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A Comparison Of Students' And Parents' Mathematics Attitudes And Achievement At A Private Historically Black University

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A COMPARISON OF STUDENTS' AND PARENTS' MATHEMATICS ATTITUDES AND ACHIEVEMENT AT A PRIVATE HISTORICALLY BLACK UNIVERSITY

by

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ABSTRACT

The focus of this research was to compare students' and their parents' mathematical attitudes using the Attitudes Towards Mathematics Instrument (ATMI). The sample consisted of 476 newly-enrolled students and 263 parents attending the New Student Orientation and Leadership program at a private historically black university. The sample was predominantly African American, with 96% of the students and 95% of the parents identifying themselves as African American. The ATMI total score and subscale scores of self-confidence, value, enjoyment, and motivation were explored to determine if there was a relationship between the mathematics attitudes of students enrolled at a private historically black university and their parents'. Analysis was conducted to determine if there was a relationship between the students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their mathematics attitude. Additional analysis was conducted to determine if there was a relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their parents' mathematics attitude. The researcher found a statistically significant relationship between mathematics attitudes of students and their mothers as measured by the ATMI total score and subscales: self-confidence, value, enjoyment, and motivation. The researcher found a statistically significant relationship between mathematics attitudes of students and their fathers as measured by the ATMI motivation subscale. No statistically significant relationship was found between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their parents' mathematics attitude total score or the subscale scores. A statistically significant relationship between students' academic achievement and their attitudes towards mathematics total score and subscale scores: self-confidence, value, enjoyment, and motivation was found in this research. The findings of this study provide a line of research to further explore mathematics attitudes and its relationship to African American student achievement.

To my wife, La'Quisha, thank you for taking this journey with me. I could not have done this without you.

To my daughter, Kyla, I love you with all of my heart.

To my brothers, Kennard and Tony, thank you for always being there. We've laughed together, cried together, and at this moment we will celebrate together.

To mom and dad, you have always supported me in all of my endeavors. You always told me to dream big and believe in myself. You taught me that hard work and dedication pays off. Thank you for being the best parents ever.

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1
THE PROBLEM AND ITS CLARIFYING COMPONENTS

Introduction

Once again I am meeting with the parents of one of my high school students for a parent-teacher conference. Seated at the table are the parents, the student, a guidance counselor, and myself. After the guidance counselor explains the student's current academic progression, it is my turn to address the parents. I hand the parents a copy of the student's, their child's, gradebook. We begin to review each assignment for the term. I inform the parents of the student's submitted and non-submitted assignments. I inform them of the quality, or lack thereof, of each submitted assignment. Upon giving my review of the gradebook, I inform them that their child is currently failing the course. I also inform them that their child, with increased effort, has tremendous potential to do well in the course, and that there is still time left in the semester for the child to improve the overall course grade. The parents acknowledge my assessment of the situation. Then one of the parents states, "I understand your point Mr. Childs, but I was never good in math and neither was my spouse; thus, my child will never be good in math."

After participating in several parent-teacher conferences, this became a repetitious conversation among the researcher, a former teacher, and parents. Often, parents believed, because they were not academically successful in mathematics, that their children would not be academically successful in mathematics. Based upon these discussions with parents, the researcher began to question the extent to which parental views expressed influenced their children's views of their mathematics ability and, in turn, their attitudes toward mathematics. It is this topic that was the focus of this dissertation. In essence, did parents' attitudes towards mathematics influence students' attitudes towards mathematics?

Purpose of the Study

The purpose of this study was to compare students' and their parents' mathematical attitudes. The study sought to explore the attitudinal subscales: self-confidence, value, enjoyment, and motivation. Allowing the research to answer the question, "Is there are relationship between students' enrolled at a historically black university mathematics attitudes and their parents' mathematics attitude?" Upon analyzing this question further, knowledge can be gained from exploring the relationship between a student's and his or her parents' mathematics attitude and the student's mathematics academic achievement. By studying these relationships, new insights were gained through an improved understanding of students' academic achievement and the attitudinal constructs. For the purpose of this study the terms attitude and achievement have been defined.

Definition of Terms

Attitude: predisposition of an individual to respond positively or negatively to a concept (Aiken, 1970); for this study assessed by confidence, anxiety, value, and enjoyment (Tapia and Marsh, 2004)

Achievement: level at which students perform on a standardized assessment (Powell, 2010); measured by ACT/SAT mathematics subset score (ACT, 2011a; SAT, 2011)

United States Current Mathematics Achievement

In 2001, then President George W. Bush signed into law the No Child Left Behind Act of 2001 (No Child Left Behind [NCLB], 2002). NCLB was designed to "improve student achievement and change the culture of America's schools" (NCLB, 2002, p. 9). NCLB was based upon four key principles: (a) accountability for results, (b) greater flexibility for the state's use of federal funds, (c) more choices for parents as it relates to school choice, and (d) emphasis on effective teaching methods (NCLB, 2002). A key component of NCLB was accountability. The NCLB Act was designed to increase accountability of educators so as to assist in students meeting high academic standards and ensure that "no student is left behind" (NCLB, 2002, p. 9).

According to the 2011 Nation's Report Card, fourth and eighth graders scored higher in 2011 on the National Assessment of Education Progress (NAEP) than in previous assessment years (National Center for Education Statistics [NCES], 2011). In 2011, 82% of students had a basic knowledge of fourth-grade mathematics and 73% of students had at least a basic knowledge of eighth-grade mathematics (NCES, 2011). In Florida, 84% of fourth graders had basic knowledge of mathematics and 68% of eighth graders had basic knowledge of mathematics. These assessment measures were in accordance with the accountability component of NCLB. But according to the NCLB Act, data must be disaggregated by race and ethnicity (NCLB, 2002). In Florida, on the fourth-grade NAEP in 2011, African American students had an average score of 23 points lower than Caucasian students. On the eighth-grade NAEP, African American students had an average score that was 29 points lower than Caucasian students (NCES, 2011). Thus, though NCLB was enacted to ensure that all students meet high academic standards.

According to the U.S. Department of Education (Vannerman, Hamilton, Baldwin, Anderson, & Rahman, 2009), achievement gap is defined as "The difference between how well low-income and minority children perform on standardized tests as compared with their peers" (p. 4). For many years, low-income and minority students have been falling behind their Caucasian peers in terms of academic achievement.

The measurement in the United States of mathematics school-aged performance has become more sophisticated over time. In 2009, the NAEP assessed a nationally representative sample of 12th graders from public and private schools across the nation. The assessment measured students' knowledge and abilities across four content areas: number properties and operations, measurement and geometry, data analysis, statistics and probability, and algebra. The assessment measured students' achievement levels and defined them as basic, proficient, and advanced (NCES, 2011). Basic was defined as partial mastery of prerequisite knowledge and skills that are fundamental for proficient work. Proficient was defined as representative of a solid academic performance, students reaching this level were deemed demonstrating competency. Advanced was defined as representative of superior performance.

Since 2005, the average mathematics score of 12th-grade students increased by three points (NCES, 2010). A total of 26% of 12th-grade students performed at or above the proficient level in mathematics in 2009 (NCES, 2010). As in 2005, results from the 2009 assessment indicated that Caucasian and Asian/Pacific Islander students scored higher on average than African American, Hispanic, and American Indian/Alaska Native students (NCES, 2010). Between African American and Caucasian students in 2009 there was a 30-point average scale score difference with Caucasian and African American students having average scores of 161 and 131 respectively (NCES, 2010).

A major characteristic of students with higher mathematics scores was their post high school plans. Students who expected to attend a four-year college had higher mathematics scores than students who did not expect to attend a four-year college (NCES, 2010).

African American Mathematics Achievement

Throughout the years, researchers have shown that African American students lag behind Caucasian students in mathematics achievement (Lee, 2012; NCES, 2010; Vanneman, et al., 2009). Lee (2012) found large achievement gaps in mathematics among racial and socioeconomic groups. African American's mathematics achievement has been correlated by a number of factors. These factors can be indirect or direct. Ethington and Wilson (2009) posited the factors to be gender, prior achievement, socioeconomic status (SES), parental involvement, highest level of mathematics taken, perceived difficulty, and student effort. Ethington and Wilson (2009) have also shown that African American males outperform African American females in mathematics.

According to Parsons, Adler, and Kaczala (1982), most parents have higher expectations of their sons than of their daughters as related to mathematics. The higher expectations stem from parents' view of mathematics as a male domain and the fact that fathers have found mathematics to be more useful than mothers in their daily lives. Parsons et al. wrote that this impression, when observed by children, can evolve into a self-concept and expectancy based upon their father's influence and example.

Ethington and Wilson (2009) defined socioeconomic status as comprised of the following facets: parental income, education, and occupation, with parental income relying on parental education and parental occupation dependent upon parental education. Students living in low SES conditions typically attend schools that are often underfunded, and in a majority of these schools, there are less qualified teachers (Ethington & Wilson, 2009). Burris, Heubert, and Levin (2006) found that low SES typically correlates to low academic achievement. The influence of poverty decreases, according to Davis-Kean (2005) as students' progress through the elementary, middle, and high school grade levels. According to Davis-Kean (2005) the negative effects of SES can be minimized if parents provide an emotionally stable and stimulating environment.

Parental involvement is a key factor in student mathematics achievement. Ethington and Wilson (2009) whose research wrote parents' educational values are naturally instilled in their children. They posited that when parents are not involved in their children's education, students do not see education as a priority and this often results in a lack of effort on the part of students.

Researchers have found that parental education is a vital predictor of student achievement. Davis-Kean (2005) found that parents' education influenced student achievement indirectly through its impact on parents' achievement beliefs and stimulating home behavior. She also sought to determine how parental education might influence the beliefs and behaviors of parents of school-age children. In this regard, she found that parents' education and family income positively influenced the types of literacy-related material and behavior in the home as well as the affective relationship between parents and their children. Structure of the home environment was found to be dictated by the amount of schooling that parents received. This schooling, in turn, determined how parents interacted with their children in promoting academic achievement (Davis-Kean, 2005). Davis-Kean found that, among African Americans, parents' educational attainment and family income were both related indirectly to students' achievement through the parents' educational expectations and the reading and the warmth of parent-child interactions. In their research, Alexander, Entwisle, and Bedinger (1994) found that high income parents held performance beliefs and expectations close to the actual performance of their students, but low-income families' performance beliefs and expectations did not correlate with students' actual in-class academic performance as indicated by course grades. Alexander et al. (1994) suggested that, in order to structure a home environment, which promoted academic success, parents needed to form accurate beliefs and expectations regarding students' performance. During students' early schooling, parents' education helped them to become efficient teachers in the home because they were familiar with the material (Davis-Kean, 2005).

Stevenson, Lee, Chen, Stigler, Hsu, and Kitamura (2002) found that parents had relatively high satisfaction with their children's mathematics performance even though the United States mathematics performance of students has been poor in comparison to that in other countries. Crystal and Stevenson (1991) stated, "United States parents tend to evaluate their children's mathematics skills uncritically and their lack of awareness of the frequency or severity of children's problems reduces their effectiveness as a source of help to their children" (p. 375). In two studies, Pezdek, Berry, and Renno (2002) observed that parents overestimated their children's mathematics scores by 17.13% in the first student and 14.40% in the second study. Translated to letter grades, these estimations would be about one and one-half letter grades higher. Pezdek et al. (2002) found that parents were more accurate in predicting the mathematics achievement of lower performing students and were less accurate in predicting the mathematics achievement of higher performing students.

Mathematics Expectancy Value Model

Eccles et al. (1983) created the expectancy value model. The model was created to study the importance of expectancies for achievement-related behaviors, thus building on the notion that past successes or failures do not directly determine students' expectancy, but their interpretation of reality. According to Jacobs, Davis-Kean, Bleeker, Eccles, and Malanchuck (2005), in the expectancy value model the key determinants of choice are the relative value and perceived probability of success of each available option. In the expectancy value model, expectancies, and values are assumed to directly influence performance and task choice and are influenced by task-specific beliefs. According to Jacobs et al. (2005), these social cognitive variables are influenced by students' perceptions of other peoples' attitudes and expectations for them. Also, students' perspectives are influenced by cultural and social beliefs, their aptitudes, and their previous achievement-related performance.

Throughout the years, researchers have studied parenting practices and students' achievement motivation. In this vein, Eccles et al. (1983) endorsed the model of parent socialization. In this model, it is believed that characteristics of the parents, family, and neighborhood and characteristics of students will influence parents' behaviors and beliefs. In turn, these beliefs will influence parenting behaviors, which affect student outcomes. Four ways in which parents influence their children are: (a) by the general social-emotional climate they offer and their childrearing beliefs, (b) by providing specific experiences for the child, (c) by modeling involvement in valued activities, and

(d) by communicating their perceptions of the child's abilities and expectations for performance (Jacobs et al, 2005).

According to Jacobs et al. (2005), the environment, role modeling, and messages parents provide regarding the value they attach to science and mathematics activities influence a student's motivation to pursue those fields. Jacobs et al. (2005) expressed the belief that the values instilled in students by their parents influence their future decisions. Jacobs et al. (2005) found this parental influence to be bidirectional between self-beliefs and values. Jacobs et al. (2005) found that as students develop interest in mathematics, parental roles shift from providing exposure and opportunities to providing encouragement and guidance.

Successful parental socialization is also related to positive parent-child relationships (Jacobs et al., 2005). Jacobs et al. (2005) concluded that parents who had connectedness with their elementary-age children continued this bond into adolescence, leading to children's positive perceptions of parental support. This level of connectedness is a positive indicator of successful development.

Jacobs et al. (2005) also determined that parental discussions with children led to the direct and indirect shifting of parental viewpoint to children. Students reflect their parents' values by their actions and desires. Jacobs et al. (2005) found that parental perceptions influenced their children's performance and self-perceptions of their abilities. Thus, parental interpretations of their children's behaviors are conveyed and influence their self-perceptions and academic performance. Parental influence, according to Jacobs et al. (2005) was more significant than students' previous academic performance.

Jacobs et al. (2005) found that family characteristics also influenced the experiences parents provide for their children. Experiences gained first as children, then as students, are often based on the parents' perceptions of their children and parents' perceived value of the activity. Factors, which affect these activities, are the availability of resources and time constraints. Jacobs et al. also found that parents' behaviors are adopted as a part of a child's distinguishing characteristics. These researchers noted that the ways parents spend their time and their choices send influential messages to their children about values.

Wigfield and Eccles (2000) studied changes in students' mathematics attitudes over time. With respect to success, students appeared less optimistic over time, and their anxiety increased in situations associated with mathematics. Few studies have addressed this issue during students' adolescence. This relates to expectancy-value theory, typically used in achievement motivation studies. According to Chouinard and Roy (2008), expectancy components refer to students' beliefs about how they will perform on a task and if they will be able to complete the task. The value component refers to students' interest in the task.

Wigfield and Eccles (2000) also studied motivation in mathematics and noted its decline, as students grew older. Wigfield and Eccles observed male students' perceptions of having the capacity to succeed and produce appropriate responses that may lead to success diminished over time. In contrast, they determined that girls' competence beliefs remained stable throughout secondary school. During the study, there was a steady decrease of high school students' perception of the utility value of mathematics. Also, there was a decline during the high school years in students' positive attitudes towards the learning of mathematics. Chouinard and Roy (2008) wrote that a decrease in mathematics motivation was a two-step phenomenon: a decrease between and within grade levels.

Inequities in Education

Inequity and inadequacy have been issues debated for over 50 years as they relate to the learning environment of disadvantaged minority students. Researchers have indicated that low income and racially segregated schools with fewer resources, and less qualified instructors have a harder time meeting national standards (Lee, 2007). Lee (2012) expressed the belief that schools should not be held accountable to high-stakes standards without adequate resources. These high-stakes standards, referred to as opportunities to learn, have received varied responses from stakeholders. They have ranged from a demand for all students to have equal access to high-quality learning by specifying key inputs to having accountability for performance creating incentives to discover effective practices.

Lee and Wong (2004) determined that most impoverished school districts with African American or Hispanic students spend less on education than advantaged and Caucasian districts. Lee (2012) defined equity as focusing on relative achievement among different groups of students and adequacy as investigating how well students perform in absolute terms against a desired achievement level. He elaborated, expressing the belief that it is not enough to reduce the achievement gap. Rather, the adequacy of resources must be improved for disadvantaged groups. "Poor minority students are often double-bound by problems with less adequate instructional resources and less qualified teachers in their schools along with challenges posed by their relatively disadvantaged home learning environment" (Lee, 2012, p. 66).

Lee (2012) found a significant relationship between mathematics achievement and in-field mathematics teaching and also between mathematics achievement and per-pupil expenditures. Lee observed only a small degree of significance as it related to racial and socioeconomic disparities in school funding and teacher qualifications. Regardless of race, there was a low percentage of students meeting the mathematics proficiency standard as well as corresponding benchmarks of school funding and in-field teaching.

Research Studies of Attitude and Achievement

> Teachers and other mathematics educators generally believe that children learn more effectively when they are interested in what they learn and that they will achieve better in mathematics if they like mathematics. Therefore, continual attention should be directed towards creating, developing, maintaining and reinforcing positive attitudes. (Suydam & Weaver, 1975, p. 45)

Attitude and achievement are two intertwined components, as the relationship is reciprocal with attitudes affecting achievement and achievement affecting attitudes (Aiken, 1970). Throughout the years the relationship between attitude and achievement has been studied. This reciprocal relationship is demonstrated throughout a student's K-

12 schooling. Lindgren, Silva, Faraco, and Da Rocha (1964) found a positive correlation between problem-solving attitudes and arithmetic achievement test scores in their study of elementary school students. Alpert, Stellwagon, and Becker (1963) found a correlation between performance and measures of attitudes and anxiety towards mathematics in their study of elementary school students. At the high school level, Anttonen (1968) concluded there was greater academic achievement among students whose attitudes had remained favorable since elementary school. Similarly, researchers have found that college students have more positive attitudes in regard to academics than their non-college counterparts (Aiken, 1970). Papanastasiou (2000) stated there was a positive relationship observed between mathematics achievement and students' attitudes towards mathematics, among fifth graders.

In 1976, Fennema and Sherman made a substantial contribution in the measurement of mathematical attitude, creating the Fennema-Sherman Mathematics Attitudes Scales. The purpose of the scales was to gain information in regard to females' learning of mathematics. The scales consisted of the following dimensions:

> the Attitude toward Success in Mathematics Scales, the Mathematics as a Male Domain Scale, the Mother/Father Scale, the Teacher Scale, the Confidence in Learning Mathematics Scale, the Mathematics Anxiety Scales, the Effectance Motivation Scale in Mathematics, and the Mathematics Usefulness Scales. (pp. 325-326)

Significance of the Study

At the time of the present study, current attitudinal research was focused on students and their beliefs, exclusively. The present study was unique in examining parents' of university student's attitudes and comparing parental attitudes with their child's (referred to as students) attitudes to determine if there was a relationship. Based on a review of the literature, no researcher has investigated parental and student attitudes at the university level. Thus, this study sought to address a gap in the research and literature. Researchers (Ginsburg, Rashid, English-Clark, 2008; Yam & Lin, 2005) have demonstrated a connection between student achievement and parents' education and behaviors; however, the connection between parents' attitudes about mathematics needed to be further explored to determine if there was a relationship with student academic achievement. It has already been established that students' attitudinal beliefs contribute, in part, to their academic success in a mathematics course (Tocci & Engelhard, 1991). Learning more about the impact of parents' and students' attitudes about mathematics as they relate to motivation and academic achievement can be useful to all stakeholders. Findings from this study may be useful to educators in working with parents to ensure that motivation remains high throughout students' years of formal schooling and impacts achievement positively.

