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UNIVERSITY OF NORTHERN COLORADO

Greeley, Colorado

The Graduate School

DEMOGRAPHIC PREDICTORS OF MATH ANXIETY IN ELEMENTARY SCHOOL CHILDREN

A Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Arts

Melissa Reann Flowerdew

College of Education and Behavioral Sciences
School of Psychological Sciences
Educational Psychology

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This Thesis by: Melissa Reann Flowerdew

Entitled: *Demographic Predictors of Math Anxiety in Elementary School Children*
has been approved as meeting the requirements for the Degree of Master of Arts in the College of Education and Behavioral Sciences in the School of Psychological Sciences, Program of Educational Psychology

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ABSTRACT

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Due to the increasing interest of math anxiety in elementary level children, the present study explored math anxiety contextual factors through Bandura’s (1999) Social Cognitive perspective. Using the *Children’s Anxiety in Math Scale*, researchers gathered data from 40 primary-level children to explore four demographic predictors--grade-level, special needs identification, gender identity, and socioeconomic status-- of mathematics anxiety through a hierarchical regression model. Findings indicated demographic variables accounted for over one-third of the variance in math anxiety scores at 38.2% (grade level: 12.3%, SNI: 8.4%, gender identity: 13.2%, SES: 4.1%). With the exception of socioeconomic status, all predictors were significant. These findings provide implications and recommendations for educators, parents, and future researchers.

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CHAPTER I

INTRODUCTION

Understanding Mathematics Anxiety

Experiencing non-pathological anxiety is common in humans, as it originates from our innate fear response, which instinctually serves as a means of survival in response to an undesired stimulus (Jansen et al., 1995). Homo sapiens of the prehistoric age faced daily life-threatening encounters (e.g., ferocious animals); these experiences activated the autonomic nervous system to better equip the body with resources to flee or face the situation, including increased heart rate and strength of heartbeat, redistribution of blood to vital areas (i.e., blood and energy is sent to muscles instead of the digestive system), and increase in oxygen intake (McCarty, 2016). Humans have mitigated fearful encounters throughout evolution, but still experience these physiological responses when perceiving danger. Even when danger is absent, the body experiences anxiety--mirroring the same physiological response as fear (Milosevic & McCabe, 2015). Stimuli that is not life-threatening can still be perceived as a threat. In an academic setting, many students find mathematics threatening; thus, mathematics anxiety is a common type of academic performance anxiety (Finlayson, 2014; Luttenberger et al., 2018).

Math anxiety is fear, tension, or avoidance that affects manipulating numbers or solving mathematic problems in both academic and ordinary life circumstances (Ashcraft, 2002; Hopko et al., 2003). Tasks are viewed as threatening or challenging through personal judgment of an individual's own abilities (Şakar et al., 2015). Those who lack in resources (e.g., self-efficacy, motivation, intelligence, knowledge, social support) view the task at hand as threatening—eliciting physiological responses of fear (Ashcraft & Faust, 1994; Faust, 1996; Shi & Liu, 2016;

Sorvo et al., 2017). When an individual deems themselves as having the ability to meet the demand, they view the task as a challenge and avoid the physiological changes (Blascovich & Mendes, 2010; Lyons & Beilock, 2012). Triggering stimuli is relative to the individual and can range from plausible (i.e., high-pressure testing situations; Maloney & Beilock, 2012) to unconventional circumstances (i.e., budgeting or calculating a tip at a restaurant; Harari et al., 2013).

Occupational or academic settings can elicit math anxiety, but it can also be found in non-academic daily life (e.g., refiguring a restaurant bill or counting change at the grocery store; Jansen et al., 2016). In educational settings, subtraction and division (problems requiring carrying operations) are most frequently recognized as anxiety inducing (Ashcraft, 2002); even so, demands of basic numerical skills and processing of any kind can elicit an anxious response (Maloney et al., 2010; Richardson & Suinn, 1972; Rubenstein & Thompson, 2012; Suinn et al., 1988; Wu et al., 2012). Various tasks like reading math problems, completing homework, or teachers assigning time restrictions can invoke tension and distress among students (Ashcraft & Moore, 2009; Maloney & Beilock, 2012; Onwuegbuzie & Wilson, 2003; Sorvo et al., 2017). Occupations, especially those in the STEM field, present opportunities for employees to experience math anxiety; for instance, a math anxious nurse may experience distress while counting pills or configuring medication dosages (Beilock & Maloney, 2015; McMullan et al., 2012). Maladaptive negative cognitions and concerns develop from forecasted performance and outcome-based settings—making numerical anxiety a subtype of performance-based anxiety (Ashcraft, 2002; Ashcraft et al., 2007; Harari et al., 2013; Hopko et al., 2001).

Albeit currently missing diagnostic criteria in the DSM-V, the negative response indicates an affinity with social phobia and general anxiety (Ashcraft & Moore, 2009; Egger &

Angold, 2006). Performance-based anxiety stems from the potential for undesirable evaluation or judgement that a student may experience when an instructor is selecting a learner at random to solve a problem on the whiteboard or asking a math problem to be read aloud. Completing assessments, answering questions in front of classmates, and the anticipation of high-pressure aptitude tests like the GRE or SAT also present the potential for unwanted evaluation (Ashcraft & Moore, 2009; Hembree, 1990; Hopko et al., 2001; Jameson, 2013; Klados et al., 2017; Ramirez & Beilock, 2011; Sorvo et al., 2017; Vukovic et al., 2013; Wu et al., 2014). Math anxiety shares similar characteristics with test anxiety, but empirical research has found they need not be concurrent, and the common variance is only 37% (Sorvo et al., 2017).

For math anxious individuals, prospective thoughts alone are enough to invoke negative reactions and disrupt performance (e.g., low test scores or incorrect solving strategies) but do not solely indicate an individual has math deficits or poor numerical ability (Aiken, 1976; Ashcraft, 2002; Ashcraft & Moore, 2009; Ashcraft & Ridley, 2005; Beilock & Maloney, 2015; Beilock & Willingham, 2014; Suinn & Edwards, 1982). Researchers recognize math anxiety as a multifaceted construct that has several contextual factors affecting the expression and impact among demographically diverse populations.

Despite missing criteria in the DSM and the lack of emphasis in most educational settings, math anxiety is not an atypical experience among any populace—adults, adolescents, or children (Ashcraft & Moore, 2009; Dowker, 2005; Dowker et al., 2016; Stevenson et al., 2000).

Purpose

The current study explored the relationship between personal and environmental contextual factors and CAMS mathematics anxiety scores. Intrigued by the existing research of contextual factors and children, the research team sought to broaden the understanding of the predictive role contextual factors play in math anxiety levels.

Research Question

A demographically diverse sample was targeted to address the following posed research question:

Q1 How do demographic variables contribute to students' math anxiety scores based on the *Children's Anxiety in Math Scale*?

CHAPTER II

REVIEW OF LITERATURE

Math Anxiety and Age

Adults and Adolescents

Most research conducted on math anxiety over the last 60 years has been on adults and adolescents. International investigations have estimated 17% of the world's adult population suffer from a significantly high degree of math anxiety (Ashcraft & Moore, 2009) and 33% of 15-year-olds report experiencing mathematics anxiety (The Organization for Economic Co-Operation and Development, Program of International Student Assessment, 2013). Research has consistently provided evidence that math anxiety is an increasingly prevalent issue among these populations (Baloglu & Koçak, 2006; Betz, 1978; Jain & Dowson, 2009; Jameson & Fusco, 2014; Ma & Xu, 2004; Richardson & Suinn, 1972; Rodarte-Luna & Sherry, 2008).

