I DON'T KNOW WHAT TO DO: A MIXED METHOD STUDY OF MATH ANXIETY AS PERCEIVED BY STUDENTS AND THEIR PARENTS

A Dissertation

by

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BA, Ohio University, 1992
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Submitted in Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILSOPHY

in

CURRICULUM AND INSTRUCTION

Texas A&M University-Corpus Christi
Corpus Christi, Texas

August 2021

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This dissertation meets the standards for scope and quality of
Texas A&M University-Corpus Christi and is hereby approved.

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ABSTRACT

Mathematics anxiety is a problem for elementary students and affects mathematics self-concept, mathematics performance, and student's perceptions of their ability to learn mathematics. This mixed method study examined the perceptions of fourth and fifth grade low-performing students and their parents concerning their mathematics anxiety, if there was a correlation between parents and their child's mathematics anxiety, and the mathematics talk occurring at home. The instruments used to measure mathematics anxiety was the Mathematics Anxiety Rating Scale for Elementary students (MARS-E) and the Mathematics Anxiety Rating Scale for adults (MARS-SV). Interviews were conducted to determine a more in-depth examination of the perceptions of mathematics anxiety experienced by students and their parents and their mathematics talk. There was n=38 families that participated and consisted of one parent and one child. Students attended a school in Southern Texas.

Findings provided evidence that there is a relationship between a child and their parent's mathematics anxiety. Data analysis revealed four themes: Mathematics talk with three sub-themes, schoolwork, real-world, and assessment mathematics talk; positive mathematics self-concept; performance anxiety, and test anxiety. The MARS scale results informed the interview questions, and five profiles were found: child and parent with high mathematics anxiety (HMA), child and parent with low mathematics anxiety (LMA), child and parent with moderate mathematics anxiety (MMA), child with LMA and parent with HMA, and child with MMA and parent with HMA. Data analysis used the Confirmatory Six-Factor Model to further decipher the parents MARS-SV scale results which placed anxiety into six categories: Evaluation Anxiety 1" (EA1) corresponding to anxiety experienced from taking mathematics tests, "Evaluation Anxiety

2” (EA2) resembling the anxiety felt when thinking about mathematics tests, “Learning Mathematics Anxiety” (LMA), “Everyday Numerical Anxiety” (ENA), “Performance Anxiety” (PA), and “Social Responsibility Anxiety” (SRA).

The study revealed a child and parent’s mathematics anxiety to show similarities such as both experienced mathematics anxiety when thinking about taking mathematics tests, numerical anxiety as in mathematics computations, and performance anxiety such as doing mathematics in front of others. Although, families experienced mathematics anxiety, they still had a positive mathematics self-concept, good attitudes towards mathematics, and their self-perceptions regarding their mathematical skills were high. More importantly, families who experienced mathematics anxiety had a great deal of mathematics talk occurring in the home. Mathematics talk, parent support, parent interactions, and a positive attitude concerning mathematics contributed towards a positive mathematics self-concept, impacted mathematics performance, and generated healthy mathematics attitudes among students. In addition, parents in the study exhibited parent support instead of parent control during mathematics homework and despite, experiencing high mathematics anxiety, parents were cognizant of their mathematics anxiety negatively affecting their children.

DEDICATION

This dissertation is dedicated to my family, to my extended family known as my professors, classmates, and friends; to the families who assisted me with this study; and to those families experiencing mathematics anxiety or difficulties. To my mother, Antonia Garza Runkle, who is the best listener, offers her constant support, and is my best friend. To my deceased father, Pedro Ramon Elizondo, my constant reminder of what a good education can offer and my inspiration to help people. To my stepmother, Linda Louise Elizondo, who pushes me to be my best, who makes me laugh, and supports my decisions. To the late Roger Dudley Runkle, my stepfather, who showed me it is possible to do the things that you love to do. To my sister, Antonia Suzzann Lyman, her husband Shawn Lyman, my niece Gabriella Lyman, and my nephew Logan Lyman who provide the study breaks, playtime, and delicious meals to keep me going. Also, a special mention to my recently deceased sister, Rhonda Atkins, I will miss your laugh, kindness, and gently nature. Lastly, to the love of my life, Dr. David Lee DeMaris, the constant star to set my gaze upon that keeps me grounded, the one who forgives, and is still my friend despite the obstacles.

ACKNOWLEDGEMENTS

It is necessary to acknowledge all the people and organizations that have contributed their time, expertise, and care to assist me in this journey to complete my dissertation. Without their contributions, the completion of this dissertation would not have been possible.

I would like to thank my committee chair and professor, Dr. Corinne Valadez, whose expertise, encouragement, and teachings taught me how to complete this dissertation. I am grateful for all the time and energy she put into helping me be successful as a person and as a professional. I would like to thank my committee members, Dr. Faye Bruun, who has assisted me with all my mathematics research, spent time helping me perfect my manuscripts for publication, and encouraged me to attend national conferences to disclose my findings. I will never forget her dedication to the field of mathematics, her kindness, and for allowing me the opportunities to work with her throughout the years. Thank you Dr. Bruun, I would not be here without you. Thank you to Dr. Kathleen Lynch-Davis, my committee co-chair who provided insight into the methodology section of this dissertation, gave me wonderful ideas regarding my research and analysis, and always made me feel welcomed and appreciated. Also, thank you to Dr. Rabih Zeidan, my graduate faculty representative who supported me through my proposal, offered great ideas on moving forward with my dissertation, and always answered my emails.

It is important for me to thank all my professors for their constant support, encouragement, and shaping me into the professional that I am today. Thank you to Dr. Bethanie Pletcher, who taught most of my reading courses and inspired me to share that information with my students. I will never forget your smile and laughter! Thank you for allowing me to help you with research and assisting me with all my manuscripts for publication. You are truly committed to helping all of us succeed and I will never forget the time and energy you gave to me. Thank you to Dr. Kelli Bippert who showed me that we are all in this together. I will always remember our conversations, providing reading interventions to middle school students, and presenting at conferences. You always made everything seem easy which put my mind at ease and helped me become a better presenter. Thank you Dr. B., you are truly amazing!

There is a special person who I would like to thank, Donna Degaish. I would like to thank Donna for always answering all my questions which helped me with the classes that I taught, assisted me with turning in the right paperwork for everything, helped me with all my traveling to conferences, and she was just the friendly face I needed to see. You are truly a special person Donna and I hope you realize how much you are appreciated. Thank you for everything.

Thanks to all my family for believing in me, for being the entertainment I needed especially when things became serious, and thanks for giving me something to look forward to that did not involve schoolwork. I love you all and I hope you realize how much I appreciate you in my life. A special thanks to my Uncle Rocky Dominquez, Aunt Irma Dominquez, Aunt Dila Benavidas, Aunt Cede Perez, and my Uncle Manual Perez who came to visit us often, listened to my ideas regarding my research, and thank you for accepting me as I am.

Let me thank my dear friend Dr. David Lee DeMaris for putting up with my constant emails regarding my research, for offering his advice, and giving me the study breaks I desperately needed. Thank you for always being there when I need you.

Finally, I would like to thank the Catholic Daughters at St. Phillips for helping me become a better person. I would also like to acknowledge that without the help of our Lord Jesus, his mother the Virgin Mary, the Holy Spirit and all the saints and angels none of this would have been possible.

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CHAPTER I: INTRODUCTION

The Organization for Economic Co-operation and Development (OECD) surveyed adult mathematics skills ranging from basic mathematical concepts to more advanced statistical formulas and found numeracy skills to be utilized extensively in work settings worldwide (Desjardins, Thorn Schleicher, Quintini, Pellizzari, Kis, & Chung, 2013). According to participating OECD countries, 38% of workers aged 16 to 65 reported using fractions at work once a week and 29% use basic algebra or formulas. However, a continual issue for the United States and globally concerns students' inadequate mathematics skills (Desjardins et al., 2013; Gottfried, Marcoulides, Gottfried, & Oliver, 2013) and a disinterest in pursuing careers in mathematics (Desjardins et al. 2013; Gottfried et al., 2013; Ma, 1999). In fact, in the United States, the National Association of Education Progress (NAEP) reported 20% of fourth graders scored below basic regarding their mathematics skills, 39% attained basic level scores, and only 32% were considered proficient in mathematics (NAEP, 2018). This is a problem, especially since the demand for science, technology, engineering, and mathematics (STEM) professions are predicted to increase (Lacey & Wright, 2009), mathematics skills are an essential life skill (Patton, J. R., Cronin, M. E., Bassett, D. S., & Koppel, A. E. ,1997; Vijayan, V., & Joshith, V. P. 2018), and mathematics is a gateway in providing access to higher education and better employment opportunities (Bryk & Treisman, 2010; Frankenstein, 1995; Stinson, 2004).

The United States has recognized a need to increase mathematics achievement nationally (Gottfried et al., 2013) and according to Trends in an International Mathematics Study (TMS) and the Program of International Student Assessment (PISA), mathematics achievement of American students is behind those of other countries (Fleischman, Hopstock, Pelczar, & Shelley, 2010; Hanushek, Peterson, & Woessman, 2010). The TMS and PISA found 15-year-olds in the

United States to have an average score of 487 on the mathematics literacy scale (MAS) and the United States was found to be lower than the OECD average score of 496 (Fleishman et al., 2010). The mathematics literacy scale consisted of assessing the student's ability to analyze, reason, and interpret mathematics problems in various situations. In addition, among the 33 other OECD countries participating in the study, 17 countries had higher average scores than the United States. The top five countries with a MAS score between 546 and 527 included Korea, Finland, Switzerland, Japan, and Canada.

There is a national agenda to promote positive mathematics attitudes, increase mathematics achievement, and increase the amount of mathematics courses taken in high school (Gottfried et al., 2013). For these reasons, the effects on the amount and level of mathematics courses taken in high school has received increasing attention in research. According to Gottfried and colleagues (2013), taking mathematics courses has been positioned as an important gateway to further education and job earnings. In addition, the more advanced level of high school mathematics courses taken, a students' educational attainment, showed their career success improved. However, only students with more positive mathematics attitudes, motivation, and task values tend to take higher-level high school mathematics courses (Ma, 1999, 2006; Updegraff, Eccles, Barber, & O'Brien, 1996).

Students' academic success depends on many factors especially if students are to graduate from high school or have the mathematics skills needed for most jobs (Desjardins et al. 2013; Gottfried et al., 2013; Ma, 1999). Unfortunately, studies have found another obstacle to mathematics achievement known as mathematics anxiety. Mathematics anxiety has been found to decrease both mathematics motivation and mastery of mathematics skills (Ashcraft & Krause, 2007). Therefore, if a student has mathematics anxiety, this decreases their ability to learn mathematics, lowers their mathematics motivation, and they avoid situations involving mathematics such as taking higher-level high school mathematics courses or pursuing careers in mathematics (Gottfried et al., 2013; Ma, 1999; Ma and Xu, 2004; Ma, 2006). Therefore, it is critical to understand the problems associated with mathematics anxiety.

Mathematics anxiety is a widespread, worldwide problem affecting all age groups (Luttenberger, Wimmer, & Paechter, 2018) and 59% of adolescents aged 15 to 16 years of age from 33 countries were worried mathematics classes would be difficult, 33% became very tense when they had to do mathematics homework, and 31% were very nervous when completing mathematics problems (OECD, 2013). Mathematics anxiety has a negative impact on mathematics skills, which has consequences that adversely affect career choice, employment, and professional success (Ma, 1999). Negative emotionality about completing mathematics-related tasks creates mathematics anxiety and according to Ashcraft and Ridley (2005) apprehension including increased physiological reactions occur when individuals manipulated numbers, solved mathematics problems, or they were asked to evaluate a situation connected to mathematics (Carey, Hill, Devine, & Szucs, 2017; Hopko, Mahadevan, Bare, & Hunt, 2003; Paechter, Macher, Martskvishvili, Wimmer, & Papousek, 2017). This type of mathematics anxiety is associated with poor mathematics performance in both children and adults (Ashcraft & Ridley, 2005) and decreased mathematics achievement. (Hembree, 1990; Luttenberger et al., 2018).

Mathematics anxiety has been known to effect individuals on a physiological, emotional, and cognitive level. On a physiological level, symptoms of mathematics anxiety include increased heart rate, clammy hands, upset stomach, and feelings of tension (Blazer, 2011). High levels of anxiety among students showed greater increases in cardiovascular reactivity when solving mathematics problems when compared to students with low mathematics anxiety (Luttenberger et al.,2018). Therefore, students with higher levels of mathematics anxiety put more of a physiological strain on their bodies. Mathematics anxiety also effects an individual's emotions and they can experience feelings of stress, nervousness, apprehension, worry (Papuosek, Ruggeri, Macher, 2012; Spielberger, 1985) and even fear (Wigfield & Meece, 1988). These symptoms are hardly conducive for learning and may even hinder academic achievement. In addition, mathematics anxiety compromises the function of working memory (Ashcraft & Krause, 2007; Ramirez, Gunderson, Levine, & Beilock, 2013) and working memory processing is critical to arithmetic and mathematics performance especially involving more complex computations like multistep mathematical problems (Ashcraft & Krause, 2007; Luttenberger et al., 2018). As a result, students' cognitive learning processes are affected by mathematics anxiety. These particular studies measured the physiological, emotional, and cognitive levels of mathematics anxiety and have shown the negative effects on students. However, further research is needed to contend with the problems associated with mathematics anxiety.

Another challenge to consider is the influence of parent's mathematics anxiety on the development of their child's mathematics competence. Research has found parent's mathematics anxiety to affect their child's mathematics anxiety, mathematics attitudes, and mathematics achievement (Berkowitz, Schaeffer, Maloney, Peterson, Gregor, Levine, & Beilock, 2015; Gunderson, Ramirez, Levine, Beilock, 2012; Maloney, Ramirez, Gunderson, Levine, & Beilock, 2015; Schaffer, Rozek, Berkowitz, Levine, & Beilock, 2018). The problem for low-performing mathematics students is further exacerbated by the influence of their parent's preconceived ideas concerning mathematics and their own mathematics anxiety and mathematics attitudes. Gunderson and colleagues (2012) stated this to be an issue especially regarding the influence of parent's interactions with their child concerning mathematics which effects their child's mathematics attitude and mathematics performance. There is limited research in this area and therefore, further research is needed to understand parent's preconceived ideologies towards mathematics and the transformation that may occur regarding the parent and even the child. This is especially important since research has already found parent's behaviors and beliefs linked to diminishing mathematics performance and mathematics motivation (Kung & Lee, 2016; Levpuscek & Zupancic, 2019).

As educators, we need to better assist our students and especially those low performing academically and understand the challenges faced by students and their parents. Students that academically struggle in school are at-risk for dropping out (Lee & Burkam, 2003) and may experience other potential risk factors. Research has found a connection between schooling and incarceration with students who perform well academically being less likely to enter the criminal justice system (Rocque & Paternoster, 2011). Mathematics fosters the life skills that assist us with problem solving, managing our finances, increasing our chances to better job opportunities, and are needed for higher education. Without fundamental numeracy skills, the quality of life diminishes and effects people's health, the ability to trust others, and the capacity to find work (Desjardins et al., 2013).

Statement of the Problem

The problem of concern relates to the number of under-represented elementary students continually performing low academically and specifically in mathematics. Research has shown several problems connected to low mathematics achievement including mathematics anxiety (Ashcraft & Krause, 2007; Hembree, 1990; Luttenberger et al., 2018 Ma & Xu, 2004; Meece et al., 1990; Papuosek et al., 2012; Ramirez, Gunderson, Levine, & Beilock, 2013; Spielberger, 1985; Wigfield & Meece, 1988), parent mathematics anxiety (Berkowitz, Schaeffer, Maloney, Peterson, Gregor, Levine, & Beilock, 2015; Gunderson, Ramirez, Levine, Beilock, 2012; Maloney, Ramirez, Gunderson, Levine, & Beilock, 2015; Schaffer, Rozek, Berkowitz, Levine, & Beilock, 2018), and issues related to self-beliefs such as low self-concept (McCleod, 1992; Shavelson, Hubner, Stanton, 1976; Shavelson & Bolus, 1981) and lower self-efficacy (Lee, 2009; Pajares & Schunk, 2001). Studies have found under-represented populations such as Hispanics and African Americans mathematics progress to be lower in mathematics achievement than other populations (NAEP, 2019). For example, the NAEP report of 2017 found 29% of Hispanics and 37% of African American in the fourth grade were below basic mathematics progress compared to 12% of Whites. Mathematics progress is a national problem that needs immediate attention especially in the under-represented populations.

The problem of low performance in mathematics persists nationally and globally (Fleischman et al., 2010; Hanushek et al., 2010), people continue to struggle with basic numeracy competency, problem solving skills are decreasing, and mathematics continues to be a skilled needed for the 21st century labor force (Desjardins et al., 2013). These problems will continue to be an issue for our world until research can fully comprehend every nuance concerning these issues and work towards finding solutions. If research does not continue to fully explore the problems associated with mathematics achievement, as reported by the OECD, the lack of cognitive abilities to perform basic numeracy skills will affect the world economy especially in a technologically driven society (Desjardins et al., 2013). Educators, policymakers, and business leaders need to realize the importance of helping students with low mathematics performance, understand the negative consequences associated with low mathematics achievement, and continue research to provide strategies to increase mathematics skills. The

OECD reported that lower academic achievement in reading, mathematics, and science is affecting not only the people with lower abilities in these areas but is affecting our ability to build a sustainable future for our society (Desjardins et al., 2013).

There is little empirical evidence that studies the perceptions of mathematics anxiety as experienced by fourth and fifth grade under-represented students considered low performing in mathematics, their parent's mathematics anxiety, the relationship of mathematics anxiety among parents and students, how parents and students are talking about mathematics, and how this may affect mathematics achievement. The aim of this study is to further investigate these issues by using a mixed method approach to further explore areas that may provide insight into how to help children and parents who experience mathematics anxiety, assist parents in having better mathematics discussions with their children at home, and work towards increasing mathematics skills. Until, educators can fully comprehend the educational challenges faced by our students and parents, the problems concerning mathematics will continue to be an issue.

Significance of the Study

This study will contribute to the literature by providing descriptive statistics regarding mathematics anxiety of fourth and fifth grade under-represented student low performing in mathematics and their parents' mathematics anxiety. The research will also further explore the types of mathematics discussions occurring between the child and parent through interviews. There is limited research that investigates the perceptions of mathematics anxiety in under-represented students considered low performing in mathematics specifically those in fourth and fifth grade and predominantly Hispanic. In addition, more research on the effects of a parent's mathematics anxiety on their child's mathematics development especially centered around mathematics discussions is needed. It is unclear how parent's frame of references (ideologies) affects their child's mathematics anxiety and mathematics achievement. There is very limited research in this area. Studies are needed to explore parent's mathematics anxiety, teach parents ways to support their child through positive mathematics discussions and help parents reduce their child's mathematics anxiety. This study will attempt to illuminate the perceptions of mathematics anxiety experienced by parents, understand the types of discussions occurring between a parent and their child regarding their interactions with mathematics, and provide recommendations for combating the problems mentioned. A more in-depth analysis of these challenges must be examined especially concerning low performing mathematics students.

Purpose of Study

The goal of this study is to provide quantitative and qualitative findings regarding the perceptions of mathematics anxiety experienced by fourth and fifth grade under-represented students considered low performing in mathematics. The study will examine a students' perceptions of mathematics anxiety, a parent's perceptions of mathematics anxiety, investigate a students' mathematics anxiety in association to their parent's mathematics anxiety, and understand how parents and students talk about mathematics.

The quantitative aspect of the study will administer two surveys (Appendix A & B); the Suinn Mathematics Anxiety Rating Scale Elementary Form (MARS-E) comprised of 26-items and measures the degree of anxiety experienced by students in a variety of mathematics-related situations that occur inside and outside of the classroom (Suinn, Taylor, & Edwards, 1988). The second survey, the Mathematics Anxiety Rating Scale (MARS-30) is a 30-item scale that measures parent's mathematics anxiety (Suinn and Winston, 2003). These scales will provide a students and parents perceptions of mathematics anxiety plus examine the relationship between a parent's and student's mathematics anxiety.

The qualitative portion of the study was a descriptive analysis of how students and parents' talk about mathematics. Five students and five parents who consented to participate in the study were purposively selected to be interviewed using semi-structured questions. The semi-structured questions were created from the quantitative survey results. The quantitative data informed the qualitative data and provided a more in-depth exploration of mathematics anxiety. Qualitative inquiry is beneficial when the researcher seeks to get a deeper understanding of the participants' motivations, aspirations, attitudes, behaviors, value systems, and concerns (Creswell, 2010).

Research Questions

The following four research questions guided this study to explore the perceptions of mathematics anxiety experienced by fourth and fifth grade under-represented students considered low performing in mathematics, their parent's perceptions of mathematics anxiety, the relationship between a parent's mathematics anxiety and their child's mathematics anxiety and understanding how parents and children talk about mathematics. Each research question contained the same descriptor "fourth and fifth grade under-represented students considered low performing in mathematics". The four research questions guiding the study were:

(1) What are the perceptions of mathematics anxiety of fourth and fifth grade students considered low performing in mathematics?

(2) What are the perceptions of parents' mathematics anxiety?

(3) Is there a relationship between a parents' mathematics anxiety and a student's mathematics anxiety?

(4) How do parents and their students talk about mathematics?

Definition of Terms

The following definitions will provide clarification and a better understanding of this study. Definitions are derived from the work of several researchers and modifications are clearly stated.

Self-Concept- a student or parent perception of him or herself (Shavelson, Hubner, Stanton, 1976; Shavelson & Bolus, 1981). The perceptions are created by a person's experience and by one's environment, perceptions are influenced by reinforcements, evaluations of significant others, and how one acknowledges their own behavior (Shavelson et al., 1976).

Academic Self-Concept- a student's favorable perception of their academic achievement (Marsh, 2008; Marsh & Craven, 2006) which is developed through a social comparison process in which their peers are the frame of reference to judge their own abilities (Marsh, 1988, 2006; Marsh et al., 2008; Skaalvik & Skaalvik, 2002). Academic self-concept in particular school subjects influence subsequent task choice, motivation, sustained effort, and persistence leading to improved academic achievement and academic self-concept (Marsh, 1990; Shavelson et al., 1976).

Mathematics Self-Concept- A student's mathematical self-concept refers to their perception or belief in their ability to do well in mathematics or their confidence in learning mathematics (Reyes, 1984).

Low-Performing Students- These are students who did not pass their State of Texas (Mathematic) Assessment of Academic Readiness (STAAR) exam.

Mathematics Anxiety-The anxiety that a student feels in relation to learning new mathematics skills, practicing mathematics skills, doing mathematics homework, or participating in mathematics-related activities. This anxiety can be physical, emotional, or psychological. The definition is composed from various research studies regarding the work of Ashcraft and Krause (2007), Hembree (1990), Ma and Xu (2004), and Meece, Wigfield, and Eccles (1990).

Mathematics Talk-included interactions with numbers, geometrical shapes, quantities, and other mathematical concepts (Susperreguy & Davis-Kean, 2013). In addition to conversations occurring while doing mathematics homework; discussing mathematics learned at school, conversations over mathematics grades, STAAR exam results, and benchmark scores; talking about everyday mathematical concepts such as the value of money, budgeting, allowances, and shopping.

Schoolwork Mathematics Talk- consisted of families discussing mathematics homework, reviewing for mathematics tests, and talking about what is being learned in mathematics class.

Real-World Mathematics Talk- are conversations held while shopping, conversing about budgets, saving money, and regarding chores for an allowance.

Assessment Mathematics Talk- involved mathematics grades, tests, and results on the STAAR mathematics exam. AMT also referred to conversations over parent's expectations concerning mathematics grades, tests, and STAAR results.

Under-Represented Populations- This refers to low socio-economic students, students predominantly Hispanic, and a small percentage of African American students.

Limitations

The limitations of the study included a limited number of students who have not passed their State of Texas Assessments of Academic Readiness (STAAR) exam in mathematics regarding the quantitative portion being measured and challenges faced with data collection due to the Corona Virus. Another limitation is the MARS-SV has one item "Realizing that you have to take a number of mathematics classes to fulfill the requirements in your major" and many of the parents participating in the study have not attended a higher education institution. In addition, findings may not be generalizable beyond the specific population from which the sample was derived.

Delimitations

A delimitation of the study includes the criteria of the participants for this study. Participants will be fourth and fifth grade under-represented students considered low performing in mathematics. This delimitation can be generalizable to this population and provide educators with information regarding how to help these students from these findings. Another delimitation includes the parents of the students participating in the program to be a good representation of low socio-economic families with lower educational attainment and the struggles that they may encounter due to mathematics anxiety. The schools are located in predominantly low-income neighborhoods and a majority of families who live in these areas are considered under-represented which fit the criteria of this study.

Assumptions

An assumption made was that the topic under study concerning mathematics anxiety would generate findings because a (unpublished) pilot study was conducted in the summer of 2018 and found mathematics anxiety to be an issue with fifth-grade under-represented students considered low performing in mathematics and their parents. For this reason, the decision to study mathematics anxiety was given careful consideration. Conducting a mixed method study assumes that the quantitative and qualitative findings may add depth to the findings and provide a better understanding of mathematics anxiety. This will allow relationships to emerge between the two constructs of quantitative and qualitative paradigms. These relationships emerged from the pilot study and also augmented the findings of the current study.

CHAPTER II: REVIEW OF THE LITERATURE

The primary focus of the study was to explore students and parents' perceptions of mathematics anxiety, explore the relationship between a parent's mathematics anxiety and a student's mathematics anxiety, and how the parent and student discuss mathematics. Literature pertinent to this study included the self-concept theory utilized as the theoretical framework for this study and the examination of literature on the academic self-concept and mathematics self-concept. Other literature examined for this study included mathematics anxiety, mathematics anxiety instruments, parent mathematics anxiety, and the influence of parent involvement on mathematics achievement.

Self-Concept Theory

Self-Concept provides one perspective to help us understand an individual's behavior and it is a central concept relevant in psychology (Epstein, 1973). Several prominent scholars have identified the self-concept as arising from our social interactions and how others react to us (Mead, 1934), a child's interactions with their mother (Sullivan, 1953), the nucleus of our personality (Lecky, 1945), and our perceptions of who we are, what we control, and our ability to maintain and enhance the self (Rogers, 1951). This concept of the self-system is recognized as "an organization of educative experiences called into being by the necessity to avoid or to minimize incidents of anxiety" (Sullivan, 1953, p. 165). For example, a student seeks approval by significant people such as their teacher and the student works to avoid any unpleasant affect and works within certain frameworks organized into "the good student" or "the bad student". Rogers (1951) further stated that a threat to the organization of the self-concept generates anxiety and if the threat persists and it cannot be defended against. this results in calamitous disorganization. This disorganization can result in distress (Lecky, 1945), anxiety, (Rogers, 1951; Sullivan, 1953) and a disruption to inward unity (Lecky, 1945; Epstein, 1973).