Summary

Mathematics attitudes are developed over a course of time. Several key factors affect children's development of their mathematics attitudes. Once a negative attitude has been assessed, strategies can be implemented with the student to assist in developing a positive mathematics attitude (Aiken, 1970; Cain-Caston, 1993; Hannula, 2002). This study was designed to examine the relationship between students' and parents' attitudes toward mathematics. Also of interest was the relationship of these attitudes with students' mathematics achievement.

Chapter 2 provides a review of the relevant literature as it relates to attitude and academic achievement. In the chapter, factors that contribute to students' attitudes and how those attitudes relate to academic achievement are of primary interest. Literature related to parents' influence on students' attitudes and their direct and indirect influence on academic achievement are also reviewed.

CHAPTER 2
LITERATURE REVIEW

Introduction

This chapter provides a review of the literature as it relates to attitudes towards mathematics and mathematics achievement. This chapter will factors affecting attitude and ways to measure attitudes, which are addressed in subsequent sections of the chapter. Literature was reviewed on parental influences on students' attitudes and academic achievement to provide the basis for comparisons that were made in the data analysis. Previous research has investigated the linkage between the attitudes of parents and students. In this research, the investigation of students' mathematics attitudes was extended to determine if there was a relationship between parents' and students' mathematical attitudes and students' academic success.

What is Attitude?

Webster's Concise Dictionary (1997) defined attitude "as a mental position with regard to a fact or to a state; a feeling or emotion toward a fact or state" (p. 46). Over time the definition of attitude has evolved from a single dimension to a multi-dimensional construct. Typically, attitude is considered a mixture of the following components: cognitive, affective and conative. Ruffell, Mason and Allen (1998) defined the components as "cognitive—expressions of beliefs about an attitude object, affective—expressions of feelings towards an attitude object and conative—expressions of behavioral intention" (p. 2). According to Hannula (2002), four evaluations produced what is defined as attitude: (a) a situational evaluation with no prior experience of the entity to be evaluated, (b) evaluation dependent upon previous experiences, (c) evaluation which is activated in a partially familiar situation, and (d) evaluation of one's whole life and the value one places upon goals in it. Hannula stated attitude was not a singular concept, but emerged as a multitude of these evaluative processes. Attitude can be considered as a positive or negative construct.

What is Mathematics Attitude?

In referencing attitude, one is generally referring to someone's basic like or dislike of a familiar target (Hannula, 2002). There are two basic approaches to defining attitude towards mathematics according to DiMartino and Zan (2001): (a) a simple definition describes it as the degree of affect associated with mathematics and (b) a three-component definition distinguishes emotional response, beliefs, and behavior as components of attitude.

Adult attitudes toward mathematics can be traced to adults' childhoods (Aiken, 1970). Stright (1960) concluded that attitudes toward arithmetic might be formed as early as third grade. He also noticed that attitudes tended to be more positive than negative in elementary school. Aiken (1970), however, observed that as students progressed through their school years (K-12), attitudes towards mathematics became more negative. Poffenberger and Norton (1959) determined that students carried their mathematics attitudes into high school classes and noted that these attitudes were long in building and once established, were difficult to change.

Greenwood (1997) examined self-efficacy and supported the notion that students with more positive attitudes towards mathematics had a higher level of self-efficacy and as a whole performed better in mathematics than students with negative attitudes. Neale (1969) determined that the relationship between attitudes and performance was a consequence of a reciprocal influence in that attitudes affected achievement and achievement, in turn, affected attitude.

In 1961, Corcoran and Gibb described three techniques to measure attitudes towards mathematics: (a) observational methods, (b) interviews, and (c) self-report methods such as questionnaires and attitude scales. Using observation, researchers witnessed students' behavior. Interviews consisted of the researcher-querying students as to their feelings about mathematics. Questionnaires and attitude scales were used to gather self-report data using non-scaled or scaled questionnaire items.

Past studies of student attitudes have focused on the K-12 student population and have often considered parents' and students' attitudes over lengthy periods of time. The present study differed from prior research in that it focused on a post-secondary student population.

Previous research (Eccles et al., 1993; Ginsburg et. al, 2008; Jacobs & Eccles, 2000) has discovered that student and parental beliefs change over time. These studies (Eccles et al., 1990) have also focused on gender as it relates to parental attitudes and beliefs. Eccles et al. (1993) found that parents tended to view mathematics as a male domain and that this viewpoint was often passed on to their children.

Wigfield (1982) concluded in his research that parental beliefs and students' mathematics beliefs were related. In his study of students enrolled in Grades 5-12, he found that "parents' beliefs about their children, particularly their perceptions of children's ability, the difficulty of math for children and their expectancies for future success, related to children's own beliefs" (Wigfield, 1983, p. 9). Cain-Caston (1993) reached the conclusion that parental attitudes were not the only determining factor affecting students' attitudes and performance. Cain-Caston's (1993) results indicated that third-grade students did not show a significant relationship between their attitudes toward mathematics and their performance. Research indicates students' are influenced by their parents' mathematics attitudes (Jacobs & Eccles, 1992) and Cain-Caston (1993) found students' attitudes were positive although their fathers' were negative. This led her to conjecture that teachers and peers might influence students' attitudes and performance. While teachers and peers influence some students, some practice an avoidance behavior towards mathematics.

Mathematics Avoidance Attitudes

A student's avoidance of mathematics is not an instantaneous phenomena but the result of a conglomeration of activities and events over a period of time (Calvin, 2012). Avoidance attitudes are typically the outcome of negative events in which students begin to disassociate themselves from mathematics, thereby forming an attitude of avoidance of mathematics (Calvin, 2012). Calvin (2012) defined an attitude of avoidance as "the tendency in an individual to manifest in a solution or a given object, reaction or a set of conducts whose goal is to take him away in an anticipative manner from the situation which is aversive or disagreeable" (pp. 249-250). Students who display an attitude of avoidance of mathematics demonstrate the following characteristics: they do not study mathematics, they do not discuss mathematics, and they "manifest a strong disposition to react negatively to the attitude of the teacher tending to expand his didactic act above the usual limits" (Calvin, 2012, p. 250). As avoidance attitudes define a student's disposition towards mathematics, parental mathematics attitudes play an attributable role in a student's mathematics attitude.

Parental Mathematics Attitudes

A study by Poffenberger and Norton (1959) supports the importance of parental attitudes in determining attitudes of students.

> The comment of the parent that 'John has never liked mathematics' or 'Our family never was good in mathematics' or 'Of course girls are not as good in mathematics as boys' is bound to have its effect in the developing self-concept of the child since the child sees himself as he believes his parents see him. (Poffenberger & Norton, 1959, p. 174)

There are three ways that parents influence their children's attitudes and performance: (a) by parental expectations of child's achievement, (b) by parental encouragement, and (c) by parents' own attitudes (Poffenberger & Norton, 1959).

The Effect of School Experiences on Mathematics Attitudes

Morrisett and Vinsonhaler (1965) traced adult mathematics attitudes back to individuals' childhood experiences. Dutton (1962) noted that students developed their mathematics attitudes throughout their second through twelfth grade school years, but Grades 4-6 were the most influential. McDermott (1956) reported that college students who indicated they were afraid of mathematics stated they first met frustration in the elementary grades. At the junior high school level Aiken (1970) found that student attitudes towards mathematics became increasingly negative as they progressed through the third through sixth grades. Dutton (1968) believed junior high school to be the critical point as it related to the formation of attitudes towards mathematics. Similar to several studies involving junior level high school students (Dutton, 1968; White & Aaron, 1967), Alpert et al. (1963) found there was a significant correlation between mathematics attitude and academic achievement. In 1968, Anttonen reached a similar finding in that attitudes at the high school level were moderately correlated to the academic achievement of 11th and 12th grade students.

Several studies have been conducted to determine a relationship between attitude and achievement in elementary school students. Researchers have consistently reported a low positive relationship as it relates to the correlation coefficient between attitudes toward mathematics and student achievement in mathematics (Anttonen, 1968; Dutton, 1962; Lindgren et al., 1964). Among African American high school students there is typically a positive correlation between higher levels of math and achievement (Ethington & Wilson, 2009).

Though parental influence at the K-12 level has been studied, the present research sought to determine if parental influence remained significant at the college level. Aiken (1970) stated mathematics performance should increase as students proceed through elementary school. Aiken (1970) posited that college students, on average, had more positive attitudes than non-college students. In 1960, Harrington determined there was a statistically insignificant relationship between attitude and academic achievement in college students. Aiken and Dreger (1961) found attitude scores were a significant predictor of mathematics achievement.

Measuring One's Attitude Towards Mathematics

Traditionally mathematics has been viewed as an unpopular subject by students. Thus measuring ones's attitude towards mathematics has become an important topic of mathematics teachers (Michaels and Forysth, 1978). Michaels and Forsyth (1978) developed a series of questions to evaluate any instrument designed to measure attitudes towards mathematics. The questions were:

> (a) How do you collect data on attitudes? (b) What facets of attitude should your attitude scale measure? (c) Does the scale reflect the content in the areas you're interested in? (d) Does the scale include items asking for extraneous information? (e) Are the items specific enough? (f) Are the items appropriate for the age level of your pupils? (g) Does the scale measure what you want it to measure? (pp. 22–24).

Michaels and Forsyth (1978) arrived at two common methods for gathering data from students in regard to their mathematics attitudes: self-report techniques and observational rating techniques. Self-report techniques involved paper instruments for students to complete. Examples of self-report techniques included: (a) open-form items, (b) checklist items, (c) Likert-scale items, and (d) semantic differential items. Observational rating techniques involved the researcher observing students and recording their behaviors. Michaels and Forsyth (1978) also identified three problems with observational rating techniques: (a) difficulty in identifying behaviors that reflected a student's attitude, (b) difficulty in standardizing one's observations, and (c) difficulty in quantifying a student's behavior.

Michaels and Forsyth (1978) posited that determining what facets one should measure was key to identifying the appropriate instrument. They identified three general facets of attitudes towards mathematics: (a) enjoyment of mathematics, (b) security and confidence with mathematics, and (c) appreciation of the usefulness and value of mathematics. They recommended that if one was interested in a specific area as it related to attitudes towards mathematics when performing an analysis of results, a separate score for each facet should be obtained.

Michaels and Forysth (1978) offered advice in regard to instrument selection. They recommended remaining cognizant of specific items, i.e., whether the items are general and difficult to answer or specific and easy to answer and if the wording of each item is age appropriate for the administrative group. They also believed that length was an important factor when considering attitudes towards mathematics instruments. Most importantly, Michaels and Forysth (1978) asked if the scale measured what one wanted to ascertain. The instrument needs to match one's overall purpose of administration and needs to have its validity verified to establish its credibility and effectiveness. They identified three methods of validation: content validation, predictive validation, and construct validation.

Michaels and Forysth (1978) identified eight key areas to review when selecting an instrument:

> (a) although self-report procedures have weaknesses they are better than observational techniques, (b) the instrument should measure facets of attitude that are of interest to the researcher, (c) the instrument should make reference to the researcher's areas of interest, (d) the instrument should focus on attitudes towards mathematics only, (e) items should be specific, (f) the content and vocabulary should be appropriate for the research group, (g) the instrument should have enough items to permit the identification of different degrees of attitudes, and (h) the scale should have evidence of construct and content validity. (pp. 22-24)

The most popular attitude scaling techniques, according to Aiken (1970) are Thurstone's and Likert's methods. Thurstone's method consists of a series of statements reflecting different negative and positive attitudes, presented in equal-appearing intervals, where each is given a scale value and the median of the scale values is assigned to it by a group of judges. Scoring is based upon the sum or mean of the scale values of the statement which the respondent endures. Likert's method is a summation of ratings, where the respondent indicates whether he strongly agrees, agrees, is undecided, disagrees, or strongly disagrees.

The present study focused specifically on an African American population, which was minimally targeted in previous studies. Tocci and Engelhard (1991), in concluding their research, suggested future research should focus on attitudes toward mathematics, especially those related to race. African Americans are a particularly important population, as it has been repeatedly demonstrated that African American students lag behind their peers academically. This study sought to identify the specific negative attitudinal areas (self-confidence, value, enjoyment, and motivation) demonstrated by parents and their children. The results of this study could lead to steps being taken to review and consider needed strategies to modify attitudes at a post-secondary level. The impact of this determination is further magnified because the next generation of students will be parented, in part, by the current generation of post-secondary students.

What is Achievement?

Researchers (Eccles, Wigfield, Harold, & Blumenfeld, 1993) hypothesized that there is a bidirectional relation between achievement and interest and between interest and self-concept ability. Bandura (1982) found that social cognitive theory predicted that interest was essentially a function of the perceived likelihood to succeed on a specific group of tasks. Deci and Ryan (2000) further speculated that interest in mathematics could result in the belief that one is able to understand mathematical problems.

Eccles et al. (1983) expressed the belief that a measurement for expectancy for success is a student's belief about how well he or she will perform on upcoming tasks. Wigfield and Eccles (2000) defined ability beliefs as the perceptions of individuals about their current competence at a given activity. They offered further clarification that ability beliefs focused on present ability and expectancies focused on the future. Tocci and Engelhard (1991) determined the causes of student attitudes and achievement factors were important in a study in which they found students with higher achievement had positive mathematics perceptions.

Eccles, Adler, and Kaczala (1982) designed a comprehensive expectancy-value model of children's achievement behavior that suggests there is an important role for parents' beliefs in determining children's academic performance and motivation. In the model, parents' beliefs about their children's abilities and values influence children's perceptions and values, which, in turn, influence children's performance and motivation.

Achievement in mathematics has been closely linked to future opportunities involving mathematics and careers; therefore researchers have closely studied factors that influence mathematics (Hemmings, Grootenboer, & Kay, 2011). Prior to studying the factors one must define achievement. Spence and Helmreich (1983) define achievement as "a task-oriented behavior that allows the individual's performance to be evaluated according to some internally or externally imposed criterion, that involves the individual in competing with others, or that otherwise involves some standard of excellence" (Spence & Helmreich, 1983, p. 12). Spence and Helmriech described achievement by two behaviors: "activities occurring in settings in which there are generally agreed-up standards by which to judge the quality of performance and in which evaluation of the performer routinely occurs and achievement–oriented behavior occurring in avocational and extracurricular contexts" (p. 12). Spence and Helmriech's definition allows either the individual or an assessor to evaluate an individual's performance according to some standard of excellence and designates the standard.

Achievement Related Behaviors

Self-concepts of Abilities and Expectancies.

Self-concepts of abilities are formed through a process of observing and interpreting one's own behaviors and the behaviors of others (Bleeker & Jacobs, 2004). Self-concept is defined as the assessment of one's own competency to perform specific tasks (Bleeker & Jacobs, 2004). Bleeker and Jacobs (2004) found that student self-concepts are established in the early childhood years. Therefore, it is imperative that students receive positive mathematical experiences in the early grades, as the formation of their attitude towards mathematics is developed during this time frame.

Poffenberger and Norton (1959) stated that their findings expand upon the pervasive thought that lack of interest in mathematics was instilled by a child's family and that the family conditioned the attitudes of the child. These researchers suggested that one's attitude towards mathematics was a cumulative phenomenon with one experience building upon another. This made it imperative that students receive positive mathematical experiences in the early grades during this formative period.

Eccles et al. (1983) found that achievement expectancies played a significant role in student academic choices. Eccles et al. (1983) proposed that expectancies were directly influenced by self-concept of ability and students' estimates of task difficulty and that historical events, past experiences, and cultural factors were mediated through the individual's interpretation and perceptions of the expectancies of others. Researchers have indicated that there has been a consistent and positive relationship over the years between mathematics achievement and perception of mathematical ability (Eccles et al., 1983; Kung, 2009; Parsons, Croft, & Harris, 2009; Rech, 1994).

Perceptions of Task Difficulty.

Researchers have suggested that self-concept is an important characteristic as it relates to achievement (Eccles et al, 1983). Self-concept of ability has been defined as the assessment of one's own competency to perform specific tasks. It has been shown, in a number of studies, that those who have a high estimate of their ability to perform a task perform better on the task. Eccles, et al. (1983) posited that task difficulty may influence self-concept of ability; thus, students who see a task as difficult develop lower estimates of their ability.

Perceptions of Task Value

Task value, as defined by Atkinson (1964), is the value that an individual attaches to success or failure in regard to a task. Eccles et al. (1993) defined task value as three components: (a) the attainment value of the task, (b) the intrinsic value of the task, and

(c) the utility value of the task. Attainment value is the importance of doing well on the task. Intrinsic value is the inherent, immediate enjoyment one receives, and utility value is determined by the importance of the task for a future goal. Eccles et al. (1993) summarized task value as a function of both perceived qualities of the task, the individual's needs, goals, and self-perceptions.

Personal Goals and Self-schemata.

Eccles et al. (1983) addressed the importance of sex-role identity, supporting the notion that it should influence task value only to the extent the task is sex-typed by the individual. Sex-typing is defined as "the need to behave according to a set of social prescriptions for sex-appropriate conduct, or sex role identity" (Parsons, 1981, p. 3). Research on this topic has been limited to what specific individuals consider sex-typed. Eccles et al. (1983) also found that personal values and life goals could result from perceived sex differences and that values and goals have the ability to influence the values one attaches to various activities.

Adolescent Self-Esteem

Wigfield and Eccles (1994) studied self-esteem in adolescents. They stated that self-esteem is thought to develop during the elementary and middle school years. The expansion of self-esteem incited researchers to focus on competence or ability beliefs and efficacy and expectancy beliefs (Wigfield & Eccles, 1994). Wigfield and Eccles (1994) posited that these beliefs refer to children's sense of how good they are at a given activity. Bandura (1996) stated that children's and adults' competence and efficacy beliefs related to their achievement performance, choice of achievement tasks, amount of effort exerted, cognitive strategy use, achievement goals, and overall self-worth. Adults' competency is an intriguing aspect as it relates to their influence on their child.

Parental Influence

Researchers have studied the relationship of parental mathematics beliefs and their influence on their children's mathematical beliefs (Pritchard, 2004). Beliefs as defined by Sigel (1985) are constructions of reality that usually are based on parents' knowledge of their children. Bacon and Ashmore (1986) noted that these beliefs are subject to change, and that to understand parents' interactions with their children, one must understand parents' beliefs. Eccles, Jacobs, Harold, Yoon et al. (1993) stated these beliefs were important because of (a) their impact on the expectations and goals parents develop for their children, (b) parents' perceptions of their children's interests and talents, and (c) the ways in which parents interact with their children. Junior high school students rated their parents as the most influential people in their course enrollment decisions (Eccles, et al., 1983). Davis-Kean and Schnabel (2001) believed parental influence was very powerful in predicting academic outcomes of children. Miller (1986) found that parents were reasonably accurate at estimating their children's general abilities.

Eccles, Jacobs, and Harold (1990) suggested that parental beliefs are important because of their impact on the expectations and goals parents develop for their children and parents' perceptions of their children's interest and talents. Merttens (1999) wrote that parents have a crucial role in learning, as they are the single biggest factor in a child's educational success. Bandura and Walters (1963) suggested that children learn through observational learning, meaning parents exhibit behaviors, which children imitate and later adopt. Thus, parents play an important role in formation of student attitudes toward subject matter. For example, parents may form specific expectations regarding their child's probable performance in a specific course. Eccles-Parsons et al. (1982) stated that parents might convey these expectations regarding their beliefs about their child's abilities, difficult tasks, and the importance of achievement.

