacobs, Finken, Griffin, and Wright (1998) stated that females are more likely to indicate interest in biology than physical science and were more likely to predict having future careers in health sciences than the physical sciences.

Summary of Gender and Major with Parental SES

This survey question asked, my family's yearly income is. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on parental SES. There was not a statistically significant main effect of gender on parental SES. The main effect of major on parental SES was not statistically significant. There was not a statistically significant interaction between gender and major on parental SES.

Discussion of Gender and Major with Parental SES

My findings differ with the current literature on parental SES and academic major choice. Leppel, Williams, and Waldauer (2001) reported that having a father in a professional or executive occupation has a larger effect on female students than does having a mother in a similar occupation. The opposite holds true for males. My research findings did not indicate a significant main effect on gender and major or interaction between gender, and major.

Summary of Gender and Major with Mathematics Grades

This survey question asked, would you say most of the grades you earned in your high school mathematics courses were. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on mathematics grades. There was a statistically significant main effect of gender on mathematics grades. The main effect of major on mathematics grades was statistically significant. There was not a statistically significant interaction between gender and major on mathematics grades.

Discussion of Gender and Major with Mathematics Grades

The grades that students earn in high school reflect several different aspects of the process of educational attainment (Linn & Kessel 1996). First, they represent students' ability to master the curricular material of a certain class. Yet they also capture the degree to which a student meets teacher expectations, both in terms of actual performance and more subjectively, in terms of attitude and behavior (Moreno & Muller 1999). Additionally, grades reflect students' effort and engagement, as they make choices concerning how hard they work and study for a certain course (Rosenbaum, 2001).

In general, high school females earn higher grades compared with males in all subjects, including mathematics (National Center for Educational Statistics 2001), but males score higher in standardized testing (Downey & Yuan, 2005). Downey and Yuan also stated that females' better grades are primarily a function of their more agreeable classroom behavior, an advantage that generalizes to all subjects. In contrast, the tendency for males and females to be involved in different activities outside of the classroom helps explain the sex difference in test scores. Gender differences in the extent to which males and females value mathematics do not appear to be present during elementary school (Jacobs et al., 2002; Wigfireld, Eccles, MacIver, Reuman, & Midgley, 1991). There is, however, some evidence for gender differences in the value of

mathematics for older adolescents and higher achieving populations (Eccles, 1994). High school males have been found to report greater interest in mathematics and rate mathematics higher in utility value, particularly advance mathematics, than do high school females (Eccles, 1983).

Tyson, et al., (2007) reported that students who complete advance mathematics courses have higher educational attainment within Florida than their classmates at Algebra II or below. Around 40% of students in the Trigonometry and Statistics and Precalculus groups in high school obtain a baccalaureate degree from a Florida 4-year university within 6 years. Calculus makes the largest contribution to degree attainment with 46.7% of students who take this course successfully in high school obtaining a Florida public university degree. Tyson et al., also stated among these students almost half of the 2,324 STEM degree recipients in the 1996-1997 high school graduating class (1,131, 48.7%) took a calculus course.

My research findings agree with the literature reviewed that examines gender and major on mathematics grades. Students who choose to major in STEM related fields usually have at their foundation high school advance levels of mathematics courses. High school mathematics course completion is sequential which is predicated by early success in mathematics course, which usually translates into students that have positive grades in these courses.

Summary of Gender and Major with Science Grades

The survey question asked, would you say that most to the grades you earned in your high school sciences courses were. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on science grades. There was a statistically significant main effect of gender science grades. The main effect of major on science grades was not statistically significant. There was a statistically significant interaction between gender and major on science grades.

Discussion of Gender and Major with Science Grades

Farmer, Wardrop, Anderson, and Risinger (1995) reported that science GPA had a moderate total effect on persistence for males but not for females in their study. Science GPA in high school was not a critical variable for women's persistence in a science related field. Madigan (1997) showed that students who took more rigorous science courses had greater increase in science proficiency, regardless of their initial proficiency levels, and that the rigor of science courses was more important than the number of science courses for increasing proficiency. Tyson et al., (2007) study reported that over a quarter of the students in their study, the highest science course completed was a secondary life science course such as general biology, ecology, zoology or marine biology. Tyson et al., also reported that 22.3% of students reported taking chemistry-I and 24.7% of students completed or took physics. Only 425 students took chemistry II or physics II. Over 72% of graduates completed a biology, chemistry or physics course with a C or above.