Individuals with minimal academic exposure experience fewer formal opportunities to trigger their math anxiety, thus the majority of research in this population has been conducted on college-level students. Near the beginning of college-level research, Richardson and Suinn (1972) estimated 11% of undergraduate students showed levels of math anxiety high enough to be in need of formal advising, tutoring, or counseling. Betz (1978) later found that approximately 68% of United States undergraduate students enrolled in math classes experienced high mathematics anxiety. In the last 10 years, research has found 25% of four- year university students and 80% of community college students report experiencing moderate-to-high levels of math anxiety. This is potentially influenced by students having low self-efficacy or poor math-concept (Beilock & Willingham, 2014; Chang & Beilock, 2016).

Feelings of nervousness, fear, and loathing were reported by 75% of adults in regard to mathematics (Furner & Duffy, 2002). Neural research found math-anxious adults experience slower reaction times and heightened activity in frontal brain regions (Klados et al., 2017; Núñez-Peña et al., 2015; Núñez-Peña & Suárez-Pellicioni, 2014), and fMRI scans have indicated that math anxious adults may experience phobia-related neural patterns—resembling those of a physical pain response—when doing math-related tasks (Lyons & Beilock, 2012). Math-related cues can inhibit activation in brain regions needed for mathematical reasoning in both adults and children, fostering disengagement and avoidance behaviors (Hembree, 1990; Klados et al., 2017; Pizzie & Kraemer, 2017; Ramirez & Beilock, 2011; Wu et al., 2014). Johnston-Wilder et al. (2014) found 48% of STEM apprentices experience numerical anxiety—18% experiencing moderate and 30% experiencing high levels (Beilock & Maloney, 2015; Johnston-Wilder et al., 2014). Reports from those who study or work in a math-driven field continue to encourage research on the contextual factors of mathematics anxiety. Taking into consideration that 93% of adults in the US report negative numerical experiences during their K-12 education, investigating arithmetic experiences in elementary-level children became crucial for understanding the origin of math anxiety (Furner & Duffy, 2002).

Children

After decades of investigating the influence of math anxiety on adolescents and adults, researchers sought to understand development with hopes to cultivate prevention plans and treatment (Harari et al., 2013; Jameson, 2013). Initial research of elementary students concluded that children could hold negative attitudes towards math, but further research was needed to confirm if those feelings were equivalent to experiencing math anxiety (Gierl & Bisanz, 1995). Through cognitive interviews and pilot testing, children demonstrated the ability to comprehend and report feelings related to mathematics anxiety such as nervousness, anxiety, or tension levels (Ganley & McGraw, 2016; Ramirez et al., 2013; Vukovic et al., 2013). After concluding children were capable of experiencing math anxiety, research focused on time of onset. Data collection indicated that students began encountering math anxiety as early as kindergarten (Chang & Beilock, 2016; Frost et al., 1990; Sorvo et al., 2017).

Subsequently, researchers saw a number of parallels with adolescents/adults and children experiencing math anxiety; this led to investigating similarities among neural patterns and correlates. Young et al. (2012) evaluated regional activation in 7-to-9-year-old children during math related scenarios. Researchers found similar activity in regions associated with pain and areas connected to numeracy, emotions, and problem solving (i.e., amygdala, posterior parietal and dorsolateral prefrontal cortex, right caudate and left hippocampus). To properly grasp math anxiety beyond cerebral functioning and basic self-reports, understanding causal factors involved in its development during childhood is essential to deter and mitigate effects of numerical anxiety. Contributions to development and achievement are examined through environmental, personal, and behavioral contextual factors. This triad of mutually interacting factors is known as triadic reciprocal causation--the basic foundation of Social Cognitive Theory (Bandura, 1989).

Social Cognitive Perspective of Math Anxiety

The groundwork for Social Cognitive Theory (Bandura, 1989) emphasizes humans' ability to manage their own life course by making agentic choices. A combination of physiological systems (i.e., sensory, motor, and cerebral), brain mechanisms, and environmental influences aid in future direction and goal achievement (Bandura, 1999; Harre & Gillett, 1994).

Human agency focuses on individuals' control over their own thoughts, opinions, and actions through a mind that pairs its reactive tendencies with self-reflection, assessment, and creation (Bandura, 1999). As previously mentioned, contextual factors are not unidirectional; triadic reciprocal causation declares that environmental elements, personal factors (cognitive, affective, and biological), and behavioral patterns interact simultaneously (Bandura, 1986, 1997). This causation model is a valuable tool in helping researchers establish implications for future areas of research, populations of interest, and treatment.

Environmental Factors

Culture influences students via societal ideals or beliefs and through their individual appraisals of their relationship with mathematics (Bieg et al., 2015). Previous empirical research implies that cultural practices likely mediate the relationship between negative reactions, performance or achievement, and maladaptive views on failure (Dowker et al., 2016; Stevenson et al., 2000). Culture develops through "joint experience of a group of people who share vital or labor activities" (Gorgorió & Planas, 2000, p. 1). Cultural beliefs responsible for shaping student appraisals are fostered through the national climate regarding values, race, and gender (Geary, 1994).

Cultural differences on the approach of mathematical performance or presence of math anxiety can impact student's expectation, beliefs, and motivations (Brown et al., 2020; Eccius-Wellmann et al., 2017). For example, Columbian students are educated about low performance levels in mathematics; this knowledge may impact self-efficacy or self-concept levels (Brown et al., 2020) as training for educators in Columbia has not targeted problem resolution (García-Santillán et al., 2016). Reports of math anxiety values and practices suggest variables like pedagogical techniques or curriculum impact cultural groups individually, likely because each culture differs in organization, values, and policies in the education system (Andrews & Brown, 2015; Brown et al., 2020; García-Santillán et al., 2016).

Race has also been identified as a cultural influencer for mathematics attitudes and performance (Gross, 1988; Matthews et al., 1984). Studies found students in the Asian American community outperformed Caucasian students; performance patterns also found that Asian American and Caucasian students outperformed Hispanic students. Students in the African American community were found to be the lowest performers. In second grade, Hispanic and African American students begin to fall behind a grade level in their math performance, while Asian American and Caucasian students begin advancing (Gross, 1988). Students who fall behind or advance a grade-level are more likely to continue to do so, widening the gap. Reported levels of enjoyment regarding math mirrored these patterns—Asian Americans and Caucasians reported higher enjoyment of math, while Hispanic and African American students enjoyed math less (Gross, 1988; Hall et al., 1999).

