12-9-2011

Exploring Math Anxiety as It Relates to Math Achievement, Gender, and Race

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EXPLORING MATH ANXIETY AS IT RELATES TO MATH ACHIEVEMENT, GENDER, AND RACE

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A Dissertation
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy
in Elementary, Middle, and Secondary Education Administration
in the Department of Leadership and Foundations

Mississippi State, Mississippi

December 2011

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Title of Study: EXPLORING MATH ANXIETY AS IT RELATES TO MATH ACHIEVMENT, GENDER, AND RACE

Pages in Study: 72

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Students' mathematic achievement has not met national, state, or local expectations for decades. The No Child Left Behind Act mandated that by school year 2013-2014, all students in public schools across the nation are to perform at the proficient level or higher in math. The specific problem addressed in the present study was low measures of students' math achievement in one Mississippi school district. Prior research suggested that math anxiety was a major factor that influenced students' math performances.

Hypothesis 1 for this study stated there is a statistically significant negative relationship between seventh grade students' math anxiety scores and their math achievement scores. Hypothesis 2 stated there is not a statistically significant difference in measures of math anxiety between 7th grade boys and girls. Hypothesis 3 stated there is not a statistically significant difference in measures of math anxiety between Black and White 7th grade students.

To test hypothesis 1, a correlation coefficient was computed using the Pearson Product-Moment Coefficient, also known as Pearson *r*. To test hypotheses 2 and 3, a *t*-Test was used to determine whether differences between the means for math anxiety for the two samples were significant.

The results of this study indicate that math anxiety and math achievement are negatively related. As math anxiety increased, measures of math achievement decreased. The results of this study also suggest that math anxiety is a general concern for all students, in that there were no differences in measures of math anxiety between boys and girls or Black students and White students. It is very important that teachers take the time to identify students who have math anxiety so they can assist the students by implementing strategies and techniques to eliminate math anxiety for those students who may benefit with higher math achievement.

DEDICATION

I would like to dedicate this research paper to my husband, Arthur Kavardis Merritt; my unborn child, Merci Mijoi Merritt; my late grandmothers, Willie Mae Reece and Aileen Merritt; my late God-father, John Larry Fry; and to ALL, you know who you are, who are instrumental role models in my life.

ACKNOWLEDGEMENTS

I would like to first and foremost acknowledge my God Almighty for giving me life so that I can perform according to His will. Secondly, I would like to thank my major professor, Dr. Debra L. Prince, for her guidance, support, firmness, unyielding patience, and unique sense of humor. I would also like to acknowledge my committee members, Dr. James E. Davis, and Dr. Kay Brocato, for their priceless feedback. I would like to give special thanks to committee member and department head, Dr. Frankie Williams, for her persistent critiques and phenomenal advice. I would like to thank my family, friends, my colleague Tim Wilder, Covenant House Word of Faith Ministries family, my first lady Tifany Reed, and my pastor Johnnie L. Reed for motivating me, encouraging me, and believing in me. Last but not least, I certainly thank my grandfather, Ed Willie Reece; my mother, Lue Helen Pittman; my father, Nathaniel Shelton; my aunt, Martha Eskridge; my godmother, Harriet Fry; my MIL, Sandra Braxton; and my amazing God-sent husband, Arthur Kavardis Merritt, for being my role models and backbones throughout life and this process.

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CHAPTER 1

INTRODUCTION

For years educators have searched for ways to more effectively teach mathematics to all students. While many students have achieved academic success, others have not. Although it is essential that all students receive proper math education, according to Lim (2008), equity issues in mathematics education are a controversial topic in the United States. High-stakes assessments have become a common measure of accountability to ensure that all students are taught effective curriculums (Herbert, 2002). In addition to the accountability measures associated with high-stakes assessments, the emergence and growth of the global economy have resulted in many stakeholders relying on international comparisons to assess how well students in the United States are performing (Miller, Sen, & Malley, 2007). For this reason, it is vital that United States school officials strive to enhance the educational achievement of its students so that they can reach the highest level of academic achievement and compete internationally.

While students' success in all subject areas is an issue of concern, mathematics has been a difficult subject for many students to effectively learn. Student achievement in math is a widely recognized national concern, with half of all students performing below grade level in math (Platonic Realms, 2009).

A major goal of the U.S. during the past two decades has been to improve the math achievement of its students (Faulkner et al., 2008). Policy makers have passed

legislation, formulated policies, raised standards, and redesigned assessments to aid in effectively teaching mathematics (MacCaffrey et al., 2001). The No Child Left Behind Act (NCLB) of 2001 emphasized the importance of mathematics among other areas by requiring that all United States students be proficient in math by 2014, as measured by annual state-level assessments (United States Department of Education [USDE], 2001). Therefore, with the push for education accountability in the United States, educators began searching for ways to improve scores on state mandated high-stakes tests (Olson, 2000). In doing so, educators must make sure that all students reach their highest level of potential to successfully comprehend mathematics.

During the last three decades, American researchers confirmed persistent disparities in mathematics achievement when math achievement was examined by race and gender (Johnson & Kritsonis, 2006). Historically, White, middle-class males out-performed females and ethnic minority groups such as Blacks and Latinos on measures of math achievement (Lee, 2004; Secada, 1992). Moreover, research showed that mathematic performances by Black students and Hispanic students were lower than any other ethnic group. Despite efforts to close the achievement gap, the academic achievement of minority groups has remained lower than that of children of White European ancestry (Hilliard, 1995; Sosa, 2002). For example, a study conducted by Hall, Davis, Bolen, and Chia (1999), examined gender and racial differences in mathematics achievement among fifth and eighth grade students in the United States, and found that while there were no significant differences in achievement by gender, and White students scored significantly higher than Black students. Further, another research

study showed that the math academic performance of Blacks was lower than any other racial group in America (Hughes, 2003).

According to the 2007 National Assessment of Educational Progress (NAEP) results, while Black fourth and eighth graders experienced increases in math scores, a significant achievement gap persisted between Black students and their White peers. Fourth grade scores revealed a decrease in the achievement gap from the years 1990, where the achievement gap was 31 points, to 2007, where the achievement gap was 26 points. Since 2003, the change in the size of the achievement gap has not been statistically significant. In 2003, there was a 27 point gap in scores between Black students and White students. Over the four years between 2003 and 2007 the size of the gap only decreased by one point. Examination of eighth grade scores revealed an even larger gap. White students on average scored 33 points higher than Black students. However, it should be noted that between the years of 1992 and 2000, the achievement gap escalated to 40 points. Nevertheless, nationally, the achievement gap in math between Black students and their White counterparts was still statistically significant (National Center for Education Statistics [NCES], 2009).

Similar to the national trend, there is also a math achievement gap between Black students and White students in the state of Mississippi. In 2007, the average NAEP math scale score of Black students was 217, some 22 points lower than the average scale score of their White peers at the fourth grade level. At the eighth grade level, the difference was 28 points with the average score of Black students being 251 and their White counterparts' average score being 279. However, at both the fourth and eighth grade levels, not only were the difference in scores statistically significant, but the magnitude of

the differences or the size of the achievement gap remained relatively unchanged for the previous four years. The math achievement gap between Black students and White students is significant and well documented for both Mississippi and the nation.

In addition to differences in math achievement based on race, there are also differences in math achievement based on gender. However, these differences are not as pervasive or dramatic as the differences associated with race. Examination of NAEP results for the nation from 1990 to 2009 revealed that in each of the years, the average scale math score for males was higher than it was for females at both the fourth and eighth- grade levels (NCES, 2009). The average score for fourth grade boys was 240 compared to 238 for girls. The scores at the eighth grade level for boys and girls were 283 and 281, respectively. At both the fourth and eighth grade levels, the average scale score for boys was two points higher than the average scale score for girls. However, for students in Mississippi, the scale scores differences between boys and girls reversed. For the 2009 NAEP assessment, the average scale score for girls (228) was one point higher than it was for boys (227) at the fourth grade level. At the eighth grade level, the average scale score of both boys and girls was 265. However, it should be noted that the scores for the students in the state of Mississippi were still below the national average and the average of most other states.

The causes of racial and gender differences in math achievement have yet to be determined with any degree of certainty. More importantly, it is still not obvious how educators can accomplish equity in their mathematics classrooms to alleviate the differences in achievement (Lim, 2008). According to National Council of Teachers of Mathematics (NCTM, 2000), teachers must see to it that “mathematics can and will be

learned by all students" (p. 13). Further, NCTM, a global leader and authority in mathematics education, has a goal of ensuring that all students have access to the highest quality mathematics teaching and learning, and identified equity as its first principle for school mathematics. According to NCTM (2000), "Equity requires accommodating differences to help everyone learn mathematics" (p. 13). This means that educators must have methods in place to ensure that all students have the proper resources and guidance to effectively learn mathematics. There are several factors that prevent teachers from effectively teaching math. One major factor identified in the literature as affecting math achievement and preventing students from effectively comprehending math is math anxiety (Cates & Rhymer, 2003).