The main effect of major was not significant and does not agree with the literature reviewed on science grades and academic major. Seymour and Hewitt (1997) stated that women question the societal relevance of science, technology, engineering, and mathematics (STEM) careers and leave these academic majors despite high grades and other indicators of academic success, for majors that will lead to more personally fulfilling careers. Fouad and Smith (1996) stated that during early school years, girls have more science interest and better grades than boys. The sexes begin to diverge in science interest and achievement at the start of high school, and this difference becomes pronounced in further education (Holden, 1987). Attribution patterns for girls success in science (as well as mathematics, which is essential to science) change as girls get into high school, moving from ability and interest in science and mathematics to a decreased interest and effort in these areas (Seymour, 1995).

Summary of Gender and Major with Advance Placement/Gifted Talented

The research question was: Did you take any Advance Placement (AP) or Gifted Talented (GT) courses in grades in 9-12. A factorial ANOVA (analysis of variance) was used to determine the differences between gender, major, and interactions between gender and major on advanced placement/gifted talented courses taken. There was a statistically significant main effect of gender on advance placement/gifted talented courses taken. The main effect of major on advance placement/gifted talented courses taken was statistically significant. There was not a statistically significant interaction between gender and major on advance placement/gifted talented courses taken.

Discussion of Gender and Major with Advanced Placement/Gifted Talented

The findings from this study are consistent with the literature on gender and advance placement/gifted talented students and their choice of college academic major. Advance Placement (AP) courses provided demanding college-level coursework in high school. The AP program involves a collaborative effort between high schools and colleges. High schools provided the instruction in a variety of different college-level course to selected students. The students complete AP examinations covering the college-level courses material and submit the scores to colleges and universities (Ackerman, Bowen, Beier, & Kanfer, 2001). The tests are scored on a range of one to five. Students that receive 4 or 5 are most often given college credit whereas those obtaining scores of one or two are almost always denied (Ackerman et al, 2001).

The College Board (2007) reported that there is a national difference in enrollment rates of boys and girls. Typically, a greater percentage of males enroll in mathematics and science AP courses than do females, whereas a greater percentage of females enroll in AP languages, literature, and history courses.

Ackerman, et al. (2001) reported from data taken from the College Board (2000) reported that 574,905 test were administered to males and 667,419 test were administered to females. Scores of 4 or 5 were obtained by 225,575 males but only 217,572 females. Even though, 92,514 more test were taken by females, males obtained more passing scores than females (39.2% verse 32.6%).

Tolan (1994) stated that gifted individuals are usually identified during childhood, when their characteristics, behaviors, and age at reaching developmental milestones are significantly different from those of their chronological age peers. Freeman, (2000) stated that gifted females are twice as likely as their males counterparts not to be identified as talented.

This dissertation found that there was a significant main effect between major on advance placement/gifted talented on academic major selection. Theses finding are congruent with the current literature on this subject. Kerr and Colangelo (1988) examined the college plans of academically gifted high school students. Among these highly talented students, the most popular majors were in engineering and health sciences. Kerr and Colangelo did find differences between the genders, males were much more likely to choose an engineering and or physical science major and females were more likely to choose biology major. York (2008) reported that a significantly greater proportion of males than females said they were interested in majoring in mathematics, computer science, or engineering and a significantly greater proportion of females than males were interested in majoring in the humanities or social sciences.

The interaction between gender and major on advance placement/gifted talented was not significant. These finding are inconsistent with the literature reviewed on this subject. Santoli, (2002) reported that a significant difference in college majors chosen by AP and non-AP students, concluding that AP student choose more challenging majors, including students majoring in the natural sciences, than do non-AP students. Kerr et al., stated that when highly talented students

were presented with 196 choices of college majors, 50% crowded into 3 categories: engineering (25.7%), health professions (12.3%), and physical science (10.1%). Social sciences (9.3%) undecided (9.2%) were also relative popular areas. Highly talented students avoided majors in agriculture (0.2%), trades (0.3%), and home economics (0.1%), all associated with high school vocational education, which student typically guided away from.

Summary of Research Question 5

Discriminate analysis was conducted to access whether the predictors, interest in the discipline or field, desired to attend graduate school, desire to attend professional school, desire for high salary, desire to complete research or practice, desire to teach, desire to please parents, job stability, opportunity for more scholarships, STEM Club membership, high school counselor, highest level mother education, highest level father education, quality of counseling in high school, high school preparation, perception of mathematics, perception of science, grades in high school mathematics, grades in high school science classes, physics, calculus, trigonometry, and gifted and talented/ advanced placement classes, could distinguish those who choose STEM majors from those who choose non-STEM majors.