Gender is a societal factor that is sustained through stereotype threat; Stereotype threat is fear an individual will uphold a stereotype based on their racial, ethnic, gender, or cultural group (Spencer et al., 1999, 2016). Limited research has been done on this topic outside of the gender binary, thus the following data exclusively reflects male and female identities. Geary (1994) discusses the US culture as a potential contributor to threat preservation:

> ...US culture abounds with attitudes that foster math anxiety. Math is taught to be inherently difficult (as Barbie dolls used to say, “math class is hard”), aptitude is considered far more important than effort, and being good at math is considered relatively unimportant, or even optional. (p.7)

Until recent reforms of gender, Barbie has been classified as an exclusively feminine toy--implying the most exposed population to Barbie's perspective of mathematics was gender identifying females. Students who found themselves similar to Barbie used her perceived math-concept, perceived ability and beliefs create personal schemas about skill capability, to judge their own abilities through vicarious experience, resulting in stereotype threat (e.g., Barbie is a female who thinks math is difficult; it's likely that female-identifying children assume they will inherently struggle and find math hard; Bieg et al., 2015; Geary, 1994; Nash & Grossi, 2007; Steele & Aronson, 1995). Parental attitudes, family SES, and educator practices are also culturally influenced environmental factors.

Home Environment Factors

Parents are considered the main influencers of vicarious experience and verbal persuasion in their children. Parents and their chosen parenting styles play a primary role in socializing their children (Chang & Beilock, 2016; Jameson, 2014; Maloney et al., 2015). Data has diligently shown that mathematics anxiety is not fostered solely in schools, inferring parenting practices shape their children's attitudes (Chang & Beilock, 2016; Jameson, 2013, 2014; Maloney et al., 2015; McLeod et al., 2007; Ramirez et al., 2018; Wood et al., 2003). Positive parenting aids in math-concept by developing better attitudes and beliefs about their academic capabilities through encouragement, positive feedback, and modeling appropriate behaviors (Daches Cohen & Rubinsten, 2017; Harper & Daane, 1998;). These parenting practices not only increase efficacy but have been shown to correlate with lower levels of numerical anxiety (Bong, 2008; Campbell & Verna, 2007; Fan & Williams, 2010; Koutsoulis & Campbell, 2001; Scarpello, 2007; Turner et al., 2004). Parents with a controlling style that monitor homework or demand continuous high achievement, negatively impact math-concept and self-efficacy (Bleeker & Jacobs, 2004) and likely causing a reduction in interest and motivation (Bong, 2008; Campbell & Verna, 2007; Ginsburg & Bronstein, 1993).

Parental beliefs and personal experiences about math can also be modeled or communicated to their children (Maloney et al., 2015; Vukovic et al., 2013). Parents who do not report having math anxiety and who have positive attitudes towards math can help lessen anxiety and increase problem-solving performance levels; however, those with higher levels of anxiety can cause children to experience confusion from suggesting alternative problem-solving methods or a decreased achievement (Quach et al., 2015). Parents that express negative attitudes towards math may encourage children to conclude that math is something to be feared or infer they have poor arithmetic ability due to receiving uninvited help (Maloney et al., 2015; Pomerantz & Ruble, 1998).

Similarly, parents' gender stereotypes in math can transmit to their children and affect attitudes and achievement (Eccles et al., 1990; Gunderson et al., 2012; Jacobs & Eccles, 1992; Midgley et al., 1989; Yee & Eccles, 1988). Parent reports indicate beliefs of higher math ability and natural talent in their male children even if their male and female children show no differences in math achievement (Jacobs, 1991; Parsons et al., 1982; Yee & Eccles, 1988). For example, studies of 3rd and 4th grade children found parents of male students reported higher math ability than those of female students (Tiedemann, 2000); parents of kindergarten children also believed males to be better at math, while females were thought to be better at reading (Lummis & Stevenson, 1990). This longitudinal study confirmed parent gender-stereotypes affected students by 5th grade with males reporting higher expectations for success in math than females (Lummis & Stevenson, 1990).

Educational Factors

Elementary students in the US spend on average, a minimum of 26 instructional hours (not including lunch, recess, or certain specials) in school per week--an 880-hour average school year (Education Commission of the States [ECS], 2020). Consequently, a large amount of math ability, attitudes, and efficacy are also developed in the elementary classroom. Exposure to educator beliefs has the potential to shape student abilities, perceptions, and gender-stereotypes (Gunderson et al., 2012). For instance, similar to parent effects, teachers who endorse gender-stereotyped math views can also lead students to endorse like ideals, expectancies, and later achievement (Fiske & Neuberg, 1989; Keller, 2001; Tiedemann, 2000, 2002).

In-service and preservice educators in the U.S. have reported moderate-to-high levels of numerical anxiety (Battista, 1986; Bryant, 2009; Hembree, 1990). After reviewing U.S. standardized test scores and observing little change from year-to-year, data indicated a lack of mastery in fraction and division operations (National Mathematics Advisory Panel [NMAP], 2008). Qualitative researchers investigated this deficit by assessing conceptual ideas and foundational underpinnings in educators. Elementary and middle school teachers (1st-8th grade) displayed minimal understanding when asked to generate an explanation for the operational use of “invert-and-multiply” (e.g., $abcd=adbc$; Ma, 1999; Moseley et al., 2007; Seigel, 2012). Data suggest that educators in Japan and China not only understood conceptual ideas but were able to generate multiple explanations for inverse operations. These outcomes are a potential of multiple contextual factors including teacher anxiety and low self-efficacy (Allen, 2009; Chavez & Widmer, 1982; Markovits, 2011; Ramirez et al., 2018). Teachers who are numerically anxious claim the link began inside elementary classrooms; the pedagogical practices encouraged development of anxiety due to poor or hostile responses from teachers when in need of support with math (Allen, 2009; Bryant, 2009; Bulmahn & Young, 1982; Furner & Berman, 2005; Jackson & Leffingwell, 1999; Ramirez et al., 2018).

In addition to responding negatively to students, low self-efficacy and anxiety tend to encourage textbook-based teaching approaches instead of engaging strategies, making numeracy inherently a negative stimulus for students who may later become educators This cyclical influence continues to affect future educators, parents, and cultural practices (Ahmed et al., 2012; Bursal & Paznokas, 2006; Gresham, 2008; Jain & Dowson, 2009; Swars et al., 2006). Thus, environmental influence on the development of numerical anxiety continues in co-occurrence with personal factors.

Personal Factors

Attributes

Demographically diverse children that develop math anxiety are influenced individually by their personal characteristics--namely foundational knowledge, grade level, gender, and special needs identification.

Research shows math anxiety development may, in part, stem from foundational knowledge and numerical building block deficits (Bieg et al., 2015; Gunderson et al., 2018; Maloney et al., 2015). At the base of conceptual understanding are basic numerical processing skills such as counting (Maloney et al., 2010), comparing quantities of single-digit numbers (Dietrich et al., 2015; Pantoja et al., 2020), and 3D rotation visualization (Ferguson et al., 2015; Maloney et al., 2010). Findings also indicate a negative association with spatial processing skills and the development of the mental number line—an innate ability rather than developed skill (Harari et al., 2013). A weak math number line may cause negative experiences with math, likely effecting performance and leading to math anxiety (Ferguson et al., 2015; Pantoja et al., 2020).