Mathematics anxiety was first detected and defined in the late 1950s. Dreger and Aiken (1957) noticed undergraduate college students reacting emotionally to arithmetic and mathematics. The authors labeled mathematics anxiety as number anxiety and suggested that a high level of anxiety would impair math performance. Since the late 1950s, several other researchers offered their definitions of math anxiety. Math anxiety, according to Ashcraft (2002), is defined as a feeling of tension, apprehension, or fear that interferes with one's performance in math. Cates and Rhymer (2003) stated that math anxiety is a condition in which students experience negative reactions to concepts involving numbers and to math evaluation procedures such as testing. Ma and Xu (2004) defined mathematics anxiety as a disturbing feeling that appears when students have to do mathematical work or tasks. Ma and Xu went on to say that indicators of this anxiety are often displayed in specific behavioral patterns such as worrying, being tense, being fearful, and feeling desperate. According to Karimi and Venkatesan (2009), people who

are affected by math anxiety tend to avoid involvement with mathematics which results in a decline in mathematics achievement.

According to Ruffins (2007), many people with an aptitude for math suffer from anxiety that interferes with their ability to perform math-related tasks. While math anxiety affects people of all ages, researchers have determined that mathematics anxiety begins in elementary school (Leung & Cohen, 2004) and continues throughout students' education. Furthermore, Perry (2004) stated that even beyond academic situations, the manipulation of numbers and solving mathematical problems in ordinary life situations continues to create anxiety for some people throughout their lives.

Statement of the Problem

Students' mathematic achievement has not met national, state, or local expectations for decades. As previously stated, the NCLB mandates that by school year 2013-2014, all students in public schools across the nation are to perform at the proficient level or higher in math (USDE, 2001). However, based on information from the latest NAEP results, a large percentage of America's students are not proficient in math (NCES, 2009). Furthermore, in comparisons among states, the state of Mississippi ranks next to last among the lowest performing states in the nation in terms of math achievement (NCES, 2009).

Tobias (1993) stated, "For most people mathematics is more than a subject; all people endure some mathematics anxiety, but it disables the less powerful - that is women and minorities - more"(p. 9). Researchers continue to explore multiple avenues to begin to understand the factors that are related to or the factors that impede math

performance. Three factors that have drawn much attention from researchers, as they relate to math achievement are race, gender, and anxiety (Johnson & Kritsonis, 2006). As a result of a review of the literature, it is widely stated that Blacks have lower measures of math achievement than any other racial group in America, boys generally perform better in math than girls, and many people experience anxiety when working with numbers (Johnson & Kritsonis, 2006). Jackson and Leffingwell (1999) concluded that math anxiety in students had become a major concern for American society. In addition, Bower (2001), stated math anxiety exasperates learners and disrupts their ability to perform, translating into lower achievements and higher levels of self-defeating attitudes.

Rossnan (2006) stated the fear of mathematics is deeply rooted and is often initiated by a child's first experience with institutional math. Math anxiety stems from a fear of failure or a feeling of inadequacy, which can be related to elements of a student's life outside the classroom (Perry, 2004). Younger students, such as those in middle school, feel an extreme fear of looking silly or being embarrassed in front of their peers, which can lead to feeling overly self-conscious (Perry, 2004; Salvin, 2003). Clearly, a better understanding of anxiety as it relates to math is warranted.

The specific problem to be addressed in the present study is the low measures of students' math achievement in one Mississippi school district. The school district consisted of one elementary school, one middle school, and one high school with a total district population of 4,277. District personnel noticed that students' state assessment math scores tended to drop beginning in the seventh grade. The Mississippi Curriculum Test 2 (MCT2) mathematics results for seventh grade students for the academic school year 2009-2010 were as follow: 14.6 % scored minimal, 25.9 % scored basic, 49.7%

scored proficient, and 9.8 % scored advanced (Mississippi Department of Education [MDE], 2011). While the goal is for all students to score in the proficient or above range, that goal had not been achieved at this school. Approximately 40% of the seventh grade students in this district scored in the basic or below range. Moreover, seventh grade students' MCT2 math scores had not improved for the last three years. While research suggested that math anxiety has a negative effect on math achievement, the literature did not reveal that one racial group or gender automatically has low achievement in math. However, it is possible that there may be an interaction effect between anxiety and the variables of race and gender. That is, certain racial or gender groups may experience more math anxiety than other racial or gender groups.

Purpose of the Study

Research studies have shown that there is a relationship between math achievement and the variables of race and gender. Research studies also indicated that math creates anxiety for many people. As an extension of those lines of research, the present study had a two-fold purpose. The first purpose was to explore the relationship between math anxiety and math achievement of seventh grade students attending a specific middle school in Mississippi. The second purpose was to determine if gender and race account for differences in measures of math anxiety among those seventh grade students.

Research Hypotheses

As a means of fulfilling the purposes of the present study, three hypotheses were developed. One directional hypothesis and two null hypotheses were tested. The following represents the hypotheses that were tested in this study:

Hypothesis 1 (Directional): There is a statistically significant negative relationship between seventh grade students' math anxiety scores and math achievement scores.

Hypothesis 2 (Null): There is no statistically significant difference in measures of math anxiety between seventh grade boys and girls.

Hypothesis 3 (Null): There is no statistically significant difference in measures of math anxiety between seventh grade Black students and seventh grade White students.

The Theoretical Framework

The theoretical framework of this study is supported by the premise that math anxiety is related to student math achievement (Ashcraft & Moore, 2009). The researcher determined that math anxiety was related to math achievement and that math anxiety measures were not statistically significantly different based on race and gender for students who attended a particular middle school in Mississippi.

Math is a subject in which many students want to do well, but there are many obstacles that prevent them from doing so. The pressure to perform well is intense, the math itself is challenging, and the students must still grapple with the internal worries and fears associated with math anxiety (Ashcraft & Moore, 2009). Ashcraft and Moore

(2009) theorized that math anxiety functions as a disability in the sense that there are well investigated and negative personal, educational, and cognitive consequences of math anxiety. In addition, math anxiety is a "clear-cut negative, mental, emotional, and/or physical reaction to mathematical thought processes and problem solving" (Arem, 1993, p.1). According to Ashcraft and Moore (2009) math anxiety starts to affect students' performances in the classroom when they are unable to comprehend what is presented to them and the effects are exasperated when math is performed under timed, high stakes conditions, both in laboratory tests as well as in educational settings. Unfortunately, these negative consequences affect a substantial percentage of the population (Ashcraft, 2002; Ashcraft, Krause, & Hopko, 2007).

Limitations

There were certain aspects of this study that may limit the generalization of the results. One limitation of this study was the students in this study had three different math teachers who utilized different teaching strategies and techniques; thereby, quality of the teaching may have influenced the students' performance on the MCT 2. Another limitation was only 188 students out of 306 potential candidates participated in the study. Students took the MARS-A test months after they took the MCT2; therefore, timing was a limitation. The students took their nine weeks test two days before taking the MARS-A, and this could have influenced their answers to the MARS-A due to testing a couple of days prior. Further, variables other than math anxiety may have contributed to the results.

Delimitations

Seventh grade students from only one school in the state of Mississippi were represented in the study. The researcher only chose seventh graders because students' MCT2 math scores had begun to drop in this grade at the particular school. Students who only received regular educational services were allowed to participate in the study. Students were allowed to take the MARS-A in only one of the three designated teachers' room verses taking the test in a preferable classroom.

Significance of the Study

This study is of significance because student achievement is not where it should be. There are many students who have not reached the proficient or above level in mathematics, and efforts have to be made to increase students' mathematics achievement. According to Phillips (2009), Mississippi students scored lower than all other students in every state on the math portion of NAEP, also known as the Nation's Report Card. Former Mississippi Interim State Superintendent of Education, John W. Jordan (as cited in Phillips, 2009) stated, "These results show it will take some extraordinary changes in the way we teach students if we are going to reach the national average" (para. 10).

While school district personnel expect students' achievement scores to increase from year to year in an effort to have all students perform at or above the proficient level, seventh grade students' math achievement has not improved, according to the results from the MCT2, for the last three years. It is very important that every child's academic performance in math, reading, and language arts is at the proficient level or higher due to the NCLB 2001. In this particular middle school, students' math performances are not

meeting these standards, particularly in the seventh grade. There are many different variables to consider pertaining to students' math achievement and why it has not increased.

Math, more than any other subject, engenders anxiety and avoidance in students (Shores, 2005). This is why one needs to know if students possess math anxiety. Rossnan (2006) stated math must be looked upon in a positive light in order to reduce math anxiety. Rossnan also stated teachers must re-examine traditional teaching methods which often do not match the students' learning styles and skills needed to be productive in society. Some have an extremely hard time trying to grasp the concepts of mathematics. Shores (2005) stated, unless math anxiety is confronted, it can turn into a permanent block.

This study is important because the results from this study can encourage further research using a different design such as experimental design to effectively aid in the creation of manuals on prevention, reduction, or elimination strategies for math anxiety. The results will be useful to the administrative team, teachers, students, and parents to aid in reaching the proficient goal of the NCLB.

Summary

Math anxiety is very prevalent and has considerable influence on students' math achievement. Chapter I provided an introduction and laid the foundation for the entire study by incorporating the following: statement of the problem, purpose of the study, research hypotheses, theoretical framework, limitations, delimitations, significance of the study, and the summary. This chapter provided the reader with an opportunity to become

familiar with math anxiety as it relates to the variables of math achievement, gender and race.

CHAPTER 2

LITERATURE REVIEW

Mathematics achievement in the United States and Mississippi has not met expected growth by numerous students for several years (NCES, 2009). Research shows that White students typically achieve higher than Blacks students in mathematics, and males achieve higher than females in mathematics. There are many factors that affect students' mathematic achievement and math anxiety is one. According to Richardson and Suinn (1972) and Hembree (1990), mathematics anxiety is related to poor performance for mathematics. The purpose of this study was two-fold. The first purpose was to explore the relationship between math anxiety and math achievement of seventh grade students. The second purpose was to determine if gender and race account for differences in measures of math anxiety among seventh grade students.