Parental promotive strategies offer successful developmental pathways for children. Parental promotive strategies include: providing tight parental supervision, providing a safe home environment, enrolling children in afterschool programs, and identifying a mentor for their child (Ardelt and Eccles, 2001). Ardelt and Eccles (2001) expressed that parents who use promotive strategies may encourage and work with their children's skills, talents, and interests to prevent the occurrence of negative events and experiences. In contrast, Eccles et al. (1993) stated that parents who feel that they have little or no control over their children's lives and their children's environment utilize less promotive strategies. Ardelt and Eccles believed that a parent's sense of efficacy would affect the developmental success of children indirectly through promotive strategies as well as directly through the presentation of a positive role model.

Bandura (1997) wrote of the impact of effective parenting, noting that it tends to enhance feelings of personal efficacy as a parent. In contrast, parents who are low on perceived self-efficacy may try only halfheartedly to engage in promotive parenting strategies and give up easily when they encounter difficulties (Bandura, 1997). Ardelt and Eccles (2001) stated,

> Parents with a strong sense of efficacy are determined to overcome the barriers that prevent success. Similarly children who observe their parents succeed and overcome difficulties in their lives are most likely to develop a strong sense of self-efficacy themselves and to prevail even under adverse circumstances. (p. 949)

Similarly, Epstein (1992) wrote, “Students at all grade levels do better academic work and have more positive school attitudes, higher aspirations, and other positive behaviors if they have parents who are aware, knowledgeable, encouraging and involved” (p. 1141). A growing body of literature has emerged suggesting that involving parents in the education process enhances school success. This is helpful if parents have positive attitudes about the subject matter, but there is a question about this strategy in regard to parents who display a negative attitude. Negative attitudes may affect parents’ ability to enhance their children’s success.

It has been shown that parents guide their children consistently using three general principles: (a) appropriate levels of structure, (b) consistent and supportive parenting, and (c) observational learning (Eccles, 2007). Eccles commented on parenting as follows: “Families that provide a positive emotional environment are more likely to produce children who want to internalize the parents’ values and goals and therefore want to imitate the behaviors being modeled by their parents” (p. 672). When parents value and model goal achievement, the child is more likely to develop a positive achievement orientation (Eccles, 2007). Eccles et al. (1993) suggested six specific parental beliefs as likely influences on children's motivation: (a) causal attributions for their children's performance across various domains, (b) perceptions of the difficulty of various task for their children, (c) expectations for their children's probably success and confidence in their children's abilities, (d) beliefs regarding the value of various tasks and activities coupled with the extent to which parents believe they should encourage their children to master various tasks, (e) differential achievement standards across various activity domains, and (f) beliefs about the external barriers to success coupled with beliefs regarding both effective strategies to overcome these barriers and their own sense of efficacy to implement these strategies for each child. Fredricks and Eccles (2002) regarded these beliefs and messages as predictive of children's subsequent self- and task-beliefs.

Parents structure children's' experiences to impact self- and task-values, skill acquisition, preferences, and choice (Jacobs et al., 2007). Jacobs et al. (2007) found that child and family characteristics influenced the experiences parents provided for their children. These experiences were impacted by parental perceptions of their children's abilities and interests (Jacobs et al., 2007). Parents also act as interpreters of reality to their children. Nicholls (1978) found that when children are young, they are not good at assessing their competence; thus, they must rely on their parents' interpretations. The links between self-competence and value are extremely important and thus parental interpretations are critical to their children's continued interest (Jacobs et al., 2007). The present study focused on the mathematical aspect of links between self-competence and value.

Ability perceptions affect a variety of achievement behaviors including mathematics academic performance, task persistence, and task choice. People with positive perceptions of their ability approach achievement tasks with confidence and high expectations for success (Eccles et al., 1983). Jacobs and Eccles (2000) found that over time children construct their own self-perceptions and interest based on their parents' messages. They integrate these beliefs into their self-systems, and use such beliefs in future task choices. Self-systems are composed of three universal and fundamental needs:

> competence the need to experience oneself as capable of producing desired outcomes and avoiding negative outcomes, autonomy as the need to experience a choice in activities, and relatedness as the need to feel securely connected to the social world and to see oneself as worth of love and respect. (Jacobs & Eccles, 2000, p. 413)

Attitudes towards mathematics research have been conducted extensively for years. Researchers have conducted longitudinal studies involving children and their mathematics attitudes. They have studied the changes in their mathematics attitude and the factors associated with this change. Few researchers have studied university students' mathematics attitudes, specifically a historically black university population. Parental attitudes have been studied as it relates to children in the primary grades, but yet has a study to explore parental attitudes and their children at the university level. This study addresses gaps in the current literature as it explores a first year university student population at a historically black university.

CHAPTER 3
METHODOLOGY

Introduction

This chapter contains an explanation of the methods and procedures used to conduct the study. It has been organized to review the purpose of the study and to state the research questions, which guided the study. Also included in the chapter are explanations of the research design, the population, and the setting of the study. The instrumentation used to gather data are discussed along with data collection and analysis procedures.

Purpose of the Study

The purpose of this study was to compare students' and their parents' mathematical attitudes. The study sought to explore the attitudinal subscales: self-confidence, value, enjoyment, and motivation. This investigation was conducted to determine if there was a relationship between the mathematics attitudes of students enrolled at a historically black university and the mathematics attitudes of their parents.

Research Questions

The following research questions were used to guide this study:

1. Is there a relationship between the mathematics attitudes of students enrolled at a historically black university and those of their parents?

2. Is there a relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their parents' mathematics attitude?
3. Is there a relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their mathematics attitude?

Research Method

A quantitative research design was chosen for this study. Quantitative methods emphasize objective measurement and numeric analysis of data collected through polls, questionnaires, and/or surveys. Quantitative research focuses on gathering numeric data and generalizing it across a group of people (Creswell, 2012). The researcher answers a research problem by establishing the overall tendency of responses from the individual and notes how the tendency varies (Creswell, 2012).

Quantitative methods are considered objective, indicating that the behaviors are easily classified or quantified. A quantitative research design allows the researcher to "use postpositive claims for developing knowledge, employ strategies of inquiry, and collect data on predetermined instruments that yield statistics data" (Creswell, 2009, p. 21). The strengths include: allowance for a broader study, greater objectivity and accuracy, establishment of standards, and avoidance of personal bias.

There were two goals of the research study: (a) to determine if there was a relationship between two independent variables, students mathematics attitudes and their parents mathematics attitudes, and (b) to determine if there was a relationship between an independent variable and an outcome variable, student and parent mathematics attitudes and the students mathematics achievement. The study was descriptive in nature, as it only sought to establish associations between variables. The variables were attributes or characteristic of individuals that were being studied (Creswell, 2012). Also, the study was classified as a cross-sectional study (Rosner, 2011). A cross-sectional study permitted a snap shot of the current situation of interest and was assessed only once to determine the relationship between the variables of interest (Rosner, 2011).

Two strategies were employed for purposeful selection of the participants, typical case sampling and criterion sampling. Typical case sampling was used to select the site based upon survey data and demographic analysis, per the definition of typical case sampling the site is illustrative not definitive (Patton, 1990). The research site is a historically black university whose demographic population is illustrative of a typical historically black university's population. For the present study, all participating students were newly enrolled students for the Fall 2013 semester, including first-time freshman and transfer students and their respective parents.

The study was a correlational design that examined the relationship between students' attitudes and their parents' attitudes, and students' and parents' attitudes as they related to academic achievement. Additional statistical analyses were used to explore the instrument's subscales.

Research Site

In order to best understand mathematics attitudes of students and their parents at a private historically black university, a site was chosen to allow one to learn a great deal about the topic supporting the purpose of the research. Therefore an information-rich university, as it relates to the definition of a historically black university was chosen for the site of the purposeful sampling, which highlights the questions being studied.

In the United States there are 103 Historically Black Colleges and Universities (HBCU) (NCES, 2013). HBCU's are defined as institutions of higher education founded before 1964 that have the intentional mission to educate African Americans (NCES, 2013). HBCUs have a total enrollment of 391,217 students (NCES, 2013). Females account for 61% of the student population and males for 39% of the student population at HBCU's (NCES, 2013). HBCU's ethnic makeup is 82% African American, 14% Caucasian, 3% Hispanic, 1% Asian, and less than 1% American Indian (NCES, 2013). The selected university is representative of the national demographic data of historically black universities.

Population

The study university was located in the State of Florida. The population of students currently attending the university was 3,577 (University, 2012). Of this student population, 61% were female and 39% were male. A total of 92% of the population was African American, 1% Caucasian, 1% Hispanic, 1% Native Hawaiian, and 5% other (University, 2012). Of the enrolled students, 96% were full-time equivalent students.

Sample

This study involved a purposeful sample of undergraduate students at the study university. Purposeful sampling is used to select representative individuals and then generalize from these individuals to a population (Creswell, 2012). The goal of the purposive sample is to make claims about the population and to build theories that explain the population (Creswell, 2012). Students participating in this study were 476 newly-enrolled students and 263 parents of those students who attended the New Student Orientation and Leadership Program during the summer of 2013. Three orientation sessions were offered throughout the summer as a part of the New Student Orientation and Leadership program. Participants in this research attended one of these three sessions. All session attendees had the opportunity to participant in the research study. All attendees received the study information upon entry to the town hall style welcome meeting.

Role of Participants

All students and their parents attending the New Student Orientation and Leadership Program were administered the Attitudes Towards Mathematics Inventory (ATMI) designed by Tapia and Marsh (2004). Permission to utilize the ATMI was granted by Martha Tapia. The ATMI is displayed in Appendix A. Students and their respective parents completed the Inventory during the opening session of the orientation program.

Instrumentation

Attitudes Towards Mathematics Inventory (ATMI)

Tapia and Marsh (2004) developed the Attitudes Towards Mathematics Inventory (ATMI) to investigate students' attitudes towards mathematics variables and theoretical constructs. The instrument was initially developed under the following theoretical constructs: value, anxiety, motivation, confidence, enjoyment, and adults' perspectives. The initial ATMI consisted of a 49-item scale. Tapia and Marsh through factor analysis eliminated items one at time with the lowest item-to-total correlation until the value of alpha discontinued increasing.

The inventory contains 40 questions with four subscales: (a) self-confidence, (b) value, (c) enjoyment, and (d) motivation. The self-confidence category measures students' confidence and self-concept of their performance in mathematics (Tapia & Marsh, 2004). The value category was designed to measure feelings of anxiety and consequence of these feelings (Tapia & Marsh, 2004). The enjoyment category was designed to measure the degree to which students enjoy working with mathematics and in mathematics classes (Tapia & Marsh, 2004). The motivation category was designed to measure interest in mathematics and desire to pursue studies in mathematics (Tapia & Marsh, 2004). The 40 items are measured using a Likert-type scale with the following anchors: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The instrument has a coefficient alpha of 0.97 with standard error of measurement 5.67 (Tapia & Marsh, 2004). Tapia and Marsh established content validity by relating items to the variables: confidence, anxiety, value, enjoyment, and motivation. "Structure was explained by the four-factor model supporting different interpretations for students' self-confidence, value, enjoyment and motivation as underlying dimensions of attitudes toward mathematics" (Tapia & Marsh, 1996, p. 16). The Attitudes Towards Mathematics Inventory was scored using the previously described individual item scale of 1 (*strongly disagree*) to 5 (*strongly agree*). The items were totaled, and final scores had the potential for ranging from 40 to 200.

In 2002 Tapia and Marsh tested the Attitudes Towards Mathematics Inventory with American college students. In prior studies the inventory was used with middle school students from a private, bilingual college preparatory school in Mexico City, Mexico (Tapia & Marsh, 2002). A total of 134 undergraduate students enrolled in a state university in the Southeast, United States were administered the inventory (Tapia & Marsh, 2002). The population consisted of 71 males, 58 females, 80% Caucasian and 20% African American (Tapia and Marsh, 2002). In the present study, the Attitudes Toward Mathematics Inventory (ATMI) was used as the instrument to measure parental mathematics values and their child's mathematical values in a predominately African American population.

ACT/SAT

Academic achievement for the study was measured by the ACT or SAT mathematics subset score. The ACT Concordance Table was used to equate ACT and SAT mathematics subset scores (ACT, 2011a). The ACT is designed to assess the mathematical skills students have typically acquired in courses up to the beginning of grade 12. An ACT score reflects educational achievement in college-preparatory courses. The ACT consists of 60 questions. The ACT mathematics sections covers six content areas: pre-algebra, elementary algebra, intermediate algebra, coordinate geometry, plane geometry, and trigonometry. The SAT is designed to assess one's academic readiness for college. The SAT consists of 54 questions. The SAT mathematics section covers: arithmetic operations, algebra, geometry, statistics, and probability. The ACT college readiness benchmark score for mathematics is a 22, a student meeting this minimum score has a high probability of success in a credit-bearing college course such as College Algebra.

Data Collection

The Attitudes Towards Mathematics Inventory (ATMI) (see Appendix A) was administered to all students and parents at the New Student Orientation and Leadership Program. The ATMI was administered during the morning opening session of the orientation program. The researcher spoke to both students and their parents during the opening session, explained the research, and administered the survey. The participants each received a packet containing a letter explaining the project (see Appendices B and C), a demographic questionnaire and the ATMI with a pre-assigned identification number. The student survey version demographic section contained items in regards to gender, ethnicity, marital status, age, classification, first generation college student, last mathematics course completed, and academic school. The parent survey version demographic section contained items in regards to gender, ethnicity, marital status, age, last mathematics course completed, highest level of education, and household income. The demographics section allows the researcher to further investigate the participants and determine further relationships, if any in regards to mathematics attitudes and mathematics achievement. The explanation of research provided to the student and parent participants are included in Appendices B and C. Standardized examination scores were obtained at the conclusion of the program from the Office of the Registrar.

Permission to retrieve ACT/SAT scores was provided through the approval of the study university. The study was initially approved by the University of Central Florida's Institutional Review Board (see Appendix D). The researcher obtained ACT/SAT scores from the Registrar's Office at the University. Each score was associated with the student using his or her university student ID number, after which a specialized identification number was assigned linking individuals' ACT/SAT scores with their survey data. No names were associated with the scores.

Data Analysis

ACT/SAT scores and Attitudes Towards Mathematics Inventory (ATMI) scores were the only sources of data used in the statistical analysis. The ATMI subscales (self-confidence, value, enjoyment, and motivation) were analyzed collectively and individually. Cronbach's alpha was calculated for the instrument to estimate the internal consistency of the scores. The mean, standard deviation, and standard error of measure were also calculated for the instrument. Cronbach's alpha for each subscale was calculated to estimate internal consistency and reliability of the scores. The data were analyzed in responding to each of the research questions, which guided this study.

To respond to Research Question 1 as to whether there was a relationship between the mathematics attitudes of students enrolled at a historically black university and those of their parents, a paired samples t-test was used. In instances where there were multiple parents/guardians, the test was repeated for each individual parent/guardian. The ATMI instrument was not designed to average multiple attitudinal scores, therefore each parent was analyzed separately. Analyzing the parents separate further allows the exploration of the relationship, if any, of the student and his or her mother or father.

For Research Question 2, as to the relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset scores and their parents' mathematics attitudes, students' ACT/SAT scores were correlated with their parents' ATMI scores. Correlation was used to determine if there was a relationship between students' ACT/SAT scores and their parents' ATMI scores. Analysis was conducted for both parents, if applicable, and a separate analysis was conducted for each individual parent. A scatter plot was generated with attitude as the explanatory variable and the ACT/SAT score as the response variable.

For Research Question 3 as to the relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset scores and their mathematics attitudes, students' ACT/SAT scores were correlated with their ATMI scores. Correlation analysis was used to determine if there was a relationship between students' ACT/SAT scores and their ATMI scores. A scatter plot was generated with attitude as the explanatory variable and the ACT/SAT score as the response variable.

Summary

This chapter presented the methods and procedures used to conduct this study, the purpose of which was to investigate the relationship between parental mathematics attitudes, student mathematics attitudes, and academic success as measured by the ACT/SAT. The research site, the population, the sample, and the role of the participants were discussed. The instrumentation used to conduct the study was detailed, and the data collection and analysis procedures were explained. Chapter 4 contains a summary of the analysis of the data for the three research questions. Chapter 5, the concluding chapter of the dissertation, includes a summary and discussion of the findings and implications of the study.

CHAPTER 4
DATA ANALYSIS

Introduction

The purpose of this study was to compare students' and parents' mathematical attitudes and students' achievement at a private historically black university using the Attitudes Towards Mathematics Inventory (ATMI). The ATMI consists of four subscales: self-confidence, value, enjoyment, and motivation. The total score and each subscale score were analyzed to further investigate the attitudes of students and parents. Descriptive statistics were computed for the participants' demographics and for the ATMI. Factor analysis and reliability were performed on the ATMI. Correlation was used to determine relationships between students' mathematics academic achievement and their parents' mathematics attitudes. Correlation was also used to determine relationships between students' mathematics academic achievement and their mathematics attitude.

This chapter presents the analysis of data. It has been organized around the three research questions that guided the study.

1. Is there a relationship between the mathematics attitudes of students enrolled at a historically black university and those of their parents?
2. Is there a relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their parents' mathematics attitude?

3. Is there a relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their mathematics attitude?

The study's student participants consisted of a population representative of the university's population with respect to gender and ethnicity. Participating in the study were 476 students. A total of 42% of the participants were male, and 58% were female. Of the participants, 96% were African American, less than 1% Asian Pacific Islander, 2% Hispanic, less than 1% Native American, and 2% Caucasian. A total of 96% of the student participants were between the ages of 18 and 21, 2% were between the ages of 22 and 25, 1% between the ages of 26 and 30, and 1% between the ages of 31 and 40. Of the participating students, a total of 44% identified themselves as first generation college students. The participating students' average ACT score was 17.

The study's parent participants consisted of 263 parents, legal guardians, relatives and grandparents. The study included legal guardians, relatives, and grandparents in the classification of parents in the data analysis. Of these participants, 21% were male, 77% were female, and 2% did not indicate their gender. A total of 95% were African American, 1% Asian Pacific Islander, 3% Caucasian, and 1% did not indicate their ethnicity. Regarding marital status, 23% were single, never married; 43% were married; 8% separated; 21% divorced; 3% widowed; and 2% did not indicate their marital status. Highest level of education ranged from some high school to "obtained a graduate degree." With 5% having completed some high school. A total of 21% were high school graduates, 30% had completed some college, 22% had obtained a college degree, 18%

either completed graduate coursework or obtained a graduate degree, and 4% did not indicate their highest level of education completed. Regarding household income, 13% had a household income of less than $20,000; 25% reported an income between $20,000 and $34,999; 18% reported an income between $35,000 and $49,999; 18% reported an income between $50,000 and $74,999; 9% reported an income between $75,000 and $99,999; 11% reported an income greater than $100,000; and 6% did not indicate their household income.

Factor Analysis of the Attitudes Towards Mathematics Inventory (ATMI)

Factor Analysis of the Attitudes Towards Mathematics Inventory (ATMI) (Entire Participant Population)

Exploratory factor analysis of the ATMI using the entire participant population was conducted. The 40 items of the ATMI were subjected to principal factors analysis using SPSS. Prior to performing principal factor analysis, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of .3 and above. The Kaiser-Meyer-Olkin value was .958, exceeding the recommended value of .6 (Kaiser, 1970, 1974), and Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix.

Principal factors analysis revealed the presence of five factors with eigenvalues exceeding 1, explaining 37.5%, 10.2%, 6.3%, 3.6%, and 2.7% of the variance respectively. An inspection of the scree plot (see Appendix E) revealed a clear break after the fourth factor. Using Catell's (1966) scree test, it was decided to retain four factors (see Appendix F) for further investigation.