Discussion of Research Question 5

The initial discriminate analysis was conducted to determine which combination of variables contributed the most to STEM major prediction. Wilks' lambda was significant which indicated which variables were able to identify between the two groups. The predictor variables that were identified as the variables that contributed most to STEM major selection were, high school preparation, science background, science perception, job stability, and STEM Club membership.

A second discriminate analysis was conducted using the items that were identified as contributors to STEM major. Of the five items included in the function, (high school preparation,

science background, science perception, job stability, and STEM Club memberships) two items (high school preparation and science background) contributed most to distinguish those students who choose STEM majors from non-STEM majors. The results from this study are congruent with the literature on variables that predict college academic major selection.

Nicholls et al., (2007) suggested that the variables most valuable in identifying students potentially inclined to study a STEM area include both quantitative measures of academic ability and qualitative measures of interests, attitudes, and personal characteristics. Specifically, quantitative indicators of strong STEM interest include high SAT mathematics scores, high school grade point average, and to a lesser extent SAT verbal scores. Qualitative measures such as self-ratings of mathematical ability, computer skills, and academic ability are good indicators of a STEM orientation while needing remedial mathematics training is a good indicator of a non-STEM orientation.

Summary of Research Question 6

A cross-tabulation was used to determine the association between students who took calculus, physics, and trigonometry and were a member of a STEM Club while in high school and major. A significant Pearson chi-square was yielded between calculus, physics, trigonometry, and STEM Club and major. The effect sizes ranged between medium and large for all.

Discussion of Research Question 6

My expectations of this research question were that student who took calculus, physics, trigonometry, and participated in STEM Clubs in high school would have a higher likelihood of entering college and choosing a STEM major. Literature in the area of high school students who participated in STEM related clubs support the findings of this study.

Hall (1999) study revealed that 41% of students took calculus in high school, 70% took physics, and 78% took trigonometry. The results from my dissertation revealed that approximately

14% of the respondents took calculus, 30% took physics, and 30% took trigonometry. Hall's results were due to having a higher number of students (n=320) and all of his respondent were in STEM majors.

Yelamarti and Mawasha (2008) study examined a pre-engineering program for under-represented low-income and/or first generation college students. The program participants were 7th through 10th grade students in Dayton Public School (DPS) system. Of the students that participated in the program and graduated from college, 47% majored in a STEM discipline.

Lam, Srivatsan, Doverspike, Vesalo, and Mawasha (2005) study reported on a ten year assessment of the pre-engineering program for under-represented, low income and/or first generation college students at the University of Akron. The students who participated in this study were identified in high school. Lam et al., reported on data obtained from the past ten years, 100% of the participants from their program graduated from high school, 94% of the participants entered college. The 68 seniors that graduated from the academic program, 38 attended The University of Akron. Twenty four of the 38 students majored in STEM, overall 45 out of the 68 majored in a STEM career area.

Summary of Additional Findings Research Question 7

A *t*-test was used to test whether the responses to the survey revealed attitudinal differences between genders. A *p* value of less than 0.01 was used as a more conservative *p* value than normally used in social science research, since there are multiple *t*-tests. Females were significantly higher than males on support from advisor, satisfaction with department, satisfaction with academic performance, satisfaction with intellectual development, and satisfaction with economic circumstances. Males were significantly higher than from females on the variable visits with professors.

Discussion for Additional Findings Research Question 7

This research question is based on student's perception, examining the differences, if any, in rating of satisfaction between male and female students. Understanding the importance of student satisfaction, much of the contemporary literature is devoted to academic achievement (DeBerard, Spielmans, and Julka, 2004; Donhardt, 2004) and student retention (Allen, Robbins, Casillas, and Oh, 2008; Elliott, 2003; Lau, 2003). The findings in this study are consistent with Thomas and Galambos (2004); Hale, Graham and Johnson (2009); Suhre, Jansen, and Harskamp (2006) studies. Each of the studies found student satisfaction was paramount to retention.

Prior to conducting the statistical analysis, the variables I thought would rate highest were satisfaction with academic performance, prospects for future employment, satisfaction with program of study and satisfaction with faculty. My expectations for this outcome were based on the academic level of the students who participated in the study. The students who participated in this research study have achieved a certain level of academic success based on their academic level at the time the survey was given. Taking into consideration that these students were either going to progress towards graduation or leave the university I believed that the combination of variables identified would be the most important or the most logical choice. Borden (1995) also found a strong relationship between student satisfaction and persistence.