Scholars broadly defined self-concept as a person's perception of him or herself (Shavelson, Hubner, Stanton, 1976; Shavelson & Bolus, 1981). The perceptions are created by a person's experience and by one's environment. Perceptions are influenced by reinforcements, evaluations of significant others, and how one acknowledges their own behavior (Shavelson et al., 1976). Shavelson, Hubner, and Stanton (1976) provided the definition of self-concept that created the theoretical framework for self-concept research. These scholars further identified the construct of self-concept to be defined by seven critical features: (1) self-concept is formed by people categorizing information about themselves and then relating that information for understanding, (2) it is multifaceted and the facets are part of the category system accepted by an individual or a shared group of people, (3) it is hierarchical with perceptions of behavior at the foundation and moving to judgments about the self in subareas such as mathematics, (4) general self-concept is stable as it descends the hierarchy, however as self-concept becomes more situation-specific, it is less stable, (5) self-concept becomes more multifaceted from infancy to adulthood, (6) self-concept is descriptive and evaluative, individuals can describe themselves as "I am happy" and evaluate themselves as "I do well in mathematics", and (7) self-concept can be different from other constructs such as academic achievement (Shavelson et al., 1976).

Shavelson, Hubner, and Stanton's (1976) model is a hierarchy with four main tiers. The first tier represents general self-concept (GCP) and underneath GCP are academic self-concept and non-academic self-concept. The third tier symbolizes subareas of self-concept and the last tier denotes the evaluation of behavior in specific situations. Within the second tier, under non-academic self-concept are subareas referred to as social self-concept, emotional self-concept, and physical self-concept. The subareas of self-concept found in the third tier under academic self-concept are English, mathematics, history, and science. Under the subareas of non-academic self-concept, peers and significant others fall under social self-concept, emotional states are beneath emotional self-concept, and physical ability and physical appearance are below physical self-concept (Shavelson et al., 1976) A pictorial representation of the Shavelson model can be found in figure one.

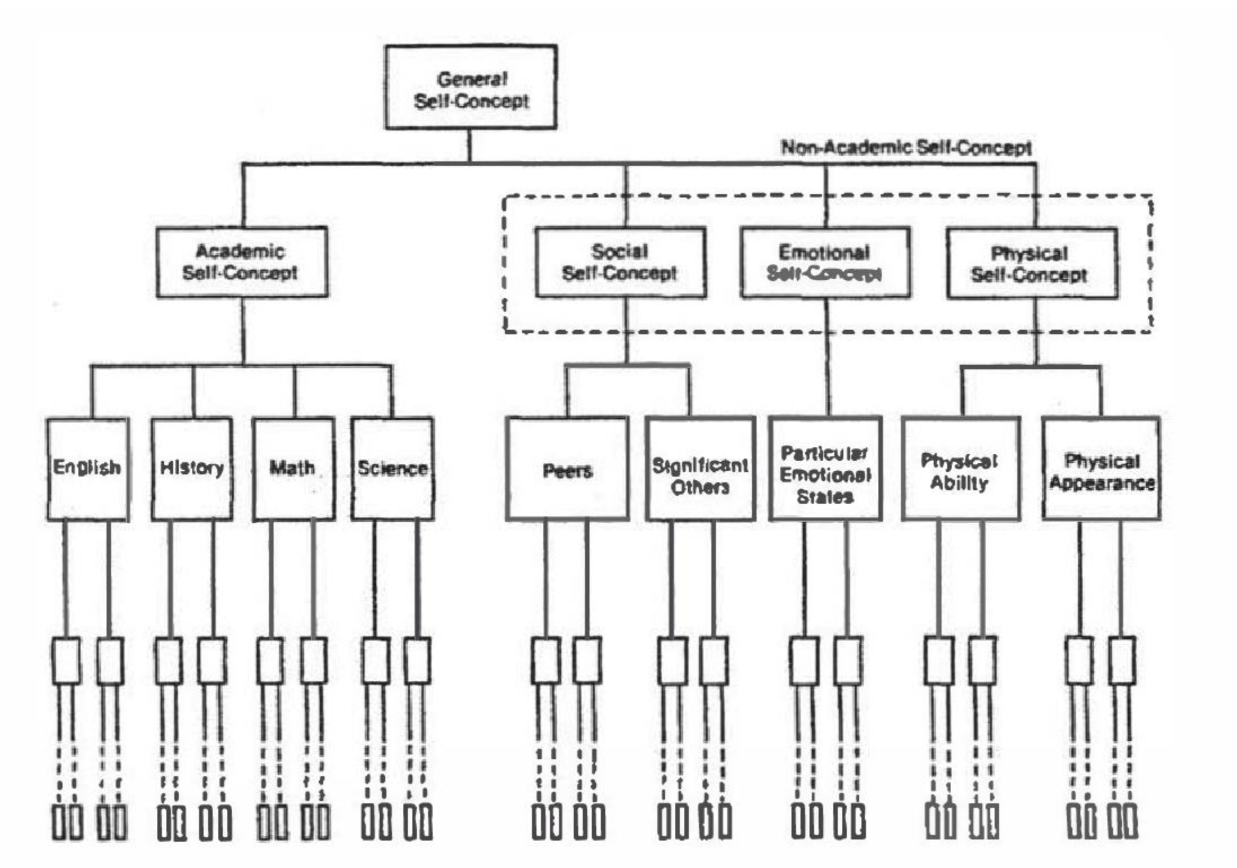

Figure 1. Shavelson Model

Marsh and Shavelson (1985) revised the Shavelson model and added two higher order academic factors including mathematics/academic self-concept and verbal/academic self-concept instead of one factor of academic self-concept (Marsh & Shavelson, 1985). This revision was necessary as the previous model did not adequately fit the data. Evidence showed when there was a second-order model (academic self-concept) with just one higher order factor (general self-concept) analysis was unable to explain relations among the first order factors at any grade level (Marsh & Shavelson, 1985). When two second-order factors such as academic self-concept and non-academic self-concept were analyzed, this was better, but also was not adequate. Finally, when academic mathematics self-concept and academic reading self-concept were added into the model as second-order factors, this model fit the data significantly better at each grade level. The final model called the Marsh/Shavelson model also was consistent with the original Shavelson model which makes the assumption that self-concept is hierarchically ordered. Marsh and Shavelson (1985) discovered that the higher order structure of self-concept was far more complex than they had originally anticipated.

The separation between mathematics and verbal self-concepts was the basis of the Marsh/Shavelson revision, but this also led to the development of the Internal/External (I/E) frame of reference model (Marsh, Byrne, Shavelson, 1988). This supported the multifaceted validity of self-concept and Bryne (1984) found academic achievement to be more highly correlated with academic self-concept than with non-academic self-concept and general self-concepts. Marsh (1990) created the I/E frame of reference model to describe the difference between verbal and mathematics self-concepts and the content specific relations to verbal and math achievements. Frames of reference are critical in the development of academic self-concept (Marsh, 1990) and the Internal/External (IE) frame of reference model found self-perceptions of mathematics and verbal abilities as a basis for the formation of academic self-concepts (Marsh, 1990).

The internal/external frame of reference was proposed by Marsh (1990) to distinguish between English and mathematics self-concepts. The model stipulated that mathematics and English self-concepts are formed in relation to external and internal comparisons or frames of references. For example, the external references referred to students comparing their own perceptions of their mathematics ability with the perceived skills of other students. This served as one basis for the student's mathematics self-concept. The internal comparison related to how students compared their self-perceived mathematics with their self-perceived English skills. According to the I/E model verbal and mathematics achievements are highly correlated. Verbal achievement had a strong, positive direct effect on verbal self-concept however, verbal achievement had a weaker, negative effect on mathematics self-concept. Mathematics achievement had a significant positive effect on mathematics self-concept, however had a weaker, negative effect on verbal self-concept.

Academic Self-Concept

The literature has established academic self-concept as a student's favorable perception of their academic achievement (Marsh & Craven, 2006; Marsh & O'Mara, 2008). Academic self-concept is developed through a social comparison process in which their peers are the frame of reference to judge their own abilities (Marsh, 1987, Marsh & O'Mara, 2008; Skaalvik & Skaalvik, 2002). Academic self-concept in particular school subjects influences subsequent task choice, motivation, sustained effort, and persistence leading to improved academic achievement and academic self-concept (Marsh, 1990; Shavelson et al., 1976). A longitudinal study conducted by Sewasew and Schroeders (2019) followed 21, 396 students from first grade to fifth grade and found a reciprocal relation between multiple academic self-concepts and achievement.

Mathematics achievement and academic self-concepts were strongly correlated over time with a combination of skill development. Guay, Marsh, and Boivin (2003) found similar results from studying 365 French Canadian elementary children. In addition, the study revealed as children grow older their academic self-concept responses became more reliable, more stable, and more strongly correlated with academic achievement. These studies confirmed the reciprocal, long-term, and causal effects between achievement and academic self-concept.

One of the most common methods of measuring academic self-concept included student's self-reporting on items such as "I have always done well in mathematics" and "I am good at mathematics" (Bong & Skaalvik, 2003). Assessing a student's academic self-concept relies strongly on social comparative information and our perceptions of appraisals from significant others. These include "Compared with others my age, I am good at mathematics" or "In mathematics, I am one of the best students in my class." A study by Renick and Harter (1989) found when disabled students compared themselves to other typically developing students, their self-concept suffered. Other research found gifted students and students with higher levels of mathematics perception had difficulty maintaining their academic self-concept when they compared themselves to other gifted students or students with higher levels of mathematics perception (Coleman & Fults, 1982; Marsh, 1990)

Research on academic self-concept has looked at increasing mathematics skills, improving performance, and goal orientations. A study of 2,786 high school students in Australia found focusing only on mathematics skill improvement is necessary to improve mathematics performance, however, students must also have positive perceptions concerning their mathematics abilities (Seaton, Parker, Marsh, Craven, & Yeung, 2014). The findings attested to the significance of self-concept in improving later mathematics performance and a reciprocal positive relation between prior mathematics self-concept and both mastery and performance approach goal orientations were found. The study proved a clear relation between mathematics self-concept and mathematics achievement and the results contributed to the domain-specific effects on achievement (Marsh, 1990; Marsh & Craven, 2006). A positive academic self-concept has shown to have effects on academic achievements, educational aspirations, occupational ambitions, university attendance, course selections, and educational attainment levels (Guay et al., 2004; Marsh 1990).

Hispanic Academic Self-Concept.

Psychological factors in mathematics interest and a student's self-concept of their mathematic ability play a critical role in mathematics achievement (Guay, Larose, & Bolvin, 2004). Hispanic students enter middle school with lower mathematics achievement than their peers (Aud, Hussar, Kena, Bianco, Frohlich, Kemp, & Tahan, 2011) and their transition from elementary to middle school is more challenging than other ethnic groups (Akos & Galassi, 2004). A study looked at 2,200 Latinx students, 2,020 Black students, and 8,680 White students in 10^{th} and 12^{th} grade (Seo, Shen, & Benner, 2019). The researchers found contrary to their hypothesis, Black and Latinx students on average, placed a greater value on academics than White students. Academic value had a consistent positive relation to self-concept and achievement for all three groups. Latinx and White students' self-concepts were not significantly different; however, Latinx students' achievement was significantly lower than their White counterparts. The 10^{th} grade Black and Latinx students demonstrated lower academic achievement, but more positive (among Black adolescents) or similar self-concept (among Latinx adolescents) as compared to their White peers.

Mathematics Self-Concept

A student's mathematical self-concept refers to their perception or belief in their ability to do well in mathematics or their confidence in learning mathematics (Reyes, 1984). Educators have realized the importance of fostering a student's self-concept as a critical component of mathematics education (Mcleod, 1992; NCTM, 2000) especially since a student's mathematics self-concept decreases as a they progress through school (Dossey, 1988; Wilkins & Ma, 2003). A study by Wilkins (2004) examined 290,000 students in 41 countries and of 13 years of age. Internationally, the correlation between student mathematics self-concept and mathematics performance was positive and significant among 39 out of the 41 countries. In addition, students had positive views about their mathematics performance and on average, a student with more positive self-concepts had greater achievement and student's with negative self-concepts had lower achievement.

Scholars have claimed a reciprocal relationship may exist between self-concept and mathematics anxiety (Ahmed, Minnaert, Kuyper, & Van Der Werf, 2012) and mathematics anxiety can foster negative self-concepts regarding mathematics abilities (Ashcraft & Kirk, 2001; Wu, Barth, Marsh, Craven, & Yeung, 2014). Studies have shown correlations ranging from .30 to .70 between mathematics anxiety and mathematics self-concept (Lee, 2009; Justica-Galiano, Martin-Puga, Linares, & Pelegrina, 2017; Pajares & Kranzier, 1995; Pajares & Miller, 1994). A research study conducted on mathematical self-concept examined the role of mathematics anxiety and mathematics performance in 167 third and fifth graders (Justicia-Galiano et al., 2017). The results found a relationship between mathematics anxiety and mathematical self-concept, in addition, the idea of mathematics anxiety undermined self-concept. When there is evidence of a lower mathematical self-concept, this leads to mathematics avoidance or less effort resulting in lower mathematics performance (Justicia-Galiano et al., 2017).

A study conducted by Lee (2009) examined 250,000 15-year-old participants from 41 countries and reported mathematics self-concept, mathematics self-efficacy, and mathematics anxiety as separate constructs. The results reported mathematics self-concept to have a positive relationship to mathematics performance especially in the Western European regions such as Finland, Norway, Denmark, Iceland, and Sweden. The highest correlations between mathematics scores and mathematics anxiety were found mostly in the Western and Eastern European countries such as Denmark, Norway, Poland, and Finland and Asian countries, such as Hong Kong, Japan, Korea, Macau-China, Thailand, and Indonesia. The Netherlands, Belgium, and France were among the countries showing the lowest correlations with mathematics anxiety. The United States ranked in the middle compared to other countries regarding mathematics anxiety and ranked as one of the highest concerning mathematics self-concept. The author explained that Western European including the United States have social benefits and value systems not strictly built upon school achievement unlike some Asian countries such as Japan. Therefore, these countries are less critical regarding their academic performance. This information should be considered when examining the mathematics self-concept in relation to mathematics anxiety, and mathematics performance internationally (Lee, 2009).

A similar study by Jameson and Fusco (2014) examined 226 undergraduates of non-traditional and traditional students. The same three constructs studied by Lee (2009) were also studied and included mathematics anxiety, mathematics self-concept, and mathematics self-efficacy. Research findings found that mathematics self-concept and mathematics anxiety was not different between non-traditional and traditional students. However, non-traditional students showed higher self-perceptions regarding real-world mathematics and lower mathematics self-concept towards academic mathematics. Lee (2009) showed different findings as Jameson and

Fusco (2014) did not find a correlation between mathematics anxiety and mathematics self-concept. Jameson and Fusco (2014) stated the lack of correlation may be partially explained by the forced classification of participants into groups of non-traditional and traditional students.

Hispanic Students and Mathematics Self-Concept.

Research conducted on Hispanic students reported lower mathematics self-concept than European American students (Bouchey & Harter, 2005). Denner, Valdes, Dickson, and Laursen (2019) studied 263 Latino students in California with a low-income background. The study examined the relationship between mathematics interest and mathematics self-concept during the transition from primary school to middle school. The results revealed that mathematics self-concept can help minimize a decrease in mathematics interest during the transition to middle school. Mathematics self-concept and mathematics interest influence each other over time and low levels in mathematics interest places a student at risk for a decline in mathematics self-concept. If students show declining mathematics interest or mathematics self-concept then mathematics achievement may decrease (Denner, 2019; Guay, Larose, & Boivin, 2004).

Literature

Mathematics Anxiety

Mathematics anxiety can be defined as feelings of tension and nervousness (Richardson & Suinn, 1972) feelings of trepidation and increased physiological susceptibility (Carey, Hill, Devine, & Szucs, 2017; Hopko, Mahadevan, Bare & Hunt, 2003; Paechter, Macher, Martskvishvili, Wimmer, & Papousek, 2017) when individuals manipulate numbers and solve mathematical problems in academic situations (Carey et al., 2017; Hopko et al., 2003; Paechter et al., 2017; Richardson & Suinn, 1972). In some cases, students fear completing any mathematical task or making mistakes, (Chipman, Krantz, & Silver, 1992; Dutton, 1951) students feel stress and worry about completing simple mathematics problems, and they struggle with low mathematics performance (Bekdemir, 2010; Hembree, 1990; Wigfield & Meece, 1988). These factors influence a students' anxiety, affect their performance and their mathematics achievement (Bekdemir, 2010; Ma, 1999). Survey results showed the majority of individuals in the United States dislike and fear mathematics (Burns, 1998; Zaslavsky, 1994) regardless of socio-economic status and results showed having negative experiences as early as elementary school (Jackson & Leffingwell, 1999).

Studies have found students' mathematics anxiety to negatively impact one's ability to master mathematics content, lower one's mathematics learning, and motivation to learn mathematics (Ashcraft & Krause, 2007; Hembree, 1990; Ma & Xu, 2004; Meece, Wigfield, & Eccles, 1990) even among elementary students (Harari, Vukovic, & Bailey, 2013; Ramirez, Gunderson, Levine, & Beilock, 2012). A study by Wigfield and Meece (1988) found that mathematics anxiety was similar in younger and older students (grades 5-12) and that anxiety is more than a lack of confidence. Mathematics anxiety also produces negative reactions such as nervousness, fear, discomfort, and worry. These negative emotions were found to interfere with the learning process and impair test or task performance. Researchers have discovered students' that have lower mathematics achievement have higher anxiety and in contrast, those who have higher mathematics achievement have lower anxiety (Hembree, 1990; Ma & Xu, 2004; Wigfield & Meece, 1988). When students have a negative relationship to mathematics performance, this affects the amount of effort that students put into mathematics (Paechter et al., 2017; Wigfield & Meece, 1998) and studies have found stronger negative behaviors of avoidance in males enrolled in grades 6-12 (Hembree, 1990). Furthermore, mathematics-anxious students have a tendency to avoid mathematics-related situations such as taking mathematics classes (Akinsola, Tella, & Tella, 2007; Ashcraft & Krause, 2007) and exhibit procrastination type behavior (Akinsola, Tella, & Tella, 2007; Okoije, Okezie, & Nlemadim, 2017).

Mathematics Cognitive Effects.

Mathematics-anxious individuals experience increased levels of anxiety in mathematics-related situations and this anxiety reveals itself on a cognitive level (Luttenberger, Wimmer, & Paechter, 2018). Ashcraft and Krause (2007) state that there is considerable evidence in the past ten to fifteen years concerning the critical role that working memory plays in mathematical cognition. The working memory process is critical to arithmetic and mathematics performance especially involving computations that are more complex like multistep mathematics problems (Ashcraft & Krause, 2007; Luttenberger et al., 2018). As the number of mathematical steps increase, students rely on their working memory to solve mathematics problems (Ashcraft & Krause, 2007). Since, mathematics anxiety affects working memory (Ashcraft & Krause, 2007; Luttenberger et al., 2018; Young et al., 2012), this affects mathematics performance and negative emotions associated with fear and avoidance. Working memory impairments involve specific aspects of mathematical proficiency, especially accuracy related to mathematical errors and procedural fluency regarding minimal effort and time to complete mathematical problems (Luttenberger et al., 2018). Mathematics anxiety influences a students' cognitive processing and when working memory resources are compromised, a student experiences anxiety, thus resulting in poor performance and mathematics achievement.

In relation to mathematics anxiety and cognitive processes, the amygdala, a center region of the brain, is associated with processing negative emotions and fearful stimuli (Artemenko, Daroczy, & Nuerk, 2015; Phelps & LeDoux, 2005). In children, seven to nine years of age, mathematics anxiety is associated with hyperactivity and abnormal affective connectivity of the amygdala and children with high mathematics anxiety show above and beyond neural activity within the amygdala region (Artemenko et al., 2015; Young, Wu, & Menon, 2012). The amygdala encompasses complex cognitive-emotional behaviors and interacts with other parts of the brain (Pessoa, 2008). Therefore, mathematics anxiety can be traced to these regions that relate to specific phobias and generalized disorders in adults (Young et al., 2012). In the study by Young and associates (2012), the children (seven to nine years of age) reported their own anxiety in situations comprised of mathematical problem solving and the effects were traced back to amygdala response and connectivity. Mathematics anxiety impairs genuine mathematical cognitive processes (Luttenberger et al., 2018) and other cognitive processes that depend on fluency that assist with text related to mathematics (Hopko, Ashcraft, Gute, Ruggiero, & Lewis, 1998).

Neurocognitive research has shown how mathematics anxiety compromises the functioning of working memory in elementary students (Ramirez, Gunderson, Levine, & Beilock, 2013) and college adults (Seyler, Kirk, & Ashcraft, 2003). The study by Ramirez and colleagues found mathematics anxiety to have a negative impact on children's mathematics achievement as early as first and second grade. The children who used more working memory to solve mathematical problems were more susceptible to the deficit effects of mathematics anxiety than those children who used less working memory. These findings align with adult literature on the impact of mathematics anxiety especially concerning computationally demanding problems. One study found that the impact of cognitive functions with adolescents and adults do not differ regarding the influence of anxiety on working memory performance (Patel, Vytal, Pavletic, Stoodley, Pine, Grillon, & Ernst, 2016). Therefore, from a neurological perspective, mathematics anxiety compromises the functioning of working memory in all ages.

Mathematics Emotional Effects.

On an emotional level, mathematics anxiety produces apprehension, nervousness, worry (Papousek, Ruggeri, & Macher, Paechter, Heene, Weiss, & Freudenthaler, 2012; Wigfield & Meece, 1988), and fear (Dutton, 1951; Wigfield & Meece, 1988). Research conducted by Wigfield and Meece (1988) examined 1,315 white, middle class students in grades five through twelve and found negative emotional reactions to mathematics. These emotional reactions included nervousness, fear, discomfort, and worry. Findings for the negative affective reactions (nervousness, fear, and discomfort) correlated more strongly and negative to mathematics ability perceptions, mathematics performance perceptions, expectations regarding mathematics, and mathematics performance. The worry scale also used in the study, related more strongly to the importance students place on mathematics and to the actual effort students put into mathematics. Students also reported worrying about doing poorly in front of the teacher. Furthermore, a study by Dutton (1951) showed deeply rooted, highly emotional attitudes from childhood affected unfavorable responses to mathematics. His study of 211 undergraduate students showed that even a lapse of mathematics for several years did not erase the negative feelings associated with mathematics.

Mathematics Physiological Effects.

From a physiological standpoint, the symptoms of mathematics anxiety include increased heart rate, clammy hands, upset stomach, and lightheadedness (Blazer, 2011). Mathematics anxiety also increases heart rate (Ushiyama, Ogwawa, Ishii, Ajisaka, Sugishita, & Ito, 1991) and blood pressure (Reims, Sevre, Fossum, Hoieggen, Eide, & Kjeldsen 2004; Ushiyama et al.,

1991) Research examined 26 Japanese adults to determine how mathematics anxiety affected their heart rate, systolic, and diastolic blood pressure (Ushiyama, Ogwawa, Ishii, Ajisaka, Sugishita, & Ito, 1991). After experiencing 20 minutes of mathematics anxiety, the mean heart rate increased by 19.7% and their systolic and diastolic blood pressure rose by 10.3%. A study by Reim and colleagues (2004) found similar results when comparing 20 Oslo men with high blood pressure and 21 men with normal blood pressure in relation to mathematics anxiety. In addition, participants myocardinal oxygen consumption also increased to 71% (Ushiyama, 1991). Myocardinal oxygen is the amount of oxygen required for the heart to maintain optimal function (NCBI, 2019). Blazer (2011) reported a need for research to study the physiological effects in children concerning mathematics anxiety and stated the complexity of undertaking such a study.

Mathematics Anxiety and Test Anxiety

Studies have shown a relationship between mathematics anxiety and mathematics text anxiety (Devine, Fawcett, Szucs, & Dowker, 2012; Dodeen, Adelfattah, & Alshumrani, 2014; Hembree, 1990; Richardson & Woolfolk, 1980; Zettle & Raines, 2000). Richardson and Woolfolk (1980) argued that mathematics anxiety is a person's reaction to numbers (mathematical computation) and evaluative situations such as testing. Furthermore, they maintained mathematics anxiety could be associated with feelings of perfectionism and inferiority. Studies showed moderate correlations between mathematics anxiety and test anxiety between .30 and .50 (Dew and Galassi, 1983; Dew, Galassi, & Galassi, 1984). However, mathematics anxiety correlated more highly within anxiety than with test anxiety with scores between .50 and .80. This suggested that mathematics anxiety was a distinct construct and not just a form of test anxiety. Hembree (1990) also found mathematics anxiety to be closely related to mathematics test anxiety and maintained mathematics anxiety should be measured as a separate construct. The idea of mathematics anxiety as a separate construct was disputed until further research was conducted and showed mathematics anxiety and mathematics test anxiety as related, but separate constructs (Ashcraft and Ridley, 2005; Dew and Galassi, 1983; Hembree, 1990)

More recent research examined 433 elementary children and found a positive correlation between mathematics anxiety and test anxiety (Devine et al., 2012). Study findings showed levels of mathematics test anxiety and mathematics anxiety higher in girls than boys. Research suggested girls may experience specific anxiety towards mathematics and boys are experiencing general test anxiety. When the researchers controlled for test anxiety there was a negative correlation between mathematics performance and test anxiety. Another similar study examined 626 secondary students and found mathematics anxiety had a significant negative relationship with test taking skills (Dodeen et al., 2014). Findings showed that test taking skills accounted for 30% of mathematics anxiety (MA), motivation to learn mathematics was 25% of MA, and attitudes towards mathematics was 17% in relation to mathematics anxiety. Moreover, 40% of mathematics anxiety contributed to attitudes towards tests. The study concluded improvement of testing skills significantly correlated with variables that play a role in a student’s level of achievement in mathematics and may affect mathematics anxiety.

Mathematics Anxiety Instruments

Scholars have made considerable efforts to develop instruments to measure mathematics anxiety in children and adults (Aarnos & Perkkilä, 2012; Alexander & Martray, 1989; Chiu & Henry, 1990; Gierl & Bisanz, 1995; Hopko, Mahadevan, Bare, & Hunt, 2003; Ramirez, Gunderson, Levine, & Beilock, 2012; Richardson & Suinn, 1972; Suinn & Edwards, 1982;

Suinn, Taylor & Edwards, 1988; Suinn & Winston, 2003; Thomas & Dowker, 2000; Wu, Barth, Amin, Malcarne, & Menon, 2012; Vukovic, Kieffer, Bailey, & Harari, 2013 The MARS created by Richardson and Suinn (1972) was a 98-item scale and it was intended to measure mathematics anxiety in adults. The study examined 376 students attending a large university in Missouri and found the MARS to be a valuable assessment instrument for psychotherapy research in general or mathematics anxiety. Over the years, it was found that the MARS, although reliable, was time consuming for participants to take and the MARS-Short Version or MARS-30 was created (Suinn and Winston, 2003). The MARS-30 is a 30-item scale and the instrument was developed utilizing 63 women and 61 men who were introductory psychology students attending a state university. A Cronbach alpha of .96 was found and the test-retest reliability was .90 compared to the MARS of .91. Correlations and comparisons were calculated between the MARS-SV and the MARS (Suinn & Winston, 2003). The analyses created the foundation to assess if the MARS-SV was equivalent to the MARS and results found that it was the same. Other results in the study, predicted high scores on mathematics anxiety to be negatively correlated with grade point average (GPA) in mathematics courses. This provided further validation of mathematics anxiety effecting mathematics performance.