Chapter II includes a discussion of the literature that was reviewed to inform this study. Specifically this chapter discusses literature related to math anxiety which includes: (a) math performances and math anxiety, (b) gender and math anxiety, and (c) race and math anxiety. The chapter concludes with a summary of the literature reviewed and the identification of gaps in the literature that were revealed through this review.

Math Performances and Math Anxiety

For several years, math has been a very important subject for students to proficiently perform. Kesici and Erdogan (2010) stated, "One of the most significant reasons preventing mathematics achievement is mathematics anxiety" (p. 54). In the early 1970s, researchers began to examine relationships between math anxiety and math performance in ways similar to the examination of test anxiety and performances in the early 1950s (Hembree, 1990). Moreover, according to Hembree, many researchers viewed math anxiety as a form of test anxiety.

Many studies were conducted to identify the effect of math anxiety on mathematics achievement and the relationships between math anxiety and mathematics achievement. Clawson (1991) stated, "Math anxiety can begin at any age of schooling, even as young as elementary school, but most students commonly have negative experiences between seventh and tenth grade" (p. 2). Further Clawson suggested, math anxiety can continue throughout adulthood, unless it is identified and treated. Studies indicated that math anxiety is found in elementary students (Birgin, Baloglu, Catlioglu, & Gurbuz, 2010; Ma, 1999) in high school students (Hembree, 1990; Karimi & Venkatesan, 2009; Khatoon & Mahmood, 2010; Ma and Xu, 2004; Osborne, 2001), and in college students (Ashcraft & Kirk, 2001; Betz, 1978; Clute, 1984; Hembree, 1990; Miller & Bichsel, 2004; Woodard, 2004). Geist (2010) reported, "A fear of mathematics or what is commonly known as 'math anxiety' is creating a disparity between levels of mathematics achievement" (p. 24). Math anxiety affects people of all grade levels; although the research pertaining to lower level grades is sparse.

Elementary Students' Performances and Math Anxiety

As mentioned in the previous section, elementary math anxiety studies are sparse, even though the construct of math anxiety is not a new phenomenon. Some studies were conducted in the United States and some studies were conducted in other countries. Despite the recurrent assumption that math anxiety is revealed in children at an early age, very little research has been conducted to support this assumption (Bonnstetter, 2007; Gierl & Bisanz, 1995). For example, in a meta-analysis of research on sex differences in mathematics anxiety and attitudes toward math, Hyde, Fennema, Ryan, Frost, and Hopp (1990) did not identify a single study of mathematics anxiety involving children younger than 11 years of age. Apparently, there were not many studies involving children younger than 11 years of age to include in the meta-analysis. In addition, Hembree (1990) conducted a meta-analysis that only included a few studies involving students who were younger than 11 years of age. Out of 151 studies, only 7 studies involved students from first grade through sixth grade (Hembree, 1990). No studies involved students from first, second, or fourth grade. Although Hembree's study contained a lot of valuable information, the results can not directly pertain to elementary students because of the small number of studies included in the meta-analysis. The negative correlation of (r = -.31) found between student achievement and math anxiety, specifically came from the results of students in Grades 7 through 12 (Hembree, 1990).

To address the gap in knowledge pertaining to mathematics anxiety in elementary school students, Gierl and Bisanz (1995) evaluated third and sixth-grade students on measures of mathematics anxiety, school test anxiety, and attitudes toward mathematics anxiety to determine (a) whether different forms of mathematics anxiety existed, (b)

whether mathematics test anxiety differed from school test anxiety, and (c) whether mathematics anxiety was related to different attitudes toward mathematics. In Gierl and Bisanz's study, third grade students reported similar levels of nervousness in math test and math problem-solving situations. In contrast, sixth grade students reported higher levels of nervousness in math test situations than in math problem-solving situations. Sixth grade students reported higher levels of mathematics test anxiety than did third grade students, $F(1, 180) = 11.50$, $p < .01$, but the effect of grade on mathematics problem-solving anxiety was insignificant. Gierl and Bisanz's (1995) interpretation of these results was that nervousness about mathematics testing may increase as students progress through elementary school, whereas nervousness about mathematics problem solving remains low and relatively stable.

To further attempt to close the gap, another meta-analysis was conducted by Ma (1999) where 26 studies were examined on the relationship between math anxiety toward mathematics and achievement in mathematics among elementary and secondary students. The results showed a negative relationship between math anxiety and math achievement was ($r = -.27$). This indicated that a negative relationship existed among the students, but only a few of the studies involved students from first through sixth grades. Ma (1999) concluded that this meta-analysis showed studies were rare in the early elementary grades, probably because of the lack of instruments that measure mathematics anxiety of children at the lower elementary level. Ma's meta-analysis also contained studies that were conducted in different countries, so results further revealed that math anxiety was prevalent worldwide.

In Turkey, a study was conducted by Birgin et al. (2010) to investigate mathematics anxiety among 220 sixth through eighth grade Turkish students in terms of mathematics achievement levels, perceived enjoyment of the mathematics teaching method, perceived enjoyment of mathematics, and perceived help with mathematics from parents. Research studies showed that math anxiety increased as students moved from grade level to grade level. Birgin et al. found that, in terms of the relationship between math anxiety and math achievement, the lowest anxiety was measured among the sixth graders ($M = 28.32$, $SD = 8.24$) and the highest anxiety was among the eighth graders ($M = 33.49$, $SD = 7.57$) which indicated that mathematics anxiety levels increased as students' grade levels increased.

In Germany, a study was conducted by Krinzinger, Kaufmann, and Willmes (2009) to longitudinally investigate the relationship between calculation ability, self-reported evaluation of mathematics, and math anxiety in 140 German primary school children between the end of first grade and the middle of third grade. The results from the Krinzinger et al. study, for self reported evaluation of mathematics and math anxiety, revealed a statistically significant increase in math anxiety for age (slope=1.32), $t(139) = -8.97$, $p<.001$, 109 children presented a negative score, 29 children presented a positive score, and 2 children did not develop change. No significant association was found between calculation ability and math anxiety.

The studies conducted involving elementary students may be sparse as noted by other researchers. Krinzinger et al. (2009) reported:

> Almost nothing is known about the causal relations between math anxiety and math ability during development, particularly at the beginning of primary school,

when children are introduced to formal calculation, receive feedback on their performance, and start to compare their skills with those of their peers. (p. 222)

More studies need to take place to fill the gap in knowledge regarding elementary students' and math anxiety and math performance to help understand the cause and root of math anxiety.

Secondary Students' Performances and Math Anxiety

More studies involving middle and high school students' math anxiety than elementary students were found in the literature. Hembree (1990) found that mathematics anxiety increases during junior high grades, reaches its peak in 9th and 10th grades, and levels off during senior high grades. This implies that the relationship increases as students' grade levels increase.

Prior research studies showed that math anxiety really starts during junior high/middle school years (Hembree, 1990). Many junior high students experience different achievement motivational levels and worry about their social life. Math anxiety may become more noticeable during these critical years. Research studies conducted worldwide supports this information. For example, in Turkey, Kesici and Erdogan (2010) conducted a study to clarify whether 156 (86 males, 70 females) eighth grade middle school students' mathematics anxiety differed, according to their low and high achievement motivation and their levels of self-esteem stemming from social comparison. The results from Kesici and Erdogan's study revealed that students with high achievement motivation had significantly higher mathematics anxiety than those students with low achievement motivation. The students may have wanted to perform

well and in turn, their math anxiety level increased. The results also determined that students with low self esteem had significantly higher mathematics anxiety than those students with high self-esteem. Kesici and Erdogan (2010) stated, "They compared themselves to their peers, instead of determining their own deficiencies and mistakes" (p. 60).

Further, Khatoon and Mahmood (2010) conducted a study in India that involved 1,652 secondary students from 15 different management types of school. The researchers developed the '*Mathematics Anxiety Scale*' (MAS) and '*Mathematics Achievement Test*' (MAT) instruments and used the instruments for data collections along with the t-Test and correlation techniques for statistical analysis. Results showed that nearly half of the students had moderate levels of anxiety. Findings also revealed a significant negative correlation of (r = -.48) between math anxiety and math achievement, indicating there was a strong relationship between the two variables.

Karimi and Venkatesan (2009) conducted a study involving 284 (144 males and 140 females) 10th-grade high school students from Karnataka, India. The researchers sought to examine the relationship between levels of math anxiety, math performance, and academic hardiness among high school students in Karnataka, as well as examine the effects of gender on students' levels of math anxiety, mathematics performance, and academic hardiness. The results indicated there was a negative significant correlation found between mathematics anxiety and mathematics performance. As students' levels of math anxiety increased, their levels of math performance decreased.

In his (1990) meta-analysis, Hembree found that students in Grades 5 through 12 displayed a statistically significant negative relationship between math anxiety and math

performance. This meta-analysis included several studies involving students in Grades 7 through 12. Hembree's (1990) results showed a moderate correlation of (r = -34) for students in Grades 5 through 12. The conclusions were math anxiety seriously constrains performance in math tasks and that reduction in anxiety was consistently associated with improvement in math achievement. The findings in a meta-analysis conducted by Ma (1999) supported the findings of Hembree (1990).