The four-factor solution explained 57.6% of the variance, with factor one contributing 37.5%, factor two contributing 10.2%, factor three contributing 6.3%, and factor four contributing 3.6%. To aid in the interpretation of these four factors, varimax rotation was performed. The rotated solution shown in Table 1, revealed the presence of simple structure with the factors showing a number of strong loadings and all variables loading substantially on only one factor.

Table 1 delineates the ATMI into four factors. Factor one consisting of 18 questions: 17, 18, 19, 22, 23, 24, 26, 27, 29, 30, 31, 32, 33, 34, 35, 37, 38, and 40; factor two consisting of 10 questions: 9, 10, 11, 12, 13,14, 15, 16, 20, and 21; factor three consisting of 10 questions: 1, 2, 3, 4, 5, 6, 7, 8, 36, and 39; factor four consisting of two questions: 25 and 28. The researcher's factor one questions contained some similarities to Tapia and Marsh (1996) factor three questions. Questions 24, 26, 27, 29, 30, 31, 37, and 38 were the same for both the researcher and Tapia and Marsh. In addition, Tapia and Marsh factor three contained questions 3 and 25, but did not contain questions 17, 18, 19, 22, 23, 32, 33, 34, 35, and 40. The researcher's factor two questions contained some similarities to Tapia and Marsh factor one questions. Questions 9, 10, 11, 12, 13, 14, 15, 16, 20, and 21 were the same for both the researcher and Tapia and Marsh. In addition, Tapia and Marsh factor one contained questions 17, 18, 19, 22, and 40. The researcher's factor three questions contained some similarities to Tapia and Marsh factor two questions. Questions 1, 2, 4, 5, 6, 7, 8, 36, and 39 were the same for both the researcher and Tapia and Marsh. In addition, Tapia and Marsh factor two contained question 35, but did not contain question 3. The researcher's factor four questions differed from Tapia and Marsh factor four questions. Tapia and Marsh factor four included questions 23, 28, 32, 33, and 34, but did not include the researcher's factor four questions 25 and 27.

Table 1

Principal Factor Analysis of the ATMI: A Four-factor Solution with Varimax Rotation (Entire Population)

	Factors/Subscales				
	1	2	3	4	Communalities
30. I am happier in a math class than any other class.	**.768**	.174	.092	-.012	.628
34. The challenge of math appeals to me.	**.766**	.165	.253	-.045	.679
29. I really like mathematics.	**.743**	.246	.138	-.087	.639
33. I plan to take as much mathematics as I can during my education.	**.707**	-.023	.233	-.106	.566
32. I am willing to take more than the required amount of mathematics.	**.696**	.016	.168	-.182	.547
31. Mathematics is a very interesting subject.	**.696**	.178	.296	-.112	.617
24. I have usually enjoyed studying mathematics in school.	**.689**	.275	.174	.020	.582
26. I like to solve new problems in mathematics.	**.645**	.245	.184	-.057	.513
38. I am comfortable answering questions in math class.	**.638**	.300	.256	.244	.623
17. I have a lot of self-confidence when it comes to mathematics.	**.624**	.399	.225	.313	.697
22. I learn mathematics easily.	**.619**	.343	.111	.256	.579
40. I believe I am good at solving math problems.	**.615**	.339	.269	.313	.663
27. I would prefer to do an assignment in math than to write an essay.	**.601**	.189	.081	.119	.417
35. I think studying advanced mathematics is useful.	**.571**	.077	.440	-.170	.555
23. I am confident that I could learn advanced mathematics.	**.570**	.191	.285	.250	.505
37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	**.526**	.179	.378	.141	.471

	Factors/Subscales				
	1	2	3	4	Communalities
18. I am able to solve mathematics problems without too much difficulty.	**.486**	.309	.273	.403	.569
19. I expect to do fairly well in any math class I take.	**.470**	.186	.285	.315	.436
11. Studying mathematics makes me feel nervous.	.140	**.807**	.098	.100	.690
13. I am always under a terrible strain in a math class.	.268	**.801**	.105	.112	.737
12. Mathematics makes me feel uncomfortable.	.211	**.790**	.137	.086	.695
15. It makes me nervous to even think about having to do a mathematics problem.	.149	**.783**	.099	.033	.647
10. My mind goes blank and I am unable to think clearly when working with mathematics.	.138	**.776**	.109	.021	.634
14. When I hear the word mathematics, I have a feeling of dislike.	.283	**.772**	.116	-.023	.690
21. I feel a sense of insecurity when attempting mathematics.	.132	**.738**	.131	-.073	.585
20. I am always confused in my mathematics class.	.082	**.703**	.101	-.114	.525
9. Mathematics is one of my most dreaded subjects.	.306	**.598**	-.100	-.090	.470
16. Mathematics does not scare me at all.	.442	**.469**	.238	.387	.622
5. Mathematics is important in everyday life.	.101	.104	**.809**	.003	.675
4. Mathematics helps develop the mind and teaches a person to think.	.129	.146	**.759**	.118	.628
6. Mathematics is one of the most important subjects for people to study.	.220	.154	**.730**	-.071	.610
8. I can think of many ways that I use math outside of school.	.183	.097	**.702**	-.012	.536
7. High school mathematics courses would be very helpful no matter what I decide to study.	.214	.121	**.680**	.020	.522

	Factors/Subscales				
	1	2	3	4	Communalities
1. Mathematics is a very worthwhile and necessary subject.	.188	.179	**.671**	.080	.525
2. I want to develop my mathematical skills.	.141	-.125	**.616**	.015	.415
36. I believe studying math helps me with problem solving in other areas.	.441	.096	**.580**	-.121	.555
39. A strong math background could help me in my professional life.	.442	.065	**.522**	-.034	.473
3. I get a great deal of satisfaction out of solving a mathematics problem.	.412	.207	**.506**	.042	.470
28. I would like to avoid using mathematics in college.	.077	.470	.128	**-.519**	.512
25. Mathematics is dull and boring.	.233	.468	.175	**-.480**	.535

Note. Extraction Method: Principal Factor Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 8 iterations.

Factor Analysis of the Attitudes Towards Mathematics Inventory

(Student Participant Population)

Exploratory factor analysis of the ATMI using the student participant population was conducted. The 40 items of the ATMI were subjected to principal factors analysis using SPSS. Prior to performing principal factors analysis, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of .3 and above. The Kaiser-Meyer-Olkin value was .948, exceeding the recommended value of .6 (Kaiser, 1970, 1974), and Bartlett's Test of

Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix.

Principal factors analysis revealed the presence of six factors with eigenvalues exceeding 1, explaining 36.7%, 10.0%, 5.8%, 3.7%, 2.7%, and 2.5% of the variance respectively. An inspection of the scree plot (see Appendix G) revealed a clear break after the fourth factor. Using Catell's (1966) scree test, it was decided to retain four factors (see Appendix H) for further investigation.

The four-factor solution explained a total 56.2% of the variance, with factor 1 contributing 36.7%, factor 2 contributing 10%, factor 3 contributing 5.8%, and factor 4 contributing 3.7%. To aid in the interpretation of the four factors, varimax rotation was performed. The rotated solution in Table 2, revealed the presence of simple structure, with the factors showing a number of strong loadings and all variables loading substantially on only one factor.

Table 2

Principal Factor Analysis of the ATMI: A Four-factor Solution with Varimax Rotation (Student Population)

	Factors/Subscales				
	1	2	3	4	Communalities
11. Studying mathematics makes me feel nervous.	**.787**	.011	.095	.270	.701
10. My mind goes blank and I am unable to think clearly when working with mathematics.	**.784**	.100	.089	.206	.676
12. Mathematics makes me feel uncomfortable.	**.776**	.100	.144	.236	.689
13. I am always under a terrible strain in a math class.	**.773**	.126	.124	.313	.728
15. It makes me nervous to even think about having to do a mathematics problem.	**.762**	.131	.140	.210	.662
14. When I hear the word mathematics, I have a feeling of dislike.	**.758**	.253	.082	.214	.691
21. I feel a sense of insecurity when attempting mathematics.	**.739**	.106	.145	.119	.593
20. I am always confused in my mathematics class.	**.732**	.123	.111	.069	.568
9. Mathematics is one of my most dreaded subjects.	**.605**	.269	-.100	.144	.469
25. Mathematics is dull and boring.	**.570**	.274	.170	-.167	.457
28. I would like to avoid using mathematics in college.	**.546**	.174	.144	-.331	.459
30. I am happier in a math class than any other class.	.178	**.717**	.071	.298	.639
33. I plan to take as much mathematics as I can during my education.	-.030	**.713**	.268	-.019	.582
32. I am willing to take more than the required amount of mathematics.	.055	**.704**	.121	-.018	.513
34. The challenge of math appeals to me.	.171	**.691**	.254	.261	.639
29. I really like mathematics.	.278	**.684**	.111	.247	.619
31. Mathematics is a very interesting subject.	.187	**.662**	.269	.243	.604

	Factors/Subscales				
	1	2	3	4	Communalities
24. I have usually enjoyed studying mathematics in school.	.240	**.612**	.153	.292	.540
35. I think studying advanced mathematics is useful.	.145	**.577**	.420	.083	.538
26. I like to solve new problems in mathematics.	.264	**.550**	.223	.219	.470
27. I would prefer to do an assignment in math than to write an essay.	.220	**.515**	.135	.294	.419
38. I am comfortable answering questions in math class.	.238	**.498**	.228	.464	.571
37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	.137	**.437**	.362	.323	.445
5. Mathematics is important in everyday life.	.103	.092	**.762**	.072	.605
4. Mathematics helps develop the mind and teaches a person to think.	.141	.076	**.730**	.167	.586
2. I want to develop my mathematical skills.	-.098	.140	**.701**	.008	.521
6. Mathematics is one of the most important subjects for people to study.	.185	.194	**.692**	.072	.556
8. I can think of many ways that I use math outside of school.	.071	.143	**.645**	.145	.463
1. Mathematics is a very worthwhile and necessary subject.	.177	.186	**.623**	.185	.489
7. High school mathematics courses would be very helpful no matter what I decide to study.	.123	.180	**.595**	.223	.451
39. A strong math background could help me in my professional life.	.097	.344	**.547**	.153	.451
36. I believe studying math helps me with problem solving in other areas.	.100	.483	**.516**	.068	.515
3. I get a great deal of satisfaction out of solving a mathematics problem.	.215	.331	**.504**	.231	.463
18. I am able to solve mathematics problems without too much difficulty.	.242	.264	.244	**.649**	.609
16. Mathematics does not scare me at all.	.399	.196	.227	**.634**	.652

	Factors/Subscales				
	1	2	3	4	Communalities
17. I have a lot of self-confidence when it comes to mathematics.	.320	.389	.242	**.599**	.671
40. I believe I am good at solving math problems.	.297	.419	.261	**.570**	.657
22. I learn mathematics easily.	.273	.502	.128	**.525**	.618
19. I expect to do fairly well in any math class I take.	.106	.246	.333	**.486**	.418
23. I am confident that I could learn advanced mathematics.	.113	.408	.260	**.482**	.479

Note. Extraction Method: Principal Factor Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Table 2 delineates the ATMI into four factors. Factor one consisting of 11 questions: 9, 10, 11, 12, 13, 14, 15, 20, 21, 25, and 28; factor two consisting of 12 questions: 24, 26, 27, 29, 30, 31, 32, 33, 34, 35, 37, and 38; factor three consisting of 10 questions: 1, 2, 3, 4, 5, 6, 7, 8, 36, and 39; and factor four consisting of seven questions: 16, 17, 18, 19, 22, 23, and 40. The researchers factors had good internal consistency with a Cronbach alpha coefficient of .92, .91, .88, and .89 respectively. The researcher's factor one questions contained some similarities to Tapia and Marsh (1996) factor one questions as shown in Table 3.

Table 3

Comparisons of Tapia and Marsh Self-Confidence Subscale and Researcher's Factor 1

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40

Note. Researchers factor 1 items are shaded.

Questions 9, 10, 11, 12, 13, 14, 15, 20, and 21 were the same for both the researcher and Tapia and Marsh. Based upon Tapia and Marsh's factor one having 15 items and the researcher's factor one containing 9 of those items, there was a 60% match. In addition, Tapia and Marsh factor one contained questions 16, 17, 18, 19, 22, and 40, but did not contain questions 25 and 28. The researcher's factor two questions contained some similarities to Tapia and Marsh factor three questions as shown in Table 4.

Table 4

Comparisons of Tapia and Marsh Value Subscale and Researcher's Factor 3

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40

Note. Researchers factor 3 items are shaded.

Questions 24, 26, 27, 29, 30, 31, 37, and 38 were the same for both the researcher and Tapia and Marsh. Based upon Tapia and Marsh factor three having 10 items and the researcher's factor two containing 8 of those items, there was a 80% match. In addition, Tapia and Marsh factor three contained questions 3 and 25, but did not contain questions 32, 33, 34, and 35. The researcher's factor three questions contained some similarities to Tapia and Marsh factor two questions as shown in Table 5.

Table 5

Comparisons of Tapia and Marsh Enjoyment Subscale and Researcher's Factor 2

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40

Note. Researchers factor 2 items are shaded.

Based upon Tapia and Marsh factor two having 10 items and the researcher's factor three containing 9 of those items, there was a 90% match. Questions 1, 2, 4, 5, 6, 7, 8, 36, and 39 were the same for both the researcher and Tapia and Marsh. In addition, Tapia and Marsh factor two contained question 35, but did not contain question 3. The researcher's factor four questions differed from Tapia and Marsh factor four questions with the exception of question 23 as shown in Table 6.

Table 6

Comparisons of Tapia and Marsh Motivation Subscale and Researcher's Factor 4

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40

Note. Researchers factor 4 items are shaded.

Based upon Tapia and Marsh factor four having 5 items and the researcher's factor four containing 1 of those items, there was a 20% match. Tapia and Marsh factor four contained questions 28, 32, 33, and 34, but did not contain the researcher's factor four questions 16, 17, 18, 19, 22, and 40.

Factor Analysis of the Attitudes Towards Mathematics Inventory
(Parent Participant Population)

The 40 items of the Attitudes Towards Mathematics Inventory were subjected to principal factors analysis using SPSS. Prior to performing principal factors analysis, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of .3 and above. The Kaiser-Meyer-Olkin value was .933, exceeding the recommended value of .6 (Kaiser 1970, 1974), and Bartlett's Test of Sphericity (Bartlett 1954) reached statistical significance, supporting the factorability of the correlation matrix.

Principal factors analysis revealed the presence of six factors with eigenvalues exceeding 1, explaining 38.7%, 11.6%, 7.4%, 3.6%, 2.9%, and 2.8% of the variance respectively. An inspection of the scree plot (see Appendix I) revealed a clear break after the fourth factor. Using Catell's (1966) scree test, it was decided to retain four factors (see Appendix J) for further investigation.

The four-factor solution explained a total 61.2% of the variance, with factor 1 contributing 38.7%, factor 2 contributing 11.6%, factor 3 contributing 7.4% and factor 4 contributing 3.6%. To aid in the interpretation of the four factors, varimax rotation was performed. Table 3 contains the principal factors factor analysis with varimax of the ATMI of the parent participant population.

Table 7

Principal Factor Analysis of the ATMI: A Four-factor Solution with Varimax Rotation (Parent Population)

	Factors/Subscales				
	1	2	3	4	Communalities
34. The challenge of math appeals to me.	**.800**	.103	.214	.177	.727
33. I plan to take as much mathematics as I can during my education.	**.775**	.090	.231	.058	.666
29. I really like mathematics.	**.767**	.108	.118	.283	.694
17. I have a lot of self-confidence when it comes to mathematics.	**.767**	.387	.156	-.053	.765
30. I am happier in a math class than any other class.	**.763**	.109	.070	.083	.605
32. I am willing to take more than the required amount of mathematics.	**.747**	.015	.248	.172	.650
24. I have usually enjoyed studying mathematics in school.	**.745**	.285	.155	.067	.664
38. I am comfortable answering questions in math class.	**.717**	.336	.290	-.109	.723
40. I believe I am good at solving math problems.	**.715**	.277	.258	-.117	.669
26. I like to solve new problems in mathematics.	**.705**	.165	.114	.241	.596
27. I would prefer to do an assignment in math than to write an essay.	**.681**	.070	.043	-.003	.471
23. I am confident that I could learn advanced mathematics.	**.661**	.216	.284	-.026	.565
19. I expect to do fairly well in any math class I take.	**.655**	.200	.191	-.047	.508
31. Mathematics is a very interesting subject.	**.639**	.101	.308	.343	.631
22. I learn mathematics easily.	**.618**	.352	.045	-.063	.512
18. I am able to solve mathematics problems without too much difficulty.	**.612**	.228	.228	-.252	.542
16. Mathematics does not scare me at all.	**.585**	.408	.196	-.089	.556
37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	**.555**	.222	.424	-.004	.537

	Factors/Subscales				
	1	2	3	4	Communalities
35. I think studying advanced mathematics is useful.	**.536**	-.073	.440	.281	.565
3. I get a great deal of satisfaction out of solving a mathematics problem.	**.472**	.119	.451	.069	.445
15. It makes me nervous to even think about having to do a mathematics problem.	.099	**.797**	.013	.024	.646
11. Studying mathematics makes me feel nervous.	.248	**.787**	.100	.052	.693
13. I am always under a terrible strain in a math class.	.402	**.776**	.041	.042	.767
12. Mathematics makes me feel uncomfortable.	.337	**.776**	.112	-.011	.728
14. When I hear the word mathematics, I have a feeling of dislike.	.265	**.773**	.112	.089	.688
21. I feel a sense of insecurity when attempting mathematics.	.119	**.729**	.080	.135	.570
10. My mind goes blank and I am unable to think clearly when working with mathematics.	.123	**.714**	.110	.048	.539
20. I am always confused in my mathematics class.	-.018	**.643**	.008	.139	.433
9. Mathematics is one of my most dreaded subjects.	.315	**.525**	-.156	.249	.461
5. Mathematics is important in everyday life.	.101	.082	**.871**	-.026	.776
4. Mathematics helps develop the mind and teaches a person to think.	.165	.126	**.795**	-.097	.684
7. High school mathematics courses would be very helpful no matter what I decide to study.	.156	.023	**.785**	.075	.646
6. Mathematics is one of the most important subjects for people to study.	.230	.089	**.774**	.120	.674
8. I can think of many ways that I use math outside of school.	.187	.073	**.770**	.067	.638
1. Mathematics is a very worthwhile and necessary subject.	.135	.153	**.720**	-.140	.579
36. I believe studying math helps me with problem solving in other areas.	.389	.093	**.641**	.143	.591
2. I want to develop my mathematical skills.	.144	-.121	**.599**	.065	.399

	Factors/Subscales				
	1	2	3	4	Communalities
39. A strong math background could help me in my professional life.	.505	-.019	**.511**	.274	
25. Mathematics is dull and boring.	.168	.282	.106	**.740**	.667
28. I would like to avoid using mathematics in college.	.002	.422	.053	**.631**	.578

Note. Extraction Method: Principal Factor Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Table 3 delineates the ATMI into four factors. Factor one consists of 20 questions: 3, 16, 17, 18, 19, 22, 23, 24, 26, 27, 29, 30, 31, 32, 33, 34, 35, 37, 38, and 40. Factor two consists of nine questions: 9, 11, 12, 13, 14, 15, 20, and 21. Factor three consists of nine questions: 1, 2, 4, 5, 6, 7, 8, 36, and 39. Factor four consists of two questions: 25 and 28. The researcher's factor one questions contained some similarities to Tapia and Marsh (1996) factor three questions. Questions 3, 24, 26, 27, 29, 30, 31, 37, and 38 were the same for both the researcher and Tapia and Marsh. In addition, Tapia and Marsh factor three contained question 25, but did not contain questions 16, 17, 18, 19, 22, 23, 32, 33, 34, 35, and 40. The researcher's factor two questions contained some similarities to Tapia and Marsh factor one questions. Questions 9, 11, 12, 13, 14, 15, 20, and 21 were the same for both the researcher and Tapia and Marsh. In addition, Tapia and Marsh factor one contained questions 16, 17, 18, 19, 22, and 40. The researcher's factor three questions contained some similarities to Tapia and Marsh factor two questions. Questions 1, 2, 4, 5, 6, 7, 8, 36, and 39 were the same for both the researcher and Tapia and Marsh. In addition, Tapia and Marsh factor two contained question 35. The researcher's factor four questions differed from Tapia and Marsh factor four questions with the exception of question 28. Tapia and Marsh factor four contained questions 23, 32, 33, and 34, but did not contain the researcher's factor four question 25.