Epilogue

Hall's (1999) dissertation analyzed characteristics of undergraduate African American students participating in the Alliance of Minority Participation (AMP) program. The participants were STEM majors located in six different states in the Southeast region of the United States, who attended either Historically Black Colleges and Universities or Primarily White Institutions.

Hall's dissertation had four primary research questions:

1. How are AM students characterized in regards to: (a) their reasons for majoring in their field, (b) their level of satisfaction, (c) their reason for thinking of switching majors, (d) their impressions of support programs and persons, (e) their impressions of faculty and advisors, (f) their emotional self-descriptors, and (g) their level of high school preparation?
2. Do African American AMP students attending Majority White Institutions have different characteristics among the various groups of factors as compared with those attending Historically Black Colleges and Universities?
3. Are there any distinguishing or different patterns of student characteristics, among the groups of factors, affecting African American students in the five alliances participating in this study?
4. Are African American AMP students attending Majority White Institutions significantly different from those attend Historically Black Colleges and Universities in terms of financial need, parental college attendance, and level of high school preparation and achievement in science and mathematics?

Hall's data collection was based on a one time survey questionnaire with randomly selected students for follow up interviews and focus group session. Hall distributed a total of 809 survey questionnaires to AMP participants at 24 different colleges and universities in the Southeast region of the United States. The states represented were, Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina. Hall had a 40% response rate for a total of 320 completed survey questionnaires.

As noted in Chapter III, this dissertation used a modified version of the questionnaire Hall used to conduct his research study. The similarities between this dissertation and Hall's

dissertation are based on both studies using African American students located in the Southeast region of the United States and limited to Hall's first research question.

Each heading or section of Hall's first research question was comprised of additional questions, factors, or variables that consisted of Likert Scale items with a range of 1 – 4. With 1 representing "Not at all Important," 2 representing "Not too Important," 3 representing "Somewhat Important," and 4 representing "Very Important." Hall examined the mean, median, and standard deviation for each item in the group.

The following is a comparison of Hall's first research question results by sections using the individual factors as the focus of comparison with the results of this research study. Although, this study and Hall's study used many of the same variables or factors, there were variables or factors that Hall used exclusively. Also, this study used these variables or factors in more complex statistically analysis verses Hall's analysis using the mean, median, and standard deviation. Additional analysis were completed using the same variables or factors (were appropriate) that Hall used for his study to compare the mean, median, and standard deviation as a method to accurately compare Hall's results to the results from this study. Hall's results were reported as he originally stated them with factors or variables his participants indicated were pertinent.

How are AM students characterized in regards to: (a) their reasons for majoring in their field, (b) their level of satisfaction, (c) their reason for thinking of switching majors, (d) their impressions of support programs and persons, (e) their impressions of faculty and advisors, (f) their emotional self-descriptors, and (g) their level of high school preparation?

(A) Their reasons for majoring in their field consisted of the following variables: Interest in field; Desire for a high salary; Loved science/mathematics as a child; Desire to help others through research; Desire to go to graduate school; Shortages of minorities in the field; Desire to go to professional school; Encouragement from mentors; More available scholarships; Desire to please

parents; and Desire to teach. Hall used the mean and median to identified three factors that AMP participants indicated as the most important reasons for them to major in their field: their *Interest in their Field* (3.76, 4.0), their *Desire for a High Salary* (3.50, 4.0), and they *Loved Science/Mathematics as a Child* (3.46, 4.0).

An analysis using mean and median revealed comparable results for the following factors: Interest in disciple or field (4.40, 5.0), Support of advisor (4.00, 4.0), and Desire for a high salary (3.79, 4.0). These would have rated highest for the reason for selecting their major.

(B) Their level of satisfaction with themselves and their institution consisted of the following factors: Program of study; Treatment as a student; Intellectual development; Prospects for future employment; Relationship with other AMP students; College or university; Department; Faculty in their department; Support programs for students; Social life; Academic performance; and Economic circumstances. Hall's results revealed that the AMP program participants were most satisfied with their: *Program of study* and (3.30, 3.0) and their *Treatment as a student* (3.28, 3.0) and they were least satisfied with their *Academic performance* (2.85, 3.0) and *Economic circumstances* (2.52, 3.0).