Apparently math anxiety exists in secondary school students and it increases from grade to grade. For example, in a study conducted by Ma and Xu (2004), researchers aimed to determine the causal ordering between mathematics anxiety and mathematics achievement among students from 52 public middle and high schools across the United States. About 60 students were selected from seventh grade in each of the schools and were monitored for six years. The total sample was 3,116 students (1,626 boys and 1,490 girls). The researchers' goals were to (a) explore the causal nature of the relationship between mathematics anxiety and mathematics achievement across six grade levels (from 7th grade through 12th grade), and (b) examine gender differences in the causal relationship between mathematics anxiety and mathematics achievement using data from the Longitudinal Study of American Youth (LSAY). Ma and Xu (2004) provided the following results:

> Our data analysis has revealed considerable stability in the levels of mathematics anxiety and mathematics achievement. We found that mathematics anxiety became stable from Grade 8 whereas mathematics achievement became stable from Grade 7. Therefore, the early grades of junior high school are critical

to set the stage for an effective prevention of mathematics anxiety a healthy growth in mathematics achievement. (pp. 176-177)

Math anxiety is more evident in secondary schools. Although the statement is clear that math anxiety becomes stable in junior high school, many studies in the literature focused more on high schools and colleges.

Ma and Xu (2004) stated:

> Programs that help students cope with the frustrations in learning of mathematics and help students improve mathematics achievement are essential; overall, educators need to pay more attention to the cognitive and affective well-being of students during this (and other) critical transition period, particularly for girls. (p. 177)

College Students' Performances and Math Anxiety

Several initial studies resulted in substantial evidence for performance differences as a function of math anxiety and revealed that math anxiety may cause students to make unwise choices. College students' career choices are affected by their math anxiety globally. Many students choose careers that do not require them to take many math courses due to math anxiety (Scarpello, 2007). According to Zettle and Raines (2000) and Ashcraft and Kirk (2001), math anxiety has been found to limit career choices of college students, especially women.

In the meta-analysis conducted by Hembree (1990), the researcher examined the construct of mathematics anxiety and integrated the findings of the research on mathematics anxiety, regarding its nature, effects, and reliefs using data from 151 studies.

Out of those studies, 122 involved college students. The results showed the mean correlation of mathematics anxiety and performance for college students was (r = -.31). The results indicated that there was a negative relationship between math anxiety and math performance and supported the findings of Betz (1978) and Clute (1984).

In more recent studies, the results of math anxiety and mathematic achievement in college students revealed a negative relationship existed as well. For example, Woodard (2004) examined the nature of math anxiety in 125 (33 males, 92 females) developmental math students who attended a community college in Virginia. The researcher's focus was to determine if differences in math anxiety scores were related to gender and age, and if there was a relationship between math anxiety scores and achievement scores (exit exams). Using the Pearson Product Moment Correlation procedure, a significantly low negative relationship was found between exit exam scores and math anxiety scores (p = .027, r = -.201). The results supported the notion that as math anxiety scores increase, achievement scores decrease. The finding was consistent with Betz (1978), Clute (1984), Ma (1999), and Miller and Bichsel (2004).

Studies outside the United States involving college students' math anxiety and math performance were consistent with findings of studies inside the United States. Standing's (2006) study involved 75 undergraduates from a college in Canada and used performance data from the D'Amor Test (Hume, 1932), a measure of elementary arithmetic skills which uses 10 simple items taken from a third grade curriculum of 1932. Unlimited time and written rough work were allowed, but two thirds of the college students failed the D'Amor Test by achieving a score below 10. The hardest test item,

with a 32% error rate, was to evaluate 92 x 34. Students' performances were correlated negatively with math anxiety. The information and results from Standing's (2006) study further confirmed that students' math achievement is affected by math anxiety. Standing's findings supported that of Zakaria and Nordin (2007), where results revealed a low negative correlation ($r = -.32$, $p < 0.05$) between math anxiety and math achievement for 88 students attending a college in Malaysia. Although the negative correlation was low between math anxiety and math achievement, there was a statistically significant negative relationship between the two variables in Zakaria and Nordin's study.

Math anxiety and math performance showed a negative relationship for several studies. Prior research showed that as math anxiety decreases, math performance increases (Hembree, 1990). Numerous studies found in the literature review showed that it is essential that math anxiety is identified and treated at an early stage, so that the negative math anxiety and math performance relationship for students can eventually become positive (Arem, 1993). The hope is that students' will be prone to embrace math instead of avoiding it.

Gender and Math Anxiety

The research studies on gender differences and math anxiety have produced differing evidence. According to Geist (2010), girls are thought to be good at math only because of their hard work, while boys are good at math because they are talented. For years math anxiety was found to affect females more than males (Tobias, 1993). The assumption held true for several studies that include students in middle school, high

school, and college. Girls in middle and secondary schools, freshman college students, and adult women were found to show higher levels of math anxiety (Bonnstetter, 2007).

The difference in results of math anxiety between males and females applied to students in elementary school through college. Gierl and Bisanz's (1995) study focused on third grade students and sixth grade students. The results from Gierl and Bisanz's study indicated no gender differences for measures of math anxiety. Ashcraft and Kirk (2001) and Haynes et al.'s (2004) study involved college students and the results indicated no gender differences for measures of math anxiety.

In contrast to those findings, several studies supported the notion that females have higher math anxiety than males (Baloglu & Kocak, 2006; Betz, 1978; Karimi & Venkatesan, 2009; Khatoon & Mahmood, 2010; Osborne, 2001; Woodard, 2004; Zettle & Raines, 2000). Math anxiety had a greater impact on most females and as a result, females were less likely to seek mathematic careers, and tended to avoid any activities that were math related. Hembree (1990) also found that women reported higher math anxiety than men, especially in colleges.

The results regarding gender differences varied, although studies favored females having higher math anxiety measures than males. Either way, math anxiety is a factor, and it affects mathematic performance for males and females. Gender differences in mathematic performances can be explained by differences in levels of mathematics anxiety (Osborne, 2001). In contrast, Haynes et al. (2004) studied the cause of mathematics anxiety in undergraduate students and specifically focused on gender differences. The researchers found that there was no significant difference in the amount of mathematical anxiety between males and females.

On the other hand, some studies supported that males have higher math anxiety levels than females. In Hembree's (1990) meta-analysis, results indicated negative behaviors associated with math anxiety were more pronounced in high school males than females. Hembree's results supported the findings of Miller and Bichsel (2004) where results revealed that math anxiety had a stronger influence on the performance of males when solving problems of basic calculations than females.

According to the Trends in International Mathematics and Science Study (TIMSS) 2003, fourth-grade males in Italy, Scotland, and the United States outperformed females in math (Miller et al., 2007). In the United States, the difference in math performance was eight points with males scoring an average of 522 compared with a 514 average score among females (Miller et al., 2007). In a study reported by Thilmany (2009) the results showed that out of 885 first-year students at a particular university, 47% of the men became anxious around numbers and 62% of the women became anxious. In general, studies showed math anxiety influenced math achievement for male and female students and also influenced math achievement for Black students and White students.

Race and Math Anxiety

The United States consists of a growing population of minorities who have been historically disenfranchised in mathematics (Rendon & Hope, 1996). More research on math anxiety as it affects math achievement and pertains to racial differences was suggested as being needed in the literature. Ma (1999) stated, "Comparisons of the

relationship between mathematics anxiety and mathematics achievement among ethnic groups are rare in the literature" (p. 533).

Lockhead, Thorpe, Brooks-Gunn, Casserly, and McAloon (1985) reviewed 16 studies of race differences in mathematics performance spanning fourth grade through eighth grade and found a clear pattern of performance among various student groups. Lockhead et al. found that Asian American students usually outperformed White students, Asian American students, and White students performed better than Hispanic students, and all three groups outperformed Black students.

Osborne (2001) found that educational and psychological research repeatedly showed that students from disadvantaged minority groups tended to underperform in the academic realm relative to White or Asian students. Convincing evidence showed that students from disadvantaged minority groups experienced poorer outcomes at every level, even when given equal preparation, than that of White and Asian students (Osborne, 2001). In Osborne's study, findings indicated highly significant differences in anxiety relating to test taking as a function of race, with race accounting for between 4% and 5% of the variance in anxiety. As expected, White students had lower anxiety scores than the non-White students.

In contrast to the previous findings that supported the notion that there was a statistically significant difference in the levels of math anxiety as it pertains to race, Hembree (1990) discovered five studies where Black and White college students' (N=804) math anxiety scores were compared. The mean effect size in comparing the math anxiety of Blacks to Whites was not statistically significant.

Although, there is abundant research pertaining to math anxiety, the research on math anxiety as it pertains to race is limited. Apparently, the differences in math performance between Whites and Blacks differ greatly, but more research is needed pertaining to math anxiety as a major factor to account for the differences in mathematics achievement between Black students and White students.

Summary

In Chapter 2, emphasis was placed on math performance and math anxiety, gender and math anxiety, and race and math anxiety. Math anxiety was found to be prevalent and affects people of all ages, races, and gender. This literature review identified gaps in the literature pertaining to math anxiety and math achievement for different grade levels, differences in measures of math anxiety for gender, and differences in measures of math anxiety for race. Although math anxiety is widespread among various people, the literature identified areas such as elementary students and math anxiety and race and math anxiety, in which more research studies are needed to further understand math anxiety relationships and differences for elementary students and ethnicity.