Existing research indicates that math anxiety can manifest as early as kindergarten; most research shows that math anxiety increases over time, until dropping off in late high school or early college years (Cargnelutti et al., 2017; Hembree, 1990; Ma, 1999; Vukovic et al., 2013). Researchers suggest this progression occurs when math curriculum increases in difficulty (Tankersley, 1993; Yeo, 2005) or students experience the bidirectional relationship between math anxiety levels and performance (Cargnelutti et al., 2017; Gunderson et al., 2018; Luo et al., 2014; Park et al., 2014). Evidence is limited and inconsistent for children in 1st-3rd grade, but most indicates grade level and anxiety are either positively correlated (Jameson, 2013, 2014; Krinzinger et al., 2009; Passolunghi et al., 2014) or reflect no correlation (Finlayson, 2014; Gunderson et al., 2018; Namkung et al., 2019; Ramirez et al., 2013). Some research also finds negative correlations between grade level and math anxiety (Maloney et al., 2015; Ramirez et al., 2016), suggesting that math anxiety decreases as children move throughout elementary school, perhaps due to increased efficacy, prior knowledge, or social comparisons (Eccles, 1984; Gunderson et al., 2018; Jordan et al., 2007).

Gender research has consistently been of interest due to the prominence of stereotype threat--especially in its relation to math anxiety (Halpern et al., 2007). As previously discussed, identifying as a woman increases subjection to the negative stereotypes indicating men are superior at mathematics (Costa et al., 2001; Egloff & Schmukle, 2004; Spencer et al., 1999). While some researchers (e.g., Benbow & Stanley, 1980, 1983) viewed gender as indicative of math performance, other researchers (e.g., Eccles, 1987; Fennema & Sherman, 1978; Levine & Ornstein, 1983; Meece et al., 1982) argue socialization differences of women are a larger contributor than innate biological differences. Little differences in performance have been found among gender; female participants indicated a slight advantage in computation skills and male participants had an advantage in problem-solving ability (Hyde et al., 1990). These differences do not typically emerge until adolescence, and even then, the difference in performance was not significant (Hyde et al., 1990; Spencer et al., 1999). Alternatively, gender differences are significantly apparent in math attitudes and anxiety levels (Hembree, 1990; Hyde et al., 1990; Meece et al., 1990; Spencer et al., 1999). A meta-analytic review (Halpern et al., 2007) concluded that women report experiencing more math anxiety than men who score lower on trait anxiety self-report scales. Possible influential factors are gender society norms or men feeling reserved when publicly revealing personal attitudes (Costa et al., 2001; Egloff & Schmukle, 2004). While female elementary school students report higher levels of academic self-esteem compared to their male counterparts, female students tend to report lower levels of math-specific self-efficacy and higher levels of math anxiety than their peers (Bentz & Hacket, 1983; Costa et al., 2001; Halpern et al., 2007; Hembree, 1990; Hyde et al., 1990).

Special needs identification (SNI) may also mediate the relationship with math anxiety. SNI includes gifted and talented students as well as any student in need of an individualized education plan or 504c. It is estimated 6%-14% of students have learning disabilities in math (Barbaresi et al., 2005); these students tend to struggle with low math achievement due to difficulties selecting problem solving strategies appropriate for achieving a goal (Duncan & McKeachie, 2005; Jain & Dowson, 2009; Kramarski & Michalsky, 2010; Ramirez et al., 2018). Gifted children and those with learning deficits equally struggle with self-efficacy and are commonly alienated from other children. Students of all special need designations develop aversions to math, resulting in an underdevelopment of skill and potential (Byrne & Shavelson, 1996; Fennema & Sherman, 1978; Robinson & Noble, 1991). SNI children share in developing learned helplessness (Covington & Beery, 1976; Dweck & Reppucci, 1973), avoid mastering concepts deemed as un-useful (Rubinsten & Tannock, 2010), and persistence –all indicators of low math achievement and performance (Eccles, 1984; Fennema & Sherman, 1976; Fennema et al., 1990; Steele et al., 2002)

Behavioral Factors

Math Anxiety and Performance

Highly math anxious individuals are typically low performers; this is, in part, due to working memory as well as social cognitive factors like self-efficacy, motivation, and stereotypes.

Working Memory. Findings indicate working memory plays a role in mathematics performance that goes far beyond ability (Barrett et al., 2004; Conway, 2005; Engle, 2002; Smith & Jonides, 1999). Working memory, a short-term memory mechanism responsible for integrating, storing, and manipulating information relevant to a given task, is a vital performance indicator (Baddeley, 2002; Baddeley & Hitch, 1974; Chang & Beilock, 2016; Engle, 2002; Miyake & Shah, 1999). Capacity of working memory (5-7 pieces of information at a time; Eysenck & Calvo, 1992) is compromised when presented with threatening stimuli (i.e., numeracy challenges or worries founded in concerns for consequence of failure; Liebert & Morris, 1967). Worries become intrusive thoughts that occupy valuable attentional resources (Chang & Beilock, 2016; Engle, 2002), limiting the ability for one interact with details needed for problem solving requiring holding and manipulating information synchronously (Ashcraft & Kirk, 2001; Baddeley & Hitch, 1974; Beilock et al., 2010; Beilock & Maloney, 2015; Hopko et al., 1998; Peng & Terng, 2016). Students experiencing working memory disruptions frequently use strategies like pause, look back, and read aloud to help themselves maintain information accuracy (Ashcraft & Faust, 1994; Walczyk & Griffith-Ross, 2007). While effective, strategies may sacrifice efficiency and problem-solving speeds in children—an increasingly important aspect of education productivity demands (Lopez, 2007; Valli & Buese, 2007). Students without time constraints show higher achievement and less errors on basic math problems. In total, working memory accounts for 30% of performance variance, rather than domain competence issues, within math anxious students (Ashcraft & Kirk, 2001; Ashcraft & Moore, 2009; Ashcraft & Ridley, 2005; Geary et al., 2009; Jordan et al., 2007).

Self-Efficacy. Self-efficacy expresses an individual's confidence in their ability to perform, persevere, and respond when faced with a task (e.g., performing mathematics; Ashcraft & Rudig, 2012; Bandura, 1997; Bandura & Locke, 2003). Self-efficacy levels form through past experiences (e.g., vicarious experience or verbal persuasion), perception of task difficulty, and performance (Bandura, 1997; Lopez & Lent, 1992; Özyürek, 2005; Shell et al., 1989; Stajkovic & Luthans, 1998). Vicarious experiences occur when a child compares themselves to another individual whom they feel similar to and judges their abilities based on the abilities of that figure (e.g., Barbie, as previously discussed, or a female student with a female teacher). A child with a higher self-efficacy level may compare themselves to a successful person when having a vicarious experience; while low efficacious students will compare themselves with someone less successful (Bandura, 1989, 1993; Jameson, 2013). Verbal persuasion increases or decreases levels of efficacy through praise, encouragement, or criticism given by others--especially from a significant figure like a parent or educator (Jameson, 2013; Pajares, 1997; Schunk, 1982).

Verbal persuasion influenced narratives become part of the student's identity or thought process--affecting decisions, behavior, and performance in the future. (Jameson, 2013, 2014; Pajares, 1997). Feedback, reinforcements, and evaluations remain the most impactful when forming beliefs and confidence (Bandura & Locke, 2003; Byrne & Shavelson, 1996). Belief not only eases the use of everyday mathematics but can impact academic outcomes and performance. While belief does not provide knowledge or ability, it assists with navigating the application of skills they already possess (Bandura, 1989). If personal ability is surpassed, efficacious beliefs no longer predict behavior or performance (Chen, 2002; Jain & Dowson, 2009; Walczyk & Griffith-Ross, 2007). However, high efficacy can potentially encourage expectations of easy success and cause effort to be withheld. These actions will negatively affect performance, attitudes, and motivation levels (Chen, 2002; Pajares, 1997; Pajares & Graham, 1999; Valentine et al., 2004; Zimmerman, 2000).