Reliability of a Scale

The Attitudes Towards Mathematics Inventory (ATMI) was developed in 1996 by Tapia and Marsh. Tapia and Marsh (1996) sought to measure students' attitudes towards mathematics to find the dimensions that comprised one's attitude towards mathematics. The ATMI consists of 40 items evaluated by a Likert-type scale of five ratings with the following designations: 1 (*strongly disagree*), 2 (*disagree*), 3 (*neutral*), 4 (*agree*), and 5 (*strongly agree*).

Tapia and Marsh (1996) found the instrument to have a coefficient alpha of 0.97 with standard error of measurement of 5.67 with a population of high school students. Analysis of the four subscales (self-confidence, value, motivation, and enjoyment) indicated reliability of 0.95, 0.86, 0.89, and 0.88, respectively.

In 2000, Tapia and Marsh found the instrument to have a coefficient alpha of 0.95 with a standard error of measurement of 5.42 with a middle school population. The middle school population analysis resulted in three subscales, which provided the best simple structure fit (Tapia & Marsh, 2000). Analysis of the three subscales (self-confidence, enjoyment, and value) resulted in reliability coefficients of .94, .92, and 0.84, respectively (Tapia & Marsh, 2000).

Prior studies using the ATMI focused on high school and middle school populations. Tapia and Marsh (2002) sought to determine if the four subscales would hold if a college population were administered the inventory. Thus, the inventory was administered at a state university in the southeast. The study consisted of 134 undergraduate students, 53% males and 43% female and 3% who did not indicate their gender (Tapia & Marsh, 2002). The sample consisted of approximately 80% Caucasian students and 20% African American students (Tapia and Marsh, 2002). Results of the study indicated a four-factor model of self-confidence, value, enjoyment, and motivation (Tapia and Marsh, 2002). The Cronbach alpha coefficients were calculated to be 0.96, 0.93, 0.88, and 0.87, respectively.

In this study, the researcher found the Cronbach alpha coefficient of the whole instrument and *all participants* to be 0.96. The Cronbach alpha coefficients for the subscales (self-confidence, value, enjoyment, and motivation) were: 0.93, 0.89, 0.89, 0.73, respectively. In this study, the researcher found the Cronbach alpha coefficient of the whole instrument of the *student participants* to be 0.96. The subscale (self-confidence, value, enjoyment, and motivation) Cronbach alphas of the student participants inventory were: 0.93, 0.88, 0.89, and 0.69, respectively. In this study the researcher found the Cronbach alpha coefficient of the whole instrument of the *parent participants* to be 0.96. The subscale (self-confidence, value, enjoyment, and motivation) Cronbach alphas of the parent participant inventory were: 0.92, 0.92, 0.90, and 0.80, respectively. Table 4 provides descriptive statistics for the total score of the ATMI separated by students and parents.

Table 8

Descriptive Statistics of the ATMI Total Score

Respondent Status		N	Mean	Std. Deviation	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Student	ATMI_Total	409	134.79	28.451	.014	.121	-.280	.241
	Valid N (listwise)	409						
Parent	ATMI_Total	210	144.10	27.066	-.232	.168	-.135	.334
	Valid N (listwise)	210						

A total of 409 students of the 476 student participant population completed the ATMI, and 210 of the 263 parent participant population completed it as well. Students' mean total score on the ATMI was 135, and parents' mean total score was 144. The total score for the ATMI could range from 40 to 200, with 40 indicating a negative attitude and 200 indicating a positive attitude. The total score of participants who selected neutral for all of the questions would be 120. Thus, on average, parents had a slightly higher positive attitude toward mathematics than did students. The descriptive statistics for the ATMI subscales item per factor and the percentage of each response are in Appendices K, L, M, N, O, P, Q, and R. Each item's highest score could range from 1 to 5, with 1 indicating a negative attitude and 5 indicating a positive attitude. Three indicated a neutral attitude in regard to the item. For the self-confidence subscale, the highest scoring item for students was *I expect to do fairly well in any math class I take,* with a mean item score of 3.60 and 56.8% of students' selecting strongly agree or agree.

Parents' highest scoring item for the self-confidence subscale was *When I hear the word mathematics, I have a feeling of dislike,* with a mean item score of 3.65 and 64.5% of parents selecting strongly agree or agree. The lowest scored item for the self-confidence subscale for students and parents was *Mathematics is one of my most dreaded subjects*, with a mean item score of 2.82 and 3.07 respectively, and 42.3% of students, and 36.2% of parents selecting strongly disagree or disagree. For the value subscale, students' highest scoring item was *I want to develop my mathematical skills,* with a mean item score of 4.16 and 81% of students selecting strongly agree or agree. The highest scoring value subscale item for parents' was *Mathematics is a very worthwhile and necessary subject,* with a mean item score of 4.40 and 87.8% of parents selecting strongly agree or agree. The lowest scoring item for the value subscale for students and parents was *I think studying advanced mathematics is useful,* with a mean item score of 3.33 for students and 3.68 for parents, and 20.6% of students and 12.5% of parents selecting strongly disagree or disagree. For enjoyment, the highest scoring item was *I get a great deal of satisfaction out of solving a mathematics problem,* with a mean item score of 3.43 and 3.84 for students and parents respectively, and 47.4% of students and 68% of parents selecting strongly agree or agree. The lowest scoring item for the enjoyment subscale was *I am happier in a math class than any other class* for both students and parents, with a mean item score of 2.63 and 2.92 respectively, and 47% of students and 38.2% of parents selecting strongly disagree or agree. For the motivation subscale, the highest scoring item for students was *I am confident that I could learn advanced mathematics,* with a mean item score of 3.41 and 48.1% selecting strongly agree or agree. The highest scoring motivation item for parents was *I would like to avoid using mathematics in college,* with a mean item score of 3.69 and 61.4% selecting strongly agree or agree. The lowest scoring motivation subscale item for students and parents was *I am willing to take more than the required amount of mathematics,* with a mean item score of 2.84 and 3.10 respectively, and 37.4% of students and 28.2% of parents selecting strongly disagree or disagree. The subscale item responses helped to frame the overall students' and parents' similarities and differences within the subscale items. This, in turn, led to the first research question as to whether there was a relationship between students' and their parent's mathematical attitudes.

Research Question 1

Is there a relationship between the mathematics attitudes of students enrolled at a historically black university and those of their parents?

A paired-samples t-test was conducted to evaluate the relationship between students' and their parents' total scores and subscale scores on the Attitudes Towards Mathematics Inventory (ATMI). The ATMI was analyzed using Tapia and Marsh's (1996) scoring scale and identified subscales. Parents were separated by their gender; thus students' attitude relationships with their mothers and fathers were explored separately as shown in Table 5. Parent separation by gender allowed the researcher, if a relationship between mathematics attitude of the student and parent was found, to delineate the plausible parent. The number of cases varies within Table 5 based upon the paired matches of students' and parents' total ATMI scores and subscale scores.

There was a statistically significant difference in the ATMI total score between the students and their fathers (M = 129.37, SD = 28.209) and (M = 158.23, SD = 25.310), t(29) = 5.768, $p < .05$. The mean difference in the ATMI total scores was 28.867 with a 95% confidence interval ranging from 39.102 to 18.631, and the effect was large (eta squared = .53). There was not a statistically significant difference in the ATMI total score between the students and their mothers (M = 134.09, SD = 30.182) and (M = 137.05, SD = 27.094), t(99) = .781, $p > .05$. The mean difference was 2.960 with a 95% confidence interval ranging from 10.478 to 4.558. There was a statistically significant difference in the AMTI self-confidence subscale score between the students and their fathers (M = 48.17, SD = 14.227) and (M = 58.37, SD = 10.756), t(29) = 4.219, $p < .05$. The mean difference in the ATMI self-confidence subscale score was 10.2 with a 95% confidence interval ranging from 15.144 to 5.256, and the effect was large (eta squared = .38). There was not a statistically significant different in the ATMI self-confidence subscale score between students and their mothers (M = 50.29, SD = 14.345) and (M = 49.79, SD = 11.399), t(106) = .303, $p > .05$. The mean difference was .505 with a 95% confidence interval ranging from 2.795 to 3.805. There was a statistically significant different in the ATMI value subscale score between the students and their fathers (M = 35.10, SD = 7.203) and (M = 42.93, SD = 6.918), t(29) = 5.458, $p < .05$.

Table 9

Relationship Between Students' and their Parents' ATMI Total Score and Subscale Score

Descriptors	M	N	SD	SE	*r*	*p*
AMTI Total Score (S)	129.37	30	28.209	5.150	.480	.007
ATMI Total Score (F)	158.23	30	25.310	4.621		
AMTI Total Score (S)	**134.09**	**100**	**30.182**	**3.018**	**.128**	**.204**
ATMI Total Score (M)	**137.05**	**100**	**27.094**	**2.709**		
Self-Confidence SS (S)	48.17	30	14.227	2.598	.466	.009
Self-Confidence SS (F)	58.37	30	10.756	1.964		
Self-Confidence SS (S)	**50.29**	**107**	**14.345**	**1.387**	**.120**	**.218**
Self-Confidence SS (M)	**49.79**	**107**	**11.399**	**1.102**		
Value SS (S)	35.10	30	7.203	1.315	.381	.038
Value SS (F)	42.93	30	6.918	1.263		
Value SS (S)	**37.05**	**107**	**7.766**	**.751**	**.133**	**.172**
Value SS (M)	**39.52**	**107**	**8.079**	**.781**		
Enjoyment SS (S)	30.70	30	8.264	1.509	.427	.019
Enjoyment SS (F)	38.23	30	6.735	1.230		
Enjoyment SS (S)	**31.58**	**106**	**9.250**	**.898**	**.153**	**.118**
Enjoyment SS (M)	**32.22**	**106**	**8.364**	**.812**		
Motivation SS (S)	**15.42**	**31**	**3.344**	**.601**	**.058**	**.755**
Motivation SS (F)	**18.48**	**31**	**3.705**	**.665**		
Motivation SS (S)	**15.39**	**105**	**4.110**	**.401**	**.043**	**.661**
Motivation SS (M)	**16.04**	**105**	**4.135**	**.403**		

Note. SS = Subscale Score; S = Student; F = Father; M = Mother

The mean difference in the ATMI value subscale score was 7.833 with a 95% confidence interval ranging from 10.769 to 4.898, and the effect was large (eta squared = .51). There was a statistically significant difference in the ATMI value subscale score between the students and their mothers (M = 37.05, SD = 7.766) and (M = 39.52, SD = 8.079), $t(106) = 2.455$, $p < .05$. The mean difference in the ATMI value subscale score was 2.477 with a 95% confidence interval ranging from 4.477 to .477, and the effect was moderate (eta squared = .05). There was a statistically significant difference in the ATMI enjoyment subscale score between the students and their fathers (M = 30.70, SD = 8.264) and (M = 38.23, SD = 6.735), t(29) = 5.074 with a 95% confidence interval ranging from 10.570 to 4.497, and the effect was large (eta squared = .47). There was not a statistically significant difference in the ATMI enjoyment subscale score between the students and their mothers (M = 31.58, SD = 9.250) and (M = 32.22, SD = 8.364), t(105) = .575, p > .05. The mean difference was .642 with a 95% confidence interval ranging from 2.853 to 1.570. There was a statistically significant difference in the ATMI motivation subscale score between the students and their fathers (M = 15.42, SD = 3.344) and (M = 18.48, SD = 3.705), t(30) = 3.523, p < .05. The mean difference in the ATMI enjoyment subscale score was 3.065 with a 95% confidence interval ranging from 4.841 to 1.288, and the effect was large (eta squared = .29). There was not a statistically significant difference in the ATMI motivation subscale score between the students and their mothers (M = 15.39, SD = 4.110) and (M = 16.05, SD = 4.135), t(104) = 1.164, p > .05. The mean difference in the ATMI motivation subscale score was .648 with a 95% confidence interval ranging from 1.751 to .456.

As a result the researcher found there was a relationship between students enrolled at a historically black university and their mothers' attitudes towards mathematics as measured by the ATMI total score and a relationship of mathematics attitudes as it related to self-confidence, value, enjoyment, and motivation. The researcher also found there was a relationship between students enrolled at a historically black university and their fathers' attitudes towards mathematics as it relates to motivation. The researcher must note that data were analyzed for total ATMI scores for 30 students and their fathers and105 students and their mothers. For the ATMI subscale self-confidence score 30 students and their fathers and 107 students and their mothers were analyzed. For the ATMI subscale value score 30 students and their fathers and 107 students and their mothers were analyzed. For the ATMI subscale enjoyment score 30 students and their fathers and 106 students and their mothers were analyzed. For the ATMI subscale motivation score 31 students and their fathers and 105 students and their mothers were analyzed.

Research Question 2

Is there a relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their parents' mathematics attitude?

The relationship between the Attitudes Towards Mathematics Inventory (ATMI) and ACT/SAT mathematics subset score was investigated using a Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity, and homoscedasticity (Pallant, 2011). The ATMI was analyzed using Tapia and Marsh's (1996) scoring scale and identified subscales. Table 6 shows the relationships between the students' mathematics achievement as demonstrated on the ACT/SAT by the mathematics subset score and their parents' ATMI total score and subscale scores. Legal guardians, relatives, and grandparents have been included in the classification of parents'

Table 10

Pearson Product-moment Correlations Between the ATMI and ACT/SAT Mathematics Subset Score (Parents)

Scale	ACT/SAT Mathematics
ATMI Total	.086
Self-confidence	.084
Value	-.019
Enjoyment	.068
Motivation	.007

Note. ** p < .001 (2-tailed)

There was not a statistically significant correlation between the ATMI and ACT/SAT mathematics subset score, r = .086, n = 208, p > .001. There was not a statistically significant correlation between the ATMI self-confidence subscale score and ACT/SAT mathematics subset Score, r = .084, n = 218, p > .001. There was not a statistically significant correlation between the ATMI value subscale score and ACT/SAT mathematics subset score, r = -.019, n = 219, p > .001. There was not a statistically significant correlation between the ATMI enjoyment subscale score and ACT/SAT mathematics subset score, r = .068, n = 218, p > .05. There was not a statistically significant correlation between the ATMI motivation enjoyment subscale score and ACT/SAT mathematics subset score, r = .007, n = 218, p > .001.

The relationship between the ATMI and its subscales and ACT/SAT mathematics subset score of the participating parents by gender was also investigated using a Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity (Pallant, 2011). Table 7 shows the relationships between students' mathematics achievement as demonstrated on the ACT/SAT by mathematics subset score and their parents' separated by gender (father/mother) ATMI total score and subscale scores. Parent separation by gender allowed the researcher, if a relationship between students' mathematics academic achievement and their parents' mathematics attitude was found, to delineate the plausible parent.

Table 11

Pearson Product-moment Correlations by Parent Gender Between the ATMI and ACT/SAT Mathematics Subset (Parents)

	ACT/SAT Mathematics Subset	
Scale	Father	Mother
ATMI Total	.214	.048
Self-confidence	.213	.066
Value	.095	.066
Enjoyment	.225	-.049
Motivation	.191	-.030

Note. ** p < .01 (2-tailed)
* p < .05 (2-tailed)

There was not a statistically significant correlation between the ATMI and ACT/SAT mathematics subset score among the fathers, $r = .214$, $n = 45$, $p > .05$. There was no correlation between the ATMI and ACT/SAT mathematics subset score among the mothers, $r = .048$, $n = 159$, $p > .05$. There was not a statistically significant correlation between the ATMI self-confidence subscale and ACT/SAT mathematics subset score among fathers, $r = .213$, $n = 45$, $p > .05$. There was not a statistically significant correlation between the ATMI self-confidence subscale and ACT/SAT mathematics subset score among mothers, $r = .066$, $n = 169$, $p > .05$. There was not a statistically significant correlation between the ATMI value subscale and ACT/SAT mathematics subset score among fathers, $r = .095$, $n = 49$, $p > .05$. There was not a statistically significant correlation between the ATMI value subscale and ACT/SAT mathematics subset score among mothers, $r = -.049$, $n = 166$, $p > .05$. There was not a statistically significant correlation between the ATMI enjoyment subscale and ACT/SAT mathematics subset score among fathers, $r = .225$, $n = 48$, $p > .05$. There was no correlation between the ATMI enjoyment subscale and ACT/SAT mathematics subset score among mothers, $r = .024$, $n = 166$, $p > .05$. There was not a statistically significant correlation between the ATMI motivation subscale and ACT/SAT mathematics subset score among fathers, $r = .191$, $n = 48$, $p > .05$. There was not a statistically significant correlation between the ATMI motivation subscale and ACT/SAT mathematics subset score among mothers, $r = -.030$, $n = 166$, $p > .05$.

The researcher found there was not a relationship between students' academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their parents' mathematics attitudes as assessed by their ATMI total score. The researcher further analyzed the relationship by studying the students' academic achievement and the parents' mathematics attitudes as assessed by their ATMI subscale scores. The researcher did not find a relationship between students' mathematics academic achievement and their parents' mathematics ATMI subscale score.

Research Question 3

Is there a relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their mathematics attitude?

The relationship between the Attitudes Towards Mathematics Inventory (ATMI) and its subscales and ACT/SAT mathematics subset score of the participating students was investigated using a Pearson product-moment correlation coefficient. The ATMI was analyzed using Tapia and Marsh's (1996) scoring scale and identified subscales. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity, and homoscedasticity (Pallant, 2011). The ATMI was analyzed using Tapia and Marsh's (1996) scoring scale and identified subscales. Table 8 shows the correlations between the ATMI and the students' ACT/SAT mathematics subset score.

Table 12

Pearson Product-moment Correlations Between the ATMI and ACT/SAT Mathematics Subset (Students)

Scale	ACT/SAT Mathematics Subset
ATMI Total	.299 **
Self-confidence	.352 **
Value	.122 *
Enjoyment	.259 **
Motivation	.168 **

Note. ** p < .01 (2-tailed)
* p < .05 (2-tailed)

There was a medium, positive correlation between the ATMI total score and the ACT/SAT mathematics subset score, $r = .299$, $n = 392$, $p < .01$. There was a medium, positive correlation between the self-confidence subscale score and the ACT/SAT mathematics subset score, $r = .352$, $n = 397$, $p < .01$. There was a small, positive correlation between the value subscale score and the ACT/SAT mathematics subset score, $r = .122$, $n = 400$, $p < 05$. There was a small, positive correlation between the enjoyment subscale score and the ACT/SAT mathematics subset score, $r = .259$, $n = 398$, $p < .01$. There was a small, positive correlation between the motivation subscale score and the ACT/SAT mathematics subset score, $r = .168$, $n = 404$, $p < .01$.