Research studies showed that math anxiety unfolds during the junior/middle schools years; therefore, more research is needed in earlier grades to identify the cause of math anxiety at an earlier stage so implementation of strategies can take place to reduce or eliminate math anxiety before students enter the junior/middle schools. In this way, the cycle will not continue to the next grade levels, in hope that math anxiety may decrease, and math performance may increase.

CHAPTER 3

METHODOLOGY

The purpose of this study was two-fold. The first purpose was to explore the relationship between math anxiety and math achievement of seventh grade students attending a middle school in Mississippi. The second purpose was to determine if gender and race account for differences in measures of math anxiety among seventh grade students attending a middle school in Mississippi.

Chapter three discusses the methodology that was used in this study. The organization of this chapter is as follows: (a) research design, (b) participants, (c) instrumentation, (d) procedure, (e) data analysis, and (f) summary.

Research Design

To address the two-fold purpose of this study and to test the research hypotheses, both correlational and causal comparative research designs were used. A correlational research design was used to gather data and test directional hypothesis one, which stated that there was a statistically significant negative relationship between math anxiety and math achievement. A causal-comparative design was used to gather data and test null hypotheses two and three which looked for differences in measures of math anxiety by gender and race.

Correlational Research

According to Fraenkel and Wallen (2006), correlational research is used to determine if, and to what degree, a relationship exists between two or more quantitative variables. A correlation coefficient is calculated to determine the magnitude of the relationship between two or more variables. Correlation coefficients range from -1 to +1. The closer the coefficient is to the absolute value of 1, the stronger the relationship between the variables. The positive and negative value associated with the coefficient indicates the type or direction of the relationship. A positive value indicates that as one variable increases the other variable also increases. A negative value indicates that as one variable increases, the other variable decreases. In essence, correlational research determines if two or more variables vary in a systematic way. If the correlation coefficient indicates a strong relationship between variables, then measures of one variable, the predictor variable, can be used to predict measures on the other variable, the criterion variable.

A correlational design was deemed most appropriate for research hypothesis one. This study sought to determine if there was a negative relationship between measures of math anxiety and measures of math achievement. Therefore, the variables for hypothesis one are measures of math anxiety and measures of math achievement.

Causal-Comparative Design

Causal-comparative research, also known as *ex-post facto* research, was used to test research hypothesis two and research hypothesis three. Causal comparative research is used to examine differences between two or more groups. Similar to experimental

designs, causal comparative designs have independent and dependent variables. However, unlike experimental designs, causal comparative designs do not allow the researcher to manipulate the independent variable. The inability of the researcher to manipulate the independent variable results from one of three reasons. Either the independent variable has already occurred, or it would be unethical to manipulate the independent variable, or it is impossible to manipulate the independent variable (Gay, Mills, & Airasian, 2009). In which case, causal comparative designs are not robust enough to detect cause and affect relationships with any degree of certainty. Nevertheless, causal comparative designs are able to determine if differences in the independent variable are associated with differences in the dependent variable. Furthermore, "in causal-comparative research, investigators attempt to determine the cause or consequences of differences that already exist between or among groups of individuals" (Fraenkel & Wallen, 2006, p. 370).

The causal comparative design was deemed most appropriate for the purpose of this study to address research hypotheses two and three. In both of the hypotheses, differences in measures of math anxiety, the dependent variable, were examined by differences in the independent variables of race and gender. Because of the nature of the independent variables, it was not possible for the researcher to manipulate them. However, this design allowed the researcher to determine if there was a difference in measures of math anxiety between White and Black students and if there was a difference in measures of math anxiety between boys and girls.

Participants

The participants for this study were students who were in the seventh grade during the academic school year 2009-2010 at a middle school in a rural area of Mississippi. The total population of this middle school for 2009-2010, consisting of sixth, seventh, and eighth graders, was 1,006, with a racial make-up of 51% White, 48% Black, and 1% other. The gender make-up of the school was 48% male and 52% female. The seventh grade population consisted of 338 students. The racial make–up of the seventh grade was 52% White and 48% Black and there were 175 males and 163 females.

The academic school year 2009-2010 total population of 338 seventh grade students was delimited to 306 students because only students who did not receive special education services were potential candidates for this study. Specifically, the participants for this study were students who were in the seventh grade during the academic school year 2009-2010, at this particular middle school in Mississippi who did not receive special educational services, who returned their parental consent forms, who signed their student assent forms, and who took the MCT2 test for the academic school year 2009-2010.

Instrumentation

In order to effectively address the research hypotheses for this study, proper instruments were used. The researcher used data collected from two instruments in this study. The two instruments were the *Mississippi Curriculum Test, 2nd Edition* (MCT2), and the *Mathematics Anxiety Rating Scales for Adolescents* (MARS-A) (see Appendix E for a sample page).

Mississippi Curriculum Test, 2nd Edition (MCT2)

The MCT2 consists of customized criterion-referenced reading/language arts and mathematics assessments that are fully aligned with the 2006 Mississippi Language Arts Framework Revised and the 2007 Mississippi Mathematics Framework Revised. These assessments allowed Mississippi to be in compliance with the requirements of the federal legislation of NCLB (MDE, 2011). The Mathematics segment of the test, for grades three through seven, measures students' knowledge of and skill level in general mathematics while the MCT2 for grade 8 measures students' knowledge of and skill level in pre-algebra (MDE, 2010).

According to information MDE (2010):

> All Mathematics MCT2 assessments measure grade and content specific curriculum found in the 2007 Mississippi Mathematics Framework-Revised. The student mastery of grade-level curriculum for seventh grade students is measured based upon the following competencies: (1) 12 number and operations items, (2) 13 Algebra items, (3) 10 Geometry items, (4) 7 Measurements items, and (5) 8 Data Analysis and Probability items. There are 10 experimental items and 50 core items, which makes the total 60 items for the Mathematics segment of the MCT2. Scores for students, schools, districts, and the state of Mississippi are based on the core items only. (p. 2)

The core items are the items placed on the test to measure students' knowledge about a particular subject. The experimental items are items placed on the test to see how well the students will master those items so that information can be gathered from the performance of the students to use for future tests. The results of the experimental items

are used to inform decisions regarding test revision. The MCT2 is not a timed test; however, students are instructed to attend to each competency segment of the test for at least two hours.

According to MDE (2010), the results of the assessment are reported by one of four performance descriptors. The performance descriptors for the Mathematics segment of the MCT2 are listed in Table 1.

Table 1

Performance Level Descriptors for the Mathematics MCT2

Performance Level Descriptors	Descriptions
Advanced	The advanced scores for grade 7 mathematics range from 168 and above.
Proficient	The proficient scores for grade 7 mathematics range from 150-167.
Basic	The basic scores for grade 7 mathematics range from 138-149.
Minimal	The minimal scores for grade 7 mathematics range from 137 and below.

Note. Students who score advanced perform beyond the requirements for success in that content area (mathematics) for the 7th grade.
Students who score proficient demonstrate solid academic performance in that content area (mathematics) for the 7th grade.
Students who score basic demonstrate partial mastery in that content area (mathematics) for the 7th grade.
Students who score minimal inconsistently demonstrate the knowledge or skills for mastery for that content area (mathematics) for the 7th grade.

Reliability

To successfully use an instrument to produce applicable results, the instrument must be reliable (Fraenkel & Wallen, 2006). Reliability is the consistency of the results obtained from a measurement (Fraenkel & Wallen, 2006). The focus of reliability should

be on the results obtained from a measurement and the extent to which they remain consistent over time or among items or subtests that constitute the test. Reliability is a necessary prerequisite to making appropriate score interpretations of the test results (MDE, 2008).

The reliability of the MCT2 was established by the Cronbach Alpha, an internal consistency measure (Cronbach, 1951). The Cronbach Alpha correlation coefficient for the MCT2 ranged from 0.87 to 0.91 (MDE, 2008). According to Fraenkel and Wallen (2006), coefficients greater than .70 are considered good. Therefore, MCT2 is considered a reliable measure.

Validity

Several methods were employed to establish the validity of the MCT2. As cited in Embretson (2007), the American Educational Research Association [AERA], American Psychological Association [APA], and National Council on Measurements in Education [NCME] stated, "validity refers to the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of tests" (.p. 449). There were five different types of validity established for the MCT2 and they are as follows: content validity, construct validity, differential item functioning, criterion-validity, and concurrent validity. How each type of validity was determined and the results for each are listed in Table 2. Information pertaining to the validity for the MCT2 was provided from MDE (2008).