Motivation. Motivation is the level of intent to act in regard to personal goals and beliefs (Ames, 1992; Gottfried, 1985, 1990). Findings indicate intrinsic and extrinsic motivation are mitigators of the math anxiety and performance relationship (Daches Cohen & Rubinsten, 2017; Harper & Daane, 1998). Math anxious individuals typically report low levels of intrinsic and extrinsic motivation (Daches Cohen & Rubinsten, 2017). Extrinsic motivation is driven through rewards; children are influenced through grades and praise via verbal persuasion (Timmerman et al., 2017). Intrinsic motivation is an act for the sake of one's own learning (Daches Cohen & Rubinsten, 2017; Murayama et al., 2013). Students with high intrinsic motivation levels report lower math anxiety levels and better predict future achievement; for example, intrinsic motivation levels at age nine were predictive of levels at sixteen--inadvertently forecasting performance (Gottfried, 1990; Murayama et al., 2013). Children with low motivation allow negative thoughts to disrupt working memory processing (Wang et al., 2015); thus, affecting time and effort spent mastering numerosity (Hembree, 1990; Maloney et al., 2015).

Stereotypes. Gender-based stereotypes impact future performance and avoidance levels, even with minimal differences found in skill or content understanding (Eccles, 1987; Halpern et al., 2007; Hyde et al., 1990). Female achievement may suffer when exam difficulty is discussed, expression that males outperform their peers, and superiority in STEM fields is conveyed (Costa et al., 2001; Spencer et al., 1999). As outlined earlier, low achievement may stem from parental or educator gender-stereotyping or beliefs that impact self-perceptions of ability (Bleeker & Jacobs, 2004; Jacobs & Eccles, 1992; Miller et al., 2006). Low achievement may impact willingness to approach math material, choose STEM-related college majors or careers, or taking elective classes relating to numeracy (Hembree, 1990; Ma, 1999; Meece et al., 1990).

Avoidance and Performance

Aversion to math may surface from complex problem-solving, lack of conceptual understanding, past performance, or negative emotional response (Hiebert & Grouws, 2007). Fear of failure may influence students to avoid negative stimuli by rushing through assessments or withdrawing from elective math courses (Ashcraft, 2002; LeFevre et al., 2010; Morsanyi et al., 2018; Ramani et al., 2015; Skwarchuk et al., 2014; Thompson et al., 2017). Students may also avoid math-related professions or college majors that limit career opportunities or earning potential (Beilock & Maloney, 2015; Chipman et al., 1992; Hembree, 1990) and limit use of mathematics in everyday life (e.g., reading grocery receipts, configuring discounts, or paying with cash; Ashcraft, 2002; LeFevre et al., 2010; Primi et al., 2014; Ramani et al., 2015; Skwarchuk et al., 2014).

Chronic avoidance behavior can put students at risk of creating a vicious cycle (Beilock & Maloney, 2015; Jameson, 2014); aversion of numerical encounters due to anxiety limits learning opportunities to strengthen skills and abilities. When students limit their achievement potential, they tend to fall behind in conceptual understanding, induce more numerical anxiety and negative responses, and perform poorly (Daches Cohen & Rubinsten, 2017; Hembree, 1990;

Jameson, 2014). These maladaptive reactions tend to cause further disappointments and re-solidify negative efficacious beliefs—creating a progressive cycle of worsening math anxiety (Ashcraft, 2002; Beilock & Maloney, 2015; Dowker et al., 2016; Hembree, 1990; Jameson, 2014; Krinzinger et al., 2009).

Researching Math Anxiety

Assessments

Mathematics anxiety research has used several measurements that assess affective levels across diverse populations. Richardson and Suinn (1972) developed the *Mathematics Anxiety Rating Scale* [MARS], for adult and adolescent populations; the MARS contained 98-items and was used as the primary measure for 30 years (Jameson, 2013). The length of the MARS encouraged the creation of a shortened measure [sMARS], eliminating 73-items (Ashcraft & Kirk, 2001). Following the sMARS, the *Abbreviated Math Anxiety Scale* [AMAS] was created (Hopko et al., 2003) --a nine-item measure. These were effective scales assessing anxiety in education and daily-life (Ashcraft, 2002; Suinn & Winston, 2003), but were not developmentally appropriate for children (Jameson, 2013). Existing research for children used modified versions of adult measures or a composed measure specifically tailored to the study.

Jameson (2013) recognized this deficit and developed a psychometrically sound measure for assessing math anxiety levels in primary students--the *Children's Anxiety in Math Scale* [CAMS]. The CAMS was developed based on academic curriculum standards for elementary mathematics. Items were reviewed by experts that independently deemed the original 20 items appropriate. After a pilot study to assess the function of items, four were removed to create the current 16-item scale (Jameson, 2013). The CAMS has assessed math anxiety in children in the US and Turkey [T-CAMS]; each version showed evidence of an appropriate and psychometrically sound scale (Jameson, 2013, 2014; Kandemir et al., 2016). Jameson (2014) then used the CAMS to investigate predictors of childhood math anxiety through hierarchical regression to identify the factors with the strongest influence on numerical anxiety. This study found a number of factors with average-to-strong correlations such as math self-efficacy, reading self-concept, and math self-concept (Jameson, 2014). Jameson’s work was primarily conducted with white students in the Midwest US, but her work did encourage further research of contextual variables in math anxiety in children. Current researchers were interested in investigating environmental and personal contextual factors within a more demographically diverse sample to explore other potential predictors of math anxiety levels.

CHAPTER III

METHODOLOGY

The purpose of this study was to identify various demographic predictors and the role they play in math anxiety levels among elementary school students according to the *Children's Anxiety in Math Scale* (Jameson, 2013).

Participants

Complete responses were collected from 40 primary-level children, 38 of whom resided in the United States (U.S.) and two resided in New Zealand [NZ], age 6 to 12 years (M = 8.47, Mdn = 9). This sample was composed of 22 cisgender females, 17 cisgender males, and 1 genderfluid individual. 90% (n = 36) of students identify as White or European Origin (e.g., German, Irish, English, Italian, Polish, French); 17.5% (n = 7) Hispanic, Latino/Latina, Latinx, or Spanish Origin (e.g., Mexican American, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian); 7.5% (n = 3) American Indian or Alaska Native (e.g., Navajo Nation, Blackfeet Tribe, Mayan, Aztec, Nome Eskimo Community); 2.5% (n = 1) Black or African American (e.g., Jamaican, Haitian, Nigerian, Ethiopian, Somalian); and 2.5% (n = 1) multiracial. All children spoke English as their primary language at home. 90% (n = 36) of children were monolingual and 10% were bilingual (n = 4). Two children were fluent in English and Spanish, one in English and American Sign Language, and one in English and Hebrew (see Table 1).