In comparison the students who participated in this study indicate that they were most satisfied with their: *Academic performance* (4.40, 5.0) *and Prospects for future employment* (4.43, 5.0) and they were least satisfied with *Social life* (3.79, 4.0) and *Economic circumstances* (3.62, 4.0).

(C) Their reasons for thinking of switching majors, consisted of the following factors: Other majors appeared easier; Dissatisfied with their academic performance; Other majors were more interesting; Dissatisfied with program of study; Dissatisfied with faculty in their department; Uninterested in major field; Dissatisfied with advisor; Class sizes were too large; Faculty or advisor advised student to leave. The factors the AMP participants identified as reasons for switching

majors were: *Other majors appear easier* (2.51, 3.0) and *Dissatisfied with academic performance* (2.44, 2.0). Hall also examined financial and personal reasons for switching and/or leaving which revealed which revealed students feeling Burn-out (2.47, 3.0) and too much stress and or pressure in major field.

The results from this study indicated: *Other majors were more interesting* (1.16, 1.0) and *Other majors appear easier* (1.04, 1.0). For the personal and financial reasons for switching the students who participated in this study indicated: Too much effort required (1.10, 1.0) and Too much stress and/or pressure (1.06, 1.0).

(D) Their impressions of support programs and person consisted of the following factors: AMP program directors are genuinely concerned with student success; AMP program attempts to help/encourage students having difficulty in their field; Students are encouraged to attend peer study groups by faculty and AMP directors; and Students have several opportunities to work in study group with peers. This study did not collect data using these variables.

(E) Their impressions of faculty and advisors at their institutions revealed that some: Faculty attempt to "weed out" weaker students in their major, students revealed that they were Comfortable in going to talk with faculty when having trouble in a course, and Faculty attempt to help students having difficulty in their major. Students revealed that their advisors took interest in their academic performance and students responded most negatively to interest in undergraduate research. This study did not collect data using these variables.

(F) Their emotional self-descriptions revealed: many of the classes in their major are highly competitive, and classes in their major should be highly competitive. AMP students responded felt they: Capable, happy, and occasionally feeling stressed, satisfied, and burned-out. This study did not collect data for this variable.

(G) Their level of high school preparation revealed: that majority of the respondents agreed that their high school education adequately prepared for the rigorous nature of a STEM major (3.65, 4.0). The results from this research study were somewhat lower (2.73, 3.0) in regards to their belief that their high school education adequately preparing them for the rigorous nature of a STEM major.

Limitations of the Study

Students were asked to state their perceptions which may have been influenced by factors at their institutions over which the researcher had no control. There is a possibility that students decided to answer research questions with biases or over/under emphasized results. Some questions may have been perceived as sensitive area for students.

The second limitation to this study was the percentage of students that reported their college academic level at junior verse senior. Over 75% of the students indicated that their college academic level was junior. I think the results would have been significantly different with a more diverse (Junior vs. Senior) student population of respondents.

The third limitation to this study was this study was conducted at an HBCS located in the southeastern region of the United States. Although students that attend this university are from all parts of the United States, majority of the students that participated in this study were from the region of the United States where the university is located.

Recommendations for Practice

The findings of this research study suggest that there are several factors that may contribute too or have an influence on African American students and their choice of college academic majors. This study suggested that African American students must develop an early interest in mathematics and science and have this interest cultivated and nourished throughout their K-12 educational experiences. Students must be encouraged to take higher levels of

mathematics and science courses in their K-12 education. To ensure entry into the STEM pipeline, African American students must take the prerequisite mathematics and science feeder courses in high school. A culture of expectation must be developed and successes must be celebrated. . Research has shown that students that take advanced levels of mathematics and science course have earlier success in STEM related areas and have higher retention rates in STEM areas which leads to graduation in a STEM related field.

The mentoring process or exposure to individuals in STEM fields must happen at an early age for African American students. It is imperative for some younger African American students to have a positive role model or mentor that will provide them with a different perspective about education and their potential futures.

African American female students' need more encouragement and motivation to enter and remain in the STEM pipeline. In general, female students have outperformed male students in the K-12 environment as well as displaying an early interest in mathematics and science. African American female students must be shown the relevance of and opportunities for them in STEM fields.

Recommendations from Experience and Literature

Researchers have reported that children have realistic career aspiration or ideas of what type of work they would like to do once they become adults. These studies have reported that as early as the second grade children have self identified potential careers. These career goals are usually developed by their interaction with family members, media outlets, or more often than not teachers. This leads me to believe that early education teachers have to introduce young African American students to individuals in STEM related fields. It becomes a shared responsibility between teachers and individuals in STEM fields to present information to young African American

students which will be relevant to their personal lives. Making this connection will ensure that some young African American students develop an initial interest in mathematics and science.