A study conducted by Pletzer and associates (2016) determined if the MARS-SV could provide additional factors (constructs) other than mathematics test anxiety and numerical anxiety (Pletzer, Wood, Scherndi, Kerschbaum, & Nuerk, 2016). After extensive research, the Confirmatory Six Factor model was found. This model used the MARS-SV in a study to describe the dimensionality of mathematics anxiety. After extensive study of various factors (constructs), the researchers found that a six- factor model was proven as the best fit concerning the MARS-SV scale results. The Confirmatory Six Factor model included “Evaluation Anxiety 1” (EA1) corresponding to anxiety experienced from taking mathematics tests, “Evaluation Anxiety 2” (EA2) resembling the anxiety felt when thinking about mathematics tests, “Learning Mathematics Anxiety” (LMA), “Everyday Numerical Anxiety” (ENA), “Performance Anxiety” (PA), and “Social Responsibility Anxiety” (SRA). The MARS-SV revealed the amount of mathematics anxiety that parents experienced within these six-factors according to specific items that parents answered on the scale. The analysis encompassed the specific MARS-SV questions within each factor, showed the mean, and the standard deviation.

In 1988, a study was conducted to create an instrument to measure the mathematics anxiety of elementary students. The instrument was the Mathematics Anxiety Rating Scale (MARS-E) for elementary students in fourth, fifth, and sixth grade (Suinn, Taylor, & Edwards, 1988). The original Mathematics Anxiety Rating Scale (MARS) was created by Richardson and Suinn in 1972, however, it was difficult to find measures suitable for elementary school students, therefore, the MARS-E (Suinn, Taylor, & Edward, 1988) was created upon the validity and reliability of the MARS. The MARS-E is comprised of 26-items in which a student self-reports their levels of mathematics anxiety. Each item is comprised of a mathematics-related situation, students will be asked to indicate the degree of anxiety or nervousness that they would feel in each situation, using a five-point Likert scale from 1 (not at all nervous) to 5 (very, very nervous). The total score will be calculated by taking the sum of the ratings for all 26-items, the lowest possible total score of 26 signifies low anxiety and the highest score of 130 indicates extreme anxiety (Suinn et al., 1988). The MARS-E reliability was estimated using the Cronbach’s alpha and was found to be .88.

Suinn, Taylor, and Edwards (1988) studied 1,086 fourth, fifth, and sixth graders to develop the Mathematics Anxiety Rating Scale for elementary students. The authors stated the instrument is appropriate for upper elementary school children with mathematics and reading comprehension difficulty. Content for the instrument was derived from mathematics teaching workbooks used by the school district in fourth, fifth, and sixth grade. A number of situations were analyzed from the workbooks. For example, a few items included “George brought 4 boxes of toy cars to class. If each box had 7 cars, how many toy cars did George bring?” or deciding if this problem is right “(3+4) + 2 = 4 + (2+3). The MARS-E was administered by the students’ teachers and the scale took 20 minutes to complete. The study examined the relationship between mathematics anxiety and mathematics achievement. More specifically the mathematics achievement assessment used was the Stanford Achievement (SAT). Mathematics anxiety was measured using the MARS-E and the MARS- E scores significantly correlated with scores on the SAT and total score. Results for all students showed correlations significant at the .001 level between the MARS-E and SAT. The Sanford Achievement Test (SAT) mathematic concepts were (r=-.29), mathematic applications (r=-2.6), mathematic computation (r=-26), and a total score of (r=-.31).

Other studies have used the MARS-E to study mathematics anxiety. Suinn, Taylor, and Edwards (1989) studied 105 Hispanic students. Results for Hispanic students were all significant with high anxiety being inversely correlated with low SAT scores (r=-.22). The data from this contributed to the literature on mathematics anxiety and supported the MARS-E as a value instrument to measure mathematics anxiety in Hispanic students. In addition, Satake and Amato (1995) conducted a study of 154 fifth and sixth grade Japanese students to measure the correlation of mathematics anxiety with classroom achievement grades, gender, and class. The results found significant differences among low performing students, middle performing, and high performing students. The study found that high performing mathematics students experienced more mathematics anxiety than low performing mathematics students. Ramirez and colleagues (2013) found students with higher working memory had higher levels of mathematics anxiety and argued this was a considerable threat for high performers in mathematics. In conclusion, high levels of mathematics anxiety effect mathematics achievement.

A study conducted by Baloglu and Balmlmis (2010) studied 336 Turkish elementary students after extensive research was implemented to translate the MARS-E in their language. The results found the MARS-E to be a useful indicator of measuring mathematics anxiety in Turkish students. This study analyzed the structural validity of the MARS-E and utilized a confirmatory factor analysis. The researchers found that the two-factor constructs did not fit their data and expanded to a five-factor construct. In this model, seven items on the MARS-E (1, 2, 3, 4, 10, 19, and 20) related to mathematical computation anxiety; six items (5, 6, 21, 22, 23, and 24) for application anxiety; three items (7, 11, and 14) linked to mathematics course anxiety, four items (8, 9, 12, 25, and 26) associated with mathematics teacher anxiety; and five items (13, 15, 16, 17, and 18) correlated with mathematics test anxiety.

Only one mixed method study was found to use the MARS-E measuring 600 fourth, fifth, and sixth graders enrolled in regular mathematics classes and interviewed 24 students (Hummer, 1988, unpublished dissertation). Students were selected for interviews based on their MARS-E results and only high-anxious students were interviewed. Most students were Caucasian and from a suburban town in Philadelphia. Hummer's study revealed MARS-E scale results for fourth graders (M=49.15 and SD=18.55) and fifth graders (M=51.64 and SD 14.32). MARS-E questions disclosed most anxiety occurred when getting a test back that students did not feel they did well, thinking about taking a test, and doing mathematics in front of people. Students were asked about their self-perceptions of mathematics and how good their mathematical skills were using a short survey with a Likert scale. Results found 60% of students said they liked mathematics, 65% of fourth graders, and 61% of fifth graders indicated they were good at mathematics.

Hummer's interviews found students felt division specifically long division was a very hard topic to learn and this made them feel anxious. Students discussed using mathematics outside of the classroom and three-fourths of students claimed they used mathematics for transactions involving money, cooking, and helped their father with measurements. Data also disclosed that one or more parent helped during mathematics homework and parents with high mathematics expectations made their children nervous. Students also explained when they are in mathematics class, it made them feel very anxious when the teacher called on them to answer a question or go to the board to work a mathematical problem because they were embarrassed to get the answers wrong in front of their peers. This mixed method study provided evidence to further substantiate the validity of the MARS-E as an instrument to measure elementary student's mathematics anxiety and the interviews provided an in-depth examination of that anxiety.

The MARS-E has been used in other studies to measure mathematics anxiety (Baloglu & Balglmis, 2010; Satake & Amato, 1995; Suinn & Taylor, 1989) and other instruments measuring mathematics anxiety were based on the MARS (Chiu & Henry, 1990; Gierl & Biszanz, 1995; Wu, Barth, Amin, Malcarne, & Menon, 2012). The 12-item Mathematics Anxiety Scale was also based on the MARS-E (Vukovic, Kieffer, Bailey, & Harari, 2013). As indicated by table one (Eden, Heine, & Jacobs, 2013), there are only two instruments created to measure the mathematics anxiety of fourth and fifth graders, the MARS-E and the Mathematics Anxiety Survey (MAXS). Furthermore, the creators of the MAXS utilized the MARS to create their instrument and the Cronbach's alpha of the MAXS was calculated at .70. After analyzing all the instruments, the decision to use the MARS-E was based on the Cronbach's alpha of .88, the ability to measure fourth and fifth grade elementary students which are participants for this study, the reading level was appropriate for this study, and the MARS-E has been tested on Hispanic students (Suinn & Taylor, 1989) which include the participants of this study.

Table 1

An overview of mathematics anxiety assessment instruments and their applicability for different age groups.

Instrument	Age Group
Mathematics anxiety rating scale (*MARS*; Richardson & Suinn, 1972)	High School and College
Mathematics anxiety scale (*MAS*; Fennema & Sherman, 1976)	Middle School, High School, and College
MARS-Adolescents (*MARS-A*; Suinn & Edwards, 1982)	Middle School and High School
MARS-Revised (*MARS-R*; Plake & Parker, 1982)	High School and College
MARS-Elementary (*MARS-E*; Suinn, Taylor & Edwards, 1988)	Fourth, Fifth and Sixth Grade Hispanic Students
MARS-Short Version (*MARS-SV; Suinn and Winston, 2003)*	High School and College
Shortened-MARS (*s-Mars*; Alexander & Martray, 1989)	High School and College
Mathematics anxiety scale for children (*MASC*; Chiu & Henry, 1990- based on MARS)	Fifth and Sixth Grade and Middle School
Mathematics anxiety survey (*MAXS*; Gierl & Bisanz, 1995-based on MARS)	Third, Fourth, Fifth and Sixth Grade

Math anxiety questionnaire (*MAQ*; Thomas & Dowker, 2000) (as cited in Krinzinger, Kaufmann & Willmes, 2009)	First and Second Grade
Abbreviated math anxiety scale (*AMAS*, Hopko, Mahadevan, Bare, & Hunt, 2003)	High School and College
Scale for early mathematics anxiety (*SEMA*, Wu, Barth, Amin, Malcarne, & Menon, 2012) (Based on MARS)	Second and Third Grade
Pictorial test for early signs of math anxiety (Aarnos & Perkkilä, 2012)	First, Second and Third Grade
Child math anxiety questionnaire (*CMAQ*, Ramirez, Gunderson, Levine, & Beilock, 2012) (Based on MARS-E)	First, Second, and Third Grade
12-item mathematics anxiety scale (Vukovic, Kieffer, Bailey, & Harari, 2013)	Second and Third Grade

According to the literature on mathematics anxiety instruments, there is little evidence to dispute the reliability and validity of the MARS-E to measure mathematics anxiety. The primary criticism came from Gierl and Bisanz (1995) which identified that the authors of the MARS-E did not analyze their data separately by grade or age group. Therefore, no further insights can be obtained about the developmental pathways of these two aspects. In an article written by Ashcraft and Moore (2009), they stated the MARS-E was dated. However, they did not offer any suggestions for an alternative assessment to use for measuring mathematics anxiety in elementary students.

Impact of Parents Mathematics Anxiety

Parent’s mathematics anxiety is associated with lower student mathematics achievement (Maloney, Ramirez, Gunderson, Levine, & Beilock, 2015; Berkowitz, Schaeffer, Maloney, Peterson, Gregor, Levine, & Beilock, 2015) and the students of higher anxious parents learned less mathematics during first grade than children of lower mathematics-anxious parents (Berkowitz et al., 2015). When parents do not like mathematics or feel inadequate in mathematics and frequently assist their children with their homework, their children learn less mathematics (Maloney et al., 2015). Maloney and colleagues (2015) found that higher mathematics-anxious parents and parents' perceptions of mathematics affects their child's mathematics achievement. They further discovered parents who are competent in the type of basic mathematics skills that first and second graders encounter, may still exhibit feelings of anxiety when helping children with their homework. Individuals with high mathematics anxiety often express a variety of poor attitudes about mathematics and they tend to believe that mathematics is not useful, have low mathematics self-efficacy, and low motivation to succeed in mathematics (Hembree, 1990). Maloney and colleagues (2015) also suggest when parents express these beliefs, this could be demotivating to children and likely diminish the amount of effort they devote to mathematics and thus, reduce the amount of mathematics they learn and remember.

A long-term study followed students from first through third grade where a mathematics application was utilized during the intervention (Schaffer, Rozek, Berkowitz, Levine, & Beilock, 2018). For the control group of parents who did not use the mathematics application, there was a negative relation between parents' mathematics anxiety and children's mathematics achievement. As a result, children of the higher-anxious parents experienced a five-month mathematics loss than children of less anxious parents according to their standardized test scores. However, the mathematics learning gains of children of higher and lower anxious parents did not show a difference in the intervention group. Parents' attitudes towards mathematics, parents' interactions with their child using the mathematics app, and the interactions between parent and child using the app together had a positive impact on a child's learning. For example, eliminating negative associations regarding parents' mathematics anxiety provided a beneficial outcome when using the mathematics app on students' mathematics achievement and high-quality parent-child interactions produced positive effects on learning (Schaffer et al., 2018). This study demonstrated that parents' mathematics anxiety negatively relates to children's mathematics learning, especially when they frequently interact with their children around mathematics. This negative relation can be improved when parents are provided with supports to facilitate mathematics interactions with their children (Maloney et al., 2015; Schaffer at al., 2018) such as using the mathematical app to facilitate mathematics discussions.

A study by Soni and Kumari (2017) investigated the role of parental mathematics anxiety and mathematics attitude on their child's mathematics achievement. Participants included 595 students and parents from India. The students were aged between 10 to 15 years of age. The instruments used included the MARS-E, MARS-SV, and the MARS-A for adolescents. The results concluded parent's mathematics anxiety to positively influence their child's mathematics anxiety and negatively affected their mathematics attitude. These results coincided with Gunderson and associates (2012) conducted a meta-analysis on research conducted in the United States concerning mathematics anxiety, developmental perspectives, and casual relations between parents' and teachers' beliefs and children's mathematics attitudes. At the time, the authors mentioned the lack of research regarding a parent's personal feelings about mathematics and the type of messages sent by parent's regarding mathematics and how this may influence their child's perceptions of mathematics. The study conducted by Maloney and associates (2015) made a contribution to this area. Parent's interactions with their child are influenced by their own preconceived ideologies concerning mathematics and these ideologies can influence their child's mathematics anxiety, mathematics attitudes, and mathematics achievement (Gunderson, Rameriz, Levine, & Beilock, 2012). The authors mentioned parents' ideologies based on mathematics-gender stereotypes, gender-biased mathematics expectancies, mathematics anxieties, mathematics self-concepts, mathematics self-efficacy, and beliefs effect their interactions with their child concerning mathematics. They believe that these ideologies need further exploration. Therefore, it is important to understand the interactions that may occur between parent and child especially centered on mathematical discussions that can cause mathematics anxiety, reduce mathematics self-concept, and affect mathematics performance.

Parent Involvement and Mathematics Achievement

Throughout a child's educational development, parents' have provided various degrees of support to include homework assistance, attending teacher conferences, volunteering at their child's school, and participating in various activities. Helping children with homework is the most typical form of parent involvement (Pezdek, Berry, & Renno, 2002). However, research on the effectiveness of parent involvement regarding homework assistance has shown mixed results on a child's academic performance (Cooper, Lindsay, & Nye, 2000; Hoover-Dempsey, Battiato, Walker, Reed, De Jong, & Jones, 2001; Patall, Cooper, & Robinson, 2008; Pomerantz, Moorman, & Litwack, 2007). Not all types of parent involvement are beneficial for children's academic outcomes and what is more important is the way parents help (Moroni, Dumont, Trautwein, Niggli, & Baeriswyl, 2015). Studies have shown when parents exert total control in mathematical homework situations such as doing it their way, this diminishes a child's sense of competence, mathematics self-concept, task persistence (Silinkskas & Kikas, 2019) and lowered mathematics performance (Dumont, Trautwein, Lüdtke, Neumann, Niggli, & Schnyder, 2012; Hill & Tyson, 2009; Nunez, 2015; Silinskas & Kikas, 2019). These may have negative effects as children perceived their parent’s help as interference, intrusiveness, and feel negativity during parental controlling homework assistance (Pomerantz & Eaton, 2001)

Research conducted by Silinskas and Kikas (2019) concluded parental control in 6th grade Estonia students negatively predicts children’s mathematics performance, mathematics self-concept, and task persistence. Estonia students share certain characteristics with Hispanic students in that they often come from very diverse backgrounds and they are considered minorities (Countries & Their Cultures, 2019). Despite these similarities, Estonian students ranked seventh in the world for academic achievement (OECD, 2019). Although, there is a disparity of academic achievement between Estonian and Hispanic students, there is limited research on mathematics self-concept. This study offered findings relevant to this study. Students completed a parent involvement survey measuring constructs of parent control, parent support, mathematics performance, and mathematics self-concept. The study defined parental support as the value of parental assistance with homework as perceived by the child, the sensitivity to the child’s need for support while doing homework and being available to solve problems when the child specifically asked for help (Dumont, Trautwein, Ludtke, Neumann, Niggli, & Schnyder, 2012; Nunez, Suarez, Rosario, Vallejo, Valle, & Epstein, 2015; Pomerantz, Moorman, & Litwack, 2007). Parent control during homework can be defined as the control and pressure on children to complete their homework, checking if the child has completed their homework, assisting the child with their homework without being asked, and punishing children if the homework is not completed (Silinskas and Kikas, 2019).

Silinskas and Kikas (2019) findings indicated the more children perceived their parents to be controlling in homework situations, the lower the children scored on mathematics performance, mathematics self-concept, and task persistence. The authors stated what mattered was the ways parents helped their children with homework, not how often parents helped (Moroni, Dumont, Trautwein, Niggi &, Baeriswyl, 2015; Silinskas & Kikas, 2019) and children preferred when they asked parents to help them solve problems with their homework instead of parents intervening in the homework process (Dumont, 2012; Nunez et al., 2015; Pomerantz et al., 2007; Silinkskas & Kikas, 2019. Parent control during homework undermined the child's feelings of autonomy, competence, and persists to learn (Moorman & Pomerantz, 2008; Pomerantz et al., 2007). Unfortunately, evidence suggests this may lead to inhibiting their self-concept regarding their abilities (Dumont et al., 2012), relates to children's academic performance (Dumont et al., 2012; Karbach, Gottschling, Spengler, Hegewald & Spinath, 2013; Levpuscek & Zupancic, 2009; Nunez et al., 2015), and persistence is necessary for math achievement (Chouinard, Karsenti, & Roy, 2007; Reynolds & Walberg, 1991, 1992).

Silinskas & Kikas (2019) also found parent support to show a positive relationship to task persistence and academic performance. However, there was a difference between genders found, task persistence during homework and mathematics self-concept diminishes if boys perceive their parents to be controlling. The study further revealed that girls who did not feel confident in their mathematics abilities and boys who did not show persistence during homework still rated their parents as controlling three years later. This coincides with other studies that also found parent support instead of parent control to be positively related to academic performance (Cooper et al., 2000; Dumont et al, 2012; Nunez et al., 2015; Pomerantz et al., 2007) and a reduction in self-concept if parents are too controlling during homework (Dumont et al., 2012) Silinskas and Kikas (2019) mentioned the negative effects of parent involvement may be related to children's perceptions of interference, intrusiveness, and any negativity during homework assistance. Therefore, it is imperative parents are consciously aware of how their interactions effect their child's mathematical development especially concerning homework assistance.

Other studies concerning parent involvement and mathematics achievement have found parent's behavior to contribute to explaining their child's mastery goal orientation, self-efficacy, final grade in mathematics, (Levpuscek & Zupancic, 2009) and parental beliefs foster their child's mathematics performance (Kung & Lee, 2016). The research conducted by Levpuscek and Zupancic (2009) found stronger academic pressures by parents undermined their child's development of mastery goal orientation, mathematics self-efficacy, and mathematics success in 365 Sloven eighth graders. Stronger academic pressures for this study related to unrealistic expectations, always reminding students of their school duties, and distrusting their schoolwork. In addition, strong academic pressure was found to have a negative effect on student's self-efficacy in mathematics. However, the study did find that parental academic support related to the student's mastery goal orientation and parents' involvement in school activities did show a positive relationship. The authors stated to better understand parent involvement, there is a need to conduct research examining the relation of different kinds of parental involvement in schoolwork to students' academic outcomes and especially with different cultures and educational contexts.

Funds of knowledge

Research found that parents bring various forms of knowledge into their home known as funds of knowledge which are socially, historically, and culturally developed components of knowledge and skills necessary for operating in the household and as an individual (Moll, Amanti, Neff, & Gonzalez, 1992; Vélez-Ibañez & Greenberg, 1992). Families have unique types of knowledge that can and do promote learning for their children (Moll et al., 1992). For example, one study found a group of mothers to have basic skills and prior knowledge associated with authentic learning tasks similar to classroom instruction. Researchers discovered that by learning the funds of knowledge from various families, this information could inform instruction in the classroom and change practices (Gonzalez, Moll, & Amanti, 2009). In fact, everyday mathematical concepts learned at home provide the building blocks to develop mathematical concepts learned at school (González, Andrade, Civil, & Moll, 2001). This connection provides significant meaning and allows a conscious transformation from knowledge learned at home.

Researchers examined mathematics knowledge in homes and how to link it to the classroom. Households in their study utilized mathematics in cooking, construction, sewing, and time management (González, Andrade, Civil, & Moll, 2001; Williams, Tunks, Gonzalez-Carriedo, Faulkenberry, & Middlemiss, 2020).Williams et al., (2020) found parents supported mathematics learning and that they intentionally promoted mathematics in their household (Williams et al., 2020). The type of mathematics used in the households included problem solving, reasoning and proof, communication about mathematics, connections, and representations of mathematics. Data revealed many instances of financial literacy occurring in the households, communication when doing mathematics homework, and helping students make real-world connections to concepts learned in the classroom (Williams et al., 2020). Parents held discussions regarding mathematics by using questions to help their children learn mathematical concepts and parents tended to wait for children to ask for help during mathematics homework and only provided assistance when needed. Families encouraged their children in a positive way to learn mathematics and did whatever was needed to help their children be successful in mathematics.

Other funds of knowledge research examined what can be learned from parents and the importance of parent involvement to build curriculum to teach students mathematics (Civil, 2007). It is important to understand and learn the knowledge and background of families. Families contribute valuable knowledge, and they are seen as experts which as studied by Civil, contribute to a student's mathematical learning (Civil, 2007). The idea is to view and involve parents as contributors to the curriculum. For example, Civil's garden module and project, reflected the characteristics of out-of-school learning and students learned mathematics in an everyday practice. This practice allowed students to make connections between what was learned out of school to mathematical concepts learned in school and parents played an active role. For example, parents could answer questions posed by students regarding the garden and thus were the experts. Research found that the teacher learned from the parents, students experienced authentic learning, and parent's mathematical funds of knowledge contributed to the curriculum.

Mathematics Talk

There are limited studies on "math talk" or mathematics discussions that occur between parents and students at the elementary level. However, studies have examined the type of "math talk" between parents and preschoolers at home (Ramani, Rowe, Eason & Leech, 2015; Susperreguy & Davis-Kean, 2016; Susperreguy, 2013). According to Susperreguy and Davis-Kean (2013), "math talk" included interactions about numbers, geometrical shapes, quantities, and other mathematical aspects. Ramani and colleagues (2015) "math talk" referred to fundamental number concepts, counting and identifying numerals, cardinality, and ordinal relations. Results found children are exposed to mathematics before they start school (Susperreeguy, 2013), being exposed to "math talk" was positively related to children's early mathematical abilities a year later (Susperreguy & Davis-Kean, 2016), and the number of times parents engaged their children in number related activities at home predicted children's numerical knowledge and development (Ramani et al., 2015). Further research is needed to examine the types of "math talk" occurring between fourth and fifth grade underrepresented students considered low performing in mathematics and their parents and how these mathematical discussions are affecting students.

Summary

There are many nuances to consider when exploring the effects of mathematics anxiety on students and understanding the influence of parent's mathematics anxiety, mathematical attitudes, and preconceived ideologies concerning mathematical interactions with their children. Researchers have barely begun to scratch the surface and more research is needed to gain a more in-depth analysis to help students overcome the many obstacles associated with their mathematics development. It is my hope that this study will contribute to the literature on mathematics anxiety of low performing mathematics students in elementary school, offer further insight on the influence of parent's mathematics anxiety, present findings on mathematical discussions that occur between parents and their children, and provide useful recommendations for the future.

CHAPTER III: METHODOLOGY

This study investigated fourth and fifth grade under-represented students considered low performing in mathematics and employed a mixed methods approach. The study examined the student's perceptions of mathematics anxiety, the parent's perceptions of mathematics anxiety, the relationship between parent's and student's mathematics anxiety, and how parents and student's discuss mathematics. The basis for this study was a result of a mixed method published pilot study (Elizondo, 2021) conducted in the summer of 2018. The qualitative and quantitative findings of the pilot study showed that mathematics anxiety was an issue for both students and parents. The mixed method design of the pilot study provided an in-depth investigation between the quantitative data and the interviews conducted. For example, survey items measured mathematics motivation and some of the same concepts measured were mentioned by parents and students in their interviews. The qualitative data complemented parts of the quantitative findings. For this reason, a mixed method approach was chosen for the current study.

Four research questions guided this mixed methods study. A descriptor was utilized in each research questions consisting of "fourth and fifth grade under-represented students considered low performing in mathematics".

(1) What are fourth and fifth grade under-represented students considered low performing in mathematics perceptions of mathematics anxiety?
(2) What are the perceptions of parent's mathematics anxiety?
(3) Is there a relationship between a parent's mathematics anxiety and a student's mathematics anxiety?
(4) How do parents and their students talk about mathematics?

Setting

The study took place at three elementary schools considered Title I schools located in south Texas. Schools were located in predominantly low-income areas. The current mathematics curriculum utilized by the schools is Sharon Wells Mathematics (SWM) (Sharon Well Mathematics, 2021). Teaching methods include reasoning skills, divergent thinking, process standards used in teaching mathematics skills together, deep engagement, math centers, math word wall, group settings, calendar, schedule, clock, thermometer, and a focus on comprehension. Instruction under the SWM includes student engagement, vocabulary integrated into lessons, manipulative driven, conceptual learning, fun and purposeful, procedural learning and a balance between teacher and student-centered instruction. Other mathematics programs included in the district to help students with mathematics are after school programs and summer math camp programs. Each elementary school serves approximately 350 to 700 students.

Research took place at three elementary schools with permission from each principal. Student and parent MARS surveys were conducted at mathematics workshops taught by the researcher until Coronavirus restrictions closed schools. An amendment of the IRB was needed to move student and parent surveys online. Surveys were created on Qualtrics and the schools provided benchmark scores, emails, and phone interviews to invite students and parents to take the MARS survey. The student and parent interviews were conducted via Zoom and over the phone.

The demographics for the school district involved in this study consisted of 79.5% Hispanic, 13.6% White, and 4.0% African American according to the Texas Education Agency (2019). In addition, 66.2 % of the families were economically disadvantaged. The fourth graders in this study showed 52% of students meeting mathematical standards with 84% approaching. According to TEA (2019) approaching students are not below grade level nor do they meet grade level requirements. The fifth graders represented 55% of students meeting standards in mathematics with 98% approaching grade level.