The relationship between the ATMI and its subscales and ACT/SAT mathematics subset score of the participating students by gender was investigated using a Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. Table 9 shows the correlation between the students by gender and their ATMI and ACT/SAT mathematics subset scores.

Table 13

Pearson Product-moment Correlations by Student Gender Between the ATMI and ACT/SAT Mathematics Subset (Students)

	ACT/SAT Mathematics Subset	
Scale	Male	Female
ATMI Total	.262 **	.308 **
Self-Confidence	.307 **	.371 **
Value	.059	.149 *
Enjoyment	.222 **	.149 *
Motivation	.178 *	.267 **

Note. ** p < .01 (2-tailed)
* p < .05 (2-tailed)

There was a small, positive correlation between the ATMI and ACT/SAT mathematics subset scores among the male students, $r = .262$, $n = 163$, $p < .01$. There was a medium, positive correlation between the ATMI and ACT/SAT mathematics subset scores among the female students, $r = .308$, $n = 228$, $p < .01$. There was a medium, positive correlation between the ATMI self-confidence subscale and ACT/SAT mathematics subset scores among male students, $r = .307$, $n = 164$, $p < .01$. There was a medium, positive correlation between the ATMI self-confidence subscale and ACT/SAT mathematics subset scores among female students, $r = .371$, $n = 232$, $p < .01$. There was not a statistically significant correlation between the ATMI value subscale and ACT/SAT mathematics subset scores among male students, $r = .059$, $n = 166$, $p > .05$. There was a small, positive correlation between the ATMI value subscale and ACT/SAT mathematics subset scores among female students, $r = .149$, $n = 232$, $p < .05$. There was a small, positive correlation between the ATMI enjoyment subscale and ACT/SAT mathematics subset scores among male students, $r = .222$, $n = 165$, $p < .01$. There was a small, positive correlation between the ATMI enjoyment subscale and ACT/SAT mathematics subset scores among female students, $r = .267$, $n = 232$, $p < .01$. There was a small, positive correlation between the ATMI motivation subscale and ACT/SAT mathematics subset scores among male students, $r = .178$, $n = 168$, $p < .01$. There was a small, positive correlation between the ATMI motivation subscale and ACT/SAT mathematics subset scores among female students, $r = .141$, $n = 235$, $p < .05$.

The researcher found a relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their mathematics attitude. The relationship was further analyzed by the AMTI subscales, and all subscales had a relationship with the students' academic achievement. The researcher further analyzed the relationship by student gender and the ATMI total score and subscale scores and found a relationship with students' academic achievement.

Summary

This chapter presented the findings of the research study on students and their parents' mathematics attitudes, students' mathematics achievement and the relationship to their mathematics attitude, and students' mathematics achievement and the relationship to their parents' mathematics attitude. Descriptive statistics were calculated for the students' and parents' attitudes towards mathematics using the ATMI and its corresponding subscales: self-confidence, value, enjoyment, and motivation. Paired samples tests were conducted to determine if there was a relationship between the mathematics attitudes of students enrolled at a historically black university and those of their parents. Correlation analysis was used to analyze the relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their parents' mathematics attitude. This relationship was further explored by analyzing the ATMI subscales and the student's academic achievement. Correlation analysis was used to analyze the relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their mathematics attitude. This relation was further explored by analyzing the ATMI subscales and students' academic achievement.

The students' and parents' average ATMI total scores were both above the mean of 120, which indicated that overall they had a positive attitude towards mathematics. Students and their mothers had a relationship between their mathematics attitudes as measured by the ATMI total score and subset scores. Students and their fathers had a relationship between their mathematics attitudes as measured by the ATMI motivation subscale. There was no statistically significant relationship between students' mathematic academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their parents' mathematics attitude. There was a statistically significant relationship between the students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their mathematics attitudes.

CHAPTER 5
SUMMARY, DISCUSSION, AND RECOMMENDATIONS

Summary of the Study

The purpose of the study was to examine student attitudes towards mathematics, parental attitudes towards mathematics, the relationship between students' attitudes and the attitudes of their parents, and the relationship between attitudes towards mathematics and academic achievement. The study used data gathered from the Attitudes Towards Mathematics Inventory (ATMI) to address the research questions which guided the study. Quantitative measures were used to explore the attitudes of students and parents. The ACT/SAT mathematics subset scores of the students were used to explore their mathematics academic achievement. In the study, the relationship between mathematics attitudes of students and their parents was examined along with the relationship between students' mathematics academic achievement and their parents' mathematics attitude. The study further examined the relationship between students' mathematics academic achievement and their mathematics attitudes. Descriptive statistics were calculated for the ATMI, and descriptive statistics were calculated for each subscale. A paired samples t-test was used to determine whether there was a relationship between the mathematics attitudes of students and their parents. The ATMI total score and subscale scores were examined to determine if there was a relationship. Correlation was used to determine whether there was a relationship between students' mathematics academic achievement and their mathematics attitudes or their parents' mathematics attitudes.

The population consisted of students newly admitted to a private historically black university for the fall 2013 semester and their parents. The study sample consisted of 476 students: 201 males, 273 females, and two students who did not indicate their gender. The study sample consisted of 263 parents, including legal guardians, relative, and grandparents: 56 fathers, 202 mothers, and five individuals who did not indicate their gender. The study included legal guardians, relatives, and grandparents in the classification of parents in the data analysis.

Students' attitudes were measured using the ATMI. The ATMI contains 40 items and four subscales: self-confidence, value, enjoyment, and motivation. The range of scores is 40 to 200, with the higher score indicating a more positive attitude. The ATMI was designed to measure student attitudes towards mathematics and was used in this study to measure a predominately African American first-year university student and parent population.

The researcher administered the ATMI during the New Student Summer Orientation sessions. The ATMI was administered simultaneously to students and parents. Student mathematics academic achievement data, as measured by the ACT/SAT, were obtained from the University Registrar.

Summary of the Findings

Research Question 1: Mathematics Attitude Relationship

Is there a relationship between the mathematics attitudes of students enrolled at a historically black university and those of their parents?

The relationship between mathematics attitudes of students and parents was examined using a paired-samples t-test. The researcher found a relationship between mathematics attitudes of students and their mothers as measured by the ATMI total score and subscales: self-confidence, value, enjoyment, and motivation. The researcher found a relationship between mathematics attitudes of students and their fathers as measured by the ATMI motivation subscale. The findings from this research did not support the findings of Parsons et al. (1982). Parsons et al. observed that children evolve into a self-concept based upon their father's influence. The researcher did not find a significant relationship between the ATMI self-confidence subscale of students and their fathers. The researcher's findings in regards to students and their mothers' mathematics attitude, as measured by the ATMI value subscale supported the findings of Jacobs et al. (2005) in regard to parents' influence on student beliefs. The researcher's findings in regard to students' and mothers' mathematics attitude, as measured by the ATMI, supports Jacobs and Eccles' (1992) findings that students are influenced by their parents' mathematics attitudes. These findings are important, as they extend the work of Jacobs and Eccles' by delineating parents by gender as it relates to the student mathematics attitude relationship. Tocci and Engelhard (1991) suggested future research should focus on attitudes towards mathematics, especially those related to race. Thus, these findings are especially important as they relate to African American students. They provide another viewpoint of African American student mathematics attitudes in relationship to their parents. The researcher's findings at the university level hold significance, as the next generation of students will be parented, in part, by the current generation of university students. Thus, this relationship should be further explored to determine generational relationships.

Research Question 2: Student Mathematics Achievement, Parental Mathematics Attitude

Is there a relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their parents' mathematics attitude?

No statistically significant relationship was found between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and parents' mathematics attitude. There was no significant relationship between academic achievement and the ATMI total score nor the subsequent subscales of self-confidence, value, enjoyment, and motivation. The relationship was further analyzed by the parents' gender, and the researcher did not find a significant relationship between students' mathematics academic achievement and their parents' mathematics attitude. Ginsburg, Rashid, and English-Clark (2008) found a connection between student achievement among 12^{th} grade students' and parents' education and behaviors, and stated the connection between parents' attitudes about mathematics and student academic achievement should be explored. No statistically significant relationship between students' mathematics achievement and their parents' mathematics attitude was found in this study at the university level with this specific population of students, however students at the K-12 level or students more representative of the general university population could be studied to determine if there is a relationship. Davis-Kean and

Schnabel (2001) believed parental influence was very powerful in predicting academic outcomes. Therefore, in future research parental mathematics influence should be studied at a predominately African American University as opposed to mathematics attitudes to determine if there is a relationship to academic achievement.

Research Question 3: Student Mathematics Achievement, Student Mathematics Attitude

Is there a relationship between students' mathematics academic achievement as demonstrated on the ACT/SAT by the mathematics subset score and their mathematics attitude?

A statistically significant relationship between students' academic achievement and their attitudes towards mathematics was found in this research. This relationship was further analyzed using the ATMI subscales, and a statistically significant relationship was found between self-confidence, value, enjoyment, and motivation and academic achievement. These findings did not support Harrington (1960) who determined there was a not a statistically significant relationship between attitude and academic achievement in college students. However, the findings did support Alpert et al. (1963) who found a correlation between measures of attitude and academic performance. The findings were also in agreement with those of Eccles et al. (1993) who found that people with positive perceptions of their ability approach achievement tasks with high expectations for success, as the researcher found a relationship between having a positive mathematics attitude and students' mathematics academic achievement. These findings were relevant, as the researcher examined an African American university student population and a relationship was found between mathematics attitude and mathematics academic achievement. This can lead to further studies exploring mathematics attitudes of the African American student population at earlier grade levels to determine if there is a similar relationship to mathematics academic achievement. Further studies can explore both positive and negative mathematics and changes, if any, over time and the mitigating factors. Aiken (1970) found attitude and achievement to be two intertwined components. Thus, further research into this relationship can help stakeholders investigate ways to increase student mathematics attitudes and, possibly, achievement.

Limitations of the Study

The study was delimited to the students and parents attending the New Student Orientation sessions, and the demographics were indicative of the anticipated incoming student population at a private historically black university. Sampling the entire incoming class and their parents could have provided different results. The sample was limited to the students and parents attending the opening orientation session. Late registrants or non-attendees could have provided different results. The sample contained 30 matches of students and fathers, a larger matched sample could have provided different results.

The conclusions of this study may not necessarily be generalized to all historically black universities, because this study was conducted, at a private historically black university, during New Student Orientation sessions, and neither the entire university incoming class nor the nationwide incoming historically black university class was sampled. The findings are indicative of the sample population at a specific moment in time. Truthfulness of the participants' responses to the demographics section and the ATMI is another potential limitation.

Implications

In this study, a significant relationship was found between students' and their mothers' attitudes towards mathematics. This finding supports Merttens' (1999) findings that parents were the single biggest factor in a student's educational success. This may lead future researchers to explore this relationship of students longitudinally over the course of their schooling from kindergarten to post-secondary education. The study of the mathematics attitudes of students and parents in the earlier childhood years is important because Bleeker and Jacobs (2004) found that self-concepts are formed during this time. And Sright (1960) found these mathematical attitudes could be formed as early as third grade. If negative mathematics attitudes are measured during this time, possible research could include attitudinal intervention models and exploration of individual attitudinal levels (Aiken, 1970; Cain-Caston, 1993; Hannula, 2002). This attitudinal intervention is important as Anttonen (1968) concluded there was a greater academic achievement at the high school level among students whose attitudes remained favorable since elementary school. One could seek to determine if this relationship is generational and study the mitigating factors. Correlation revealed a relationship between academic achievement and students' mathematics attitude supporting Tocci and Engelhard (1991) who found students with higher achievement had more positive mathematics perceptions. This could lead to mathematics attitudes being studied over time in relation to academic achievement. Professors could administer the Attitudes Towards Mathematics Inventory (ATMI) at the beginning of the semester and identify students with negative attitudes towards mathematics. Professors could then provide additional supports to those students to enhance their opportunities to achieve academic success in the course. The relationship between students and their mothers can also be further explored, as mathematics is tended to be viewed as a male domain (Eccles et al., 1993). A factor as it relates to not finding a relationship between students and their fathers' mathematics attitudes of self-confidence, value, and enjoyments could have been the small sample size match of students and their fathers. A future study should include a larger student and father sample size, at least comparable to the mothers' sample size, so as to further investigate this relationship. Jacobs and Eccles (1992) found that students were influenced by their parents, but their study did not delineate by parent gender.

The researcher's findings of a relationship between students and their mothers and the relationship between students' mathematics academic achievement and their mathematics attitudes are important as research is explored to determine ways to decrease the achievement gap. The study sample was predominantly African American and statistically African American students lag behind Caucasian students in mathematics achievement (NCES, 2011). This research study identified two key relationships which can be further explored to assist in improving African American mathematics academic achievement and decreasing the achievement gap.

Recommendations for Future Research

The researcher recommends the following questions be considered in future studies about student attitudes at a historically black university.

1. Is there a relationship between the mathematics attitudes of students and their post-secondary academic pursuit?
2. Is there a relationship between first generation college students' (students whose parent(s) have not attained a college degree) attitudes towards mathematics and their parents' attitudes toward mathematics?
3. Can students' mathematics attitudes be improved with a focus on developing mathematics conceptual understanding?
4. Is there a relationship between parental level of education and his/her attitudes towards mathematics?

Summary

The findings of this study demonstrated a clear relationship between the sample of participating students' mathematics academic achievement and their mathematics attitude. As educators seek to find ways to improve mathematics achievement, mathematics attitudes need to be further researched and studied. Researchers must continue to delve further into the area of mathematics attitudes and study its subscales. As the nation seeks to continually set high academic standards, it is imperative that researchers continually look for ways to increase student academic achievement, especially among the African American student population, as NCES (2011) data shows a significant achievement gap that must be bridged. This research study has provided a line of research to further explore mathematics attitudes as ways are examined to assist in obtaining high mathematics academic achievement among African American students.

APPENDIX A
ATTITUDE TOWARDS MATHEMATICS QUESTIONNAIRE

Respondent ID #####

ATTITUDES TOWARD MATHEMATICS QUESTIONNAIRE (STUDENT)

Directions:
For the following questions please bubble your response. Please bubble only one response per question.

Gender
- ☐ Male
- ☐ Female

Ethnicity
- ☐ African-American
- ☐ Asian-Pacific Islander
- ☐ Hispanic
- ☐ Native American
- ☐ White

Current Martial Status
- ☐ Single, Never Married
- ☐ Married
- ☐ Separated
- ☐ Divorced
- ☐ Widowed

Age
- ☐ 18 – 21
- ☐ 22 – 25
- ☐ 26 – 30
- ☐ 31 – 40
- ☐ 41 – 50
- ☐ 51 – 60
- ☐ 61 or older

Last Mathematics Course Completed
(select only one course and check the appropriate level box)

High School	College	**Course**
☐	☐	Algebra
☐	☐	College Math
☐	☐	Geometry
☐	☐	Liberal Arts
☐	☐	Statistics
☐	☐	Trigonometry
☐	☐	Calculus
☐	☐	Other

Classification
- ☐ Freshman
- ☐ Sophomore
- ☐ Junior
- ☐ Senior

First Generation College Student
(defined as a student whose parent(s) never enrolled in college)
- ☐ Yes
- ☐ No

Academic School
- ☐ School of Business
- ☐ School of Education
- ☐ School of Arts and Humanities
- ☐ School of Science, Engineering and Math
- ☐ School of Social Sciences
- ☐ School of Nursing

Respondent ID #####

ATTITUDES TOWARD MATHEMATICS QUESTIONNAIRE (PARENT)

Directions:
For the following questions please bubble your response. Please bubble only one response per question.

Status
- ☐ Parent
- ☐ Legal Guardian

Gender
- ☐ Male
- ☐ Female

Ethnicity
- ☐ African-American
- ☐ Asian-Pacific Islander
- ☐ Hispanic
- ☐ Native American
- ☐ White

Current Martial Status
- ☐ Single, Never Married
- ☐ Married
- ☐ Separated
- ☐ Divorced
- ☐ Widowed

Age
- ☐ 18 – 21
- ☐ 22 – 25
- ☐ 26 – 30
- ☐ 31 – 40
- ☐ 41 – 50
- ☐ 51 – 60
- ☐ 61 or older

Last Mathematics Course Completed
(select only one course and check the appropriate level box)

High School	College	**Course**
☐	☐	Algebra
☐	☐	Geometry
☐	☐	Statistics
☐	☐	Trigonometry
☐	☐	Calculus
☐	☐	Other

Highest Level of Education
- ☐ Some High School
- ☐ High School Graduate
- ☐ Some College
- ☐ College Degree
- ☐ Graduate Degree(s)

Household Income
- ☐ Less than $20,000
- ☐ $20,000 - $34,999
- ☐ $35,000 - $49,999
- ☐ $50,000 - $74,999
- ☐ $75,000 - $99,999
- ☐ More than $100,000

ATTITUDES TOWARD MATHEMATICS INVENTORY

Respondent ID #####

Directions: This inventory consists of statements about your attitude toward mathematics. There are no correct or incorrect responses. Read each item carefully. Please think about how you feel about each item. Enter the letter that most closely corresponds to how each statement best describes your feelings. Please answer every question.

PLEASE USE THESE RESPONSE CODES:

A – Strongly Disagree
B – Disagree
C – Neutral
D – Agree
E – Strongly Agree

1.	Mathematics is a very worthwhile and necessary subject.	
2.	I want to develop my mathematical skills.	
3.	I get a great deal of satisfaction out of solving a mathematics problem.	
4.	Mathematics helps develop the mind and teaches a person to think.	
5.	Mathematics is important in everyday life.	
6.	Mathematics is one of the most important subjects for people to study.	
7.	High school math courses would be very helpful no matter what I decide to study.	
8.	I can think of many ways that I use math outside of school.	
9.	Mathematics is one of my most dreaded subjects.	
10.	My mind goes blank and I am unable to think clearly when working with mathematics.	
11.	Studying mathematics makes me feel nervous.	
12.	Mathematics makes me feel uncomfortable.	
13.	I am always under a terrible strain in a math class.	
14.	When I hear the word mathematics, I have a feeling of dislike.	
15.	It makes me nervous to even think about having to do a mathematics problem.	
16.	Mathematics does not scare me at all.	
17.	I have a lot of self-confidence when it comes to mathematics.	
18.	I am able to solve mathematics problems without too much difficulty.	
19.	I expect to do fairly well in any math class I take.	
20.	I am always confused in my mathematics class.	
21.	I feel a sense of insecurity when attempting mathematics.	
22.	I learn mathematics easily.	
23.	I am confident that I could learn advanced mathematics.	
24.	I have usually enjoyed studying mathematics in school.	
25.	Mathematics is dull and boring.	
26.	I like to solve new problems in mathematics.	
27.	I would prefer to do an assignment in math than to write an essay.	
28.	I would like to avoid using mathematics in college.	
29.	I really like mathematics.	
30.	I am happier in a math class than in any other class.	
31.	Mathematics is a very interesting subject.	
32.	I am willing to take more than the required amount of mathematics.	
33.	I plan to take as much mathematics as I can during my education.	
34.	The challenge of math appeals to me.	
35.	I think studying advanced mathematics is useful.	
36.	I believe studying math helps me with problem solving in other areas.	
37.	I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in	
38.	I am comfortable answering questions in math class.	
39.	A strong math background could help me in my professional life.	
40.	I believe I am good at solving math problems.	