Recommendations for Future Research

While this study yielded results related to factors related to college academic major selection, there are additional methods to significantly contribute to the existing literature on this subject. I would recommend repeating this study and dividing the participants based on their geographical point of origin. This comparative study would examine African American students from different geographical regions of the United States. The results would reveal if there are difference or similarity based on geographical regions with regard to factors involving selecting college academic majors, differences in high school preparation, freshman year academic achievement, and the percentage of students who choose STEM majors or not. The results could reveal if certain regions of the United States are responsible for producing a greater percentage of STEM majors and the factors that affect their choice of decision of college academic major.

Another area that I would recommend for future research would be a longitudinal study that examines high achieving African American high school students who have self identified as a potential STEM major. This study could reveal why some African American students leave the STEM pipeline or add to the growing information on students who remain and if they persist toward graduation, change majors or leave the university.

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Appendix A Questionnaire

Factors assocaited college major selection survey

Directions

Please complete all appropriate items, as accurately as possible, by circling or writing that best describe you or your opinion.

Part I. Influential Factors

SA= STRONGLY AGREE **A**= AGREE **N**= NEUTRAL **D**= DISAGREE **SD**= STRONGLY DISAGREE

1. The following was a major influence in my decision to chose my college academic major:

a. Interest in the discipline or field	SA	A	N	D	SD
b. Desire to go to graduate school	SA	A	N	D	SD
c. Desire to go to professional school (e.g. medical, dental, etc.)	SA	A	N	D	SD
d. Desire for a high salary	SA	A	N	D	SD
e. Desire to help others through research and or practice	SA	A	N	D	SD
f. Desire to teach	SA	A	N	D	SD
g. Desire to please parent(s)	SA	A	N	D	SD
h. Job stability	SA	A	N	D	SD
i. Need for more ethnic minorities	SA	A	N	D	SD
j. Other family members	SA	A	N	D	SD
k. Opportunity for more scholarships and/or fellowships than other majors	SA	A	N	D	SD
l. Other, please explain _____					

2. Were you a member of any club/organization that had at its foundation mathematics and science while in high school?
_____ Yes _____ No

3. To what level did your participation in this club/organization influenced your decision to chose your major?

	SA	A	N	D	SD

4. Please indicate your personal opinion and/or perceptions of each statement.

a. My high school education adequately prepared me for the rigors nature of an agricultural, mathematical or science related academic major	SA	A	N	D	SD
b. My high school counselor helped me select classes that would prepare me for an agricultural, mathematical or science related academic major.	SA	A	N	D	SD
c. My level of high school counseling was high.	SA	A	N	D	SD

Part II. Recruitment Factors

Please answer each question to the best of your ability.

5. Were you recruited by the department? _____ Yes _____ No

If so, how? _____

6. Were you offered any financial assistance by the department? _____ Yes _____ No
If so, what type? (check all that apply)
Scholarship _____
Fellowship _____
Graduate assistantship _____
Work study _____

7. Would you be enrolled if you were not receiving any type of financial assistance? _____ Yes _____ No

8. Receiving financial assistance impacted my decision to enroll	SA	A	N	D	SD

Part III. Student Experiences

SA=STRONGLY AGREE **A**=AGREE **N**=NEUTRAL **D**=DISAGREE **SD**=STRONGLY DISAGREE

9. Do you have an advisor in your major field of study? **(Circle answer)**

a. Yes
b. No, please skip to question # 12

10. How were you paired with your advisor?

a. Assigned based on an alphabetical list of your last name					
b. Assigned based on area of specialization	SA	A	N	D	SD
c. Both A & B	SA	A	N	D	SD
d. Selected own advisor	SA	A	N	D	SD
e. Do not know	SA	A	N	D	SD
f. Other, please explain, _____	SA	A	N	D	SD

11. The following are supportive of me within the department:

a. Advisor					
b.. Professors	SA	A	N	D	SD
c. Teaching assistants	SA	A	N	D	SD
d. Administrator	SA	A	N	D	SD
e. Other students	SA	A	N	D	SD
	SA	A	N	D	SD
12. I visit with my professors, faculty and/or advisor outside of class					
a. 1 - 2 times per week	SA	A	N	D	SD
b. More than twice per week	SA	A	N	D	SD