Participants

The participants of the study consisted of n=38 fourth and fifth grade students considered low performing and who did not pass their State of Texas Assessments of Academic Readiness (STAAR) mathematics exam or students who performed below 70% on their mathematics benchmarks. Eligibility requirements for 11 students utilized the STAAR results, however, due to the Coronavirus, the STAAR exam was not administered and the remaining 27 students' criteria for eligibility used the mathematics benchmarks. Also, n=38 parents, one parent from each child participated in the study. Low performing is defined as students who did not pass their State of Texas (Mathematic) Assessment of Academic Readiness (STAAR) exam and were considered at "approaches grade level" or "did not meet grade level" as prescribed by the Texas Education Agency regarding mathematics benchmark scores. Purposeful sampling was used to focus on particular characteristics of the population under study that related to the research questions being answered (Patton, 2002). Parents and students were purposefully selected to participate in interviews based on the results from the MARS- E and MARS- SV. The benefits of this purposeful sampling were to select information-rich cases based on MARS scale results which found five profiles: student and parent with low, moderate, and high mathematics anxiety, student with low mathematics anxiety (LMA) and parent with high mathematics anxiety (HMA), and student with moderate mathematics anxiety (MMA) and parent with high mathematics anxiety. For this study, only five profiles emerged from the MARS scale results, a student with high mathematics anxiety and a parent with low mathematics anxiety and a student with low mathematics anxiety and a parent with moderate mathematics did not emerge.

Purposeful sampling has various sampling types. For the purpose of this study, homogeneous sampling was employed to select a small homogeneous sample to describe a specific subgroup in depth (Clark, 1999; Patton, 1999). In this case, the study examined fourth and fifth grade students considered low performing in mathematics and their parents.

It is important to note that for this study, any students who were receiving special services, bilingual, or classified as English as Second Language (ESL) were not included in the study findings. The rationale for this decision was based on the fact that language was not measured in this study nor the effects of language on mathematic anxiety.

Research Design

Using a mixed method research design allows researchers to rely on more than one data source (Creswell, 2009) and the combination of quantitative and qualitative data collection (Creswell & Tashakkor, 2007) can provide comprehensive data and better interpretation of the data. Furthermore, according to Teddlie and Tashakkori (2009), mixed method research encompasses four different designs that include: 1) triangulation, 2) embedded, 3) explanatory and 4) exploratory. This study utilized the explanatory model where the researcher collected the quantitative data first then collected the qualitative data. The explanatory model is a two-staged mixed method design or is otherwise known as a sequential design (Creswell & Clark, 2007). The model captures a clearer picture of the quantitative data collected as the qualitative data supports a more in-depth understanding of the quantitative findings (Teddlie & Tashakkorri, 2009). This allows the researcher to recognize particular quantitative findings that need further explanation and the straightforward mixed method design can explain the findings in two stages making it easier for the reader to interpret the findings (Creswell & Clark, 2007). This research design was chosen to offer a more detailed and comprehensive interpretation of the study's findings in relation to the research questions. In addition, the mixed method design was found to be optimal for the pilot study as revealed by the quality of rich descriptive data.

Data Collection

Quantitative Collection

At first data collection for students and parents occurred at a time and place designated by the principal as per school district guidelines. The students completed the Suinn Mathematics Anxiety Rating Scale Elementary Form (MARS-E) and the parents completed the Suinn Mathematics Anxiety Rating Scale Short Version (MARS-SV). Each student and parent survey were coded using the school code, the students' grade level, and the number assigned to the student and parent. This ensured confidentiality was maintained and kept surveys organized for data analysis.

The original Mathematics Anxiety Rating Scale (MARS) was created by Richardson and Suinn in 1972, however, it was difficult to find measures suitable for elementary school students, therefore, the MARS-E (Suinn, Taylor, & Edward, 1988) was created upon the validity and reliability of the MARS. The MARS-E was appropriate for this study since, it was created specifically for fourth, fifth, and sixth graders, the scale only took 5-15 minutes to complete, and it could be given in a group format if needed (Suinn et al., 1988). The MARS-E was also chosen because of its relation to the MARS-SV which was distributed to the parents in this study. Furthermore, after a careful evaluation of each mathematics anxiety instrument, the MARS-E was found to be the best instrument to measure mathematics anxiety experienced by fourth and fifth graders who are low performing in mathematics for this study.

The MARS- E was comprised of 26-items and measured the degree of anxiety experienced by students in a variety of mathematics-related situations. Nineteen items were asked concerning the degree of mathematics anxiety experienced in certain academic situations and seven items gathered information regarding non-related school mathematics tasks. Students were asked to indicate the degree of anxiety or nervousness that they felt in each situation, using a five-point Likert scale from 1 (not at all nervous) to 5 (very, very nervous). The total score was calculated by taking the sum of the ratings for all 26-items, the lowest possible total score of 26 signified low anxiety and the highest score of 130 indicated extreme anxiety (Suinn et al., 1988). The MARS-E reliability was estimated using the Cronbach's alpha and was found to be .88.

The second scale measured parent's mathematics anxiety utilizing the Mathematics Anxiety Rating Scale: Short Version (MARS-SV). The original MARS scale is comprised of 98-items (Suinn & Richardson, 1972) and it takes a considerable amount of time for participants to complete. Therefore, the shorter version of the MARS was selected for this study since parents from the pilot study revealed issues with time related to extenuating circumstances such as job-related constraints, family issues, and limitations of having one vehicle. Suinn and Winston developed a shorter version known as the MARS-SV in 2003. The scale was comprised of 30-items designed to measure the anxiety experienced by participants when completing mathematics-related activities.

The MARS-SV is a five-point Likert scale that parents used to rate their anxiety using descriptors of (1) not at all, (2) a little, (3) a fair amount, (4) much, or (5) very much. A few sample items include "totaling up a dinner bill that you think you were overcharged on", "calculating the sales tax on a purchase that costs more than $1.00" and "having someone watch you as you total up a column of figures". The 30-items were calculated, and total scores ranged from 35 to 128 with higher scores indicating higher levels of mathematics anxiety. Suinn and

Winston (2003) reported the MARS-SV to have a Cronbach's alpha of .96 and a test-retest reliability of .90. After careful consideration, this was the best scale to investigate a parent's mathematics anxiety.

Qualitative Collection

The qualitative aspect of the study was vital to understand the topic under study and assisted the researcher to provide the perceptions of the participants experiencing mathematics anxiety. The qualitative portion of the study was a descriptive analysis of students and parents' perceptions of mathematics anxiety and the discussions between parent and students regarding mathematics. Five families consented to participate in the study was purposively selected to be interviewed using semi-structured questions (appendix c and d). Parents were selected according to five profiles (table 2). An example, of interview questions can be found in the appendix. Some of the semi-structured questions were informed by the MARS scale results and other questions were designed to fully comprehend the mathematics anxiety present in the five profiles and the mathematics talk occurring in the home. A positive result from the pilot study revealed that the qualitative data found by interviewing students and parents complemented the quantitative data and this was the case for this study as well. In addition, the qualitative findings of the pilot study showed surprising results such as the fact that mathematics anxiety was experienced by both students and parents participating in a two-week summer mathematics intervention program.

Table 2

Five Profiles Selected for Interviews

Parent	Student (child of parent)	Family
High Anxiety	High Anxiety	Lafuente Family

Moderate Anxiety	Moderate Anxiety	Vidal Family
Low Anxiety	Low Anxiety	Hernandez Family
High Anxiety	Low Anxiety	Lucido-Schwartz Family
High Anxiety	Moderate Anxiety	Jones-Mendez Family

Data Analysis

Quantitative Analysis

The study's first question: "What are fourth and fifth grade under-represented students considered low performing in mathematics perceptions of mathematic anxiety?" measured a student's perception of their mathematic anxiety. The total scores of the MARS-E were calculated by taking the sum of the ratings for the 26 inventory items answered. The level of a student's mathematic anxiety was determined by using a 5-point Likert scale. A score of 26 the lowest possible score indicating low student mathematics anxiety and the highest score possible is 130 demonstrating high student mathematic anxiety. The researcher utilized descriptive statistics to analyze data. Descriptive statistics was used to portray the participants' mathematics anxiety in a collection of data, to depict patterns in the data, and to summarize the details of the data (Vogt, Gardner, Haeffele, & Vogt, 2014). The data was analyzed to measure the central tendency, the mean and median in the distribution. The analysis also used a measure of dispersion, the standard deviation to describe the amount of deviation from the mean. According to Vogt and associates (2014), standard deviation is more useful for descriptive purposes. Furthermore, the mean and measures of deviation from the mean are the foundation for most advanced statistics.

Further analysis was conducted using the two constructs determined by the MARS-E research that included mathematics test anxiety and numerical anxiety. However, the study did not fit the two-factor construct and therefore, the five-factor utilized by Baloglu and Balmlmis (2010) was utilized. The researchers found that the two-factor constructs did not fit their data and expanded to a five-factor construct. In this model, seven items on the MARS-E (1, 2, 3, 4, 10, 19, and 20) related to mathematical computation anxiety; six items (5, 6, 21, 22, 23, and 24) for application anxiety; three items (7, 11, and 14) linked to mathematics course anxiety, four items (8, 9, 12, 25, and 26) associated with mathematics teacher anxiety; and five items (13, 15, 16, 17, and 18) correlated with mathematics test anxiety. This allowed for further analysis of the MARS-E scale results. Results were analyzed looking at each question, determining the percentage of students who ranked those questions as high mathematics anxiety, and considering patterns among students. Then, those results were placed into the five constructs. The MARS-E questions of moderate to high mathematics anxiety were used to create interview questions to capture additional information.

The study's second research question: What are the perceptions of parent's mathematics anxiety?" will measure the perceptions of mathematics anxiety experienced by parents. The total scores were calculated by taking the sum of the ratings for the 30 inventory items answered. The level of parent mathematics anxiety was calculated by using a 5-point Likert scale (1 = *not at all*, 2 = *a little*, 3 = *a fair amount*, 4 = *much*, and 5 = *very much*). A score of 30 is the lowest possible score indicating low parent mathematics anxiety and the highest score possible is 150 demonstrating high parent mathematics anxiety (Suinn & Winston, 2003). Descriptive statistics was used for the means and standard deviations of parent's mathematic anxiety.

Analysis utilized the Qualtrics MARS-SV results and determined certain questions were answered ranked as high mathematics anxiety. These questions were analyzed as to the percentage of parents experiencing moderate to high mathematics anxiety to determine patterns. What was discovered, there were many themes emerging from the results and there was not a clear understanding of how to report these results. Further research was needed to explain the various dimensions found in the analysis and a research study was found to help. An additional analysis was used to explain the dimensionality of mathematics anxiety experienced by parents. Pletzer and associates (2016) conducted a study to determine if the MARS-SV could provide additional factors (constructs) other than mathematics test anxiety and numerical anxiety (Pletzer, Wood, Scherndi, Kerschbaum, & Nuerk, 2016). After carefully searching for an additional source to assist with the data analysis, the researcher found the Confirmatory Six Factor model.

This model used the MARS-SV in a study to describe the dimensionality of mathematics anxiety. After extensive study of various factors (constructs), the researchers found that a six-factor model was proven as the best fit concerning the MARS-SV scale results. The Confirmatory Six Factor model included “Evaluation Anxiety 1” (EA1) corresponding to anxiety experienced from taking mathematics tests, “Evaluation Anxiety 2” (EA2) resembling the anxiety felt when thinking about mathematics tests, “Learning Mathematics Anxiety” (LMA), “Everyday Numerical Anxiety” (ENA), “Performance Anxiety” (PA), and “Social Responsibility Anxiety” (SRA). The MARS-SV revealed the amount of mathematics anxiety that parents experienced within these six-factors according to specific items that parents answered on the scale. The analysis encompassed the specific MARS-SV questions within each factor, showed the mean, and the standard deviation. The researcher found this method to work best with the data analysis of this study and therefore, the Confirmatory Six-Factor model was used.

The third research question: "Is there a relationship between a parent's mathematics anxiety and a student's mathematics anxiety?" will study the measure of association between students and parents' mathematics anxiety (Vogt et al., 2014). Surveys have been specifically coded utilizing the school code, the students grade level, and an assigned number given to the student and their parent. This ensured accuracy for the data analysis and measure of association between the students and parents surveys. The most common measure of association is the Pearson *r* correlation. This correlation allows researchers to look for patterns of relationships between pairs of variables (Vogt et al., 2014). This study determined if students and parents' mathematics anxiety are somewhat related, the coefficients will have a value between 0 and 1.00 if the relationship is positive or a value between 0 and -1.00 if there is a negative relationship. A correlation coefficient is an accurate way of stating the degree to which students' mathematics anxiety is related to parents' anxiety and the direction of the relationship whether positive or negative.

Qualitative Analysis

The fourth research question to be answered includes: "How do parents and their students talk about mathematics?" Once data was gathered from the semi-structured interviews to answer this question, the data was transcribed. The researcher knew from previous research on the MARS that there were certain constructs associated with their findings that included test and numerical anxiety. Since, MARS scale results informed the types of interview questions, but were not limited to informing all interview questions, the researcher had an idea that these themes would be present. However, interview questions were also designed to provide a more in-depth rich description of mathematics anxiety as perceived by parents and students and the mathematics talk that occurred between them. Therefore, the researcher used descriptive coding or topic/theme coding (Wolcott, 1988) to allow any additional themes to naturally emerge. The data from transcriptions were summarized by a word or short phrase. Descriptive coding summarizes data by using a word or short phrase, most often a noun, and basic topics/themes emerge (Wolcott, 1994). It is important to note that the researcher also kept in mind the theoretical framework of self-concept when analyzing transcriptions and when utilizing descriptive coding. Three themes were derived from MARS constructs, the self-concept theory, and the fourth research question which included test anxiety, mathematics self-concept and mathematics talk. One theme and three sub-themes also naturally emerged from data and that included performance anxiety and school, real-world, and assessment mathematics talk.

Tesch (1990) mentions it is important that these codes identify the themes and are not merely abbreviations for the content. For example, the topics in the pilot study continued to emerge over and over when looking at the interview findings. This same process was used and once again these four main themes emerged from the data multiple times. The researcher reread the data and looked through the transcriptions over and over to ensure the extracted data from the transcriptions were indeed related to the themes. It was important during the pilot study to review data numerous times to determine if it was related to one of the themes and this was also true for this study. The themes were used for further analyses and interpretation of interview transcriptions (Wolcott, 1994, p.55) in the second cycle of coding.

The second cycle of coding was utilized to find data related to the four themes within the transcriptions and to keep data organized which was extremely helpful when writing up the results in chapter four. The second cycle coding utilized was axial coding (Boeije, 2010; Glaser, 1978; Glaser & Strauss, 1967; Strauss, 1987; Strauss & Corbin, 1998). This linked the themes found in the first cycle with interview transcriptions to determine a relation (Charmaz, 2014). A researcher applies and reapplies codes to qualitative data, a process of codifying permits data to be divided, grouped, or linked together to consolidate meaning and develop explanation (Grbich, 2013). After the data had been arranged and the main themes were verified, themes were placed onto a concept map in a diagramming process to show connections and sequential progression recommended for axial coding (Strauss, 1987). An example of axial coding utilized in this study can be found in appendix three.

During this process, "the code is sharpened to achieve the best fit" (Glaser, 1978, p.62). This assisted in making connections with the transcriptions and the main topics, allowed the researcher to stay close to the data, and helped the researcher stay focused on the study (Wolscott, 1994). One of the goals of using axial coding for this study is to achieve saturation of the data (Strauss & Corbin, 1998). This process was highly useful for the pilot study and therefore, it was used again for the current study.

Summary

This mixed method study will activate certain protocols and instruments for investigating perceptions of mathematics anxiety of fourth and fifth grade under-represented students considered low performing in math, their parent's mathematics anxiety, the relationship between a parent and child's mathematics anxiety, and describe how parents and their children discuss mathematics. The instruments for this study have been given careful consideration concerning their reliability and the ability to measure the topics under study. One important aspect of this study includes the pilot study that was conducted in the summer of 2018 which has greatly assisted in informing the research design, data collection, and data analyses for the current study.

CHAPTER IV: FINDINGS

This chapter presents a detailed description of the Mathematics Anxiety Rating Scale Elementary (MARS-E), the Mathematics Anxiety Rating Scale Short Version (MARS-SV) results, and an in-depth exploration of interviews conducted based on five profiles found during data analysis and listed in table two. Interview questions were informed by the quantitative data results based on analysis of patterns that emerged from certain questions established by overall percentages on the scales. The qualitative data further examined the student's perceptions of mathematics anxiety, the parent's perceptions of mathematics anxiety, the relationship between parents and student's mathematics anxiety, and how parents and student's discuss mathematics at home.

Research Findings for Question One: What are the perceptions of mathematics anxiety of fourth and fifth grade students considered low performing in mathematics?

Students completed the Mathematics Anxiety Rating Scale Elementary (MARS-E) scale. A 26-item scale where students rated their nervousness or anxiety levels for each question based on a 5-point Likert scale (1 = *not at all*, 2 = *a little*, 3 = *a fair amount*, 4 = *much*, and 5 = *very much*). Students' mathematics anxiety levels were calculated by adding the sum of each item on the 26 inventory items answered. A score of 26 is the lowest possible score indicating low mathematics anxiety and the highest score possible is 130 demonstrating high student mathematics anxiety (Suinn & Winston, 2003). Data results for this study showed the students' mathematics anxiety minimum to be 30 indicating low mathematics anxiety and the maximum score of 126 signifying high mathematics anxiety. According to data analysis, n= (38), m=70, and SD 20.80 indicated a moderate level of mathematics anxiety experienced by the 38 student participants in relation to the MARS-E 26-item scale.

The MARS-E had two constructs test anxiety and mathematics performance evaluation anxiety (Suinn & Winston, 2003). However, this study's data did not fit into the two-factor model. Therefore, the five-factor model was utilized. In this model, seven items on the MARS-E (1, 2, 3, 4, 10, 19, and 20) related to mathematical computation anxiety; six items (5, 6, 21, 22, 23, and 24) for application anxiety; three items (7, 11, and 14) linked to mathematics course anxiety, four items (8, 9, 12, 25, and 26) associated with mathematics teacher anxiety; and five items (13, 15, 16, 17, and 18) correlated with mathematics test anxiety (Soni, & Kumari, 2017). The tables below show the students MARS-E scale results in relation to the five constructs.

Table 3

Construct One-Mathematical Computation Anxiety

MARS-E Items	Mean	Standard Deviation
1) How nervous or tense would you feel if you had to solve this problem: George brought 4 boxes of toy cars to class. If each box had 7 cars, how many toy cars did George bring?	2.26	.99
2) Mark how nervous or tense you would feel if you had to decide if this problem is right: (3+4) +2 = 4 + (2+3)	2.87	1.13
3) How nervous or tense do you feel Reading this problem: Babe Ruth was known as the Home Run King. He had 54 home runs in 1920, 59 in 1921, and his best of 80 in 1928. How many home runs did he hit in all three years?	2.32	1.24
4) Mark how nervous you feel when you have to add 976+777+458	2.00	1.17

on paper.		
10) Looking at how much two different sizes of two different kinds of soft drinks cost and deciding which is cheaper.	1.95	1.10
19) Being given a set of multiplication problems to solve on paper.	2.45	1.37
20) Being given a set of division problems to solve on paper.	3.00	1.38

Students in this study demonstrated a moderate amount of mathematics anxiety when performing mathematical computations. In particular, being given a set of division problems to solve on paper. This finding was also consistent with qualitative findings in interviews with students. More information will be presented under the performance anxiety theme later in this section. In addition, certain types of computations involving a string of problems also caused a considerable amount of anxiety among the student participants of this study. Table four shows the MARS-E scale results for application anxiety.

Table 4

Construct Two-Application Anxiety

MARS-E Items	Mean	Standard Deviation
5) If you had to add up a cash register after you bought several things.	2.29	1.14
6) When counting how much change you should get back after buying something, how nervous do you feel?	2.29	1.25
21) Having to figure out how much each of you owe when you buy a pizza and three soft drinks with two friends	2.37	1.29

22) Counting your change after buying a movie ticket because you think you didn't get enough money back.	2.34	1.22
23) Figuring out what time it will be in 25 minutes.	2.21	1.40
24) Figuring out if you have enough money to buy a candy bar and a soft drink.	2.18	1.19

MARS-E scale results showed students experienced some nervousness associated with application anxiety. This was the one factor that revealed the least amount of anxiety in relation to everyday activities involving mathematics. The qualitative findings also disclosed that students felt confident when shopping and budgeting their money. The MARS-E scale results and interviews were consistent. More information concerning what was found is under the real-world mathematics talk section in this chapter. Table five shows results for mathematics course anxiety.

Table 5

Construct Three-Mathematics Course Anxiety

MARS-E Items	Mean	Standard Deviation
7) When getting your math book and seeing all the numbers in it, how nervous do you feel?	2.76	1.35
11) Starting to read a hard new chapter for your math homework.	3.05	1.01
14) Being given a homework assignment of many difficult problems which is due the next class meeting.	2.68	1.08

Students in the study experienced moderate mathematics anxiety in relation to mathematics course anxiety. The MARS-E scale results validated that starting to read a hard new chapter for your mathematics homework made students anxious. Interviews with students also substantiated these findings, and students discussed their feelings when reading a hard chapter in their mathematics textbook. This information is located under the performance anxiety section of this chapter. Table 6 displays the MARS-E items concerning mathematics teacher anxiety.

Table 6

Construct Four-Mathematics Teacher Anxiety

MARS-E Items	Mean	Standard Deviation
8) Getting called on by the teacher to do a math problem on the board (how nervous do you feel)?	3.13	1.42
9) Raising your hand in math class to ask a question about something you don't understand.	2.92	1.20
12) Being asked by your teacher to tell how you got your answer to a math problem.	2.61	1.14
25) Having someone watch you while you correct your math homework on the blackboard.	3.29	1.34
26) Listening as your teacher tries to help you see how to work a math problem.	2.47	1.19

The MARS-E scale results revealed that students experienced moderate mathematics anxiety in relation to certain items on the MARS-E. Students in the study expressed having more anxiety when someone watched them correct their mathematics homework on the blackboard.

Interviews also disclosed students' feelings when someone watched them do mathematics. Further findings from interviews will be given under the positive mathematics self-concept and performance section later in this chapter. Table seven shows test anxiety in relations to the MARS-E scale results.

Table 7

Construct Five-Test Anxiety

MARS-E Items	Mean	Standard Deviation
13) Taking a big test in your math class.	3.42	1.23
15) Thinking about a math test the night before the test.	2.82	1.12
16) Thinking about a math test an hour before the test.	3.29	1.30
17) Thinking about a math test 5 minutes before the test.	3.49	1.35
18) Waiting to get a math test back on which you think you didn't do well.	3.58	1.27

Test anxiety was one construct that showed higher levels of mathematics anxiety compared to the other constructs. Students were more anxious when waiting to get their mathematics test back when they felt that they did not do well. They also experienced more anxiety when taking a big mathematics test or when thinking about taking a mathematics test five minutes before the test. Interviews with students found that students were worried their mathematics test results would lower their grade. Students also felt that they would not do well on their mathematics test and this caused a considerable amount of anxiety. Further exploration of test anxiety findings for this study are under the test anxiety section of this chapter.

The normative data from the MARS-E is displayed in table 8. Suinn, Edward, & Taylor (1988) utilized normative tables for interpreting the MARS-E test scores and the tables provided percentiles of 10%, 30%, 50%, 75%, and 95% (Suinn et al., 1988). For example, a student received a MARS-E score of 69 and this fell at the 50% percentile and showed moderate mathematics anxiety. A study by Suinn and Edwards (1982) used these percentiles to place scores in ranges of low and high mathematics anxiety. The same was used for this study's findings indicating low mathematics anxiety at 30%, moderate mathematics anxiety at 50%, and high mathematics anxiety at 75%.

Table 8

Normative Data of MARS-E Percentiles and Scores

Percentile	Scores	# of Students n=38
10%	41	3
30%	60	10
50%	69	9
75%	87	9
95%	91	7

The number of different scores calculated on the MARS-E was 29 in which each percentile was found in relation to a specific score. For example, 29 multiplied by .10 produced 2.9 which was rounded up to 3. Once each MARS-E score was written, the third number in the line of scores was 41 and represented a student's score on the scale. Thus, the 10% percentile was found and the same method was used to find the remainder percentile scores. Data was further evaluated and disclosed 25 out of the 38 students fell between the 50% and 95% percentile.

Using the model from the MARS-E research (Suinn et al., 1988), 16 out of the 38 students in this study were found at or above the 75% percentile and reported experiencing a high amount of mathematics anxiety. A value above the 75% level would indicate a student has a high level of mathematics anxiety and research (Suinn et al., 1988) has shown this to be a typical value for interventions to decrease mathematics anxiety. Normative data also disclosed the percentiles for the fourth (n=16) and fifth graders (n=22) studied and table 9 displays the percentiles, MARS-E scores, and number of students within each percentile.

Table 9

Normative Data of MARS-E Percentiles and Scores

Percentile	4th Grade Scores	# of Students N=16	5th Grade Scores	# of Students N=22
10%	35	4	44	1
30%	52	4	56	3
50%	62	5	67	7
75%	93	2	76	8
95%	108	1	96	3

The normative table showed that 50% of fourth graders were at the 50% percentile with 18 out of the 22 students in the fifth grade at the 50% percentile. Fourth graders showed a m=70 and sd=29.69, Fifth graders had a m=70 and sd=15.82. Most fourth and fifth graders reported experiencing moderate mathematics anxiety in relation to certain mathematics tasks found on the MARS-E. More in-depth information was disclosed from interviews with students, and students gave details to why they felt mathematics anxiety within certain situations. This data was disclosed in the qualitative section of chapter four.

Research findings for Question Two: What are the perceptions of parents' mathematics anxiety?

The MARS-SV is a 30-item scale where parents rated their nervousness or anxiety levels for each question based on a 5-point Likert scale (1 = *not at all*, 2 = *a little*, 3 = *a fair amount*, 4 = *much*, and 5 = *very much*). The level of parent mathematics anxiety was calculated by taking the sum of the ratings for the 30 inventory items answered. A score of 30 is the lowest possible score indicating low parent mathematics anxiety and the highest score possible is 150 demonstrating high parent mathematics anxiety (Suinn & Winston, 2003).

Data results showed the parents mathematics anxiety minimum to be 30 indicating low anxiety and the maximum was 122 signifying high mathematics anxiety. A moderate level of mathematics anxiety was experienced by the 38 parent participants as measured by the MARS-SV 30-item scale with m=70 and SD= 23.15. The MARS-SV revealed the amount of mathematics anxiety that parents experienced and the Confirmatory Six Factor Model (Pletzer et. al., 2016) was used to further analyze specific items that parents answered on the MARS-SV. Descriptive statistics were used for the mean and standard deviations and calculated the total scores for N=38 within each item where parents rated their nervousness or anxiety levels for each question based on a 5-point Likert scale (1 = *not at all*, 2 = *a little*, 3 = *a fair amount*, 4 = *much*, and 5 = *very much*).