**** Thank you for your time in completing this survey. ****

APPENDIX B
EXPLANATION OF RESEARCH (STUDENT VERSION)

f

University of Central Florida

EXPLANATION OF RESEARCH

Title of Project: Students at a Historically Black University and their Parents' Mathematics Attitudes and their Relation to Mathematics Academic Achievement

Principal Investigator: Kristopher Childs, M S

Faculty Supervisor: Juli Dixon, PhD

You are being invited to take part in a research study . Whether you take part is up to you.

Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being invited to take part in a research study, which will include about 2400 people . You have been asked to take part in this research study because you are an incoming student to [redacted] University. You must be 18 years of age or older to be included in the research study.

The person doing this research is Kristopher Childs of the University of Central Florida School of Teaching, Learning, and Leadership **.**

Because the researcher is a graduate student he is being guided by Juli Dixon, PhD., an UCF faculty supervisor in School of Teaching, Learning, and Leadership.

You will be asked to complete a demographic survey and Attitudes Towards Mathematics Inventory. As part of the study, if you are a Student participant you will be asked to allow the researcher to obtain your University submitted ACT/SAT scores from the University Registrar. By completing the survey you agree to participate in this study. It is expected that you will be in this research study for one session and approximately 25 minutes.

You must be 18 years of age or older to take part in this research study.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, or think the research has hurt you, talk to Kristopher

Childs, School of Teaching Learning and Leadership, (407) 407 -823-1775 or by email at Kristopher.childs@ucf.edu or Dr. Juli Dixon, Faculty Supervisor, School of Teaching, Learning and Leadership.

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Rev iew Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823 -2901.

UCF

APPENDIX C
EXPLANATION OF RESEARCH (PARENT VERSION)

University of Central Florida

EXPLANATION OF RESEARCH

Title of Project: Students at a Historically Black University and their Parents' Mathematics Attitudes and their Relation to Mathematics Academic Achievement

Principal Investigator: Kristopher Childs, MS

Faculty Supervisor: Juli Dixon, PhD

You are being invited to take part in a research study . Whether you take part is up to you.

Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being invited to take part in a research study, which will include about 2400 people . You have been asked to take part in this research study because you are the parent or legal guardian of an incoming student at [redacted] University.

The person doing this research is Kristopher Childs of the University of Central Florida School of Teaching, Learning, and Leadership.

Because the researcher is a graduate student he is being guided by Juli Dixon, PhD., an UCF faculty supervisor in School of Teaching, Learning, and Leadership.

You will be asked to complete a demographic survey and Attitudes Towards Mathematics Inventory. By completing the survey you agree to participate in this study. The demographic questions are optional/voluntary, however the hope is you will complete this information to enhance the research. It is expected that you will be in this research study for one session and approximately 25 minutes.

You must be 18 years of age or older to take part in this research study.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, or think the research has hurt you, talk to Kristopher Childs, School of Teaching Learning and Leadership, (407) 407 -823-1775 or by email at

UCF University of Central Florida IRB
IRB NUMBER: SBE-13-09374
IRB APPROVAL DATE: 6/18/2013

Kristopher.childs@ucf.edu or Dr. Juli Dixon, Faculty Supervisor, School of Teaching, Learning and Leadership.

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

UCF

APPENDIX D
INSTITUTIONAL REVIEW BOARD APPROVAL

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Kristopher J. Childs**

Date: **June 18, 2013**

Dear Researcher:

On 6/18/2013, the IRB approved the following minor modifications to human participant research that is exempt from regulation:

Type of Review: Exempt Determination
Modification Type: Recruitment of study participants will be expanded from Summer 2013 session to include the incoming Freshman class at [redacted] and their parents/ guardians. In addition, the total number of approved study participants is being increased to a total of 2400. Revised consent documents (student and pare nt/ guardian versions) have been approved for use.
Project Title: Students at a Historically Black University and their Parents' Mathematics Attitudes and their Relation to Mathematics Academic Achievement
Investigator: Kristopher J Childs
IRB Number: SBE-13-09374
Funding Agency:
Grant Title:
Research ID: N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes af fect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so th at IRB records will be accurate.

In the conduct of this research, you are responsible to f ollow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

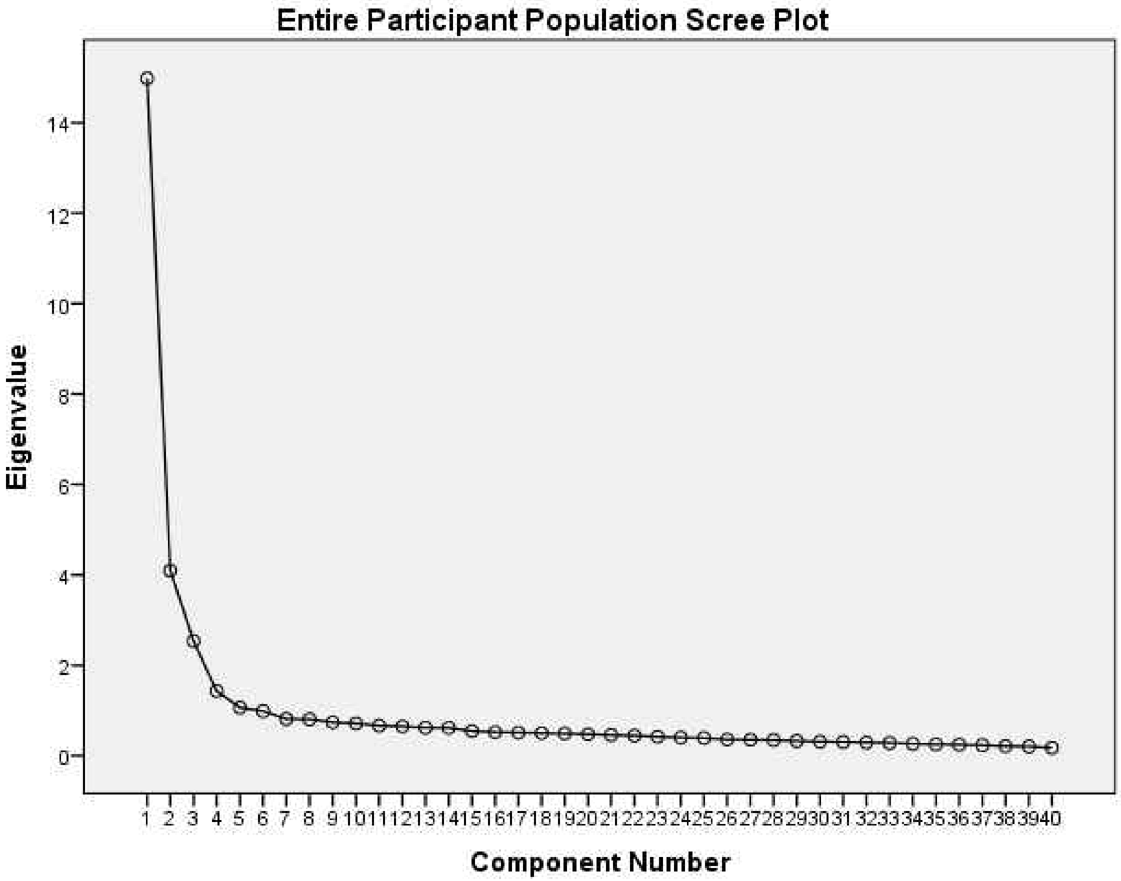
Signature applied by Joanne Muratori on 06/18/2013 03:20:32 PM EDT

Joanne Muratori

IRB Coordinator

Page 1 of 1

APPENDIX E
FACTOR ANALYSIS OF THE ENTIRE PARTICIPANT POPULATION
(SCREE PLOT)


Entire Participant Population Scree Plot
Eigenvalue
Component Number
0
2
4
6
8
10
12
14
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

APPENDIX F
PRINCIPAL FACTOR ANALYSIS OF THE ATMI (ENTIRE PARTICIPANT POPULATION) FACTOR MATRIX

Principal Factor Analysis of the ATMI (Entire Participant Population) Factor Matrix

	Factor			
	1	2	3	4
17. I have a lot of self-confidence when it comes to mathematics.	.778	.039	-.192	-.231
40. I believe I am good at solving math problems.	.761	-.029	-.169	-.233
38. I am comfortable answering questions in math class.	.746	-.059	-.193	-.160
34. The challenge of math appeals to me.	.743	-.189	-.264	.149
31. Mathematics is a very interesting subject.	.716	-.181	-.176	.201
24. I have usually enjoyed studying mathematics in school.	.714	-.041	-.255	.075
29. I really like mathematics.	.711	-.056	-.305	.191
16. Mathematics does not scare me at all.	.697	.133	-.060	-.337
22. I learn mathematics easily.	.687	.057	-.274	-.168
30. I am happier in a math class than any other class.	.675	-.100	-.383	.126
13. I am always under a terrible strain in a math class.	.666	.527	.082	-.096
26. I like to solve new problems in mathematics.	.666	-.057	-.214	.143
18. I am able to solve mathematics problems without too much difficulty.	.663	-.027	-.105	-.343
14. When I hear the word mathematics, I have a feeling of dislike.	.657	.498	.094	.040
23. I am confident that I could learn advanced mathematics.	.655	-.146	-.156	-.176
37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	.653	-.189	-.047	-.081
3. I get a great deal of satisfaction out of solving a mathematics problem.	.641	-.200	.139	-.010
35. I think studying advanced mathematics is useful.	.639	-.305	-.009	.232
12. Mathematics makes me feel uncomfortable.	.634	.517	.143	-.081
36. I believe studying math helps me with problem solving in other areas.	.627	-.331	.170	.154

Principal Factor Analysis of the ATMI (Entire Participant Population) Factor Matrix

	Factor			
	1	2	3	4
39. A strong math background could help me in my professional life.	.590	-.329	.108	.073
33. I plan to take as much mathematics as I can during my education.	.589	-.315	-.278	.207
19. I expect to do fairly well in any math class I take.	.587	-.126	-.103	-.256
6. Mathematics is one of the most important subjects for people to study.	.576	-.306	.425	.058
11. Studying mathematics makes me feel nervous.	.574	.569	.162	-.105
27. I would prefer to do an assignment in math than to write an essay.	.569	-.045	-.300	-.030
32. I am willing to take more than the required amount of mathematics.	.566	-.244	-.296	.282
15. It makes me nervous to even think about having to do a mathematics problem.	.565	.548	.162	-.036
10. My mind goes blank and I am unable to think clearly when working with mathematics.	.557	.541	.176	-.026
1. Mathematics is a very worthwhile and necessary subject.	.550	-.253	.387	-.093
7. High school mathematics courses would be very helpful no matter what I decide to study.	.537	-.309	.372	-.028
21. I feel a sense of insecurity when attempting mathematics.	.536	.503	.200	.065
4. Mathematics helps develop the mind and teaches a person to think.	.535	-.312	.473	-.144
8. I can think of many ways that I use math outside of school.	.511	-.332	.406	-.003
9. Mathematics is one of my most dreaded subjects.	.475	.465	-.107	.127
20. I am always confused in my mathematics class.	.465	.504	.210	.099
2. I want to develop my mathematical skills.	.326	-.458	.314	-.024
5. Mathematics is important in everyday life.	.508	-.361	.534	-.037

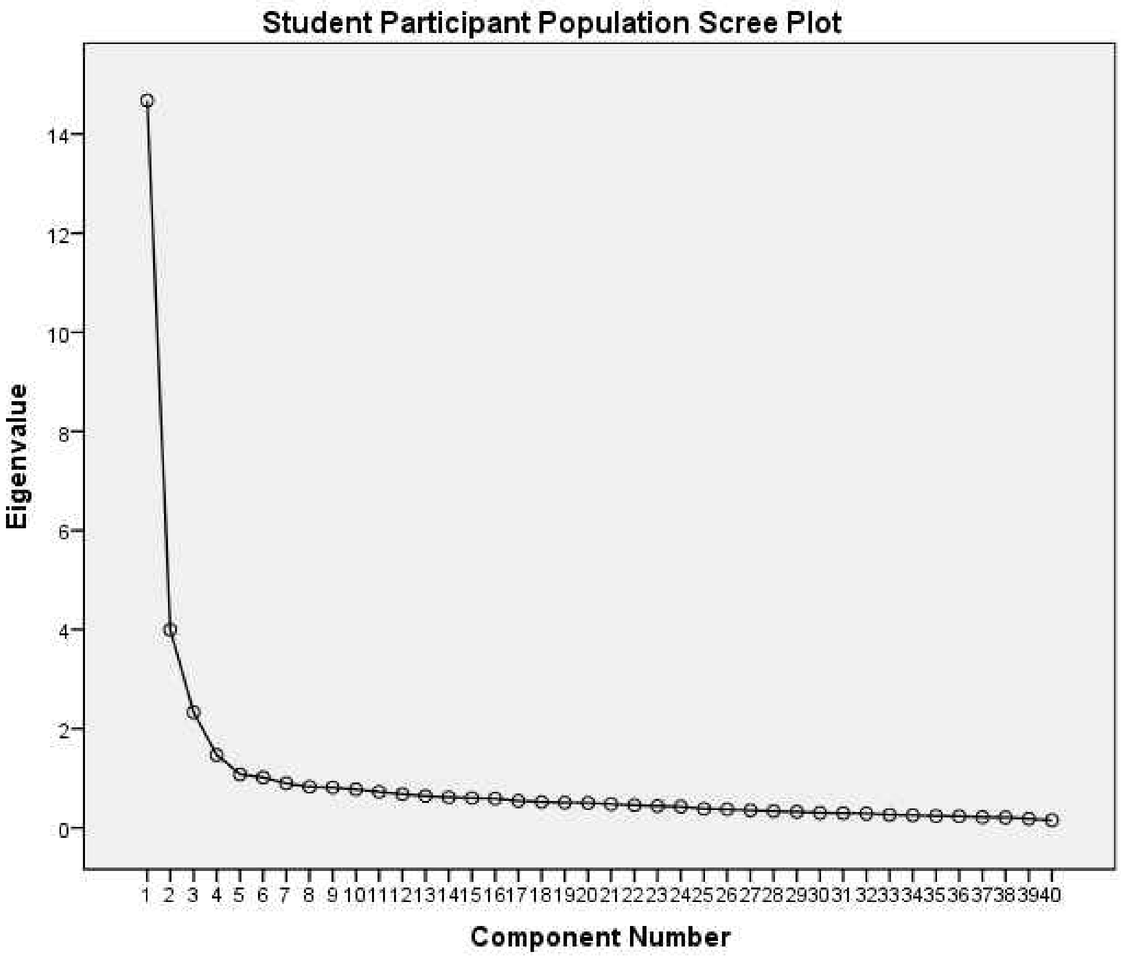
Principal Factor Analysis of the ATMI (Entire Participant Population) Factor Matrix

	Factor			
	1	2	3	4
28. I would like to avoid using mathematics in college.	.323	.315	.238	.502
25. Mathematics is dull and boring.	.457	.248	.164	.487

Extraction Method: Principal Factor Analysis.

a. 4 factors extracted.

APPENDIX G
FACTOR ANALYSIS OF THE STUDENT PARTICIPANT POPULATION
(SCREE PLOT)


Student Participant Population Scree Plot
Eigenvalue
14
12
10
8
6
4
2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Component Number

APPENDIX H
PRINCIPAL FACTOR ANALYSIS OF THE ATMI (STUDENT PARTICIPANT POPULATION) FACTOR MATRIX

Principal Factor Analysis of the ATMI (Student Participant Population)
Factor Matrix

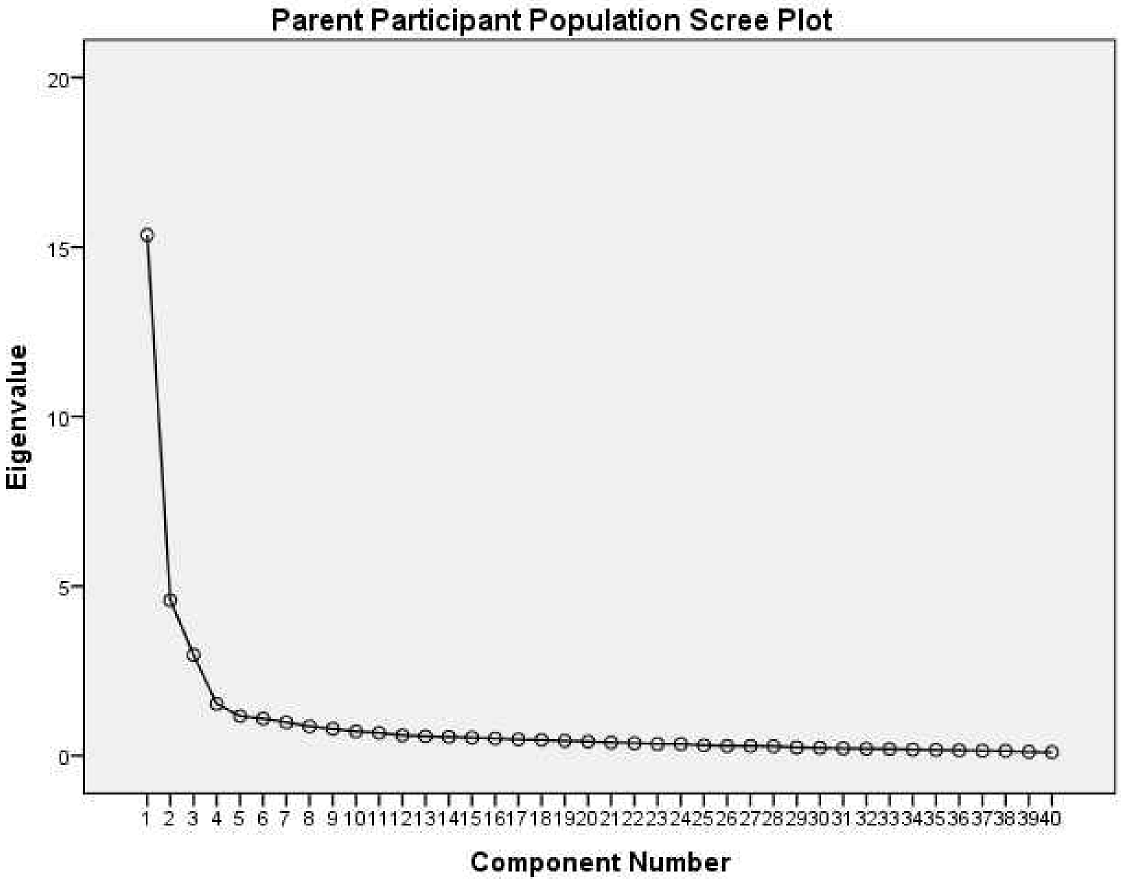
	Factor			
	1	2	3	4
40. I believe I am good at solving math problems.	.758	.036	-.134	-.251
17. I have a lot of self-confidence when it comes to mathematics.	.756	-.001	-.132	-.287
34. The challenge of math appeals to me.	.716	.220	-.254	.116
22. I learn mathematics easily.	.713	.017	-.276	-.184
38. I am comfortable answering questions in math class.	.712	.092	-.192	-.135
31. Mathematics is a very interesting subject.	.707	.205	-.219	.123
29. I really like mathematics.	.697	.062	-.332	.141
16. Mathematics does not scare me at all.	.694	-.136	-.020	-.388
14. When I hear the word mathematics, I have a feeling of dislike.	.673	-.483	.008	.068
24. I have usually enjoyed studying mathematics in school.	.673	.089	-.275	.064
13. I am always under a terrible strain in a math class.	.669	-.516	.096	-.071
30. I am happier in a math class than any other class.	.666	.134	-.412	.090
18. I am able to solve mathematics problems without too much difficulty.	.664	.021	-.082	-.400
26. I like to solve new problems in mathematics.	.652	.083	-.165	.107
35. I think studying advanced mathematics is useful.	.639	.283	-.027	.222
3. I get a great deal of satisfaction out of solving a mathematics problem.	.633	.188	.162	-.001
12. Mathematics makes me feel uncomfortable.	.632	-.518	.145	-.014
15. It makes me nervous to even think about having to do a mathematics problem.	.630	-.498	.126	.020
37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	.627	.218	-.044	-.053
23. I am confident that I could learn advanced mathematics.	.617	.179	-.143	-.213
27. I would prefer to do an assignment in math than to write an essay.	.599	.064	-.235	.014
10. My mind goes blank and I am unable to think clearly when working with mathematics.	.599	-.551	.113	.012

Principal Factor Analysis of the ATMI (Student Participant Population)
Factor Matrix

	Factor			
	1	2	3	4
36. I believe studying math helps me with problem solving in other areas.	.599	.334	.095	.188
21. I feel a sense of insecurity when attempting mathematics.	.567	-.487	.162	.084
39. A strong math background could help me in my professional life.	.566	.307	.182	.053
1. Mathematics is a very worthwhile and necessary subject.	.566	.227	.341	-.029
6. Mathematics is one of the most important subjects for people to study.	.559	.256	.415	.078
19. I expect to do fairly well in any math class I take.	.555	.167	.006	-.288
20. I am always confused in my mathematics class.	.537	-.493	.137	.133
7. High school mathematics courses would be very helpful no matter what I decide to study.	.537	.256	.303	-.075
4. Mathematics helps develop the mind and teaches a person to think.	.525	.273	.482	-.065
33. I plan to take as much mathematics as I can during my education.	.512	.392	-.232	.335
9. Mathematics is one of my most dreaded subjects.	.489	-.444	-.150	.102
32. I am willing to take more than the required amount of mathematics.	.484	.249	-.318	.340
8. I can think of many ways that I use math outside of school.	.478	.309	.371	-.031
25. Mathematics is dull and boring.	.467	-.286	.114	.379
11. Studying mathematics makes me feel nervous.	.578	-.580	.157	-.082
2. I want to develop my mathematical skills.	.356	.469	.413	.058
5. Mathematics is important in everyday life.	.489	.322	.511	.020
28. I would like to avoid using mathematics in college.	.316	-.316	.188	.474

Note. Extraction Method: Principal Factor Analysis.
a. 4 factors extracted.