Table 1

Demographic Data of Sample

Demographic Characteristic	*n*	%
Race/Ethnicity[a]	-	-
American Indian or Alaska Native	3	7.5
Black or African American	1	2.5
Hispanic, Latino/a, Latinx, Spanish Origin	7	17.5
White	36	90.0
Biracial[b]	1	2.5
Language[c]	-	-
English	40	100.0
Bilingual	4	10.0
American Sign Language	1	2.5
Spanish	2	5.0
Hebrew	1	2.5

Note. $N = 40$

[a]See Appendix C for detailed examples of race/ethnicity

[b]Biracial or Mixed Race: Student reported being of Black/African American decent and White.

[c]All participants spoke English as their primary language at home; children who were bilingual spoke English and American Sign Language, Spanish, or Hebrew.

Students were enrolled in 1st - 6th grade (*M* = 3.05, *SD* = 1.72) and attended various school types: home (*n* = 3), public charter (*n* = 4), public classical (*n* = 1), religious (*n* = 2), and public neighborhood (*n* = 30). Participants all lived in community environments with populations at or under 1,000,000; 25% (*n* =10) resided in a city, 7.5% (*n* = 3) in an exurban/commuter town, 40% (*n* = 16) in rural areas, and 27.5% (*n* = 11) in suburban areas (see Table 2).

Table 2

Key Demographics of Sample

Variables	*N*	%	*M*	*SD*	*Range* Possible	*Range* Actual
Grade Level[a]	-	-	3.05	1.74	1-6	1-6
1st Grade	12	30.0	-	-	-	-
2nd Grade	5	12.5	-	-	-	-
3rd Grade	6	15.0	-	-	-	-
4th Grade	9	22.5	-	-	-	-
5th Grade	3	7.5	-	-	-	-
6th Grade	5	12.5	-	-	-	-
Special Needs	-	-	1.43	.5	1-2	1-2
ADHD	6	15.0	-	-	-	-
Communication Disorder	2	5.0	-	-	-	-
Dyslexia	1	2.5			-	-
Emotional Disorder	1	2.5	-	-	-	-
Hearing Impairment	1	2.5	-	-	-	-
Academic G/T	4	10.0	-	-	-	-
Math G/T	3	7.5	-	-	-	-
Nonverbal G/T	2	5.0	-	-	-	-
Verbal G/T	4	10.0	-	-	-	-
IEP	7	17.5	-	-	-	-
ALP	2	5.0	-	-	-	-
504c	4	10.0	-	-	-	-
Gender Identity	-	-	1.6	.55	1-7	1-3
Male	17	42.5	-	-	-	-
Female	22	55.0	-	-	-	-
Genderfluid	1	2.5	-	-	-	-
SES	40	-	16.6	4.4	1-27	1-25
P1 Ed	40	-	5.3	1.33	1-8	1-6
P2 Ed	40	-	4.54	1.57	1-8	1-7
Income	40	-	5.25	2.09	1-9	1-9
F/R Lunch	40	-	1.65	.48	1-2	1-2

Note. N = 40. G/T = Gifted and Talented; F/R = Free or Reduced

[a] school child currently attends or will attend for the upcoming academic year if on a break.

Sampling Procedure

Participants were part of a random sample with broad inclusion criteria. Children completing the CAMS were required to be in elementary school (i.e., 1st - 6th grade) and within the age range of 6 - 12 years to participate. The participants ($N = 40$) were a self-selected sample recruited via Facebook. The CAMS was distributed on parenting and education group pages with no payments or agreements conditional for completion. Intended sample size was estimated in the hundreds, but the resultant final sample size ($N = 40$) was due to low willingness of group administrators to share the scale and member inclination to complete. With the broad inclusion criteria and online distribution, data collection locations are largely unknown, though approximate coordinates provided by Qualtrics indicated participants were in New Zealand and fifteen US states (primarily Colorado). All participation in this study was voluntary and University of Northern Colorado Institutional Review Board (IRB) approval was granted April 2019 before data collection began. This study complied with human research participant ethical guidelines of both the American Psychological Association and University of Northern Colorado.

Measures and Materials

Demographic Questionnaire

Researchers crafted an eighteen-item demographic questionnaire (see Appendix, C) to assess potential predictor variables of mathematics anxiety levels. This selected response measure was used to help researchers understand the sample diversity. Parents/guardians of children were asked to complete the questionnaire in efforts to collect accurate data about the sample; questions regarding socioeconomic status or parental education may otherwise be unknown. Items inquiring about guardian relationship to the child, ethnicity/race, gender identity, and special needs identification were selected response items that allowed participants to select multiple answers or provide a text entry. Primary language spoken at home and date of birth were exclusively text entries; the remaining items were multiple choice allowing selection of one answer.

Children's Anxiety in Math Scale

The CAMS (Jameson, 2013) is composed of 16 Likert-type items developed from elementary-level mathematics tasks and asks participants to respond by selecting one of five facial images (*very anxious* [5], *anxious* [4], *not anxious or excited/neutral* [3], *excited* [2], and *very excited/not at all anxious* [1]) that most reflect their feelings for each item. Facial expression images assist children in accurately expressing their feelings (Ganley & McGraw, 2016; Jameson, 2013; Ramirez et al., 2013; Vukovic et al., 2013). Sample items include "When I solve math problems, I feel:", "When I know that I'm going to have a math test, I feel:", or "When I make a mistake in math, I feel:" (Jameson, 2013). The CAMS measures three factors of math anxiety: general math anxiety, math performance anxiety, and math error anxiety. CAMS scores range from 16 to 80; lower scores indicate low levels of math anxiety, and higher scores reflect high levels of math anxiety. The CAMS has excellent levels of internal consistency (α = .86), and scores on the CAMS are negatively correlated with math performance (Jameson, 2013, 2014).

Typically, the CAMS is administered in a small group academic setting (e.g., classrooms) using paper-and-pencil responses. In an attempt to reach a more diverse sample, the CAMS was placed online and administered via Qualtrics. No changes were made to response options, but the online CAMS was administered individually and presumably with a parent nearby.

Design and Procedure

The present study lacked the element of variable manipulation following a single-group, non-experimental research design. The CAMS questionnaire was completed online and distributed among parent and education Facebook groups. Researchers shared the Qualtrics link and purpose of the study with admin via Facebook Messenger. Consenting admins were instructed to post on the main group newsfeed with a caption composed at an eighth-grade literacy level--the US national average (Nienkemper & Grotlüschen, 2019).

Willing group members selected the link and were redirected to the first page of the survey (see Appendix, B). Parents were explained the study and gave their informed consent by progressing to the next page; consent to participate in the study was ensured to be completely voluntary and susceptible to their termination at any point without penalty (see Appendix, A for IRB approval). Parents were instructed to answer the demographic questionnaire for their child accurately to ensure accurate information. After completing the demographic questionnaire, parents were instructed to read aloud all subsequent items to their child but to allow the child to select the face that represent their feelings. Several practice items unrelated to math were administered to the participants to become familiar with the response options. The 16-items of the CAMS (see Appendix, D) were then presented on one page, followed by a confirmation of submission page. Data collection lasted between 5-24 minutes ($\bar{x}$ = 8 mins and 20 seconds) and occurred between April and October 2019. After removing five participants with incomplete and missing data, the original sample of 45 was reduced to a final sample size of 40 which included complete responses used in all subsequent analyses.