Table 10

Evaluation Anxiety 1-Confirmatory Six-Factor Model

Factor	Item on MARS-SV	Mean	SD
EA1	(1) Taking an examination (final) in a math course	2.74	1.21
	(7) Receiving your final math grade in the mail	3.29	1.37
	(9) Being given a "pop" quiz in a math class	2.74	1.21
	(11) Taking the math section of a college entrance exam	3.26	1.52
	(12) Taking an examination in a math course	2.68	1.17

The parents mathematics anxiety for this study revealed m=2.73 and SD=.74 for these five items on the MARS-SV. The scale showed that parents are experiencing moderate levels of anxiety in relation to taking mathematics tests. Two-items showed higher levels of anxiety when receiving a final mathematics grade in the mail, and when taking the mathematics section of a college entrance exam. These two-items were further explored during the interviews with parents, and data analysis will be disclosed in the qualitative section of this chapter. Further analysis of specific items on the MARS-SV revealed the next factor "Evaluation Anxiety 2" and showed the mathematics anxiety felt when thinking about mathematics tests.

Table 11

Evaluation Anxiety 2-Confirmatory Six-Factor Model

Factor	Item on MARS-SV	Mean	SD
EA2	(2) Thinking about an upcoming math test one week before	2.37	1.22
	(3) Thinking about an upcoming math test one day before	2.89	1.35
	(4) Thinking about an upcoming math test one hour before	3.05	1.28
	(5) Thinking about an upcoming math test five minutes before	3.32	1.38
	(6) Waiting to get a math test returned in which you expected to do well	2.92	1.38

The MARS-SV scale found parents experiencing moderate mathematics anxiety when thinking about mathematics tests and the five items calculated the m=2.91 and SD=.35. Data disclosed that parents experienced higher levels of mathematics anxiety when thinking about a mathematics test one hour before or five minutes before the test would be administered. These items have been further investigated in the interviews with parents and will be disclosed in the qualitative section of chapter four. The third factor depicts the type of mathematics anxiety experienced when learning mathematics and as expressed by certain items on the MARS-SV. This third factor "Learning Mathematics Anxiety" is another dimension added to the model to further understand the type of mathematics anxiety experienced by parents in this study.

Table 12

Learning Mathematics Anxiety-Confirmatory Six-Factor Model

Factor	Item on MARS-SV	Mean	SD

LMA	(8) Realizing that you have to take a certain number of math classes to fulfill the requirements in your major	2.86	1.30
	(10) Studying for a math test	2.47	1.27
	(13) Picking up the math textbook to begin working on a homework assignment	2.13	1.24
	(14) Being given a homework assignment of many difficult problems which is due the next class meeting	2.84.	1.24
	(15) Getting ready to study for a math test	2.61	1.37

Results from the MARS-SV showed parents did have moderate mathematics anxiety with the m=2.58 and sd=.31. Thus far, the mean scores in EA1, EA2, and LMA have shown a slight decrease from 14.71-12.74. The fourth factor "Everyday Numerical Anxiety" was calculated utilizing the MARS-SV items.

Table 13

Everyday Numerical Anxiety-Confirmatory Six-Factor Model

Factor	Item on MARS-SV	Mean	SD
ENA	(18) Reading a cash register receipt after your purchase	1.76	1.13
	(19) Figuring the sales tax on a purchase that costs more than $1.00	1.97	1.22
	(20) Being given a set of numerical problems involving addition to solve on paper	2.39	1.42
	(23) Totaling up a dinner bill that you think overcharged you	2.16	1.27

	(27) Watching someone work with a calculator	1.61	1.04

Parents have moderate mathematics anxiety when performing everyday numerical functions with the m=1.98 and sd=.32. However, their anxiety is decreasing and the MARS-SV results suggested that parents felt more mathematics anxiety in relation to mathematics tests than when performing everyday mathematics tasks. The fifth factor "Performance Anxiety" in the model actually represents seven items on the MARS-SV and this must be taken into consideration when looking at the mean and standard deviation of these seven items.

Table 14

Performance Anxiety-Confirmatory Six-Factor Model

Factor	Item on MARS-SV	Mean	SD
PA	(16) Dividing a five-digit number by a two-digit number in private with pencil and paper	2.47	1.33
	(17) Adding up 976+777 on paper	1.74	1.16
	(21) Being given a set of numerical problems involving addition to solve on paper	1.95	1.17
	(22) Having someone watch you as you total up a column of figures	2.39	1.01
	(28) Being given a set of multiplication problems to solve	1.79	1.10
	(29) Being given a set of subtraction problems to solve	1.71	1.05
	(30) Being given a set of division problems		

	to solve	1.87	1.00

The fifth factor showed m=1.99 and sd=.31 and parents felt mathematics anxiety relating to performance in mathematics. Two-items reported a higher level of moderate mathematics anxiety when dividing a five-digit number from a two-digit number in private and when someone was watching them calculate a column of figures. The sixth factor "Social Responsibility Anxiety" was only represented by three-items on the MARS-SV.

Table 15

Social Responsibility Anxiety-Confirmatory Six-Factor Model

Factor	Item on MARS-SV	Mean	SD
SRA	(24) Being responsible for collecting dues for an organization and keeping track of the amount	2.16	1.45
	(25) Studying for a driver's license test and memorizing the figures involved such as the distances it takes to stop a car going at different speeds	2.55	1.21
	(26) Totaling up the dues received and the expenses of a club you belong to	2.03	1.45

The SRA showed m=2.25 and sd=.27. However, only three-items from the MARS-SV were placed in this domain from research results when creating the Confirmatory Six-Factor Model. In this study, parents experienced social responsibility anxiety when studying for their driver's license test, being responsible for finances in an organization, and when collecting dues. Further data was disclosed regarding the specific item number 25 on the MARS-SV and will be found in the qualitative section from interviews.

The confirmatory six-factor model accurately described the parent mathematics anxiety results and showed specific items where parents experienced the most anxiety in relation to the six factors. Parents seemed to have more mathematics anxiety when taking a mathematics test and thinking about taking mathematics tests in the EA1 and EA2 factors than in any of the other four factors. Overall, the data showed parents felt moderate mathematics anxiety regarding specific items on the MARS-SV and were further analyzed within certain contexts in all six-factors.

Research Findings for Question Three: Is there a relationship between a parents' mathematics anxiety and a student's mathematics anxiety?

As seen in table one, descriptive statistics were used to provide information for the distribution of scores for the variables of parent mathematics anxiety and student mathematics anxiety. For the parents (n=38) scores ranged between 30-122 on the MARS=SV with a m=70 and sd= 23.15. Students' scores were between 30-126 on the MARS-E with a m=70 and sd=20.80.

Table 16

Descriptive Statistics

	N	Range	M	SE (Std. Error)	SD	Variance	Skewness Statistic	Skewness Std. Error	Kurtosis Statistic	Kurtosis Std. Error
Parent MAS	38	92.00	70.00	3.75	23.15	535.84	.04	.38	-.58	.75
Student MAS	38	96.00	70.28	3.37	20.80	432.81	.42	.38	.23	.75

The relationship between a parent's MA as measured by the MARS-SV and student's mathematics anxiety as measured by the MARS-E was investigated using the Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality and linearity. There was a moderate correlation between the two variables (r=.38, n=38, p>0.05), with a moderate level of student mathematics anxiety associated with a moderate level of parent mathematics anxiety.

Table 17

Correlation

		Parent MAS	Student MAS
Parent MAS	Pearson Correlation	1	.38
	Sig. (2-tailed)		.016
	N	38	38
Student MAS	Pearson Correlation	.38	1
	Sig. (2-tailed)	.016	
	N	38	38

Research Findings for Question Four: How do parents and their students talk about mathematics?

The qualitative results included interviews conducted with five families that were purposely selected based on their MARS-E and MARS-30 scale results. For example, scale results showed certain parents and students with high MA and based on this information, a profile was created (HMA) and parents and students from this profile were invited to interview for this study. The MARS-SV and MARS-E scale results disclosed five profiles within the n=38 participants (family) as shown in table 19. The a priori of scale results produced the five profiles and informed the types of interview questions but were not limited to informing all interview questions. Interview questions were also designed to provide a more in-depth rich description of mathematics anxiety as perceived by parents and students and the mathematics talk that occurred between them. Table 19 represents the parent and the student (their child), their level of mathematics anxiety experienced by the MARS-SV (parent) and the MARS-E (student), and their family name. Parents and students were from the same family. The findings used the family name throughout the analysis in chapter four under each specific profile and pseudonyms were used for each family.

Table 18

Five Profiles Selected for Interviews

Parent	Student (child of parent)	Family
High Anxiety	High Anxiety	Lafuente Family
Moderate Anxiety	Moderate Anxiety	Vidal Family
Low Anxiety	Low Anxiety	Hernandez Family
High Anxiety	Low Anxiety	Lucido-Schwartz Family
High Anxiety	Moderate Anxiety	Jones-Mendez Family

An analysis of the interview transcriptions allowed a closer examination of themes that coincided with specific constructs such as test and performance anxiety, the theoretical framework of self-concept, and mathematics talk. For example, test anxiety and performance anxiety were revealed from MARS scale results for this study, (two constructs of the MARS-E and MARS-SV from previous research) and some interview questions (were created to provide a richer description of these two constructs as experienced by the parents and students. The four themes used to describe findings for research question four included mathematics talk, positive mathematics self-concept, performance anxiety, and test anxiety. The second cycle of coding was utilized to find data related to the four themes within the transcriptions and to organize data accordingly for each profile as mentioned in detail within the methodology section.

Further analysis of interview transcriptions also found three emergent sub-themes within mathematics talk that included schoolwork, real-world, and assessment type mathematics talk. The schoolwork mathematics talk consisted of discussions when parents and their children were completing mathematics homework together or studying for mathematics tests. Real-world mathematics talk included dialogue concerning shopping, saving money, budgeting money, allowances, and time management. Lastly, assessment mathematics talk took place when parents and their child spoke about mathematics grades, STAAR mathematics test results, and parent expectations regarding mathematics performance.

The next section provides a brief description of the participants, their MARS-E and MARS-30 scale results, the student's mathematics benchmark test results, and the four themes of mathematics talk, positive mathematics self-concept, performance anxiety, and test anxiety within each profile.

Profile Parent with High (MA) and Student with High (MA)

This profile represented a parent with high (MA) and a student with high (MA). The Lafuente family fit this profile. The participants of the Lafuente family were Marisol, the mother and her son Jacob, a fifth grader attending a South Texas elementary school. Marisol stays at home and manages the household, she stated mathematics was her favorite subject, and she has a good attitude regarding mathematics. Marisol mentioned problems concerning her mathematics abilities, but felt her everyday mathematics skills such as budgeting, shopping and money management were very good. She disclosed her fear of mathematics and how this fear kept her from attending college. Marisol explained she did not feel confident enough to take any mathematics college entrance exam nor college level mathematics courses.

Jacob had a good attitude about mathematics and mentioned mathematics was his favorite subject. He felt it was easy to learn mathematics although he stated he had difficulty with division. Jacob was very aware of his difficulties with certain mathematical concepts, but stated he just needed more practice. He spoke very highly of his mother and mentioned the ways she helped him in relation to mathematics homework. Jacob's mathematics benchmark scores were 58.8% and his MARS-E scale results was 96 indicating high mathematics anxiety. Marisol's MARS-SV scale score was 102 and she experiences high mathematics anxiety as well. In this study, 3 out of the 38 participants fell into this profile of a parent with high (MA) and student with high mathematics anxiety.

Schoolwork Mathematics Talk

The Lafuente family spoke about the type of mathematics conversations that occur in their household during mathematics homework time. Marisol explained that she helps Jacob with his mathematics but, she prefers that he waits until his father comes home. She mentioned, "I try to help him as much as possible, but dad (mostly) helps him. I am around when his dad is helping him so next time around I can help with his math. Once it is explained to me, I can help him." Marisol stated that the conversations between her son and husband are intense when her husband tries to help Jacob with his mathematics homework. She further added, "(Their conversation) is intense because half the time, (Jacob) is not listening or paying attention. He is patient with Jacob. It is just a tense situation because my husband is like (you have) to learn and my son is like I am trying."

When Jacob was interviewed he also commented on this situation and he said, “I feel a little nervous when my dad helps me with math. I don’t feel nervous with my mom.” Jacob also mentioned the process he goes through when needing help with his mathematics homework. He explained, “I go to my mom (first) and if we don’t understand it, we go to my dad. When my dad can’t help me, I go back to my mom or I will email my teacher.” Marisol works hard to help her son with his mathematics homework and explains how she helps him. She discussed, “I help Jacob with hands on as far as using beans (for counting) or use (different) items to help him figure out the answer. I can help him with adding, subtracting, multiplying, and dividing.” Marisol explained doing whatever is necessary to ensure her son is learning his mathematics.

Real-World Mathematics Talk

The interview with the Lafuente family revealed dialogue that takes place regarding real-world mathematics talk. Marisol rated her mathematics skills as a four (Scale of 1-10), but stated her real-world applications like measurements for cooking, budgets, paying bills, and grocery shopping skills are an eight She also spoke about the discussions that Jacob and she have regarding the value of money. Marisol explained, “I teach him the value of money, like I say when we buy one item let’s say for instance clothes, I would tell him do you want to spend this much money on one shirt or do you want to spend this much money at another store on a shirt and shorts and you will still have money to buy a toy or candy.” Jacob also talked about these conversations and he stated, “(My parents talk to me about) spending it wisely. I know how to save money, budget money, and I can shop with my own money.” The family had conversations concerning real-world mathematics and Marisol taught Jacob these skills. Jacob was very confident when he spoke about his real-world mathematical skills.

Assessment Mathematics Talk

The Lafuente family did have conversations when Jacob received a bad grade in mathematics and when he failed the STAAR mathematics test. Marisol also mentioned the family is dealing with Jacob struggling with his mathematics because of the virus and virtual learning. She explained, “He needs face to face with the teacher. His math skills have decreased. (We do) online websites to improve (his math). They are like learning games and he likes it.” She expressed that when Jacob gets a bad grade in mathematics she tells him, you (can) do better.” When Jacob failed his STAAR mathematics exam they talked about him doing better and she communicated by saying “(You) need to (at least) try.” Jacob also spoke about these conversations and he mentioned, “I am kind of not good at math because of division. The virus has hurt my math. I could be better.” He also brought up the fact that he could do better and he needs to practice. He disclosed, “I used to know all my multiplication. I (need) to practice (more). I am a little bit excited and a little bit nervous when it comes to math.”

The Lafuente family holds various dialogues concerning mathematics. Marisol and Jacob talk while they work on his mathematics homework, when he receives a bad grade in mathematics, when he needs to improve his mathematical skills, and she teaches him the value of money. Although Jacob and Marisol have high mathematics anxiety, they both disclosed that mathematics is their favorite subject and they demonstrated a positive attitude concerning mathematics. Parent involvement was evident. However, the son disclosed feeling more comfortable doing his mathematics homework with his mother instead of his father. The mother also stated that there is tension between the son and father when the father helps his son with his mathematics homework. She observed their mathematics talks and stated there was frustration that occurred during these conversations.

Positive Mathematics Self-Concept

The data for the Lafuente family revealed various examples of positive mathematics self-concept. During the interview, Jacob was asked how he felt about his mathematics skills, he replied, “Math is easy to learn. I am excited to be learning math.” He also explained that mathematics was his favorite subject. Jacob was also asked about his perceptions of how other’s view his mathematical skills, he said, “I don’t think people will think I am stupid or I don’t know math.” His final thoughts regarding his perception of mathematics were explained by saying, “I am a little bit excited and a little bit nervous when it comes to learning math.”

The same questions were posed to Marisol and she explained her perceptions by replying, “(Math) was my favorite subject. I can help (Jacob) with his math (homework).” She also added, “I help Jacob (study) for his math tests. I just have patience and help him figure out each problem without him having to get nervous.” Marisol discussed her perceptions of how others view her mathematics skills and stated, “It does not have anything to do with how people look at me, I am not a shy person and (I am) very outspoken.” She also described her mathematics skills and ranked herself a four (Scale of 1-10) in academic mathematics, but stated, “(My) everyday math skills (are) an 8. I do not work (and) I manage the household. Marisol also ranked Jacob’s mathematical skills and said, “(He is) about a 5 because right now (he is) doing it virtual and at home he is not getting the understanding he needs. (He needs) face to face with the teacher.”

The family also experienced some negative mathematics self-concept and Jacob communicated, “(On a scale of 1-10) I am a 4 because I am kind of not good at math because of the division.” However, he also added a positive self-perception of his abilities to learn mathematics by quickly adding, “If I had more help in division, I could be better.” When he was asked about how he feels when the teacher is teaching him mathematics, he commented, “(When) I barely understand it makes me nervous. I am nervous because I feel that I am not going to get it correct, but it is just practice (after all). Marisol also explained her perceptions regarding her mathematics skills and explained, “When my kids ask for (math) help, I would not even know. I have a hard time understanding the “new math.” My answer to them is wait until your dad gets home, he’s the math wizard, I am not.” She further added her perceptions about doing mathematics in front of people, “(I get) nervous because I have stage fright where I feel like I would not get it right. It makes me nervous to think that I am not going to do very well. I need more confidence in math.”

The Lafuente family experienced high mathematics anxiety and the son Jacob experienced mathematics self-concept within certain mathematics situations. Jacob explained that others' perceptions of his mathematics skills are good and he does not experience any mathematics anxiety in this regard. It still makes him a little nervous when learning mathematics and his perceptions of his own mathematics skills can be mixed, however, he still demonstrated mathematics self-concept. The mother Marisol experienced both positive mathematics self-concept and negative self-concept. Marisol had mathematics self-concept concerning everyday mathematics application, however, her perception of her academic mathematics skills showed negative mathematics self-concept. Analysis found that this family experienced high mathematics anxiety and also experienced positive self-concept and negative self-concept. Their perceptions concerning their own abilities to learn mathematics did not show mathematics self-concept within certain situations regarding mathematics.

Performance Anxiety

The Lafuente family discussed the various types of performance anxiety that they experienced. Jacob explained he feels nervous when his teacher calls on him in mathematics class or when he has to do mathematics in front of his classmates. He said, "(I get) nervous because I think that I am not going to get the answer correct (when the teacher calls on me). (I get) nervous doing (math) in front of people." Jacob's MARS-E scale results also disclosed performance anxiety when doing word problems (question 2 on MARS-E), when doing mathematics problems (question 19 and 20 on the MARS-E) and listening to the teacher help him understand how to work a mathematics problem (question 26 on the MARS-E). Jacob explained by stating, "I remember them a little bit. (I get) nervous because sometimes I don't get (them) correct. When doing math problems, I am nervous because I feel like I am not going to get it correct (even) if it's just to practice. (When the teacher tries to help me, I get) nervous because I can barely understand it so it makes me nervous."

Marabel also discussed her performance anxiety and mentioned, "(If I was better in math), it would let me be able to help my kids as far as their math homework instead of having to ask someone else. I have been out of school for so long that I would not even remember it. The way we learned back then, it's like what they know now, it's something like we did in junior high and high school what they are learning now in elementary." She also mentioned the type of performance anxiety that Jacob experienced and said, "He gets discouraged because he can't figure out how to do it. He gets frustrated when he cannot solve a math problem." Lastly, she explained her feelings in relation to college, "I would not even know where to begin (and) I would be nervous." The Lafuente family experienced high mathematics anxiety and performance anxiety within certain mathematical situations. Jacob expressed anxiety when doing word problems and general nervousness about not getting the answers correct. His mother also had performance anxiety and she felt that her mathematical skills were not good enough since she had been out of school for a long time.

Test Anxiety

The members of the Lafuente family spoke about their test anxiety during their interview. Jacob discussed how he felt when taking a mathematics test (question 13 on the MARS-E). He replied, “(I feel) a little nervous when I take a math test because I feel I am not going to do well on it.” His mother, Marisol spoke about the anxiety she felt when taking a final mathematics exam (question 1 on the MARS-SV) and said, “(I get nervous) because I know it is usually a major grade and I like to do good on it because then I know that I can pass. It makes me nervous to think that I am not going to do very well. I need more confidence in math.”

She disclosed feeling nervous when thinking about taking a mathematics test (question 2-5 on MARS-SV) and she stated, “Just the fact that it is a test because when (I take) any test, I get nervous taking all kinds of tests. (When I study for a math test I am nervous) getting the answer correctly.” She further added, her feelings regarding taking the mathematics section of a college entrance exam (question 11 on MARS-SV) and she explained, “I would be nervous because I would not even know where to begin or where to start or what is going to be coming at me.” Her final remarks regarding her feelings when taking the driver’s license test (question 30 on the MARS-SV), she described what happened and said, “(I was nervous) because I failed it and I had to take it again until I passed.” This family experienced high (MA) and test anxiety. Both the parent and student were nervous that they would not do well on their mathematics tests. The mother was also anxious regarding any tests and just thinking about taking the mathematics section of the college entrance exam caused a lot of anxiety. So much in fact, that she did not attend college.

Profile Parent with Moderate (MA) and Student Moderate (MA)

The participants of the Vidal family fit the profile of a parent and child with moderate mathematics anxiety. Analysis revealed 21 out of the 38 study's participants (parent and student) fell within this profile. The participants from the Vidal family included the father, Marcus, and his son, Alejandro, a fourth grader attending a school in Southern Texas. Alejandro's mother (Lupe) did not wish to participate in the study. Therefore, mathematics talk is from the perception of Marcus and his observations in relation to mathematics talk occurring during homework time with Alejandro and his mother. Marcus and his son had many conversations concerning real-world mathematics talk, and discussions about Alejandro's mathematics grades, mathematics tests, and benchmark scores known as assessment mathematics talk for this study.

Marcus went to college, he works as an Industrial Insulator out of town, and he uses mathematics every day at work. Marcus commented that he is often away from home weeks at a time, and his wife (Lupe) is the one who helps Alejandro with his mathematics homework. Alejandro has a positive attitude regarding mathematics, feels learning mathematics makes him better, and speaks highly of his mother and father. Alejandro received a 68.8% on his mathematics benchmark and scored a 60 on the MARS-E mathematics scale indicating moderate mathematics anxiety. Marcus scored a 62 on the MAR-SV mathematics scale representing moderate anxiety.

Schoolwork Mathematics Talk

There was a sense of comfortability when discussing the sort of mathematics talk that occurred when Alejandro needed assistance with his mathematics homework. Marcus described mathematics homework as a time when Alejandro and his mother (Lupe) sit down at the dinner table and work on Alejandro's mathematics homework. Marcus explained, "It is really hard not being around to help Alejandro with his mathematics homework. I am gone sometimes six days or the whole week, and sometimes I am not home for months.”. He spoke about when Alejandro does not understand his mathematics homework, Lupe will go over it again and again until he understands. He spoke about “It is so hard not being there and teaching him, but I am pretty (confident) in my wife teaching him.”

He explained the amount of patience his wife has with their son during mathematics homework time. “She is a lot more patient than I am, I am not very conducive with teaching young learners, and I blame that on work. We need to do it now.”. He further commented that Alexandro is reluctant to ask him for help with his mathematics homework. “He kind of shies away (from me) just because of the way I am (stricter) and the way that I teach,”, but explained again, “(My wife) is a lot more patient with it until he actually understands (his mathematics)”. Marcus expressed regret and not be able to be there at home to help Alejandro with his mathematics homework, “I would love to be able to come home every day and help him with his homework.”

When asked the question “What type of conversations do you and your parents have at home regarding mathematics?” Alejandro explained that his mother helped him with his mathematics homework and stated, “It makes me happy when she helps me because I am getting (the) help (that I need).” He said that his mother sits close to him at the dinner table and they go over the mathematics he does not understand, “We go over the answers and she makes sure it is correct.” He further stated, “In front of my mom, doing my math work makes me feel kind of good.” Alejandro expressed his comfortability of talking and doing his mathematics homework with his parents, “Doing math work with my mom makes me feel good and doing math work with my dad makes me feel good.”

For this family, schoolwork mathematics talk was centered around mathematics homework, the mother would explain to Alejandro what he could not understand, she was patient, and she would go over and over the material until he finally understood it. Alejandro expressed how his mother helped him with his mathematics homework, she made sure he had done it correctly, and it made him happy when he received help from his mother regarding his mathematics homework. He also stated the positive feelings he has when doing mathematics work with his mother and father.

Real-World Mathematics Talk

Another sub-theme found within mathematics talk was real-world mathematics talk and for the Vidal family, interviews disclosed the types of discussions occurring between the participants. Marcus talked about how most of the mathematics talk occurring between him and Alejandro related to everyday mathematics. Marcus stated, "We talk about everyday math, time management, and mostly about money." He explained when they go to a store, they will talk about how much Alejandro has to spend, if he can afford a certain item, or how much he has left to spend. Marcus described their conversation, "I'm like ok, you can spend this much, and he will be like I can't get that it is too much or (I) bought this much and now I have this left." Marcus said he also explained to Alejandro budgets and staying within the budget. He explained "If he wants to buy something, I will explain to him that funds are kind of tight and I will explain why (funds are tight)."

Marcus and Alejandro also talked about video games, calculating the scores over the course of the game, and how much he is spending on video games. Marcus said, "(We talk) more about his video games, how he is calculating stuff with his games and how much he is spending on his games." He also brought up that they have conversations regarding time management and

Alejandro knowing how much time he has to do things. Marcus added, “We talk about time management like what time he has to go to bed and other math stuff for his age.” When I asked Alejandro, “What kind of everyday math do you talk about with your parents?,” he simply stated, “ I can’t remember.”

Assessment Mathematics Talk

The third sub-theme assessment mathematics talk was found to occur with the Vidal family regarding conversations about mathematics grades, STAAR test results, and discussions about general mathematics performance. The family had discussions if Alejandro received a bad grade in mathematics. Marcus explained, “We talk about why he got a bad grade. I ask him was he goofing off or did he not understand the material. I asked him if it was the teacher and if I need to talk to his teacher.” It was clear that Marcus had certain expectations regarding mathematics grades, “I always push him, (I tell him) he needs to get an A or B, if he gets anything lower than a B, I am asking him why (and we talk about it).” When I asked, “What do you say to Alejandro when he does not pass his STAAR mathematics exam?,” he said, “We talk about why he did not pass. He is very self-critical when it comes to schoolwork and he knows how I am kind of stricter whenever it comes to how good he is doing.”

Marcus stated the importance of knowing why Alejandro did not do well in mathematics and the importance of figuring out what needs to be done. He further clarified this by saying, “If he is not understanding math then we go another route, get tutoring or find out why he is not doing well. (Ask the teacher) how can we help so we can actually learn what he needs to be better. My relationships with his teachers have been great and what they have done with him or do for him is great.” When I asked Alejandro about these types of discussions, he remained silent. The Vidal family interview disclosed mathematics talk related to schoolwork, real-world applications, and discussions over grades, STAAR exam results, and general mathematics performance. Parent involvement was evident and both parents supported their son within various contexts concerning mathematics. The mother was more supportive of Alejandro overall and the father was more controlling and stricter. The father admitted he held certain expectations regarding his son's mathematics achievement, and he felt that mathematics was important for his son to learn especially for the sake of his future. Findings did reveal a more in-depth examination of the Vidal family's conversations regarding mathematics.