Part IV. Student Perceptions

13. How satisfied are you with :

a. Your department	SA	A	N	D	SD
b. Your program of study	SA	A	N	D	SD
c. The faculty in your department	SA	A	N	D	SD
e. Your academic performance	SA	A	N	D	SD
f. Your intellectual development	SA	A	N	D	SD
g. Your social life	SA	A	N	D	SD
h. Your economic circumstances	SA	A	N	D	SD
i. Your prospect for future employment	SA	A	N	D	SD
14. I have seriously considered switching academic majors					
(If you have not then go to question # 18)	SA	A	N	D	SD

15. If you switched college academic majors please indicate your previous and new major.

From **To**

_____ _____

16. How strongly did each of the following affect your thoughts about switching majors?

a. Not interested enough in your major to continue	SA	A	N	D	SD
b. Dissatisfaction with your program of study	SA	A	N	D	SD
c. Dissatisfaction with the faculty in your department	SA	A	N	D	SD
d. Dissatisfaction with your advisor	SA	A	N	D	SD
e. Faculty or advisor advised you to switch major	SA	A	N	D	SD
f. Dissatisfaction with your academic performance	SA	A	N	D	SD
g. Other majors appeared to be easier	SA	A	N	D	SD
h. Other majors appeared to be more interesting	SA	A	N	D	SD
i. Not interested in employment opportunities in major field of study	SA	A	N	D	SD
j. Class sizes too large	SA	A	N	D	SD
k. Other reason, please specify: _____	SA	A	N	D	SD

Part IV. Student Perceptions

SA=STRONGLY AGREE **A**=AGREE **N**=NEUTRAL **D**=DISAGREE **SD**=STRONGLY DISAGREE

17. How strongly did each of the following personal reasons affect your thoughts about switching academic major

a. Family pressure (e.g., had to work to support family)	SA	A	N	D	SD
b. Too much effort required to excel in your major	SA	A	N	D	SD
c. Too much stress and/or pressure	SA	A	N	D	SD
d. Burned out	SA	A	N	D	SD
e. Unhappy with your decision to major in agriculture, mathematics and/or science	SA	A	N	D	SD
f. Lack of motivation	SA	A	N	D	SD
g. Illness or health problems	SA	A	N	D	SD
h. Did not feel you belonged in department or academic major	SA	A	N	D	SD

j. Other reasons, please specify _____

18. Please indicate your personal opinion and/or perception of each statement.

a. My first exposure to an African American mathematican or scientist was in elementary or middle school.	SA	A	N	D	SD
b. Junior or Senior high school.	SA	A	N	D	SD
c. My role model was a family member	SA	A	N	D	SD
d. My role model was someone other than a mathematican or scientist	SA	A	N	D	SD
e. College	SA	A	N	D	SD
f. I find mathematics to be easy	SA	A	N	D	SD
g. I find science to be easy	SA	A	N	D	SD
h. I would describe my family background as agricultural	SA	A	N	D	SD

Part V. Demographic Data

Please circle or write the appropriate answer.

19. What is your academic classification?
a. Freshmen
b. Sophomore
c. Junior
d. Senior
e. Graduate: Masters

20. What is your age? _____

21. What is your gender?
a. Male b. Female

22. What is your current enrollment status?
a. Full time student b. Part-time student

23. What is your current grade point average?
a. 3.5 - 4.0
b. 3.0 - 3.49
c. 2.5 - 2.99
d.2.0 - 2.49
e. below 2.0

24. What is your current major? _____

25. What is the highest educational level completed by your mother/guardian?
a. Less than high school
b. High school graduate
c. Some college
d. Bachelor's degree
e. Graduate or professional degree

26. What is the highest educational level completed by your father/guardian?
a. Less than high school
b. High school graduate
c. Some college
d. Bachelor's degree
e. Graduate or professional degree

27. My family's yearly income is
a. less than $20,000
b. $20,000 - $49,999
c. $50,000 - $74,999
d. $75,000 - $99,999
e. $100,000 or more
f. unknown

Part VI. High School Preparation and Achievement

Please circle all that apply.