CHAPTER IV

ANALYSIS

Data Analysis

Data Configuration

Missing Data

Original data collection consisted of 73 responses; 38% (*n* = 28) were deemed incomplete for missing one or more responses to the 16-item CAMS measure. 62% (*n* = 45) of responses were complete; five additional data points were eliminated due to data missing completely at random (MCAR) from the demographic questionnaire. The finalized sample size (*N* = 40) consisted of 55% of the original data and is used for all subsequent analyses.

Data Programming

Demographics. Demographic data (see table 1) was examined and used for understanding sample characteristics. To analyze the contextual factors' impact on math anxiety levels, researchers used four variables: grade level, special needs identification, gender identity, and socioeconomic status (SES). Variable coding required researchers to condense data points to reduce chances of an overfit regression model. The researchers classified students reporting characteristics required special education (i.e., disability status, gifted/talented identification, and/or any educational accommodation plan) as having a special needs identification. SES scores were the sum of parent one and parent two education level, household annual income, and qualification for free/reduced lunch; scores ranged from 4 - 27 (*M* = 16.6, *SD* = 4.4). Higher scores indicated they were had a combination of higher household income and more educated parents.

Children's Anxiety in Math Scale. Using the continuous variable of CAMS, items were combined via Qualtrics; totals ranged from 20 - 68 out of a possible 16 - 80 (*M* = 49.6, *SD* = 14.2).

Results

First, to determine which demographic characteristics would most likely provide adequate predictive value in math anxiety in children, correlational patterns between CAMS scores and all measured demographic variables were examined (see table 3). Based on correlations, grade level and special needs identification were selected as predictor variables. Based on review of the literature, gender identity and socioeconomic status were also selected as predictor variables, though they showed a weak correlation within the present study.

Table 3

Intercorrelations of Contextual Factors and Math Anxiety

Variable	1	2	3	4	5
1. CAMS	1.00	-.382**	-.321*	-.172	-.044
2. Grade level		1.00	.004	-.222	.152
3. Special needs			1.00	-.301*	.335*
4. Gender identity				1.00	.059
5. SES					1.00

*p < .05. ** p < .01. *** p < .001.

Next, a hierarchical regression analysis was completed. CAMS scores served as the outcome variable; the predictors variables were entered into the regression analysis in four steps (see Table 4). From previous research (Bandura, 1989; Chang & Beilock, 2016; Jameson, 2014; Luttenberger et al., 2018), independent variables are thought to interact and potentially be related, increasing the issue of multicollinearity. Through evaluation of the variance inflation factors (VIF), all variable values measured between 1.0 and 1.33 (see Table 3); these values indicate multicollinearity is not of concern.

The first step of the regression, grade-level, showed a significant predictive relationship with math anxiety levels, $R^2 = .146$, $\Delta R^2 = .123$, $F(1,38) = 6.484$, $p = .015$, and accounted for approximately 13% of the variance. The second step, $R^2 = .247$ $\Delta R^2 = .207$, $F(2, 37) = 6.084$, $p = .005$ indicated a significant relationship with math anxiety levels; this step indicated that special needs identification accounted for 8.4% unique variance in math anxiety and 20.7% when combined with grade level. In this model, grade level ($p = .011$) and special needs identification ($p = .031$) were found individually significant predictors. The third step was responsible for combined 34.1% of variance in the sample, $R^2 = .391$ $\Delta R^2 = .341$, $F(3, 36) = 7.714$, $p < 0.001$; gender identity uniquely contributes 13.4% of the variance in math anxiety scores. The final step including socioeconomic status, $R^2 = .445$ $\Delta R^2 = .382$, $F(4, 35) = 7.019$ $p < 0.001$, accounted for 38.2% of variance. Socioeconomic status individually accounted for 4.1% of variance, making SES the weakest predictor of the four variables. All regression statistics are available in Table 4.

Table 4

Hierarchical Regression Analysis with Children's Anxiety in Math Scale Scores as the Dependent Variable

Variables	*B*	*95%* CI	β	$t(39)$	α	*VIF*
Step 1						
Grade level	-3.114	[-5.59, -.638]	-.382	-2.546	.015	1.000
Step 2						
Grade level	-3.103	[-5.46, -.746]	-.380	-2.667	.011	1.000
Special needs identification	-9.034	[-17.22, -.849]	-.319	-2.236	.031	1.000
Step 3						
Grade level	-3.837	[-6.048, -1.626]	-.470	-3.520	.001	1.056
Special needs identification	-12.502	[-20.352, -4.652]	-.441	-3.230	.003	1.104
Gender identity	-10.627	[-18.017, -3.237]	-.409	-2.916	.006	1.161
Step 4						
Grade level	-4.262	[-6.456, -2.069]	-.523	-3.945	.000	1.107
Special needs identification	-15.605	[-23.947, -7.264]	-.551	-3.798	.001	1.327
Gender identity	-12.182	[-19.547, -4.817]	-.468	-3.358	.002	1.228
Socioeconomic status	.825	[-.084, 1.735]	.259	1.843	.074	1.242

Note. VIF= variance inflation factor. Significance level = 0.05

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Discussion

This study aimed to identify the predictive relationship of demographic factors on math anxiety levels in elementary school students. To avoid an overfit regression model due to small sample size and large number of predictors, demographic variables were correlated with math anxiety scores. The four variables most strongly correlated with CAMS scores were selected as predictor variables. Each predictor variable was added hierarchically to a regression model with math anxiety scores as the outcome variable. Gender identity accounted for the largest amount of variance among CAMS scores at 13.4%. All variables significantly contributed to the model, with the full model (grade level, special needs identification, gender identity, and socioeconomic status) accounting for 35% of the variance in CAMS scores. In this sample, demographic variables accounted for over one-third of the variance in math anxiety scores. While the remaining variance is likely accounted for by personal (Bandura, 1986, 1997, 1999; Bieg et al., 2015; Gunderson et al., 2018) and environmental (Bandura, 1999; Dowker et al., 2016; Stevenson et al., 2000) factors, this is a large amount of variance explained by demographic factors.

Grade Level

In the current research, we found a weak but statistically significant negative correlation between math anxiety and grade level; math anxiety levels decreased as children got older. Grade level accounted for 12.3% unique variance in CAMS scores. Findings support these latter interpretations of the relationship between grade and math anxiety.

Pre- and in-service elementary educators report the most elevated levels of math anxiety in comparison to the general population (25%-30% worldwide report moderate-to-high math anxiety levels) and other college majors or in-service secondary educators (Becker, 1986; Beilock & Willingham, 2014; Ganley et al., 2019; Hembree, 1990; Kelly & Tomhave, 1985). Anxious educators develop maladaptive thought processes, detrimental feelings, and aversive behaviors, but are expected to instruct students with an enthusiastic perspective (Mihalko, 1978; Pantoja et al., 2020; Wood, 1988). Not only do these educators lack efficacy in their teaching ability (Bursal & Paznokas, 2006), their low engagement and poor performance levels can compromise both their pedagogical techniques and children's math learning (Duncan et al., 2007; Foley et al., 2017; Gershenson, 2016; Wilkins, 1976). Students have attributed the onset of math anxiety to educator attitudes and expectations for student success (Gershenson, 2016; Malinsky et al., 2006; Sloan, 2010; Uusimaki & Nason, 2004; Wilkins, 1976), as teachers are the primary source for math-related knowledge in early elementary school (Cannon & Ginsburg, 2008). Supportive findings indicate teachers with high levels of anxiety are associated with lower math knowledge levels at the end of the school year in students—even after considering math ability of the educator and the knowledge level of the students at the beginning of the school year (Pantoja et al., 2020).