APPENDIX I
FACTOR ANALYSIS OF THE PARENT PARTICIPANT POPULATION
(SCREE PLOT)


Parent Participant Population Scree Plot
Eigenvalue
Component Number
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

APPENDIX J
PRINCIPAL FACTOR ANALYSIS OF THE ATMI (PARENT PARTICIPANT POPULATION) FACTOR MATRIX

Principal Factor Analysis of the ATMI (Parent Participant Population) Factor Matrix

	Factor			
	1	2	3	4
17. I have a lot of self-confidence when it comes to mathematics.	.825	.147	-.200	-.151
38. I am comfortable answering questions in math class.	.818	.021	-.114	-.203
34. The challenge of math appeals to me.	.782	-.092	-.309	.108
24. I have usually enjoyed studying mathematics in school.	.778	.080	-.229	-.018
40. I believe I am good at solving math problems.	.776	-.004	-.161	-.202
33. I plan to take as much mathematics as I can during my education.	.751	-.119	-.296	-.008
23. I am confident that I could learn advanced mathematics.	.730	-.058	-.136	-.102
29. I really like mathematics.	.729	-.016	-.340	.218
32. I am willing to take more than the required amount of mathematics.	.718	-.178	-.298	.116
31. Mathematics is a very interesting subject.	.718	-.134	-.143	.278
37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	.715	-.137	.020	-.082
16. Mathematics does not scare me at all.	.707	.144	-.054	-.181
26. I like to solve new problems in mathematics.	.698	.030	-.278	.173
30. I am happier in a math class than any other class.	.681	.003	-.376	.023
19. I expect to do fairly well in any math class I take.	.674	-.011	-.198	-.117
13. I am always under a terrible strain in a math class.	.667	.541	.149	-.082
36. I believe studying math helps me with problem solving in other areas.	.645	-.357	.203	.080
18. I am able to solve mathematics problems without too much difficulty.	.645	-.025	-.146	-.322
39. A strong math background could help me in my professional life.	.645	-.354	.004	.224
22. I learn mathematics easily.	.644	.200	-.193	-.144
12. Mathematics makes me feel uncomfortable.	.642	.495	.230	-.133
3. I get a great deal of satisfaction out of solving a mathematics problem.	.627	-.223	.043	.008
35. I think studying advanced mathematics is useful.	.615	-.351	-.084	.239

Principal Factor Analysis of the ATMI (Parent Participant Population) Factor Matrix

	Factor			
	1	2	3	4
14. When I hear the word mathematics, I have a feeling of dislike.	.596	.503	.279	-.030
11. Studying mathematics makes me feel nervous.	.580	.520	.287	-.067
27. I would prefer to do an assignment in math than to write an essay.	.578	-.011	-.366	-.051
6. Mathematics is one of the most important subjects for people to study.	.576	-.440	.381	.061
8. I can think of many ways that I use math outside of school.	.528	-.451	.394	.014
4. Mathematics helps develop the mind and teaches a person to think.	.525	-.436	.440	-.156
1. Mathematics is a very worthwhile and necessary subject.	.475	-.369	.423	-.196
15. It makes me nervous to even think about having to do a mathematics problem.	.426	.591	.330	-.084
5. Mathematics is important in everyday life.	.499	-.511	.510	-.079
21. I feel a sense of insecurity when attempting mathematics.	.455	.501	.332	.031
9. Mathematics is one of my most dreaded subjects.	.429	.498	-.027	.168
7. High school mathematics courses would be very helpful no matter what I decide to study.	.490	-.496	.399	.029
20. I am always confused in my mathematics class.	.281	.491	.332	.057
2. I want to develop my mathematical skills.	.335	-.484	.224	.046
10. My mind goes blank and I am unable to think clearly when working with mathematics.	.455	.465	.336	-.055
25. Mathematics is dull and boring.	.386	.184	.135	.683
28. I would like to avoid using mathematics in college.	.280	.326	.267	.568

Note. Extraction Method: Principal Factor Analysis.

a. 4 factors extracted.

APPENDIX K
SELF-CONFIDENCE SUBSCALE DESCRIPTIVE STATISTICS PER SURVEY QUESTION

Self-Confidence Subscale Descriptive Statistics Per Survey Question

Self-Confidence Item	M		SD		Skewness		Kurtosis	
	S	P	S	P	S	P	S	P
9. Mathematics is one of my most dreaded subjects.	2.82	3.07	1.385	1.357	.176	-.033	-1.154	-1.173
10. My mind goes blank and I am unable to think clearly when working with mathematics.	3.35	3.53	1.260	1.146	-.368	-.445	-.818	-.681
11. Studying mathematics makes me feel nervous.	3.39	3.44	1.229	1.156	-.417	-.268	-.764	-.966
12. Mathematics makes me feel uncomfortable.	3.46	3.60	1.277	1.102	-.530	-.494	-.747	-.580
13. I am always under a terrible strain in a math class.	3.45	3.55	1.240	1.098	-.477	-.504	-.679	-.553
14. When I hear the word mathematics, I have a feeling of dislike.	3.29	3.65	1.368	1.149	-.284	-.680	-1.107	-.386
15. It makes me nervous to even think about having to do a mathematics problem.	3.46	3.56	1.259	1.174	-.479	-.555	-.731	-.635
16. Mathematics does not scare me at all.	3.28	3.45	1.280	1.268	-.239	-.449	-.970	-.864
17. I have a lot of self-confidence when it comes to mathematics.	3.21	3.37	1.187	1.154	-.201	-.300	-.682	-.702
18. I am able to solve mathematics problems without too much difficulty.	3.14	3.42	1.148	1.014	-.125	-.372	-.613	-.317

Self-Confidence Item	M		SD		Skewness		Kurtosis	
	S	P	S	P	S	P	S	P
19. I expect to do fairly well in any math class I take.	3.60	3.62	1.070	.961	-.586	-.474	-.043	-.239
20. I am always confused in my mathematics class.	3.34	3.64	1.091	1.059	-.358	-.660	-.413	-.145
21. I feel a sense of insecurity when attempting mathematics.	3.34	3.53	1.128	1.084	-.282	-.497	-.622	-.522
22. I learn mathematics easily.	3.18	3.26	1.147	1.096	-.139	-.267	-.610	-.607
40. I believe I am good at solving math problems.	3.41	3.53	1.109	1.077	-.315	-.562	-.425	-.212
TOTAL	49.78	52.30	13.071	11.786	-.090	-.205	-.273	-.396

Note. S = Student; P = Parent

APPENDIX L
SELF-CONFIDENCE SUBSCALE PERCENTAGES PER RESPONSE

Self-Confidence Subscale Percentages Per Response

Self-Confidence Item	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree	
	S	P	S	P	S	P	S	P	S	P
9. Mathematics is one of my most dreaded subjects.	23.4	16.1	18.9	20.1	26.7	24.6	13.9	19.2	17.0	20.1
10. My mind goes blank and I am unable to think clearly when working with mathematics.	11.1	4.8	13.0	16.3	27.2	22.0	27.2	34.8	21.5	22.0
11. Studying mathematics makes me feel nervous.	9.4	4.0	14.4	22.0	24.3	20.7	31.1	33.0	20.8	20.3
12. Mathematics makes me feel uncomfortable.	10.8	3.5	12.0	15.4	21.2	21.1	31.6	37.4	24.3	22.5
13. I am always under a terrible strain in a math class.	9.9	4.0	11.3	16.3	26.0	20.3	29.6	40.1	23.2	19.4
14. When I hear the word mathematics, I have a feeling of dislike.	14.4	5.3	14.4	13.6	23.9	16.7	22.0	39.5	25.3	25.0
15. It makes me nervous to even think about having to do a mathematics problem.	10.2	5.7	11.6	16.2	25.1	17.5	28.6	37.6	24.6	23.1
16. Mathematics does not scare me at all.	11.1	9.2	16.6	15.7	26.8	20.1	23.9	30.6	21.6	24.5
17. I have a lot of self-confidence when it comes to mathematics.	10.5	6.6	14.3	16.3	35.3	28.6	23.6	30.0	16.2	18.5
18. I am able to solve mathematics problems without too much difficulty.	10.0	3.9	16.4	14.0	37.3	31.6	22.8	37.3	13.5	13.2
19. I expect to do fairly well in any math class I take.	5.5	1.8	7.4	11.8	30.4	25.9	35.4	43.4	21.4	17.1
20. I am always confused in my mathematics class.	6.9	4.0	13.3	11.9	33.3	20.8	32.3	42.9	14.3	20.4
21. I feel a sense of insecurity when attempting mathematics.	6.7	3.9	15.7	16.2	31.1	21.1	29.9	40.8	16.6	18.0
22. I learn mathematics easily.	9.2	6.6	15.9	18.1	37.2	30.4	23.0	32.6	14.7	12.3
40. I believe I am good at solving math problems.	6.5	5.3	11.0	11.1	36.4	26.7	27.3	38.7	18.9	18.2

Note. S = Student; P = Parent

APPENDIX M

VALUE SUBSCALE DESCRIPTIVE STATISTICS PER SURVEY QUESTION

Value Subscale Descriptive Statistics Per Survey Question

Value	M		SD		Skewness		Kurtosis	
Item	S	P	S	P	S	P	S	P
1. Mathematics is a very worthwhile and necessary subject.	3.98	4.40	1.129	1.038	-1.012	-2.120	.342	4.100
2. I want to develop my mathematical skills.	4.16	3.93	1.026	1.019	-1.449	-.950	1.913	.835
4. Mathematics helps develop the mind and teaches a person to think.	4.04	4.33	1.025	.983	-1.174	-1.827	1.257	3.295
5. Mathematics is important in everyday life.	3.93	4.37	1.040	.906	-.851	-1.878	.316	4.020
6. Mathematics is one of the most important subjects for people to study.	3.73	4.12	1.037	1.021	-.584	-1.365	-.025	1.756
7. High school mathematics courses would be very helpful no matter what I decide to study.	3.66	4.17	1.103	.954	-.670	-1.346	-.042	1.947
8. I can think of many ways that I use math outside of school.	3.53	4.16	1.105	.934	-.466	-1.402	-.350	2.307
35. I think studying advanced mathematics is useful.	3.33	3.68	1.136	1.122	-.286	-.754	-.523	.073
36. I believe studying math helps me with problem solving in other areas.	3.41	3.93	1.129	1.102	-.374	-1.216	-.394	1.096
39. A strong math background could help me in my professional life.	3.76	3.84	1.094	1.149	-.629	-1.011	-.152	.432
Value_Total	37.48	40.87	7.547	7.677	-.683	-1.371	.864	2.456

APPENDIX N
VALUE SUBSCALE PERCENTAGES PER RESPONSE

Value Subscale Percentages Per Response

Value Item	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agrees	
	S	P	S	P	S	P	S	P	S	P
1. Mathematics is a very worthwhile and necessary subject.	5.1	5.6	4.6	.9	20.1	5.6	27.3	24.0	42.8	63.9
2. I want to develop my mathematical skills.	4.4	4.3	2.3	1.7	12.3	24.3	34.5	36.1	46.5	33.5
4. Mathematics helps develop the mind and teaches a person to think.	4.4	3.9	1.9	1.7	18.4	8.3	36.1	29.1	29.2	57.0
5. Mathematics is important in everyday life.	3.5	3.0	4.4	.9	23.4	8.3	32.9	31.3	35.7	56.5
6. Mathematics is one of the most important subjects for people to study.	3.8	4.3	5.9	2.2	30.3	13.9	33.3	36.1	26.8	43.5
7. High school mathematics courses would be very helpful no matter what I decide to study.	5.9	3.1	6.8	2.2	27.5	13.5	34.7	37.6	25.1	43.7
8. I can think of many ways that I use math outside of school.	5.6	3.1	10.1	2.2	30.8	11.8	32.0	41.5	21.4	41.5
35. I think studying advanced mathematics is useful.	7.8	6.7	12.8	5.8	35.3	25.9	27.0	35.7	17.1	25.9
36. I believe studying math helps me with problem solving in other areas.	7.6	6.7	9.7	3.1	35.9	14.7	27.8	41.5	19.0	33.9
39. A strong math background could help me in my professional life.	4.5	7.1	6.0	4.4	29.4	18.7	29.1	36.4	31.0	33.3

Note. S = Student; P = Parent

APPENDIX O
ENJOYMENT SUBSCALE DESCRIPTIVE STATISTICS PER SURVEY QUESTION

Enjoyment Subscale Descriptive Statistics Per Survey Question

Enjoyment	Mean		SD		Skewness		Kurtosis	
Item	S	P	S	P	S	P	S	P
3. I get a great deal of satisfaction out of solving a mathematics problem.	3.43	3.84	1.140	1.058	-.345	-.827	-.498	.241
24. I have usually enjoyed studying mathematics in school.	3.08	3.40	1.252	1.210	-.136	-.432	-.939	-.765
25. Mathematics is dull and boring.	3.20	3.66	1.238	1.123	-.195	-.564	-.811	-.500
26. I like to solve new problems in mathematics.	3.13	3.26	1.129	1.085	-.179	-.294	-.540	-.567
27. I would prefer to do an assignment in math than to write an essay.	3.18	2.94	1.513	1.315	-.164	.056	-1.399	-1.111
29. I really like mathematics.	3.04	3.38	1.282	1.169	-.084	-.409	-.925	-.572
30. I am happier in a math class than any other class.	2.63	2.92	1.244	1.220	.316	.178	-.813	-.811
31. Mathematics is a very interesting subject.	3.20	3.51	1.239	1.183	-.214	-.541	-.786	-.517
37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	3.44	3.51	1.109	1.102	-.280	-.528	-.495	-.245
38. I am comfortable answering questions in math class.	3.31	3.44	1.134	1.111	-.251	-.427	-.507	-.354
Enjoyment_Total	31.69	33.94	8.623	8.322	-.002	-.181	-.555	-.272

APPENDIX P
ENJOYMENT SUBSCALE PERCENTAGES PER RESPOSNE

Enjoyment Subscale Percentages Per Response

Enjoyment	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree	
Item	S	P	S	P	S	P	S	P	S	P
3. I get a great deal of satisfaction out of solving a mathematics problem.	7.0	3.9	10.9	6.6	34.7	21.5	26.7	37.3	20.7	30.7
24. I have usually enjoyed studying mathematics in school.	14.0	8.4	17.8	16.4	28.9	21.3	24.6	34.7	14.7	19.1
25. Mathematics is dull and boring.	12.1	4.0	14.2	13.3	33.4	21.3	22.3	35.1	18.0	26.2
26. I like to solve new problems in mathematics.	10.2	6.6	15.2	17.7	38.0	30.5	24.5	33.6	12.1	11.5
27. I would prefer to do an assignment in math than to write an essay.	21.4	17.3	13.5	22.6	20.4	24.3	15.4	20.8	29.2	15.0
29. I really like mathematics.	16.5	8.5	14.4	12.9	33.8	29.0	19.1	31.7	16.1	17.9
30. I am happier in a math class than any other class.	22.9	13.3	24.1	24.9	29.8	32.4	13.5	15.6	9.7	13.8
31. Mathematics is a very interesting subject.	12.5	7.6	13.0	12.1	34.3	24.1	22.2	33.9	18.0	22.2
37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	5.7	6.3	11.7	9.9	36.2	29.6	26.2	35.0	20.2	19.3
38. I am comfortable answering questions in math class.	7.9	6.7	12.4	10.7	37.3	32.6	25.1	31.7	17.2	18.3

Note. S = Student; P = Parent

APPENDIX Q
MOTIVATION SUBSCALE DESCRIPTIVE STATISTICS PER SURVEY QUESTION

Motivation Subscale Descriptive Statistics Per Survey Question

Motivation	M		SD		Skewness		Kurtosis	
Item	S	P	S	P	S	P	S	P
23. I am confident that I could learn advanced mathematics.	3.41	3.59	1.141	1.036	-.354	-.756	-.529	.223
28. I would like to avoid using mathematics in college.	3.31	3.69	1.226	1.061	-.360	-.622	-.721	-.106
32. I am willing to take more than the required amount of mathematics.	2.84	3.10	1.222	1.144	.125	-.121	-.778	-.639
33. I plan to take as much mathematics as I can during my education.	3.09	3.14	1.135	1.136	-.153	-.193	-.462	-.593
34. The challenge of math appeals to me.	3.10	3.39	1.133	1.107	-.137	-.346	-.490	-.477
Motivation_Total	15.74	16.95	3.879	4.060	-.145	-.153	.069	-.342

APPENDIX R
MOTIVATION SUBSCALE PERCENTAGES PER RESPONSE

Motivation Subscale Percentages Per Response

Motivation Item	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree	
	S	P	S	P	S	P	S	P	S	P
23. I am confident that I could learn advanced mathematics.	7.1	5.3	12.3	8.9	32.5	24.0	28.9	45.3	19.2	16.4
28. I would like to avoid using mathematics in college.	11.1	4.0	12.3	9.0	29.8	25.6	28.1	37.2	18.7	24.2
32. I am willing to take more than the required amount of mathematics.	17.3	10.3	20.1	17.9	35.7	35.7	15.1	24.1	11.8	12.1
33. I plan to take as much mathematics as I can during my education.	11.6	9.9	13.0	16.2	42.3	35.6	20.8	26.1	12.3	12.2
34. The challenge of math appeals to me.	10.9	6.3	14.2	13.4	41.1	32.1	21.3	31.3	12.5	17.0

Note. S = Student; P = Parent

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