Positive Mathematics Self-Concept

The interview with Marcus and Alejandro disclosed their mathematics self-concept. Marcus discussed his perception of his academic mathematics skills, rated himself as an 8, and explained how he feels when teaching mathematics to his staff. Marcus mentioned, "On a scale of 1-10, (I am) an eight. I got good grades in math, I was in advanced math classes my entire time in school. (When teaching my staff) it comes naturally if it is something that I do every day."

When Alejandro was asked to describe his mathematics skills, he said, "(I am) like a six or seven because whenever the teacher asks me a question, I can answer it." Alejandro described how he felt when doing mathematics in front of his classmates, he stated, "(I am) ok with it." He also spoke about how he feels about doing mathematics in front of his parents, he remarked, "In front of mom doing my math work makes me feel kind of good (and) doing math in front of my dad makes me feel good." His perceptions of how others view his mathematics skills are generally positive instead of negative. The question "What do you think other people think about your math skills?" was asked and Alejandro replied, I only know what my friend thinks (which is good) and I don't know if my mom and dad think my math skills are good." However, Marcus commented on Alejandro's mathematics skills and he said, "I feel he is up to par where he needs to be for his grade level. I don't tolerate anything less than a B (on his report grade). He is actually very good with his math."

The analysis also found other comments related to general perceptions of others mathematics skills and the importance of mathematics. Marcus feels his wife's mathematical skills are good and she will teach his son what he needs to learn. Marcus's perceptions of his wife were stated, "I am pretty (confident) in my wife teaching (him) and she is (very) patient." Alejandro also mentioned his perceptions of his mom and said, "It makes me feel a little happy when mom helps me with my math homework." He also disclosed his general perceptions about mathematics and he expressed, "(Math) is fine, (math) makes me better. It's just something that you have to learn. Makes me feel kind of good."

When Marcus was asked about how he felt about mathematics, his perceptions of mathematics were generally positive. He talked about the importance of learning mathematics by saying, "I feel it is important for Alejandro to learn math because we need to start building his math skills so later on whatever kind of job (he does) like in the medical field (or) construction, everything takes a little bit of math." He also added, "I have always been good at math and loved doing math. (It) makes the world go round."

The Vidal family experienced moderate mathematics anxiety and both parent and child had positive mathematics concepts. The family's perceptions of how others view their mathematical skills was good. The son felt his friends had a positive perception regarding his mathematics skills and although he did not know what his parents thought about his mathematics skills, he indicated feeling good doing his mathematics in front of his parents. Alejandro (the son) did not have mathematics anxiety regarding others' perceptions of his mathematics skills or doing mathematics in front of others. The father Marcus also explained his perceptions of his son's mathematical abilities which were also positive.

Performance Anxiety

Data findings showed the performance anxiety experienced by the Vidal family. Marcus explained, "If it is something new that I haven't done then I do get a little bit nervous because I look less proficient in my job, to the people that I work for or that I am teaching." He further elaborated by stating, "When I teach someone, I am like ok- we (need to) learn this now and we need it now and you need to be able to do this. In my line of work, the better you are, the more work you get and (you don't want) the bosses to think that you can't do the job." Marcus also stated the importance of doing things right in his line of work. He said, (We) have to do a lot of precision cuts, a lot of measuring and if (we) don't do it right (we) waste a lot of (material) and spend a lot of money that is unnecessary." Marcus also explained how his performance using mathematics and teaching mathematics make him anxious because he said, "I know of the impact that it can actually have on how much money I can make." Marcus spoke about his anxiety regarding his performance in college, he expressed his anxiety by saying, "It makes me anxious (because) I knew that I had to take all those math classes to continue with (my career)."

When Alejandro was asked to explain how he feels before going to mathematics class or how he feels when the teacher asks him a question in math class (question 12 on MARS-E), he replied, "(I get) a little nervous (before going to math class) because (how well I do) will affect my grade. I just don't want to get the question wrong because it could lower your grade." Alejandro felt his math performance was a result of having a bad memory, he elaborated by stating, "I have a bad memory and (I) can't remember. I start to lose stuff (that I was taught).

(It makes) me a little nervous." The Vidal family displayed moments of performance anxiety. Both parent and student experienced moderate mathematics anxiety and performance anxiety in relation to certain mathematical situations. Marcus the father demonstrated performance anxiety when teaching his co-workers, a new mathematical concept and he was consistently worried about how his mathematical skills would influence his salary. Alejandro's (the son) was more anxious about his performance affecting his mathematics grade. Marcus did have high expectations regarding his son's mathematics performance and expected his son to get good grades.

Test Anxiety

The Vidal family explained the types of test anxiety that they experience in school and at work. Alejandro's MARS-E scale scores reported high mathematics anxiety in relation to question 15 studying for a mathematics test, question 16 doing division, and question 17 adding three-digit numbers together. He explained, "I get nervous because it could lower my grade and stuff like that." He also spoke about how he feels nervous when listening to his teacher help him on a math problem (question 26 on the MARS-E) and said, "(I get nervous) because it is probably going to be on the test and if I don't remember I might miss that. (I feel) a little nervous (when I don't understand what the teacher is teaching) because let's say it is on the test and I missed that."

Marcus's MARS-SV score results revealed high mathematics anxiety in relation to questions regarding taking a final mathematics exam (question 1 on MARS-SV) and he stated, "That is usually just tied to final day jitters because I might know the material and gone over it a hundred times by just the act of taking a test and knowing how it is going to affect (my) grade or what you are trying to do with work causes anxiety." Marcus discussed how nervous he feels when thinking about an upcoming test (questions 2-5 on MARS- SV) and stated, “It boils down to (how) that test is going to affect your grade and in my case, it is going to affect either a raise or some sort of certification that I am trying to get. The closer it gets to the test the more anxious I get because I know the impact that it can actually have like on how much money I can make and so forth.” His scale score indicated high anxiety when he has to wait for his mathematics test grade. He explained, “It is because of the impact that it will have on grades, work, (and) money. It’s not knowing exactly how you did even though you think you did pretty well.”

Marcus discussed his anxiety when taking his driver’s license exam (question 30 on the MARS-SV) and he said, “It goes from doing it every day to knowing the exact numbers and getting one of those questions wrong can a pass or fail for your driver’s license and that actually happened to me, I failed because I was off by a few numbers. It caused anxiety because I knew exactly how to drive. I had been driving since I was eight on the farm.”

The family showed moderate (MA) and test anxiety. Both the parent and child felt anxiety concerning the mathematical grade they would receive on a test. Alejandro (the son) had test anxiety and fear of receiving a lower grade in mathematics. He was also worried about not being able to remember what his teacher taught him by the time he had to take his mathematics test. Marcus was more concerned how his grade would affect his ability to move forward in college or how it would impact his salary.

Profile Parent with Low (MA) and Student with Low (MA)

The Hernandez family fit the profile of parents and students with low mathematics anxiety. For this study, 4 out of the 38 participants fell into this category. The participants in the Hernandez family were Victoria, the mother and Warren, the son who is a fourth grader attending a school in Southern Texas. Victoria attended college, works for a medical facility for children, and she uses mathematics every day in her job. Warren feels as though he is a natural when it comes to mathematics as he remarked during his interview, he loves mathematics, and he has a great relationship with his mother. Warren's mathematics benchmark was 68.8% , his MARS-E scale score was a 35, and he experiences low mathematics anxiety. Victoria's MARS-SV score was a 38 and she exhibits low mathematics anxiety.

Schoolwork Mathematics Talk

During the interview, Victoria and Warren spoke about the types of discussions they have regarding mathematics. Their mathematics discourse occurs during homework time and Victoria explained, "We talk about math at home. We go over his assignments, we talk about revising, going over his math (and) I make sure he understands." She mentioned, "He pretty much has (his math homework) done by the time I get home. I don't feel like he needs my help (that much). Our conversations are (more) about what he is learning, something new he is learning in math, and what is going on in math." Victoria explained that when she does help Warren with his mathematics homework, she tries to help him understand and uses real-world applications to help him learn. She said, "We try to find different solutions and (I help) him find the solution and try to make him understand in his mind (by) using things that he likes (so) he can learn the math. We try to use real world examples to help him learn." Victoria further added, "We find it easy to communicate with one another about math. We do not get frustrated."

When Warren was asked about the type of conversations he and his mother have about mathematics, he stated, "I'll tell my mom or dad whoever is here at the house that I need help. (When they help me it makes me) happy because I understand it now. (New math learned) makes me anxious because it is hard to remember what the teacher said and it is so hard because it is all coming into the brain (at once)." Warren also added, "I love things about adding, subtracting, multiplications…(I) study hard. Math is my specialty, it is almost like math, I was born with it."

The Hernandez family's interviews did not disclose any data related to real-world mathematics talk and when Warren was asked about it, he simply stated, "Not really. (We don't talk about it)." However, Victoria mentioned the times she and Warren talk about his mathematics grades and his STAAR mathematics results. She said, "(When he gets a bad math grade, I tell him) do better next time. (I make sure) he is paying attention, (I tell him) to take extra notes if needed and go over his notes for understanding and to ask his teacher for help." Victoria continued saying, "(When he does not pass the STAAR math exam, I tell him) study harder. I feel it is important for him to learn math because it is out there in pretty much everything. He does well (in math)."

The Hernandez family's mathematics talk is mainly about homework, what Warren is learning in math, and his math grades. Warren goes to both parents for mathematics help and he stated that it makes him happy when his mother helps because he understands the math after her assistance. There was parent support during mathematics homework time and the parent does have certain expectations regarding her son's mathematics performance. She understands the importance of her son learning mathematics for his future. As indicated by the interviews, the family's conversations about mathematics happened less often than the other families.

Positive Mathematics Self-Concept

During the interview, Victoria and Warren disclosed many instances regarding their positive mathematics self-concept. The question was asked, "Please describe your mathematics skills," Warren began by stating, "Good because I am making 100s on the math tests. I love things about adding, subtracting, multiplications, I will do well no matter what." Warren also explained that he is excited to be learning mathematics, he studied hard, and his perceptions of how others view his mathematics skills was positive. He explained this by saying, “(I am) not nervous (doing math in front of anyone). I am not nervous at all because I love math so much. I think my (classmates) think I am pretty good (in math). I think my parents think (I am) good.” He also stated that he is not nervous when the teacher calls on him in math class, he said, “(I am) not nervous at all.” He further added, “Math is my specialty, it is almost like math, I was born with it.”

The interview with Victoria asked her questions regarding how she felt about her mathematics skills, other’s perceptions of her mathematics skills, and learning mathematics, she stated, “On a scale of 1-10, I would say I was an 8. It does not bother me at all (when people watch me do math). (I use) math every day in my field to convert and measure different dosages. It is a big use of math.” She further explained, “I understand what he (Warren) is telling me in regards to math and what he is learning. I don’t feel like I lose my confidence in math, it just makes me want to work harder and do better to improve my math.” When she was asked about how she feels about her child’s math skills, she replied, “Good, good, he does well. I don’t feel like he needs my help.” Victoria felt mathematics is important for Warren to learn, she commented on this by saying, “I feel it is important for him to learn math because it’s out there and used in pretty much everything. It is important because it will help us (go) further in our careers.”

The Hernandez family experienced low mathematics anxiety and they both had a positive mathematics concept. The son Warren felt his mathematics skills were good and that others including his mother perceptions of his mathematics skills were also good. His mother also felt her mathematics skills were excellent and her perceptions of how others view her mathematical skills was good. It did not bother the son or the mother if others watched them do mathematics. They did not experience mathematics anxiety regarding others' perceptions of their mathematics skills.

Performance Anxiety

The Hernandez family experienced performance anxiety as indicated by their MARS-SV, MARS-E results, and in their interview. Warren discussed his performance anxiety when he opened up his mathematics book and saw all the numbers (question 7 on the MARS-E), and when reading a hard chapter in his mathematics book (question 11 on the MARS-E). He stated, "Because it's all of these math problems and I will be nervous cause it could be adding, subtracting, or multiplication and sometimes they are all together. I will be pretty nervous because it is like all these multiplications in a line and then you have (to figure out what to do) you have all those problems like that."

Warren expressed some anxiety when doing his mathematics homework, he said, "It makes me anxious because it is so hard to remember what the teacher said and it is so hard because (my mind is overwhelmed) it is all coming into (my) brain." Victoria mentioned one incidence regarding anxiety over performance when taking her driver's license test (question 30 on MARS-SV). She stated, "I am nervous about trying to recall the information and trying to remember everything."

The Hernandez family had low mathematics anxiety, but both experienced performance anxiety with certain mathematical situations. Warren had anxiety when trying to remember everything his teacher taught him in class, he also explained feeling anxious when reading a hard chapter in his mathematics textbook, and when seeing various mathematical problems in his textbook. His mother only experienced mathematics anxiety when taking her driver's license exam. Both parent and child experienced performance anxiety in association with certain mathematical situations.

Test Anxiety

The test anxiety in this family was only experienced by the mother, Victoria. Data analysis disclosed Victoria's feelings regarding test anxiety in relation to her MARS-SV score results. Victoria explained that when she has to wait for the results of her mathematics tests (question 6-7 on MARS-SV), she felt nervous and elaborated by stating, "Just the wait of knowing how well I did where I may need learning. I rather know how I did and I would rather be told in person than wait for a piece of paper to tell me." Her MARS-SV results showed she experiences anxiety when it comes to a pop quiz. In the interview, she said, "I just don't feel prepared as I would like to be. It does not give me time to study." Victoria also experienced anxiety when she took her driver's license exam and she expressed her feelings by stating, "It is more like trying to remember the signs and everything. I am nervous trying to recall the information and trying to remember everything." Only the mother Victoria who had low (MA) experienced test anxiety. Her anxiety was associated with pop quizzes and when she took her driver's license exam. She felt unprepared and nervous about having to recall the information she needed to pass.

Profile Parent High (MA) and Student Low (MA)

The Lucido-Schwartz family fell into this profile and for this study, 2 out of 38 participants fell into this category. The participants from the Lucido-Schwartz family were the mother, Marabel and her son Malakai, a fifth grader attending a Southern Texas school. Marabel received a GED, and she had some college, but dropped out because she could not handle the mathematics classes. Malakai liked mathematics and he felt he was super smart in mathematics as he stated during his interview. Malakai's mathematics benchmark score was 20.6% and his MARS-E scale score was 41 indicating low mathematics anxiety. Marabel's MARS-SV scale results were 103 and she experienced high mathematics anxiety.

The conversations regarding mathematics did not occur within this family. In fact, Marabel communicated that she did not like mathematics. She adamantly expressed this by saying several times during her interview, "I don't like math, I have never done well in math, (and) I don't understand it. I don't understand when the teacher explains it. I have never been able to really understand math." When I asked her what types of conversations she did have with Malakai regarding math homework or real-world applications, she stated, "We don't talk about math or money or anything like that. He does his (math homework) on his own. He is very good at math." When I asked Malakai, he explained, "I don't need a lot of help. I am super smart in math!" When I asked Malakai about other mathematics conversations that may occur for example with money, he simply stated, "I don't know how to manage money."

Positive Mathematics Self-Concept

The family described their positive mathematics self-concept in the interview. Malakai expressed his perceptions of his mathematics skills by disclosing, "I am super smart in math (and) I don't need a lot of help." When he was asked how he felt about learning math, he said, "(I am) good. I do good in math (and) I like math. Because, I am good in math, (I) can do all these things (in) math." His mother, Marabel explained her impression of her mathematics skills, she communicated by saying, I can do everyday math with cooking and measurements. I can do a budget and deal with money. Her viewpoint concerning Malakai's mathematical skills were positive, she expressed her opinion by stating, "(Malakai) is very good at math. It is his favorite subject (and) he does very well in math. (On a scale of 1-10) he is a 10."

Data also revealed the negative mathematics self-concept experienced by Marabel. She explained further by saying, "I have never done well in math. I don't understand when the teacher explains it (and) I have never been able to really understand math." She also verbalized that her math skills were a four and stressed, "I am not good at math." Marabel felt it was not necessary to teach children Algebra, she said, "You don't need that math. I think (Malakai) needs to know the basics but maybe not like Algebra." When she was asked her opinion about how others view her mathematics skills, she replied, "It makes me nervous because I know that I am not very good at math." She also spoke about why she did not attend college and said, "I got my GED and I barely passed that because of the math. I tried to go to college, but I could not handle the math part, I did not pass and I could not do the math so I had to drop out."

The Lucido-Schwartz family had a mother with high mathematics anxiety and a child with low mathematics anxiety. The son Malakai experienced low mathematics anxiety and mathematics self-concept. His perceptions of his mathematical abilities were very high. His mother's perceptions of his mathematics were very positive and she felt he was very good at mathematics. Although the mother Marabel experienced high mathematics anxiety and she did not demonstrate having mathematics self-concept, her son Malakai had mathematics self-concept and low mathematics anxiety despite the mathematics anxiety and lack of mathematics self-concept his mother experienced. This family and the Hernandez family had children with low mathematics anxiety and both children exhibited positive mathematics self-concept. They believed they could learn mathematics without any problems and they felt their mathematics skills were excellent.

Performance Anxiety

Data revealed that Malakai did not experience any performance anxiety. However, his mother, Marabel did mention several instances regarding her performance anxiety during the interview. She discussed how she did not understand mathematics when the teacher taught her, how doing mathematics in front of people makes her nervous, and how she tried to attend college, but failed. Marabel elaborated by stating, “I don’t understand (math) and I don’t understand when the teacher explains it. I have never been able to really understand math. It makes me nervous (to do math in public) because I know that I am not very good in math. I tried to go to college, but I could not handle the math part and I could not do the math so I had to drop out.” She also mentioned several times, “I don’t like math.”

For this family, only the parent experienced performance anxiety. The mother Marabel explained that her mathematics anxiety caused her to drop out of college. This parent emphatically stated she did not like mathematics.

Test Anxiety

Only the mother, Marabel, experienced test anxiety. She felt nervous when taking a mathematics test and her MARS-SV confirmed her feelings (question 1 and 2-5 on the MARS-SV). She explained, “I feel nervous thinking about having to take a math test because I am not good in math. I don’t have the confidence to do math. I got my GED and I barely passed that because of the math. I don’t like taking math tests because I know that I will not understand it and that I will not do well on the test.” The mother who had high (MA) also demonstrated test anxiety. She did not like mathematics and she did not like taking any mathematics tests. Marabel dropped out of college because of mathematics.

Profile Parent with High (MA) and Student Moderate (MA)

The Jones-Mendez family corresponded with the profile, a parent with high mathematics anxiety and a child with moderate mathematics anxiety. This study found 8 out of the 38 participants fell into this category. The participants of the Jones-Mendez family included the mother, Azalea and her son, Arris, a fourth grader attending a South Texas school. Azalea did not go to college, she was not working, and she had a newborn baby girl. Arris had a good attitude when it came to mathematics, he seemed easy-going regarding mathematics, and his general feelings towards mathematics was "regular" as indicated by several of his comments during his interview. Arris scored a 50% on his mathematics benchmark, scored a 66 on his MARS-E scale, and experienced moderate mathematics anxiety. Azalea scored a 126 on her MARS-30 scale which indicates high mathematics anxiety.

Schoolwork Mathematics Talk

The home of the Jones-Mendez family did experience mathematics talk centered around mathematics homework time, studying for tests, and when Arris was learning mathematics through his online mathematics class. His mother expressed that she sits down with him to help him with his mathematics homework and sometimes she reads the mathematics problems to him. She explained, "I sit there and help him like adding, subtracting, decimals, and place values. The math is not too difficult yet for me to help, but we are getting there." She also added, "He has trouble with word problems, we go over it and (I) read the questions, helping him read it where he understands if (the math problem) is adding or subtracting. He understands the reading part, but he may not be able to comprehend if he has to add or subtract." Azalea discussed the process that she and Arris go through when doing mathematics homework together. She said, "I try to help him with everything, it's not like I give him the answers, but I sit there and help him.

We go over it, but not a lot, I feel he can do it on his own. He (just needs) to slow down and take his time."

Arris also spoke about mathematics homework time with his mom and said, "I try to figure it out, but if I still can't, I ask my mom. I understand it when my mom helps me." He discussed his mathematics homework process and his feelings about his mom helping him. His comments were, "I will try it a couple of times, and then, I try it a couple of times again, (when) I am confused, I get my mom (to help me). With my mom (helping me), I feel regular." Arris talked about mathematics word problems and his confusion. He said, "Usually, I can't understand (word problems). You know there is another word that has the same meaning of plus (and) I get confused sometimes."

During the interview Azalea spoke about what takes place when Arris is doing his online learning and the rationale for her actions. She explained, "I will get up with him and listen to everything the teacher is saying because if I don't understand (then) he doesn't understand it. I tell her (and) she will show me what they are doing and if I understand it then I can explain it to him so he can understand it. He might not understand it when she explains it so I will explain it (for him to understand)." Azalea also added, "I believe the virus is affecting his learning right now, he needs more one on one focus." Arris also commented that he gets confused when he does not understand the mathematics that the teacher is teaching him. He said, "(I get) confused because I don't understand (it) and I get my mom." When Arris was asked how he felt when the teacher explains mathematics, he explained that he gets nervous. He stated, "Let's say we just start going over it and as we go over it (I feel) like it's a little test and I get nervous. When it is something that I can get wrong or right, I'm nervous."

Another form of schoolwork mathematics talk for the Jones-Mendez family included studying for tests. During the interview with Arris, he explained that mathematics tests make him anxious. His feelings were expressed when he said, "(I am nervous) because I am thinking that I am going to fail or something. He also gets anxious when waiting to get a mathematics test back, "I am not sure that I did well on the test, when I don't do well on math tests, I get nervous." His mother also commented on their conversations regarding studying for mathematics tests and she said, "Every test that he has, I help him. I thought we did good the first six weeks because we did it together (studied for the math tests). He got a 79 (for his six-week grade), but I felt like it should have been way higher."

The Jones-Mendez family disclosed the types of schoolwork mathematics talk that occurred in their home. Azalea explained that she helped by reading word problems to Arris, helped him study for his mathematics tests and listened to his teacher explain a mathematics lesson during his online class so she can help him learn the mathematics that he did not understand from his teacher. Arris and Azalea discussed their mathematics homework process and Arris explained that he tries to complete his homework on his own, but when he is confused, he will ask his mother for help.

Real-World Mathematics Talk

The Jones-Mendez family has a variety of real-world mathematics talk that takes place such as talking about Arris's allowance, understanding budgets, the value of money, and saving money. Azalea described this type of mathematics talk by saying, "I teach him the value of money. We talk about money, he understands I have to budget, we talk about saving for what he wants, about how to budget, and his allowance." Azalea spoke about the conversation that she and Arris have regarding money. She explained, "He knows if I do this (chore) I will get $5 dollars and if I do this (chore) I might get $3 dollars or I might get $2 dollars (depending on the chore). He is learning how to add it all up to where he can get gift cards for his games, but I tell him that he got to save and budget."

Arris also spoke about the kind of things that he and his parents talk about regarding mathematics. He said, "When it comes to counting money in real life, I can do it myself. I usually buy gift cards with my money for video games. I know how to budget. When I want something I (can) borrow money from my mom or get money for doing the dishes." Azalea explained that Arris gets an allowance for helping around the house, cutting the grass, or helping his grandmother with little things around the house. She stated that "My son is very grateful because I will tell him that I have to pay the bills and he understands that I have to pay the bills before I can buy things." Azalea talks to Arris about the importance of a budget and paying bills first before money can be spent on things that he wants.

When the family talks about budgets, Azalea explained, "He adds up his $10 then gets $15 dollars and he can budget his budget." She told me that he usually just wants gift cards but, she explained to him that he has to budget and save money. Azalea tells Arris, "I am just like you have to save money (and) budget (your) money." Arris described how he is still learning how to budget and count his money. He remarked, "I know how to budget and (count money). Not all the time. I might get confused (and) it might take me a couple of times." Arris also explained the type of conversation that occurs over money with his mother. He said, "When I want something to eat, I usually pay my mom later, (I know that I will) get money for doing the dishes." Azalea disclosed in the interview that although she ranks her mathematics skills as a four, she ranks her everyday mathematics skills as an 8. She mentioned, "Doing everyday math, (I am) very confident in this area. My everyday math with budgets, cooking, measurements, handling money- I am an 8."

Assessment Mathematics Talk

Conversations with Azalea and Arris occur over mathematics grades and they talk about how to do better and what might have gone wrong if Arris has a bad grade in mathematics. She explained by saying "Like see, I thought we did good the first six weeks, but the second six weeks, I don't know where we went wrong. We did it together." Sounding a bit frustrated she further added, "Now, he's like he has to do on his own and (then) we go over it. We can always go back online (to improve his math grade) and how she (the teacher) explained it. He has to focus, he has a hard time focusing. He gets the help at school, but he is not getting help now with the virus going on." Arris seemed relaxed about anything that had to do with mathematics and he simply said, "Math is just math, it is just a subject."

The Jones-Mendez family had a variety of mathematics talk discussions that emerged from their interviews. Azalea took the time to learn the mathematics that Arris's teacher is teaching during his online sessions to later explain it to him, she read mathematical problems to Arris for better understanding, and helped him study for his mathematics tests. She has taught Arris about budgeting, saving money, and how to do chores to receive an allowance. Arris claimed he has been taught real-world life mathematics skills and explained the types of conversations that he has with mother regarding budgeting, saving money, and his allowance. In addition, the parent involvement during mathematics homework time was supportive. The mother had high mathematics anxiety concerning her own mathematics skills and performance in mathematics. Despite this anxiety, she took the time to learn from her son's teacher during online instruction and she made it a point to not allow her perceptions of her mathematics skills to interfere with her son's perceptions of mathematics or his learning of mathematics.

Positive Mathematics Self-Concept

Data findings revealed the positive mathematics self-concept demonstrated with the Jones-Mendez family. When Arris was asked how he feels his mathematics skills, he began by saying, "On a scale of 1-10, I am a 7.5 because of my grades and how good I am doing in math." He also expressed feelings regarding his mathematics abilities and said, "I am not scared, I am just regular." Arris explained how his classmates rate his mathematics skills as an 8.5 on a scale of 1-10, and his mom rates him at a 7. The question about how he feels about doing mathematics in front of his classmates or parents, he responded, "(I feel) regular with classmates and with my mom." Arris also added, "When I don't do well in math, (I know that) I should do better."

The question was asked to Azalea regarding how she felt about helping or not being able to help Arris with his mathematics, she replied, "I am not nervous or feel like I will give him the wrong answers. If I don't understand, I will go to google and check my answers and I will end up getting right." Azalea also expressed her feelings about her mathematics skills and her ability to help Arris, she said, "The times when I am helping (him) I am just hoping that he understands the way I am helping him. I will get up with him (in the mornings) and listen to everything the teacher is saying and I can understand it (so) later, I can help him." She also explained that just because she lacks self-confidence in mathematics, she does not project these feelings onto Arris. She stated, "I don't project my lack of confidence onto my son because I will help him."