28. Please indicate all of the science courses you took in grades 9 - 12
a. Biology
b. Chemistry
c. Earth/Physical Science
d. Physics
e. Other(s), please specify _____

29. Would you say most of the grades you earned in your high school sciences courses were.....
a. mostly A's
b. half A's and half B's
c. mostly B's
d. half B's and half C's
e. mostly C's
f. half C's and half D's
g. mostly D's or below

30. Please indicate all of the mathematics courses you took in grades 9 - 12
a. Algebra I
b. Algebra II
c. Calculus
d. Geometry
e. Trigonometry
f. Other(s), please specify _____

31. Would you say most of the grades you earned in your high school mathematics courses were.....
a. mostly A's
b. half A's and half B's
c. mostly B's
d. half B's and half C's
e. mostly C's
f. half C's and half D's
g. mostly D's or below

32. Did you take any Advance Placement (AP) or Gifted and Talented (GT) courses in grades 9 - 12
a. Yes
b. No

33. If yes, please indicate each AP or GT course that you took and the grade-level in which you took it.

Course	Grade - level			
_____	9	10	11	12
_____	9	10	11	12
_____	9	10	11	12
_____	9	10	11	12

Thank you for your participation in this research study. Your responses will help shed more light on some of these issues that many ethnic minority students, like yourself face everyday.

Appendix B Institution Review Board Approval Colorado State University

SmartZone Communications Center Collaboration Suite wmellion@comcast.net

The following Protocol has been Approved: 08-645H

Sunday, January 04, 2009 4:05:15 PM

From: Janell.Anita.Meldrem@ColoState.EDU

To: Evelyn.Swiss@ColoState.EDU; Gene.Gloeckner@ColoState.EDU; Timothy.Davies@ColoState.EDU; Molly.Gutilla@colostate.edu; wmellion@comcast.net

The IRB has approved your protocol referenced below:

Protocol ID: 08-645H
Principal Investigator: Gloeckner, Gene

Protocol Title: Predictive Factors Associated with Ethnic Minorities' Selection of College Academic Major: Emphasis on Mathematics and Science Selection
Review Type: Expedited
Approval Date: 04/09/2008

This is not an official letter of approval. Your approval letter will be created within the next few days, and will be available to you on eProtocol.

If you have any questions regarding this approval, please contact:

Janell Barker: Janell.Barker@Research.Colostate.edu ; 491-1655
Evelyn Swiss: Evelyn.Swiss@Research.Colostate.edu ; 491-1381

TO ACCESS THIS PROTOCOL, LINK TO:
https://csu.keyusa.net/

Appendix B Institution Review Board Approval Southern University

INCORPORATED 1880 RELOCATED 1914
SOUTHERN UNIVERSITY
And
Agricultural & Mechanical College

Office of Research
and Strategic Initiatives
Post Office Box 9272
(225) 771-3890 (voice)
(225) 771-5231 (fax)

Institutional Review Board (IRB)
for the Protection of Human Subjects

Federal Wide Assurance # 00002518 **IRB Registration # 00002445**

Initial Approval Form for Exempt Research

Investigator(s): Gene Gloecker/Willie Mellion Unit: Education

Project Title: Predictive factors associated with ethnic minorities' selection of college academic major: Emphasis on mathematics and science selection

Project Number: SU-BR IRB 2008-11E

I certify that the above research project was reviewed and approved by the Southern University – Baton Rouge (SU-BR) IRB for the Protection of Human Subjects in accordance with the Code of Federal Regulations, Title 45 Public Welfare Part 46 Protection of Human Subjects, on March 17, 2008, and was determined to be exempt from this policy – Research Category Title 45 CRF 46.101(b)(2). However, before any changes to approved proposed protocols (e.g., subject selection or category, consent, risks, benefits, procedures, subject anonymity and confidentiality, etc.), the principal investigator is to present the proposed changes to the Chairperson of the SU-BR IRB for the Protection of Human Subjects for review and approval prior to implementation of these changes.

Signature: Reginald Rackley Date: 3/17/08

Name: Reginald Rackley, Ph.D.
Department of Psychology
Southern University – Baton Rouge
Baton Rouge LA 70813

reginald_rackley@cxs.subr.edu
(V) 771-2990 / (F) 771-2082

We certify that this institution applies Title 45 CRF 46 subparts A, B, C, and D to all research involving human subjects regardless of the source of support.

Chairperson of the SU-BR Institutional Research Oversight Committee

Signature: Jimmy Lindsey/MJ Date: 3/18/08

Name: Jimmy D. Lindsey, Ph.D.
(V) 771-3950 / (F) 771-5652

jimmy_lindsey@cxs.subr.edu

Authorized Institutional Official

Signature: Michael Stubblefield Date: 3/18/08

Name: Michael Stubblefield, Ph.D.
Office of Research and Strategic Initiatives

(V) 771-3890 / (F) 771-5231