Table 2

Determination and Results for the Types of Validity for the Mathematics MCT2

<table>
<tr><th>Type of Validity</th><th>How the Validity was Determined</th><th>Results</th></tr>
<tr><td>Content</td><td>a) alignment of the items to the standards was reviewed and verified independently by multiple content reviewers and Mississippi educators.
b) MCT2 core items were handed over to Pearson after the extensive reviews by MS educators and external viewers</td><td>Content validity was established because item content was aligned with the curriculum.</td></tr>
<tr><td>Construct</td><td>a) alignment of MCT2 with test specifications</td><td>a) % of Core Items and MCT2 Items
Comp 1: Blueprint 24%, 2008 Test 24%
Comp 2: Blueprint 26%, 2008 Test 26%
Comp 3: Blueprint 20%, 2008 Test 20%
Comp 4: Blueprint 14%, 2008 Test 14%
Comp 5: Blueprint 16%, 2008 Test 16%</td></tr>
<tr><td></td><td>b) alignment of MCT2 with item-total point biserial correlations</td><td>b) Adjusted Point-Biserial
Mean 0.35; Minimum 0.06; Maximum 0.56</td></tr>
<tr><td></td><td>c) inter correlation among competencies</td><td>c) Correlations Among Mathematics Competencies (C) for 7th Grade
C1: 1.00, 0.68, 0.57, 0.59, 0.63
C2: 0.68, 1.00, 0.60, 0.56, 0.60
C3: 0.57, 0.60, 1.00, 0.51, 0.52
C4: 0.59, 0.56, 0.51, 1.00, 0.56
C5: 0.63, 0.60, 0.52, 0.56, 1.00</td></tr>
</table>

Table 2 continued

Type of Validity	How the Validity was Determined	Results
Construct	d) Construct validity through confirmatory analysis	7th Grade Mathematics AGFI: 0.98** RMR: 0.01**
DIF	Reviews of Mississippi teachers and content experts.	DIF for 7th Grade Black vs. White: 4 Male vs. Female: 4
Criterion Related	Teachers' priori judgments of student achievement and their achievement levels which correspond to students scores all serve as sources of evidence.	Correlation Coefficient Range from 0.53 to 0.65
Concurrent	The trend between students' progress on the National Assessment of Educational Progress (NAEP) and their progress on the MCT2 scores.	The trends show corresponding increases in both NAEP math and reading scores on the MCT and previous versions of the MCT2.

Note. MCT2= Mississippi Curriculum Test, 2nd Edition; AGFI= Adjusted Goodness of Fit; RMR= Root Mean Square Residual; Values that indicate good fit are higher than 0.90 and RMR less than 0.05; DIF=Differential Item Functioning; DIF=substantial is above 5. Adapted from Mississippi Department of Education, 2008, *Mississippi curriculum test, second edition: Technical manual for 2007-2008 test administration.* Retrieved from Mississippi Department of Education: http://www.mde.k12.ms.us/acad/osa/technical/MCT2_TechReport_2008.pdf

Mathematics Anxiety Rating Scale (MARS-A)

The second instrument the researcher used to effectively address the hypotheses of this study was the Mathematics Anxiety Rating Scales for Adolescents (MARS-A) (see Appendix E). The Mathematics Anxiety Rating Scales for Adolescents, developed by Suinn and Edwards (1982), is an assessment designed to measure adolescents' (students in junior high and high schools) math anxiety. The assessment is comprised of 98 Likert-scale items ranging from not at all (the score would be 1) to very much (the

score would be 5). The MARS-A yields total scores from 98 (little anxiety) to 490 (much anxiety) and takes approximately 45 minutes to administer.

Each item on the scale represents a situation, which may arouse anxiety with a student such as having someone watch them as they add up a column of numbers, figuring out a simple percentage, or figuring the sales tax on something they may buy. The student decides on the degree of anxiety aroused by using the following dimensions: (1) not at all, (2) a little, (3) a fair amount, (4) much, and (5) very much. Once the student decides the level of anxiety associated with the specific statement, the student selects a choice reflecting the decision. Students are encouraged to work rapidly, as well as accurately and to describe their anxieties as they currently exist (Suinn, 1972).

To score the assessment, the examiner wrote the values at the top of each of the respective columns: column 1 "Not at all", column 2 "A little", column 3 "A fair amount", column 4 "Much", and column 5 "Very Much". The examiner did so by counting the number of checks in each column to get the total number of checks for each column. Then the examiner multiplied each total by the corresponding weight (1 to 5) for the column. For example, if a student had six checks for column 5, the examiner multiplied 6, the number of checks, by 5, the column number, and got a total of 30. The examiner did this for each column on each page, added all the scores, and then wrote the total at the top of each student's test. According to Suinn and Edwards (1982), scores that are at or above the 75th percentile, which equates to a score of 259, indicates high anxiety and that the student is eligible for intervention for math anxiety. According to the test developers, a school may wish to develop its own norms or cut-off scores to initiate intervention.

Reliability of MARS-A

Suinn and Edwards (1982) established reliability for MARS-A by selecting a sample of 1,313 junior and senior high school students, taken from two states. One school in a metropolitan city in Arizona was a combined junior and senior high facility for grades 7 to 12. The other schools were in a small city in Colorado, one school was entirely junior high and the other entirely senior high. The student sample from the Arizona school numbered 497, and Colorado junior high was 1,000, and Colorado senior high was 290.

Three methods were used to determine the reliability of the MARS-A. The Spearman-Brown formula was used and the resulting reliability coefficient for this procedure was .90, indicating that the reliability for this instrument is above good. The Guttmann Split-Half method of establishing reliability was also employed. From this analysis a reliability coefficient of .89 was found. As an index of internal consistency, which estimates reliability of scores using only one administration for the instrument, Cronbach's alpha was computed and found to be .96. According to Fraenkel and Wallen (2006) reliability coefficients higher than .70 are good indicators of instrument reliability. In effect, the results of these analyses indicate that the MARS-A is a stable and reliable instrument.

Validity of MARS-A

A study was conducted by Suinn and Edwards (1982) to develop a revised version of the Mathematics Anxiety Rating Scale (MARS) for use with adolescents. The revised form of MARS is MARS-A, which involves changes in some words or substitution of

new items appropriate for adolescents (Suinn & Edwards, 1982). In developing a revised version for MARS, validity had to be established for the revised version, MARS-A.

Two methods were used to investigate MARS-A's construct validity. The first method was determined by the concept that math anxiety is predictive of low course performances in mathematics (Dreger & Aiken, 1957). According to Suinn and Edwards (1982), the second method used to determine construct validity for MARS-A was factor analysis, which was used to determine whether a primary factor accounted for the variance in all test items. The types of validity, how it was determined, and the results for the MARS-A are shown in Table 3.

Table 3

Validity for MARS-A

Type of Validity	How Validity was Determined	Results	
1) Construct Validity	By comparing the grade averages on mathematics courses of students who scored at or below the 30th percentile and those at or above the 75th percentile on the MARS-A	School "A"	(F=14.08, p<.001)
		School "B"	(F=40.68, p<.001)
		Students with high MARS-A scores showed lower grade averages in mathematics courses than those with low math anxiety.	
2) Construct Validity	Data from students in on school (N=483) were analyzed by a factor analysis	Of 98 items, 89 showed factor loading of >.3O on a single factor, these 89 questions account for 91% of the total MARS-A, which is consistent with MARS results	

Note: Suinn, R. M., & Edwards, R. (1982). The measurement of mathematic anxiety: The mathematics anxiety rating scale for adolescents-MARS-A. *Journal of Clinical Psychology, 38(3), 576-580.*

Procedure

The researcher presented this research proposal to the researcher's committee for permission to conduct the research. After permission was granted, the researcher presented a letter to the school district's superintendent to obtain permission to conduct the study (see Appendix A). Permission to conduct the study at the particular middle school was requested from the school's principal by a letter from the researcher. The researcher then submitted the letters of permission and request to conduct research to Mississippi State University Institutional Review Board (IRB; see Appendix B).

Upon IRB approval, student assent forms (see Appendix C) and parental consent forms (see Appendix D) was secured from participants and their parents. The researcher provided instructions pertaining to the MARS-A (see Appendix E), for the three administering teachers, and the researcher asked the three teachers to ensure that the students understood the directions before MARS-A was administered.

The test was planned for one day administration, but students who were absent took the test the following day. Three math teachers administered the MARS-A test to the participants. The administration of the test was expected to take approximately 45 minutes per class section. At the end of the school day the researcher collected all tests and scored them. The researcher already had the qualified students' name, math MCT2 scores, gender, race, and a column labeled "MARS-A" to input the students' MARS-A scores. After the researcher properly recorded all MARS-A scores, the students' names were deleted and they were identified by a number.

Data Analysis

Three hypotheses were stated for the study. The following provides a description of each analysis that was used for each research hypothesis.

Hypothesis 1: There is a statistically significant negative relationship between students' mathematics anxiety scores and math achievement scores.

Hypothesis 1 predicts that there is a negative relationship between the two quantitative variables, students' math anxiety scores and students' MCT2 math scores. To test this hypothesis, a correlation was determined. Pearson Product-Moment Coefficient, also known as Pearson *r*, was computed. Fraenkel and Wallen (2006) stated, "When the data for both variables are expressed in terms of quantitative scores, the Pearson *r* is the appropriate correlation coefficient to use" (p. 209). The assumption for this hypothesis was a negative correlation would take place because the researcher assumed that the higher the math anxiety scores were, the lower the math achievement scores were. As one variable increased, the other variable decreased, which resulted in a negative correlation.

Differences for means for math anxiety for gender and race were analyzed and a causal comparative design was used for the following null hypotheses.

Hypothesis 2: There is no statistically significant difference in measures of math anxiety between seventh grade boys and girls.

Hypothesis 3: There is no statistically significant difference in measures of math anxiety between Black and White seventh grade students.

The results from these hypotheses for this study revealed whether seventh grade girls or boys possessed more math anxiety, and if seventh grade Black students or

seventh grade White students possessed more math anxiety. A t-Test was used to determine whether differences between the means of the two samples were significant. Fraenkel and Wallen (2006) stated, "The most commonly used test in causal comparative studies is the t-Test for differences of means" (p. 394).