Azalea whose MARS-SV scale results was 126 experienced high mathematics anxiety and demonstrated negative mathematics self-concept as well. She discussed this by saying, “I was never really strong in math myself. Math makes me tense up because when I was in school, they could never really break it down for me (to learn it). Most of the time, I would not get it. When the question was posed regarding how she felt about her mathematics skills, she said, “(My) academic math is a 4 (on scale of 1-10). I can mainly add and subtract and I can divide simple stuff. I always doubt myself.” Azalea discussed her feelings about her mathematics skills and spoke of her lack of confidence and how this affected her life and college, she said, “If I would have been better in math, it would have pushed me to go to college. I felt like I was not confident enough, I did not have the confidence in myself. I was scared and that is why I did not go to college.”

The Jones-Mendez family had a parent who experienced high mathematics anxiety and a child who experienced moderate anxiety. However, despite his mother having high mathematics anxiety, Arris (the son) still had a positive mathematics self- concept. He did not indicate having any mathematics anxiety regarding others’ perceptions of his mathematical skills or doing mathematics in front of others. The mother Azalea had high mathematics anxiety and she did not attend college because of her own perceptions regarding her ability to do mathematics. Azalea did not have a mathematical self- concept and in fact, analysis found she experienced a negative mathematics concept. What is significant thus far from findings is that both children in the Hernandez and Jones-Mendez family experienced moderate mathematics anxiety and positive mathematics concepts despite the fact that both their parents experienced high mathematics anxiety..

Performance Anxiety

The family demonstrated performance anxiety as indicated by the research findings. Arris stated that he felt nervous when the teacher is teaching mathematics (question 26 on MARS-E), when doing word problems (question 2 on MARS-E), or when he starts to read a new hard chapter in his textbook (question 11 on MARS-E). He explained by saying, "(I get) confused because I can't really understand. (With word problems) you know how there is another word that has the meaning of plus (then) I get confused sometimes." Arris discussed how he feels when doing mathematics, he said, "When it is something that I can get wrong or right, I'm nervous."

Azalea communicated her thoughts regarding her mathematics performance and she expressed this by saying, "If I would have been better in math, I just doubt myself (and) I don't have enough confidence to do it." She also explained how her mathematics performance kept her from attending college. She stated, "I did not have confidence in myself, taking a math test to get into college, I was scared (I would not pass it) and that is why I did not go to college." She further added, "If I would have had the opportunity for someone to help me with my math, I would of went to college."

This family had a parent with high mathematics anxiety and a student with moderate mathematics anxiety. Both parent and student also experienced performance anxiety in certain situations. The son Arris demonstrated mathematics anxiety in association with word problems, when the teacher is teaching mathematics, and when reading a hard chapter in his mathematics textbook. The mother Azalea experienced high mathematics anxiety and her anxiety kept her from attending college. Students with moderate mathematics anxiety also demonstrated some anxiousness in the classroom when learning mathematics or being asked questions over concepts learned during class. As demonstrated by Arris and Alejandro who both had moderate mathematics anxiety.

Test Anxiety

The family talked about their test anxiety and interviews provided further examination regarding their MARS score results. Arris spoke about his feelings in relation to taking a mathematics test (question 13 on the MARS-E) and said, “(I get nervous) because I am thinking that I am going to fail or something.” He also explained when he had to wait for his mathematics test grade (question 18 on MARS-E), he stated, “I am going to see my grade and I am not sure that I did well on the test. When I don’t do well on a math test it makes me nervous. When it is something that I can get right or wrong, I get nervous.”

The parent also spoke about her test anxiety and explained how she feels anxiety when having to take a final mathematics exam (question 1 on the MARS-SV). She discussed her feelings by saying, “I feel like yes, I went over this, yes, I was taught it, but am I really going to get it wrong. I always doubt myself and I am more worried about the grade that I will get.” Azalea disclosed her anxiety when thinking about taking mathematics tests (question 2-5 on the MARS-SV) and she said, “I feel anxiety because it is intense and I want to have confidence in myself and I am doubting myself in the back of my head. Do I have enough confidence to do it? The more and more it gets closer (to a math test) I am more tense.”

She talked about her feelings when waiting to receive her grade on a mathematics test or in the mail (question 6 and 7 on the MARS-SV). She expressed, “I doubt myself because I thought that I did good and then I think that I could have done better and I start thinking this way.” Azalea experienced anxiety when getting ready to study for a mathematics test and she elaborated by saying, “It all relates to my confidence. It depends on the state that I am in.” When she was asked about how she felt about taking the mathematics section of a college entrance exam (question 11 on MARS-SV), she stated, “Taking a math test to get into college, I was scared and that is why I did not go to college.” The parent of this family had high (MA) and the student had moderate (MA) and both experienced test anxiety. The son Arris was more concerned about failing a mathematics test and it made him nervous having to wait to see how he did on a mathematics test. The mother Azalea did not attend college because she was scared of taking the college entrance mathematics exam.

In conclusion of chapter four findings, table 19 shows each profile that was discussed, the characteristics specific to each profile, the parent findings within that profile, and the student findings. A key was created for the table and signifies important concepts mentioned throughout chapter four. In addition, parent findings illustrate the particular factors provided from the six-factor confirmatory model from research by Pletzer and associates (2016) and student findings represent the distinct factors of the five-factor model from Soni and Kumari's (2017) research.

Table 19

Profile Findings

Profile	Characteristics	Parent Findings	Student Findings
(Key: MSC=mathematics self-concept, PA=performance anxiety, TA=test anxiety, FS=favorite subject, PI=parent involvement, EA1=evaluation anxiety 1, EA2=evaluation anxiety 2, LMA=learning mathematics anxiety, Math CA=math computation anxiety)			
Parent (HMA) Student (HMA) (Lafuente)	More Math Talk Less Strict Parent Involvement (both) Parent Support (both) Anxiety Affected College	Positive MSC Negative MSC More PA More TA Good Math Attitude FS Math EA1 & EA2	Positive MSC Negative MSC Math CA TA Good Math Attitude FS Math Math Teacher Anxiety
Parent (MMA) Student (MMA) (Vidal)	Math Talk Stricter Parent Involvement (both) Parent Support (Mom) Parent Control (Dad) Dad uses Math at work	Positive MSC PA TA Good Math Attitude EA2	Positive MSC Math CA TA Good Math Attitude Math Teacher Anxiety

Parent (LMA) Student (LMA) (Hernandez)	Less Math Talk Less Strict Less PI (Mom) Parent Support (Mom) Mom uses Math at work	Positive MSC. PA TA FS Math Great Math Attitude EA1 & EA2	Positive MSC Math CA No TA FS Math Great Math Attitude Math Course Anxiety
Parent (HMA) Student (LMA) (Lucido-Swartz)	No Math Talk Less Strict PI (Mom) Parent Support (Mom) Anxiety Affected College	Positive MSC Negative MSC More PA More TA Bad Math Attitude EA1 & EA2	Positive MSC No Negative MSC No PA No TA Great Math Attitude
Parent (HMA) Student (MMA) (Jones-Mendez)	More Math Talk Less Strict PI (Mom) Parent Support (Mom) Anxiety Affected College	Positive MSC Negative MSC More PA More TA EA1 & EA2 LMA	Positive MSC Negative MSC Math CA TA Good Math Attitude Math Course Anxiety Math Teacher Anxiety

In chapter five, the research findings are organized to discuss the profiles revealed from the MARS scale results. Each profile provides an in-depth description of characteristics and specific findings from both parents and students. The discussion also reveals certain similarities and differences among each profile and previous research conducted on mathematics anxiety and mathematics self-concept. In addition, implications, limitations, and further research are discussed.

CHAPTER V: CONCLUSION

This mixed-method research study examined 38 students and parents' perceptions of mathematics anxiety (MA) as measured by the Math Anxiety Rating Scale for elementary students (MARS-E) and the Math Anxiety Rating Scale for adult's short version (MARS-SV). The Pearson product-moment correlation coefficient determined there was a moderate relationship between parents and students' mathematics anxiety ($r=.39$, $n=38$, $p>0.05$) and discovered various forms of mathematics talk occurring between parents and students. The study found three distinctive conversations transpiring among families that included schoolwork, real-world, and assessment mathematics talk. In addition, the quantitative findings from the MARS scale results produced five profiles (Table 20). The qualitative findings provided an in-depth examination of the MARS scale results, informed some of the interview questions, and provided a rich description of each profile. For each profile, one family was selected and interviewed and revealed certain characteristics, similarities, and differences among the profiles.

Table 20

Five Profiles

Parent	Student (child of parent)	Families
High Anxiety	High Anxiety	Lafuente
Moderate Anxiety	Moderate Anxiety	Vidal
Low Anxiety	Low Anxiety	Hernandez
High Anxiety	Low Anxiety	Lucido-Schwartz
High Anxiety	Moderate Anxiety	Jones-Mendez

There were four research questions guiding this study and each research question contained the same descriptor "fourth and fifth grade students considered low performing in mathematics". The four research questions guiding the study were:

(1) What are the perceptions of mathematics anxiety of fourth and fifth grade students considered low performing in mathematics?

(2) What are the perceptions of parents' mathematics anxiety?

(3) Is there a relationship between a parents' mathematics anxiety and a student's mathematics anxiety?

(4) How do parents and their students talk about mathematics?

This chapter reports a more in-depth look into the five profiles by connecting the results to the literature regarding the theoretical framework of self-concept research, and research conducted on mathematics anxiety, parent support, parent involvement, and mathematics talk. This section has been organized to discuss similarities between the profiles, common characteristics found within the profiles concerning the parents and students, other important considerations from findings, implications, limitations, and future research.

Similarities Between the Profiles

The findings for this study were consistent with mathematics anxiety research and found that all five profiles showed a moderate relationship ($r=.39$, $n=38$, $p>0.05$) between parents and students' mathematics anxiety (Berkowitz, Schaeffer, Maloney, Peterson, Gregor, Levine, & Beilock, 2015; Gunderson, Ramirez, Levine, Beilock, 2012; Maloney, Ramirez, Gunderson, Levine, & Beilock, 2015; Schaffer, Rozek, Berkowitz, Levine, & Beilock, 2018). However, contrary to previous research with the exception of one study (James & Fusco, 2014), mathematics anxiety did not negatively affect mathematics self-concept (Lee, 2009; Justica-Galiano, Martin-Puga, Linares, & Pelegrina, 2017; Pajares & Kranzier, 1995; Pajares & Miller, 1994). The current study found both parents and students within the five profiles had positive mathematics self-concept despite exhibiting character mathematics anxiety. Students' positive mathematics self-concept was a result of parent support instead of parent control, frequent mathematics talk between the parent and student, and students generally having a good attitude regarding mathematics. Parents' positive mathematics self-concept consisted of real-world mathematics such as managing household finances, successfully working with mathematics at their place of employment, sufficiently helping their child with their mathematics, and maintaining a good attitude about mathematics. Parents also demonstrated their mathematics funds of knowledge and used what they already knew to help their children with their mathematics. This was similar to research that found parents mathematics funds of knowledge contributed to success in mathematics. Families contributed valuable knowledge, and they were seen as experts which as studied by Civil, contributed to a student's mathematical learning (Civil, 2007).

The study's results were confirmed by previous research (Silinkskas & Kikas, 2019) that found parent support instead of parent control contributed to mathematics self-concept. For example, parent support for this study consisted of parents assisting their child with homework only when asked, parents were actively involved and included learning new mathematical concepts for their children when needed, parents did not punish their children for obtaining bad grades in mathematics, and parent expectations were realistic. These findings were consistent with the type of parent support that Silinkskas and Kikas (2019) found to contribute to a students' competence, mathematics self-concept, and task persistence. Results also found students had positive mathematics self-concept because parents were not strict or controlling during mathematics homework, parents had realistic expectations, and there was a trust between the parent and student further assisting the students' success in mathematics in this study. For instance, students felt their parents' support and involvement contributed to their success in mathematics, they were happy for the homework assistance, and the interactions between parents and students were very positive. Levpušček and Zupančič (2009) found the same results with parents who were less strict and controlling during mathematics homework, had realistic parent expectations, and there was a general trust between the parent and student. In addition, their study found parent control undermined the student's success in mathematics. Therefore, parent support instead of parent control was found to assist students in developing a positive mathematics self-concept and mathematical success and their finding was consistent with the results from this study.

Additionally, parents only helped with homework when asked by the child. This was consistent with mathematics funds of knowledge research by Williams et al., 2020 that found parents tended to wait for children to ask for help during mathematics homework and only provided assistance when needed. This same study also found that parents held mathematical discussions regarding mathematics to help their children learn mathematical concepts which was also true for the current study. The type of mathematics used in the households in Williams et al., (1992) study included problem solving, reasoning and proof, communication about mathematics, connections, and representations of mathematics. This was similar to the current study's findings, mathematics talk was a common factor found in four of the five profiles and the different types of communication that occurred within those households.

Other similarities included four out of the five profiles established that there was mathematics talk transpiring between the parent and the student (their child). The three types of mathematics talk occurring within the profiles included schoolwork, real-world, and assessment mathematics talk. Parents with high MA showed increased occurrences of mathematics talk when compared to other profiles with the exception of the parent with high MA and the student with low MA (the Lucido-Schwartz family). Results showed mathematics talk to have a positive impact for the students and parents of this study. For example, students spoke about how much their parents helped them during mathematics homework and how this contributed to their learning mathematics especially difficult concepts not understood while in their mathematics class. This finding is similar to Susperreguy and Davis-Kean (2016) who found that there was a positive impact on children's early mathematics ability when they are exposed to mathematics talk. Findings also concluded that there was a significant amount of time spent on mathematics talk with all five profiles, but especially for the profiles where parents experienced high MA. This correlates with previous research that found the amount of time parents engaged their children in number related activities in the home predicted children's numerical knowledge and development (Ramani et al., 2015). Additionally, parents in this study took extra steps to ensure their children were learning the mathematics they needed to be successful. Parents would listen to their child's online mathematics classes, listen to the other parent go over mathematical concepts when doing homework, used household items to teach mathematics such as using beans for counting and grouping, and utilized the interests of the child to make real-world connections to mathematics being learned in school.

Parents in the study utilized their mathematics funds of knowledge to facilitate mathematics learning in their homes. This is similar to research that found families have unique types of knowledge that can and do promote learning for their children (Moll, Amanti, Neff, & Gonzalez, 1992). For example, parents in the current study used beans for counting and grouping which helped their child better understand multiplication, mathematics discussions between parent and child also consisted of video game scoring and calculating totals of numerous scores, and there was a fair amount of financial literacy discussion over budgeting, shopping, saving money, time management, and allowances. This related to research that found households utilized mathematics in cooking, construction, sewing, and time management (González, Andrade, Civil, & Moll, 2001; Williams, Tunks, Gonzalez-Carriedo, Faulkenberry, & Middlemiss, 2020). Williams et al., (2020) found parents supported mathematics learning and that they intentionally promoted mathematics in their household (Williams et al., 2020). Data revealed many instances of financial literacy occurring in the households, communication when doing mathematics homework, and helping students make real-world connections to concepts learned in the classroom (Williams et al., 2020). This was also the case in the current study, parents intentionally taught their children financial literacy, communicated during mathematics homework known as mathematics talk, and helped their children make real-world connections to concepts learned in the classroom.

The parents of this study were consistent with other research conducted on adults that found higher self-perceptions regarding real-world mathematics (James & Fusco, 2014). Mathematics talk between parents and students also included discussions about parent expectations regarding mathematics grades, plans of actions for improving mathematics achievement especially concerning benchmark scores and STAAR mathematics exams. Parents and students both expressed their mathematics talk to be positive in nature, students felt supported by their parents, and parents felt they were supporting the mathematical learning needs of their children. The results showed mathematics talk assisted with mathematics learning including real-world applications and parents stated their children had good grades in mathematics. Evidently, mathematics achievement is taking place and perhaps the STAAR mathematics exam is not an adequate indicator of mathematics achievement after all.

Common Characteristics Within the Profiles

Parent Common Characteristics

The three profiles concerning parents with high MA shared some characteristics specific only to this profile. These common characteristics included low academic self-concept, but parents had positive mathematics self-concept with real-world applications such as managing their personal finances, they did not have higher education attainment, they had positive parent interactions with their children, and they experienced more test and performance anxiety than any of the other profiles.

Academic Self-Concept

Results showed parents with high MA had low academic self-concept, however, their children had high academic self-concept. Parents were aware of their own feelings regarding their inadequacies concerning mathematics and they did not want their perceptions of mathematics to influence their child's mathematics learning, anxiety about mathematics, or influence their decisions regarding future decisions. This is consistent with research that found parents' perceptions to affect a child's self-concept (Shavelson & Bolus, 1982). Parents realized their low academic self-concept adversely influenced their own decisions to attend college or stay in college. For example, one parent stated she dropped out of college because she did not feel her mathematics skills were good enough, and the other two parents feared taking the college entrance exam for mathematics because they believed their mathematics skills were insufficient. Results were confirmed by previous research that found negative self-perceptions impact adult learner retention and degree completion (Kazis, Callahan, Davidson, McLeod, Bosworth, Choitz, & Hoops, 2007). Two parents in this profile explained how these negative perceptions affected their decisions and they did not wish the same to happen to their children.

The parents with high MA in this study emphatically declared their lack of self-confidence concerning academic mathematics, and their perceptions of their academic mathematical abilities did show low academic self-concept. The parents' low academic self-concept influenced their task choices, motivation, sustained effort, and persistence which is needed to improve academic achievement and academic self-concept as found in academic self-concept research (Marsh, 1990; Shavelson et al., 1976). In addition, the parents did not have self-confidence, they felt less competent, and unsuitable for higher education. These findings were similar to other studies that found adult learners who had lower self-confidence also believed themselves to be less capable and lacked the experience needed for an academic environment such as college (Kasworm, 2008; Ross-Gordon, 2003). Parents expressed wanting their children to do well in mathematics because they felt mathematics was important for their child's future such as going to college and they felt good mathematical skills were needed to be successful in life. Parents stated the importance of learning mathematics and understood the significance of mathematics for obtaining a good job. Parents with high MA did not wish their children to experience the type of mathematics anxiety they felt or lack self-confidence concerning mathematics. These reasons influenced the parents' decisions to maintain a positive attitude regarding mathematics, to help their children with their mathematics homework, and to engage in conversations regarding mathematics such as what children were learning in school, talking about their child's grade in mathematics, and why they were not passing their benchmarks in mathematics or the STAAR mathematics exam.

Parent Interactions

Other commonalities found among parents experiencing high MA included the type of interactions demonstrated in the home. For example, when parents interacted with their child regarding mathematics, this included maintaining a positive attitude about mathematics despite their inadequate mathematical skills, lack of self-confidence, and negative beliefs concerning mathematics. Parent interactions were positive. This finding contradicts previous research that found negative parent interactions influenced their child's mathematics anxiety, mathematics attitudes, and mathematics achievement (Gunderson, Rameriz, Levine, & Beilock, 2012). Results showed the opposite in relation towards attitude and achievement but were consistent with mathematics anxiety. Students in this study had a good mathematics attitude, showed mathematical achievement, but had mathematics anxiety. Therefore, positive parent interactions and parents having a positive attitude towards mathematics contributed to their child's attitude about mathematics and assisted with their child's mathematical achievement.

Findings also showed parents did not allow their preconceived ideologies to interfere with their child's mathematics attitudes and achievement. Parents kept a good attitude about mathematics, parents did not permit their mathematics anxiety to show, nor did they allow their beliefs about mathematics to interfere with their child's perception of mathematics or their learning. Findings were opposite of research that found a parents' preconceived ideologies concerning mathematics to negatively impact their child's mathematics anxiety, mathematics attitudes, and mathematics achievement (Gunderson, Rameriz, Levine, & Beilock, 2012). Parents within this profile believed their children were good at mathematics, had the ability to learn mathematics, and were happy with their child's mathematics performance. In turn, the students within these profiles felt the same. The parents' beliefs in this study contributed to their child's mathematics performance which was substantiated by research conducted by Lee (2016) who also found parental beliefs fostered their child's mathematics performance. Parents in this study were frequently helping their children with their mathematics homework and their positive interactions contributed to their children learning their mathematics. These findings contradicted research that found that when parents did not like mathematics or felt inadequate in mathematics and frequently assisted their children with their homework, their children learned less mathematics (Maloney et al., 2015). This simply was not the case for the three profiles of parents who experienced high MA in this study.

Parents with high MA showed many instances of mathematics learning that took place contrary to Maloney and associates findings (2015) and exhibited good attitudes towards mathematics and confidence within certain mathematical contexts such as real-world applications. Students also demonstrated mathematical success regarding their mathematics grades, formal assessments such as quizzes and tests, informal assessment such as mathematics homework, and real-world mathematical applications. Even parents within this profile demonstrated mathematical learning that occurred to help their children with their mathematics. This included learning new mathematical concepts by listening to their child's online classes, researching mathematical information that they did not know, learning from another parent in the home, and asking the child's teacher. Despite experiencing high MA and negativity regarding mathematics, parents did not project these ideologies onto their children and were consciously aware how less than positive attitudes might captiously affect their children.

Test and Performance Anxiety

All five profiles showed mathematics anxiety pertaining to test and performance anxiety. However, parents with high MA demonstrated more test anxiety than any other profile in this study. They had a considerable amount of anxiety related to test taking, they felt they did not have the mathematical skills to do well on tests, and they lacked confidence regarding their mathematical abilities. The fear and worry experienced by parents were consistent with other research that has found these emotions to interfere with the learning process, impair test performance and cause mathematics anxiety (Wigfield & Meece, 1988). All profiles experienced nervousness and stress even when just thinking about taking a mathematics test. Parents with high MA also showed more performance anxiety than any other profile in this study. This is consistent with literature that found performance anxiety decreased performance and poor performance increased mathematics anxiety (Beilock, Schaeffer, Rozek, 2017). Higher mathematics anxious individuals such as the parents with high MA in this study, have more performance anxiety. They did not feel comfortable doing mathematics in front of people with the exception of their children, they worried about their ability to learn mathematics due to lack of confidence, and they feared solving mathematical problems. Results were confirmed by Richardson and Woolfolk (1980) who argued that mathematics anxiety is a person's reaction to numbers and evaluative situations such as testing and Beilock et al. (2017) stated performance anxiety can be a result about the task at hand such as solving mathematical problems. Furthermore, mathematics anxiety could be associated with feelings of inferiority (Beilock et. al., 2017; Richardson & Wookfolk, 1980) Parents in the study demonstrated the type of performance anxiety associated with negative emotions (Wigfield & Meece, 1988), poor performance (Beilock et al., 2017), and when solving mathematical problems or when taking a test (Beilock et. al., 2017; Richardson & Wookfolk, 1980).

An important note of the findings within the profile of parents with high MA, is that parent interactions with their children were positive and parents did not allow their fears with mathematics and lack of confidence to interfere with the mathematical development of their children. In fact, this group showed more of a willingness to do whatever was necessary to ensure their children were learning mathematics. They showed resilience despite their own limitations in mathematics and it was clear that their children benefited from the various types of parent interactions that took place.

Student Common Characteristics

Some common occurrences within each profile were found among the students participating in this study. All five profiles had positive mathematics self-concept, mathematical task anxiety, and a good attitude regarding mathematics. In addition, profiles with high MA and moderate MA showed more test anxiety than students with low MA.

Mathematics Self-Concept

Evidence proved students within all five profiles had positive mathematics self-concept. Despite low performance in mathematics as indicated by their STAAR's mathematics exam results, their mathematics benchmark outcomes, the level of mathematics anxiety reported on their MARS-E, students still demonstrated mathematics self-concept. Students showed positive mathematics self-concept because there was parent support, positive parent interactions, frequent mathematics talk, and positive attitudes concerning mathematics. These results were contrary to Lee (2009) who found mathematics anxiety to decrease mathematics self-concept and similar to Jameson and Fusco (2014) who did not find a relationship between mathematics anxiety and mathematics self-concept in their study. For this study, students reported their perceptions of their ability to learn mathematics, the belief in their ability to do well in mathematics, discussed their feelings when asked to do mathematics in front of classmates, and in front of their parents. Students felt comfortable doing mathematics in front of their classmates and parents for the most part. The academic self-concept (ASC) within these profiles was similar to research on academic self-concept which stated ASC is developed through a social comparison process in which peers are the frame of references for students to judge their own abilities (Marsh, 1987; Marsh & O'Mara, 2003; Skaalvik, 2002). In addition, self-concept research also stressed how the student's perceptions of how their parents view their skills has a positive relationship (Shavelson & Bolus, 1982).

Students in this study felt supported by their parents concerning mathematics. These findings are similar to research that found parent support instead of parent control to have a positive influence on academic achievement (Silinskas & Kikas, 2019) and parent control or support can affect self-concept (Dumont et al., 2012). Evidence provided examples of how parent support affected the students' self-concept. For example, students explained feeling good when their parents helped them with their mathematics homework and felt they were able to better understand the mathematical concepts taught at school. Parent support contributed to the students' mathematics self-concept (Dumont et al., 2012) and all profiles demonstrated some type of parent support during mathematics homework or when discussing mathematics. My recommendation would be for parents to continue parent support instead of parent control, maintain positive parent interactions, keep up frequent mathematics talk, and sustain their good attitudes regarding mathematics because it works. Their children are learning mathematics, receiving good grades in mathematics, have mathematics self-concept despite experiencing mathematics anxiety, and have a good attitude concerning mathematics.

Mathematical Task Anxiety

Students from each profile struggled trying to recall the mathematical concepts taught during class to complete their mathematics homework. Anxiety over completing mathematical tasks (Wigfield and & Meece, 1988) and performing mathematical computations Carey et al., 2017; Hopko et al., 2003; Paechter et al., 2017; Richardson & Suinn, 1972) were found to be a problem in this study as similar to other studies concerning mathematics. Students felt anxious, confused, and often stated having a bad memory. Even students with low MA experienced this type of anxiety. Parents were also concerned since their children were frustrated and stressed when completing their mathematics homework. Contrary to research that found when students had a negative relationship to mathematics performance, this affected the amount of effort that students put into mathematics (Paechter et al., 2017; Wigfield & Meece, 1998), students in this study demonstrated task persistence despite their anxiety and were able to understand mathematical concepts once explained by their parents. The students' task persistence was a result of parent support, positive parent interactions, mathematics talk, and parents and students' good attitudes towards mathematics. Interestingly, studies have found mathematics anxiety to negatively impact one's ability to master mathematics content (Ashcraft & Krause, 2007; Hembree, 1990; Ma & Xu, 2004; Meece, Wigfield, & Eccles, 1990) even among elementary students (Harari, Vukovic, & Bailey, 2013; Ramirez, Gunderson, Levine, & Beilock, 2012). In this case, mathematical task anxiety contributed to the students' inability to perform at grade level on their mathematics benchmark and STAAR exams.

Other mathematical task anxiety within profiles were demonstrated among students with high MA and students with moderate MA. Evidence provided characteristics within both profiles and students experienced nervousness and stress when faced with word problems. Confusion about what type of computation to use and stress over the different words for addition, subtraction, multiplication and division were the main issues. For instance, there are many words utilized for addition such as sum, altogether, all, in all, together, total, total number, add, increase, increased by, and more than. These findings compare to other mathematics anxiety research that stated MA occurs when individuals manipulate numbers and try to solve mathematical problems (Carey et al., 2017; Hopko 2003). Students discussed feeling nervous because they were afraid to get the answer incorrect or they felt overwhelmed by multistep mathematical problems. Students impacted by anxiety likely deplete their cognitive process (Ramierz, Gunderson, Levine, 2013) and this affects their working memory which students in this study stated they had a "bad memory" when it came to remembering mathematical concepts taught in class and when solving word problems. Working memory is a vital cognitive process for solving mathematical problems associated with multistep problems (Ashcraft & Krause, 2007; Luttenberger, Wimmer, & Paechter, 2018). Students in this study exhibited mathematics anxiety and negative reactions regarding mathematics and this interfered with their learning process (Wigfield & Meece, 1988). In addition, their negative reactions included fear of making mathematical mistakes (Chipman, Krantz, & Silver, 1992; Dutton, 1951) and stress over multiple step mathematical problems (Ashcraft & Krause, 2007; Chipman, Krantz, & Silver, 1992; Dutton, 1951 Luttenberger, Wimmer, & Paechter, 2018) which caused anxiety. These findings were similar to problems associated with mathematics anxiety in other research (Ashcraft & Krause, 2007; Chipman, Krantz, & Silver, 1992; Dutton, 1951; Luttenberger, Wimmer, & Paechter, 2018).

Positive Mathematics Attitudes

All profiles demonstrated a positive attitude about mathematics even students who experienced high MA. Gunderson et al. (2012) found children's learning of mathematics is linked not only to their academic skills, but also to their attitudes ("I enjoy math") and their beliefs about math ("I am a math person"). Findings had similar results and students expressed liking mathematics, the students with low MA expressed being "a natural at mathematics", "super-good with mathematics", and believed they were excellent when it came to mathematics. Parent attitudes also contributed to the students' positive attitudes concerning mathematics in this study since when parents express negativity in front of their children concerning mathematics, this can have negative consequences (Gunderson et al., 1988; Wigfield & Meece, 1988). Parents in this study maintained a positive attitude about mathematics and this was a favorable outcome regarding their child's attitudes about mathematics.

Research has found mathematics test anxiety to decrease mathematics achievement (Wigfield & Meece, 1988), this was not the case for the current study concerning students with high MA and moderate MA. However, a past study showed higher levels of anxiety before taking a mathematics test (Seng, 2015). Results found that students did have higher levels of mathematics anxiety before taking a test and they experienced negative emotions associated with mathematics tests as well. It is known that mathematics anxiety also produces negative reactions such as nervousness, fear, discomfort, and worry (Wigfield & Meece 1988) which was also experienced by the students in this study. These negative emotions were also found to interfere with the learning process and impair test or task performance (Wigfield & Meece, 1988). This was contrary to findings in the current study since students demonstrated mathematical achievement on quizzes, tests, and homework as indicated by their parents. What is unclear is why were students demonstrating proficiency with formal and informal assessment in the classroom, but not passing their mathematics benchmarks or STAAR exams.

Other Important Considerations

The results of this study brought forth other questions that need to be considered when examining mathematics anxiety. Data showed the profile of the parent with high MA and their child with low MA did not experience mathematics talk. Did this occur because the parent disliked mathematics, or felt their mathematical skills were insufficient? The child had mathematics self-concept, loved mathematics, and felt their skills in mathematics were excellent. Did the lack of mathematics talk actually help the child with their mathematics self-concept since the parent was not expressing their negative feelings concerning mathematics? As research has indicated negative discussions about mathematics effects mathematics self-concept (Dumont et al., 2012; Gunderson, Rameriz, Levine, & Beilock, 2012; Silinskas & Kikas, 2019) mathematics anxiety (Kung & Lee, 2016), and mathematics performance in children (Levpuscek & Zupancic, 2019)

Findings revealed that the studies five profiles whose profiles experienced high mathematics anxiety had positive mathematics self-concept, parents had a good attitude about mathematics, parents were not talking about mathematics in a negative way, and more mathematics talk was occurring in their homes. So, what was actually causing the mathematics anxiety in their children? Also, the profile with a parent with high MA and the student with high MA experienced tension and frustration between the father and son when doing mathematics homework and the child felt nervous when working with his father. However, the child was comfortable when working with his mother. Can one positive parent in the household be enough to foster mathematics self-concept? What would be the outcome if both parents had positive interactions? And would this reduce the child’s mathematics anxiety overall?

Results also revealed that profiles with parents and students with low and moderate MA showed parents had success in mathematics such as attending college and working in a career where mathematics is used on a daily basis. Did this affect their children's mathematics self-concept? Results generated these additional questions to consider and future research is needed to fully comprehend the various elements associated with mathematics self-concept, mathematics talk, and parental influence concerning mathematics especially future decisions regarding higher education and occupational choices.

Implications

Implications include how this study will inform interventions for students struggling in mathematics and families experiencing mathematics anxiety. It is critical to foster a student's mathematics self-concept and provide a curriculum that will accomplish such a task in school, at home, and during interventions. Parent workshops need to teach the differences between parent support and parent control, how to have positive interactions with their children, and how to remain positive even when they feel negative about their own mathematical skills. Parent workshops need to teach parents about mathematics especially since parent involvement does contribute to mathematical success and parents are eager to learn new mathematical concepts to assist their children with learning as indicated in this study. Taking these steps will assist families struggling in mathematics, experiencing mathematics anxiety, and foster mathematics self-concept for students and their parents. In addition, schools need to consider parent workshops that can build a parents' mathematical confidence to complete their GED, assistance with college entrance exams, and resources to help them stay in college. For example, extensive counseling specific to the needs of the parent and providing a mentor to assist parents academically may help parents reach higher educational attainment.

Professional development will be necessary to help teachers learn and understand mathematics anxiety, provide strategies to utilize with students and parents to reduce mathematics anxiety and learn ways to build mathematics self-concept in students and parents. Professional development can help teachers implement practices in the classroom to reduce these anxieties especially concerning anxiety associated with tests, performance anxiety such as doing mathematics in front of the class and balancing the amount of material covered in class, so students do not feel overwhelmed from too much information as found in this study. Professional development needs to teach teachers how to conduct parent workshops to help parents with their mathematics anxiety especially in association with homework assistance, positive parent interactions and attitudes regarding mathematics, and the importance of mathematics talk in the home. This is especially true for students and parents already struggling in mathematics. In addition, teachers need to take the time to know their parents, to understand their parents' mathematics funds of knowledge, and actively involve parents in the mathematical learning process (Civil, 2007).

Teachers could videotape their mathematics lessons for families to utilize as a resource when doing mathematics homework with their child and this may improve mathematics performance and reduce mathematics anxiety. This study found that the parent who watched their child's online mathematics lesson learned the mathematical concepts so they could later help their child with their mathematics homework. Teachers should implement more hands-on activities and student-centered learning when teaching mathematics since research has found this to be useful for students struggling in mathematics and helps them build their self-worth (Elizondo et al. , 2021). In addition, teachers need to create a curriculum where students work collaboratively such as using mathematics stations, help students make real-world connections to mathematics, and generate mathematical discussions that foster self-worth (Elizondo et al., 2021) and mathematics self-concept. What is important to remember is that families do experience mathematics anxiety and that measures must be taken to reduce mathematics anxiety, give students what they need to be successful in mathematics, and teach parents how to help their children in mathematics.

Furthermore, administrators and policy makers need to reexamine standardized testing and incorporate different ways to assess students' mathematical skills especially those who struggle in mathematics. Teaching to the test is a serious disservice to our students and national mathematical scores still indicate a serious problem (NAEP, 2019). Why not include assessments that allow students to demonstrate their mathematical knowledge with hands-on activities? Perhaps, educational practices need to move away from just strictly pencil and paper standardized tests and find ways to bring more types of informal assessments into the picture. As indicated by this study, students demonstrated mathematical achievement with formal and informal assessments in the classroom and even with their homework, but still scored below grade level on benchmark and STAAR mathematics exams.

It is time to move forward in mathematics education especially since research has revealed some of the problems that students, parents, teachers, administrators, and even policy makers face every day. The voices of these groups need to be heard and, now is the time to work together to improve mathematics education. In the words of Diana Ravitch (2010) "I have said it before, and I'll say it again: There are no silver bullets in education. There are no magic feathers that enable elephants like Dumbo to fly. It's hard work to improve schools, it takes dedication, resources, and time."

Limitations

Limitations of this study included the number of participants with only 38 families volunteering for the study. Complications arose concerning data collection due to the

Coronavirus. Before the virus, data was collected during mathematics workshops held at the schools with families and allowed relationships to be built with families. However, after data collection moved to online surveys it was more difficult to build those relationships, to observe families working together, and to catch incomplete surveys. Other obstacles included problems with selection of participants who were selected based on failing their STAAR mathematics exam and due to the virus, students did not take these assessments which required selection to also be based on mathematics benchmarks. Also, around 15% of participants who qualified for the study could not participate because they did not have an internet connection to complete the surveys. This was also a problem regarding interviews since families had to be interviewed by phone which made it difficult to observe expressions and build better relationships. Lastly, all students interviewed were boys. An attempt was made to interview girls, however, they did not wish to participate.

Further Research

The findings of the study raised more questions concerning mathematics anxiety, mathematics self-concept, and mathematics talk occurring between a parent and their child. One important fact that researchers have agreed upon is that mathematics anxiety has various elements affecting a person in different ways. Further research is needed to understand the psychology behind mathematics anxiety and how this affects the development of the self. How does mathematics anxiety affect self-confidence, self-efficacy, self-esteem, self-worth and are these affects detrimental to one's future? Long-term research will be needed to determine these effects, especially concerning whether a student attends college, what types of careers are pursued, and how one's fear of mathematics affects their progress in life. Research may reveal data which enhances positive parent interactions, fosters self-development such as self-concept, and reveals the conversations necessary to help family members work towards success for the betterment of our community and society.

Other research is needed to understand the positive and negative effects of mathematics talk and to what extent this affects mathematics performance. Further research could provide an in-depth examination of language used during mathematics talk, measure the relationship between mathematics talk and mathematics performance, and determine the contribution of quality mathematics talk to decrease mathematics anxiety and improve mathematics self-concept. The notion of mathematics talk deserves further investigation and research has barely scratched the surface to understand its full affect. If researchers could better understand mathematics talk, this could provide training for parents to understand better ways to help their child academically, provide training for teachers to use in their classrooms, and perhaps work towards improving mathematics, diminishing mathematics anxiety, and improving mathematics self-concept. If mathematics is considered a gateway to higher learning, better jobs, and technological advancement then further research in all areas of mathematics is sorely needed.

Conclusion

The study contributed to the literature on mathematics anxiety experienced by fourth and fifth graders low performing in mathematics in a number of ways.

1) Very few studies have measured the mathematics anxiety experienced by fourth and fifth graders, especially low performing in mathematics.
2) The MARS-E has never measured low performing students in mathematics in the United States.
3) There are very few mixed method studies examining mathematics anxiety and only one study used the MARS-E.

4) There is limited research on mathematics talk.

5) Examination of mathematics talk and mathematics anxiety has never occurred within one study.

6) Only a few studies examine the Confirmatory Six Factor model regarding the MARS-SV.

This mixed method study answered four research questions concerning the perceptions of students and their parents' mathematics anxiety. Data provided evidence to further understand. fourth and fifth graders low-performing in mathematics and their parents. Participants felt mathematics anxiety in relation to various mathematical situations, but despite their anxiety, participants experienced some form of mathematical success. Data disclosed important findings regarding five profiles and provided specific characteristics to better understand an individual experiencing low, moderate and high mathematics anxiety. More importantly, the study revealed the various types of mathematics talk occurring between parents and their children and the positive contributions that parent interactions and parent support have concerning mathematics self-concept. In addition, conducting a mixed method study provided a more in-depth examination into mathematics anxiety, mathematics self-concept, parent support, and mathematics talk. Future researchers should seriously consider implementing a mixed method design to gain a better understanding of their mathematics research.

In order to understand the complexities regarding mathematics anxiety, researchers could learn from students like Jacob who experienced high mathematics anxiety, his mathematics benchmark score was approaching grade level at 58.8% and despite this, he explained, "Math is my favorite because it is kind of easy to learn. I am excited to be learning math and I don't feel nervous when my mom helps me with my math. I could be better in math, I just need to practice."

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LIST OF APPENDICES

APPENDIX A

MATHEMATICS ANXIETY RATING SCALE-E (MARS-E)

The items below are about things that may bother you or cause you to be nervous or anxious or tense when you have to do them. Place a check (✓) in the circle that shows how nervous you would feel.

Here is an example:

Mark how nervous or anxious you would feel: in adding 4 + 5.

If you would feel very, very nervous in adding 4 + 5, then you would place a check (✓) in the circle under "Very, very nervous".

Not at all nervous	Not very nervous	Fairly nervous	Very nervous	Very, very nervous
O	O	O	O	✓

If you would not feel nervous at all adding 4 + 5, then you would put a check (✓) in the circle under "Not at all".

Not at all nervous	Not very nervous	Fairly nervous	Very nervous	Very, very nervous
✓	O	O	O	O

Now do the following sample:

Mark how nervous you would feel: in adding 976 + 50 in your head.

Not at all nervous	Not very nervous	Fairly nervous	Very nervous	Very, very nervous
O	O	O	O	O

Now read each of the items on the next pages and mark how nervous or anxious or tense you would feel. Be sure to answer every question.

		Not at all nervous	Not very nervous	Fairly nervous	Very nervous	Very, very nervous
1.	How nervous or tense would you feel if you had to solve this problem: *George brought 4 boxes of toy cars to class. If each box had 7 cars, how many toy cars did George bring?*	O	O	O	O	O
2.	Mark how nervous or tense you would feel if you had to decide if this problem is right: $(3 + 4) + 2 = 4 + (2 + 3)$.	O	O	O	O	O
3.	How nervous or tense do you feel reading this problem: *Babe Ruth was known as the Home Run King. He had 54 home runs in 1920, 59 in 1921, and his best of 80 in 1928. How many home runs did he hit in all three years?*	O	O	O	O	O
4.	Mark how nervous you feel when you have to add $976 + 777 + 458$ on paper.	O	O	O	O	O
5.	If you had to add up a cash register receipt after you bought several things.	O	O	O	O	O
6.	When counting how much change you should get back after buying something, how nervous do you feel?	O	O	O	O	O
7.	When getting your math book and seeing all the numbers in it, how nervous do you feel?	O	O	O	O	O
8.	Getting called on by the teacher to do a math problem on the board (how nervous do you feel)?	O	O	O	O	O
9.	Raising your hand in math class to ask a question about something you don't understand.	O	O	O	O	O

		Not at all nervous	Not very nervous	Fairly nervous	Very nervous	Very, very nervous
10.	Looking at how much two different sizes of two different kinds of soft drinks cost and deciding which is cheaper.	O	O	O	O	O
11.	Starting to read a hard new chapter for your math homework.	O	O	O	O	O
12.	Being asked by your teacher to tell how you got your answer to a math problem.	O	O	O	O	O
13.	Taking a big test in your math class.	O	O	O	O	O
14.	Sitting down to do your math homework on things you are just starting to learn.	O	O	O	O	O
15.	Thinking about a math test the night before the test.	O	O	O	O	O
16.	Thinking about a math test an hour before the test.	O	O	O	O	O
17.	Thinking about a math test 5 minutes before the test.	O	O	O	O	O
18.	Waiting to get a math test back on which you think you didn't do very well.	O	O	O	O	O
19.	Being given a set of multiplication problems to solve on paper.	O	O	O	O	O
20.	Being given a set of division problems to solve on paper.	O	O	O	O	O
21.	Having to figure out how much each of you owe when you buy a pizza and three soft drinks with two friends.	O	O	O	O	O

		Not at all nervous	Not very nervous	Fairly nervous	Very nervous	Very, very nervous
22.	Counting your change after buying a movie ticket because you think you didn't get enough money back.	O	O	O	O	O
23.	Figuring out what time it will be in 25 minutes.	O	O	O	O	O
24.	Figuring out if you have enough money to buy a candy bar and a soft drink.	O	O	O	O	O
25.	Having someone watch you while you correct your math homework on the blackboard.	O	O	O	O	O
26.	Listening as your teacher tries to help you see how to work a math problem.	O	O	O	O	O

APPENDIX B

SUINN MATHEMATICS ANXIETY RATING SCALE -
ELEMENTARY FORM (MARS-E)

INFORMATION FOR USERS

The Mathematics Rating Scale-E (MARS-E) is a 26 item self-rating scale which may be administered either individually or to groups. The procedure is as follows:

> Each item on the scale represents a situation which may arouse anxiety for a youngster. The youngster is to decide on the degree on anxiety aroused, using the dimensions of "not at all", "a little", "a fair amount", "much", or "very much".
>
> Once the student has decided the level of anxiety associated with a specific test item, he or she makes a check in the box next to the item reflecting his or her decision.
>
> Directions are included for the students to read on each test blank. Examples are provided to enable subjects to practice using the answering format. Students are encouraged to work as rapidly as possible, but with accuracy. Students are to describe their anxieties as they currently exist.
>
> For scoring, the examiner should begin by writing the values at the top of each of the respective columns: "1" above "not at all", through "5" above "very much". Next, the examiner should count the number of checks for each column and multiply by the corresponding weights (1 through 5) for each column. These products are recorded at the bottom of the page. This process is repeated for all pages. Finally, the sum of all the products across the pages provides the Total Score for the test.

If the MARS-E is used as the basis for forming a desensitization therapy anxiety hierarchy, the items are inspected to identify those which arouse differing levels of anxiety. Thus, if only a five item hierarchy is desired, the therapist may select one item from the "not at all" category checked by the client, one from the "a little", one from the "a fair amount", one from the "much", and one from the "very much" categories; this provides a series of situations ranked from low to high, which may be used as the anxiety hierarchy for that client.

Use of the MARS-E

The MARS-E can be used to screen individual students in order to plan their placements in special mathematics courses, provide counseling, or provide for intervention through programs such as desensitization for anxiety. Typically, a value above the 75% level would indicate the student is eligible for attention of this type, however a school may wish to develop its own norms or cut-off scores.

The MARS-E can also be used as a measure for evaluating programs. It could be administered prior to a new counseling program or curriculum change, and re-administered later to determine the effects of the programs.

Finally, the MARS-E may be used as a part of direct research on mathematics anxiety. For example, it would be a useful measure in studies which examine the role of curriculum content, parental characteristics, role modeling, etc., in influencing mathematics anxiety.

Normative Data

Several normative tables are provided for users. For most studies, Table 1 is appropriate for interpreting test scores since it provides percentile equivalents by grade levels. For example, if an individual from the fifth grade received a MARS score of 59, and you are interested in what that means, then Table 1 shows that this score falls at about the 75th percentile, therefore the student is expressing a high amount of mathematics anxiety.

Table 2 reports percentile equivalents for a sample of Hispanic students. A test score, for example, of an Hispanic girl of 44 would fall at the 10 percentile, suggesting a low level of mathematics anxiety.

From: Suinn, Taylor, and Edwards. Suinn Mathematics Anxiety Scale for Elementary School Students (MARS-E): Psychometric and Normative Data. Educational and Psychological Measurement, 1988, 48, 979-986.

Normative Data. The mean score for a Colorado sample (N = 1,119) was 54.8 with a standard deviation of 12.93 for the total sample. The mean for males was 53.8 (standard deviation of 12.19); for females the mean was 55.7 (standard deviation of 13.54).

Percentile ranks for raw scores by grade levels are as follows:

TABLE 1

PERCENTILE	FOURTH GRADE	FIFTH GRADE	SIXTH GRADE	ALL SUBJECTS
10%	43	42	42	42
30%	47	46	46	46
50%	52	50	49	50
75%	63	59	57	60
95%	85	82	76	81

Reliability. An internal consistency reliability coefficient, Cronbach's alpha was found to be 0.88. In effect, this shows that the average intercorrelation of the items in the test is quite high, and confirms the high reliability of the instrument. The reliability coefficient compares favorably with the 0.89 split-half reliability for the longer 98 item MARS-A (for adolescents) and a test-retest reliability of 0.78 on the 98 item MARS (for adults).

Validity. Construct validity was determined through correlations between the MARS-E and scores on the Stanford Achievement Test. Results confirmed correlations significant at the .001 level with the SAT mathematics concepts subtest ($r = -.29$), mathematics applications ($r = -.26$), mathematics computation ($r = -.26$), and SAT score ($r = -.31$). Similar results were also obtained for males and females, for each grade level, and for Hispanics and Asians.

A factor analysis was also calculated, leading to the identification of two primary factors. The first factor is readily identified as Mathematics Test Anxiety, while the second factor appears appropriately labelled Mathematics Performance Adequacy Anxiety. The discovery of two factors is consistent with previous analyses of other mathematics anxiety scales deriving from the same theoretical foundation: the MARS and the MARS-A.

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From: Suinn, Taylor, and Edwards: The Suinn Mathematics Anxiety Scale (MARS-E) for Hispanic Elementary School Students. Hispanic Journal of Behavioral Sciences, 1989, 11, 83-90.

Hispanic Normative Date. The mean score for a sample of Hispanic students in Colorado (N = 105) was 57.1 for the total sample (standard deviation of 13.27), 54.5 for males (standard deviation of 11.17), and 49.8 for females (standard deviation of 18.13). Percentile ranks for raw scores for males and females are as follows:

TABLE 2

PERCENTILE	MALES	FEMALES
10%	41	44
30%	46	48
50%	52	53
75%	61	71
95%	74	85

Validity. Construct validity was determined through correlations between the MARS-E and scores on the Stanford Achievement Test (SAT). Results confirmed correlations significant at the .05 level with the SAT mathematics concept subtest (r = -.27) and mathematics computation (r = -.27) for males, and with the mathematics application (r = -.31) and SAT total score (r = -.35) for females. Also, the correlation with mathematics application and with SAT total score for males were significant at the .01 level (r = -.32). For the combined sample, correlations all reached the .01 level of significance between the MARS-E and each SAT subtest as well as SAT total score.

From: Suinn, Taylor, and Edwards. Unpublished data on Asian-American students.

Validity. A small sample (N = 19) of Asian-American students took the MARS-E and the SAT. Significant correlations were found between the MARS-E and the SAT mathematics concepts subtest (r = -.53, p = .01), mathematics application (r = -.63, p = .005), mathematics computation (r = -.33, p = .05), and SAT total score (r = -.56, p = .005). This sample is too small to arrive at any major conclusions, but along with data on Caucasian and Hispanic students, the information suggests that the MARS-E is similarly useful with Asian-Americans.

APPENDIX C

NAME________________________ Total Score__________

MATHEMATICS ANXIETY RATING SCALE: SHORT VERSION

The items in the questionnaire refer to things that may cause fear or apprehension. For each item, place a check in the box under the column that describes how much you are frightened by it nowadays. Work quickly but be sure to consider each item individually.

	Not at all	A little	A fair amount	Much	Very much
1. Taking an examination (final) in a math course.	☐	☐	☐	☐	☐
2. Thinking about an upcoming math test one week before.	☐	☐	☐	☐	☐
3. Thinking about an upcoming math test one day before.	☐	☐	☐	☐	☐
4. Thinking about an upcoming math test one hour before.	☐	☐	☐	☐	☐
5. Thinking about an upcoming math test five minutes before.	☐	☐	☐	☐	☐
6. Waiting to get a math test returned in which you expected to do well.	☐	☐	☐	☐	☐
7. Receiving your final math grade in the mail.	☐	☐	☐	☐	☐
8. Realizing that you have to take a certain number of math classes to fulfill the requirements in your major.	☐	☐	☐	☐	☐
9. Being given a "pop" quiz in a math class.	☐	☐	☐	☐	☐
10. Studying for a math test.	☐	☐	☐	☐	☐
11. Taking the math section of a college entrance exam.	☐	☐	☐	☐	☐
12. Taking an examination (quiz) in a math course.	☐	☐	☐	☐	☐
13. Picking up the math text book to begin working on a homework assignment.	☐	☐	☐	☐	☐
14. Being given a homework assignment of many difficult problems which is due the next class meeting.	☐	☐	☐	☐	☐
15. Getting ready to study for a math test.	☐	☐	☐	☐	☐

	Not at all	A little	A fair amount	Much	Very much
16. Dividing a five digit number by a two digit number in private with pencil and paper.	☐	☐	☐	☐	☐
17. Adding up 976 + 777 on paper.	☐	☐	☐	☐	☐
18. Reading a cash register receipt after your purchase.	☐	☐	☐	☐	☐
19. Figuring the sales tax on a purchase that costs more than $1.00.	☐	☐	☐	☐	☐
20. Figuring out your monthly budget.	☐	☐	☐	☐	☐
21. Being given a set of numerical problems involving addition to solve on paper.	☐	☐	☐	☐	☐
22. Having someone watch you as you total up a column of figures.	☐	☐	☐	☐	☐
23. Totaling up a dinner bill that you think overcharged you.	☐	☐	☐	☐	☐
24. Being responsible for collecting dues for an organization and keeping track of the amount.	☐	☐	☐	☐	☐
25. Studying for a driver's license test and memorizing the figures involved, such as the distances it takes to stop a car going at different speeds.	☐	☐	☐	☐	☐
26. Totaling up the dues received and the expenses of a club you belong to.	☐	☐	☐	☐	☐
27. Watching someone work with a calculator.	☐	☐	☐	☐	☐
28. Being given a set of division problems to solve.	☐	☐	☐	☐	☐
29. Being given a set of subtraction problems to solve.	☐	☐	☐	☐	☐
30. Being given a set of multiplication problems to solve.	☐	☐	☐	☐	☐

APPENDIX D

Interview Questions for Students

1. Please describe how you feel about learning math?

2. Please describe your math skills.

3. Please explain how you feel right before going to your math class?

4. How do you feel when the math teacher calls on you in class to answer a question?

5. How do you feel about doing math in front of your classmates? Your parent (s)?

6. Please explain how you feel when you don’t understand the math the teacher is teaching you?

7. What do you do when you don’t understand the math that the teacher is teaching?

8. What do you think your classmates think about your math skills? Your parent(s)?

9. What do you do when you don’t understand your math homework?

10. How do you feel when a family member helps you or is unable to help with your math homework?

11. What do your parents say about math?

12. What kind of things do you and your parents talk about regarding math?

13. What happens during mathematics homework time in your home?

APPENDIX E

Interview Questions for Parents

1. Please explain how you feel about math?

2. How important or unimportant do you feel math is?

3. Please describe your math skills?

4. How do you feel about your math skills?

5. Please explain how you feel when you have to do math in public or in front of people?

6. Please tell me how important or unimportant it is for your child to be good at math?

7. How do you feel about your child's math skills?

8. Please explain what happens when your child needs help with their math homework?

9. Tell me how you feel about helping or not being able to help your child with their math homework?

10. How do you think your child feels about math?

11. What do you and your child talk about regarding math?

12. What do you tell your child about math (when they are having a hard time understanding)?

13. What do you tell your child when they get a bad grade in math?

14. What do you say to your child when they don't pass the STARR Math Exam?

15. Please describe what mathematics homework time at your home looks like?

APPENDIX F

Example of Concept Map for Second Cycle Axial Coding