Fraenkel and Wallen (2006) stated:

> A t-Test is a parametric statistical test used to see whether a difference between the means of two samples is significant. The test produces a value for t (called an obtained t), which the researcher then checks in a statistical table to determine the level of significance that has been reached and if the .05 level of significance is reached, the researcher customarily rejects the null hypothesis and concludes that a real difference does exist. (pp. 232-233)

The assumptions for the data results from the t-Test, were there will be no significant difference in the measure of math anxiety between girls and boys, and there will be no significant difference in the measure of math anxiety between Black students and White students.

Statistical analyses for all hypotheses were performed using SPSS for Windows Program version 16.0. Descriptive statistics were computed for MARS-A test. The .05 level of significance was used to guide the data analysis for all research hypotheses. The researcher analyzed the data to determine the relationship between MCT2 math scores and mathematics anxiety scores for middle school students who were in the seventh grade during the academic school year 2009-2010 at a particular middle school in Mississippi. The researcher also analyzed the data to determine mean differences of math anxiety for those girls and boys and those Black students and White students.

CHAPTER 4

RESULTS

The purpose of this quantitative research study was two-fold. The first purpose was to explore the relationship between math anxiety and math achievement of seventh grade students attending a specific middle school in Mississippi. The second purpose was to determine if gender and race account for differences in measures of math anxiety among those seventh grade students. In doing so, the MARS-A, developed by Suinn and Edwards (1982), was used to determine the students' measure of math anxiety. In addition, the students' MCT2 math results from the 2009-2010 academic school year were used to determine students' math achievement levels.

Data Analysis

The 2009-2010 seventh grade population consisted of 338 students. The racial make–up of the seventh grade students was 52% White students and 48% Black students and there were 175 males and 163 females. Of the 188 students in the study, 84 (44.7%) were female and 104 (55.3%) were male. Of the participants, 105 (55.9%) were identified as Black students and 83 (44.1%) were identified as White students. The frequencies and percent ages for nominal demographic variables are summarized in Table 4.

Table 4

Frequencies and Percents for Nominal Demographic Variables

Variable	N	%
Gender		
Female	84	44.7
Male	104	55.3
Race		
Black	105	55.9
White	83	44.1

Hypothesis 1

To examine directional hypothesis 1, a correlation was determined. The Pearson Product-Moment Coefficient, also known as the Pearson *r*, was computed to determine if there was a statistically significant negative relationship between students' mathematics anxiety scores and students' MCT2 math scores. As expected, a negative correlation took place between the variables, MARS-A scores and MCT2 scores ($r = -.22$, $p = .002$, $p < .05$). In which case, only 48% of the variance in MCT2 math scores is accounted for by the variance in MARS-A scores. Brace, Kemp, and Snelgar (2006), stated *r* values of 0 to .2 are considered weak, .3 to .6 are considered moderate, and .7 to 1 are considered strong. Although the relationship between the two variables was weak, the relationship was statistically significant.

Hypothesis 2

To examine null hypothesis 2, an independent t-Test was conducted to determine if measures of math anxiety among seventh grade students differed by gender (girls vs. boys). The result of the t-Test was not statistically significant, ($t(186) = .417$, $p > .05$), and suggested that no statistical mean difference existed between math anxiety for females ($M = 203.13$, $SD = 65.28$) and males ($M = 199.14$, $SD = 64.70$). It appears that there was no difference in math anxiety between males and females. The results of the t-Test are summarized in Table 5.

Table 5

t-Test on Math Anxiety by Gender

	Female		Male			
	M	*SD*	*M*	*SD*	*t*(1, 186)	*P*
Math Anxiety	203.13	65.28	199.14	64.70	.417	.68

*p< .05

Hypothesis 3

To examine null hypothesis 3, an independent t-Test was conducted to determine if measures of math anxiety among seventh grade students differed by race (Black students and White students). The result of the t-Test was not statistically significant, ($t(186) = 1.19$, $p > .05$), and suggested that there was no difference in measures of math anxiety between Black students ($M = 206.35$, $SD = 65.76$) and White students ($M = 195.01$, $SD = 63.57$). The results of the t-Test are summarized in Table 6.

Table 6

t-Test on Math Anxiety by Race

	Black		White			
	M	*SD*	*M*	*SD*	t(1, 186)	*P*
Math Anxiety	206.35	65.76	195.01	63.57	1.19	.24

*p< .05

Summary

Three hypotheses were tested in this study. The result of the first hypothesis indicated there was a statistically significant negative relationship between the seventh grade students' measures of math anxiety and the seventh grade students' measure of math achievement. The results from the second and third hypotheses indicated that there were no statistically significant differences for the seventh grade students' measures of math anxiety between the males and females, or between the Black students and White students.

The results for hypothesis 1 revealed as MARS-A scores increased, MCT2 scores decreased. This indicated a negative relationship between the two variables and showed that math anxiety does have a weak negative relationship with math achievement. The weak negative relationship between the two variables, MARS-A and MCT2, indicated that math anxiety was present and may have influenced the math achievement of those seventh grade students.

The results for the hypothesis 2 revealed no statistically significant difference between the measures of math anxiety for boys and girls. Although there was no

statistically significant difference, the girls' mean score was higher than the boys' mean score.

The results for the hypothesis 3 revealed no statistically significant difference between the measures of math anxiety for Black students and White students. Although the measures of math anxiety between Black students and White students were not statistically significant, Black students had a higher level of math anxiety than White students. The results from this study indicated that Black students had higher measures of math anxiety than White students.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary, conclusions, and recommendations for the study. The summary of this study is provided in the first section, which includes the research hypotheses that guided the study. The second section focuses on the findings of the study organized by the research hypotheses. In addition, the second section presents the conclusions of the study. The final section of the chapter covers the implications for practice, general recommendations of the study, and recommendations for further research.

The present study had a two-fold purpose. The first purpose was to explore the relationship between math anxiety and math achievement of seventh students attending a specific middle school in Mississippi. The second purpose was to determine if gender and race accounted for differences in measures of math anxiety among the seventh grade students. Put another way, this research study intended to determine if there was a negative relationship between math anxiety and math achievement of seventh grade students. This research study also intended to determine if the difference in math anxiety measures were accounted for by gender and race of seventh grade students at that particular middle school in Mississippi.

Summary

Participants from one particular middle school in Mississippi were included in this study. The participants were students who were in the seventh grade during the academic school year 2009-2010. The participants were 188 students who were categorized by gender (84 females and 104 males) and race (105 Black students and 83 White students). The following research hypotheses guided the study.

Hypothesis 1: There is a statistically significant negative relationship between students' math anxiety scores and math achievement scores of seventh grade students.

Hypothesis 2: There is no statistically significant difference in measures of math anxiety between seventh grade boys and girls.

Hypothesis 3: There is no statistically significant difference in measures of math anxiety between Black and White seventh grade students.

Discussion of Findings and Conclusions

To reveal the results for hypothesis 1, a correlation was determined. Pearson Product-Moment Correlation coefficient, also known as Pearson *r*, was computed. To examine hypotheses 2 and 3, a *t*-Test was conducted to determine the mean differences for math anxiety for gender (boys vs. girls) and race (Black vs. White). The following contains the results for the three hypotheses.

Hypothesis 1: There is a statistically significant negative relationship between seventh grade students' math anxiety scores and math achievement scores.

The finding for directional hypothesis 1 revealed there was a negative relationship between math anxiety and math achievement for those seventh grade students. The finding led the researcher to conclude there was a negative statistically significant relationship between math anxiety and math achievement for seventh graders. The finding was consistent with the finding of Hembree (1990) who found math anxiety was related to poor performance for mathematics. The finding also supported the statement of Kesici and Erdogan (2010) who stated, "One of the most significant reasons preventing mathematics achievement is math anxiety" (p.54).

Hypothesis 2: There is no statistically significant difference in the measure of math anxiety between seventh grade boys and seventh grade girls.

The findings for null hypothesis 2 revealed there was no statistically significant difference for the measure of math anxiety between seventh grade boys and girls, but girls' math anxiety mean score ($M = 203.13$) was higher than boys' math anxiety mean score ($M = 199.14$). The findings led the researcher to conclude there was no statistically significant difference in the measure of math anxiety between boys and girls. The findings also led the researcher to conclude that girls had a higher mean score for math anxiety than boys.

The findings were consistent with that of Gierl and Bisanz (1995) who focused on third grade students and sixth grade students, and found no gender differences for measure of math anxiety. The findings from this study also supported the findings of

Ashcraft and Kirk (2001) and Haynes et al (2004) who found no gender differences for measures of math anxiety in their studies which involved college students.

The finding that girls' math anxiety measure was higher than boys' math anxiety measure was consistent with that of (Baloglu & Kocak, 2006; Betz, 1978; Karimi & Venkatesan, 2009). In addition, the finding was consistent with Bonnstetter (2007) who found that girls in middle and secondary schools, freshman college students, and adult women were found to show higher levels of math anxiety.

Hypothesis 3: There is no statistically significant difference in measures of math anxiety between Black and White seventh grade students.

The findings for null hypothesis 3 revealed no statistically significant differences in measures of math anxiety between Black and White seventh grade students, but Black students' math anxiety mean score (M = 206.35) was higher than White students' math anxiety mean score (M = 195.01). The findings led the researcher to conclude that there was no statistically significant difference in the measure of math anxiety between Black students and White students. The findings also led the researcher to conclude that Black students' mean math anxiety score was higher than White students' mean math anxiety score. Although White students' math achievement was higher than Black students' math achievement, there was no significant difference in the level of math anxiety between the Black and White seventh grade students. This finding was consistent with Hembree (1990). Hembree found that Black and White college students' math anxiety scores were not statistically significantly different.

The finding that Black students' mean math anxiety score was higher than White students' mean math anxiety score was consistent with Lockhead et al. (1985). Lockhead et al. found that Asian American students usually outperformed White students, and both groups outperformed Black students. The finding was also consistent with Osborne (2001) who found that White students had lower anxiety scores than non-White students. This could mean that other factors may cause Black students not to achieve as well as White students achieve mathematically.

Implications of the Study

This study contributed to the literature concerning the following variables: (a) math anxiety and math achievement scores of seventh grade students, (b) the difference in math anxiety levels between boys and girls, and (c) the difference in math anxiety levels between Black students and White students. This study provided further evidence regarding the negative relationship between math anxiety and math achievement.

School policy makers at the state, district, and school levels should consider a standard math anxiety test to administer to all students at the beginning of each school year. Teachers should use the results from the math anxiety test and compare them with the MCT2 math test results for each child to better understand each student's math ability as they seek ways to show growth and progress of student learning to meet the requirements of NCLB. Teachers should use the results to implement strategies and techniques to teach each student accordingly. This is an effective way to eliminate or reduce the negative relationship between math anxiety and math achievement and may increase student math achievement.

General Recommendations

The results from the study supported the findings in the literature that math achievement does have a statistically significant negative relationship with math anxiety. Recommendations of this study are suggested for policymakers and educational professionals to consider. Schools wishing to positively influence their students' math achievement should look to identify students who have math anxiety and implement strategies and procedures to reduce or eliminate math anxiety. In this way, student math achievement may increase.

Educators must understand that math anxiety must be identified by taking an individual approach. Math anxiety is experienced by many people; therefore, educators cannot assume that math anxiety is only experienced by a specific group. It is important that all students receive the needed attention to ensure that math is effectively learned so that they can further their education and become productive efficient individuals.

Recommendations for Further Study

Based on the findings of the research study, the following are recommendations for further research. First, the study involved one seventh grade student body that consisted of 188 students who were grouped by gender (84 females and 104 males) and race (105 Black students and 83 White students). Future research should be broadened to include more schools and an increase in the number of students from each school. The school involved in this study was located in central Mississippi. Schools throughout the state, from the north to the south, should be included in future studies. Second, future research should use other math anxiety rating scales. Although the MARS-A was proven

valid and reliable, other instruments may be more beneficial to the student and the researcher.

Finally, this study contained survey data only. Qualitative data such as interviews with participants, interviews and observations with the principals, teachers, and staff may lead to a better understanding of students' math anxiety and the relationship with math achievement.

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APPENDIX A

SCHOOL DISTRICT APPROVAL TO CONDUCT RESEARCH

May 11, 2011

To Whom It May Concern:

Wanda Pittman Merritt, a doctoral candidate in the Educational Leadership Program at Mississippi State University, has requested permission to conduct a research study of Grenada Middle School students exploring math anxiety as it relates to math achievement, race, and gender. Mrs. Merritt serves as Assistant Principal at Grenada Middle School and her request to conduct this study using data for 2009-2010 seventh grade students has been approved. Tim Wilder, Principal of Grenada Middle School, will share results of the 2009-2010 Mathematics Section of the Mississippi Curriculum Test, 2nd Edition (MCT2) with Mrs. Merritt. She has also been granted permission to administer the Mathematics Anxiety Rating Scale for Adolescents (MARS-A) to these students.

All data will be kept confidential and upon completion of the study, a copy will be provided. If any additional information is needed regarding Mrs. Merritt's research study, please do not hesitate to contact me.

Sincerely,

Dr. David Daigneault
Superintendent

APPENDIX B

NOTIFICATION OF APPROVAL TO CONDUCT RESEARCH

May 12, 2011

Wanda Merritt
134 Sunflower Drive
P.O. Box 201
Grenada, MS 38901

RE: IRB Study #11-139: Exploring Math Anxiety as it Relates to Math Achievement, Race, and Gender

Dear Ms. Merritt:

This email serves as official documentation that the above referenced project was reviewed and approved via administrative review on 5/12/2011 in accordance with 45 CFR 46.101(b)(1). Continuing review is not necessary for this project. However, any modification to the project must be reviewed and approved by the IRB prior to implementation. Any failure to adhere to the approved protocol could result in suspension or termination of your project. The IRB reserves the right, at anytime during the project period, to observe you and the additional researchers on this project.

Please note that the MSU IRB is in the process of seeking accreditation for our human subjects protection program. As a result of these efforts, you will likely notice many changes in the IRB's policies and procedures in the coming months. These changes will be posted online at http://www.orc.msstate.edu/human/aahrpp.php. The first of these changes is the implementation of an approval stamp for consent forms. The approval stamp will assist in ensuring the IRB approved version of the consent form is used in the actual conduct of research. Your stamped consent form will be attached in a separate email. You must use copies of the stamped consent form for obtaining consent from participants.

Please refer to your IRB number (#11-139) when contacting our office regarding this application.
Thank you for your cooperation and good luck to you in conducting this research project. If you have questions or concerns, please contact me at nmorse@research.msstate.edu or call 662-325-3994.

Sincerely,

Nicole Morse, Assistant Compliance Administrator

cc: Debra Prince (Advisor)

APPENDIX C

STUDENT ASSENT FORM

Minor Assent Document

Your parent knows we are going to ask you to fill out this survey. We want to know about students' relationship between math anxiety and math achievement for middle school students. It will take about 45 minutes of your time to complete the *Mathematic Anxiety Rating Scale for Adolescents (MARS-A)*. Your name will not be written anywhere on the MARS-A. No one will know these answers came from you personally.

If you don't want to participate, you can stop at any time. There will be no bad feelings if you don't want to do this. You can ask questions if you do not understand any part of Exploring Math Anxiety As It Relates to Math Achievement, Race, and Gender.

Do you understand? Is this OK?

Name (Please print):_____

Signature: _____

Date: _____

Investigator's Signature: _____Date:_____

APPENDIX D

PARENTAL CONSENT FORM

Mississippi State University

Informed Parent Consent Form for Participation in Research

Title of Research Study: Exploring Math Anxiety As It Relates to Math Achievement, Race, and Gender

Study Site: Grenada Middle School, 28 Jones Road, Grenada, MS 38901

Researchers: Wanda Pittman Merritt and Dr. Debra Prince @ Mississippi State University.

We would like to ask you to allow your child to participate in a research study.

If you allow your child to participate in this study, he/she will be asked to complete a survey regarding math anxiety that will take about 45 minutes to complete. This survey will include questions/statements such as: 1) Describing how much change you should get back from buying several items, 2) Being asked to add up 976 + 777 in your head, 3) Counting a pile of change, 4) Meeting your math teacher while walking in the hall, and 5) Signing up for a math test. The survey will consist of 98 questions/statements such as those listed and the student will rate how anxious each question/statement makes them feel by marking 1) "Not at all" which is equivalent to 1 point, 2) "A Little" which is equivalent to 2 points, 3) "A fair amount" which is equivalent to 3 points, 4) "Much" which is equivalent to 4 points and 5) "Very Much" which is equivalent to 5 points. After completing the survey, the researcher will add up all the points for your child and determine his/her level of math anxiety. The researcher will then use the data from the survey to determine if there is a relationship between math anxiety and math achievement by using the MARS-A results and the results of all participants 2009-2010 Mathematic Section of the Mississippi Curriculum Test, 2nd Edition (MCT2).

If you have any questions about this research project, please feel free to contact Wanda Pittman Merritt at 662-230-1223 or Dr. Debra Prince at 662-325-7055.

Please understand that your child's participation is voluntary. Your refusal to allow your child to participate will involve no penalty or loss of benefits to which you or your child are otherwise entitled. You may discontinue your child's participation at any time without penalty or loss of benefits.
Please take all the time you need to read through this document and decide whether you would like to participate in this research study.

If you agree to allow your child to participate in this research study, please sign below. You will be given a copy of this form for your records.

_____ _____
Parent/Guardian Signature Date

_____ _____
Student Signature Date

_____ _____
Investigator Signature Date

APPENDIX E

SAMPLE PAGE OF MARS-A

Name _____ Total Score _____

MATHEMATICS ANXIETY RATING SCALE (MARS-A)

The items in the questionnaire refer to things and experiences that may cause tension or apprehension. For each item, place a check (✓) in the circle under the column that describes how much you would be made anxious by it. Work quickly, but be sure to think about each item.

	How anxious . . .	Not at all	A little	A fair amount	Much	Very much
1.	Deciding how much change you should get back from buying several items.	O	O	O	O	O
2.	Having someone watch you as you add up a column of numbers.	O	O	O	O	O
3.	Having someone watch you as you divide a five digit number by a two digit number.	O	O	O	O	O
4.	Being asked to add up 976 + 777 in your head.	O	O	O	O	O
5.	Adding up 976 + 777 on paper.	O	O	O	O	O
6.	Figuring out a simple percentage, like the sales tax on something you buy.	O	O	O	O	O
7.	Figuring out how much you will get paid for 6½ hours of work if you get paid $3.75 an hour.	O	O	O	O	O
8.	Listening to a person explain how your share of expenses on a trip was figured out (including meals, transportation, housing, etc.).	O	O	O	O	O
9.	Counting a pile of change.	O	O	O	O	O
10.	Adding up a bill for a meal when you think you have been over-charged.	O	O	O	O	O