Consequently, teachers that do not enjoy math tend to spend 50% less time on mathematics in comparison to educators comfortable in this area (Schmidt & Buchmann, 1983) and often spend time teaching students basic skills (i.e., counting) they've already learned (Engel, 2013; Gunderson et al., 2018). Findings indicate that this pedagogy is likely to foster anxious feelings within students (Greenwood, 1984). Students in early elementary (pre-kindergarten – 1st grade) were originally thought to be "overly optimistic" regarding their academic performance compared to their peers (Eccles, 1984; Eccles et al., 1990; Wigfield et al., 1997), but recent findings indicate that assessment of math achievement indeed affects negative emotions and beliefs in young students (Gunderson et al., 2018; Park et al., 2014; Ramirez et al., 2016; Stipek & Gralinski, 1996; Vukovic et al., 2013). It is possible the negative correlation of grade level is due to younger students feeling less comfortable with math due to lack of practice and conceptual understanding in earlier grade levels (Boaler, 2014; Engel, 2013; Gunderson et al., 2018).

Standardized tests and basic assessments in the United States are commonly timed as a regular part of instruction, inducing stress they otherwise may not experience when solving problems without time restrictions (Engle, 2002; Ramirez et al., 2013). As previously discussed, negative emotions (like stress) occupy space in the working memory; this prevents students from retrieving information and causes them to question their abilities (Boaler, 2014). Students are also exposed to the myth that quick math performance is good math performance—causing students who are deep thinkers to turn away from mathematics (Boaler, 2014). Educators are instructed to spend an ample amount of time preparing students for assessments by using rote learning techniques rather than developing conceptual understanding or presenting alternative solving methods (Gray & Tall, 1994; Gunderson et al., 2018; Harris et al., 2001). Standardized state math testing, developed in accordance with the No Child Left Behind Act of 2001, commonly begins second semester of 3rd grade (Greisen et al., 2018). Because of the importance of performing well on these assessments, preparation screening begins in kindergarten or first grade to identify reading difficulties and areas of improvement (Jordan et al., 2007). Math screening at this age is still in its infancy, increasing the likelihood children will be underserved prior to receiving their individualized state testing proficiency reports in fourth grade (Greisen et al., 2018; Jordan et al., 2007)—another potential explanation for higher math anxiety levels in earlier elementary.

Outside of the classroom, students may seek help from parents with homework, particularly those in early elementary. Findings have indicated that homework assistance is sometimes negatively linked to math achievement, particularly in students who have parents with mathematics anxiety (Maloney et al., 2015; Patall et al., 2008). Anxious parents might lack the proper skills or introduce solving operations that differ from those presented within the classroom, causing confusion (Maloney et al., 2015). Parents who are frequently involved also have increased opportunities to expose their child to the negative attitudes they experience towards math, resulting in their child learning less throughout the school year (Beilock & Maloney, 2015; Maloney et al., 2015). As math difficulty increases over time, the need for parent assistance declines. Correspondingly, learning impacts from parents decrease as grade levels increase, with the potential to reduce math anxiety levels (Beilock & Maloney, 2015; Maloney et al., 2015; Rubinsten et al., 2015).

Special Needs Identification

Our current research suggests the relationship between SNI and math anxiety is a significant but weak negative correlation. Overall SNI accounted for an additional 8.4% of the variance among math anxiety scores. This study indicates that students without a SNI students have higher math anxiety levels. We propose this relationship due to several educational and societal expectations relevant to this subpopulation. Because this demographic includes various difficulties and abilities, the existing empirical evidence does not assess this group as a single entity. However, the succeeding evidence is used to deduce logical reasoning in support of this prediction. Our proposed mediating factors are individual attitudes, educator training and accountability, and parenting techniques.

Research has reported SNI students commonly experience a lack of specialized curriculum and instruction sufficiently meeting their learning needs (Archambault et al., 1993; Eddles-Hirsch et al., 2010; Kahveci & AkgÜl, 2014). Differentiation is limited with minimal adjustments, potentially due to educator training deficits. In fact, 50%-60% of state and private educators indicated they were not taught instruction modification for these students (Archambault et al., 1993; Kahveci & AkgÜl, 2014). Proper pedagogy can elevate talents, interests, and potential, but inadequate instruction can contribute to underachievement and a decrease in motivation (Reis, 2002; Reis & McCoach, 2002; Reis & Renzulli, 2010). SNI students report experiencing boredom, overwhelm, pressure, or embarrassment in the classroom and a sense of estrangement within the education system (Gallagher et al., 1997; Heilbronner et al., 2009; Reis, 2002). Negative attitudes and feelings of failure may encourage apathy towards academics and potentially explain lower math anxiety levels in SNI students. Conversely, it is possible math anxiety levels decline if SNI students have a special education teacher to assist in anxiety inducing tasks and provide a sense of security.

Widespread deficits in educating early elementary teachers on SNI students indicate this curriculum lacks importance in most undergraduate programs (Sak et al., 2015; Tomlinson, 1995, 1997; Vaughn & Schumm, 1995). Apart from a certified special education teacher, students lack a support system that understands and adapts their approaches based on needs (Callahan & Hertberg-Davis, 2012; Purcell & Eckert, 2006; Reis & Renzulli, 2010; Robbins et al., 2011). Instructional adaptions require separate curriculum and modifying materials (i.e., assessments, grading criteria, presentation styles, etc.) to enhance student environment (Friend &

Bursuck, 1999; Scott et al., 1998; Scruggs & Mastropieri, 2000; Shukla-Mehta & Albin, 2003). Research findings indicate large-group instruction with minimal management techniques are favored by most elementary educators, particularly those with limited teaching resources (Avramidis et al., 2000; Avramidis & Kalyva, 2007; Kuyini & Desai, 2007, 2008; Vaughn & Schumm, 1995). Even with the existing empirical evidence, SNI students are disadvantaged in the United States education system as there or no federal mandates, laws, regulations, or guidelines apart from the Americans with Disabilities Act of 1990 that ensure adequate instruction (Gallagher, 2002; Plucker & Callahan, 2014; Stephens et al., 2008). Without training and holding teachers accountable for inclusive education practices, these environmental factors may continue to impact SNI student attitudes and their reported math anxiety levels (Ajuwon et al., 2012).

Parenting a child with needs requires specialized approaches that are often more time-consuming than class peers. Many SNI children function significantly below or above their age level and may require 1:1 attention to monitor learning or behavior (Kauffman & Badar, 2013). Parents commonly report frustration with educational interventions, especially for those who consider their parenting effective (Mowder, 2005). For successful parenting, adapting to their unique needs is essential for proper social and emotional development (Kauffman & Badar, 2013; Mowder, 2005; Mowder et al., 1995). Findings suggest parenting styles dictate the parent-child and family dynamic; they are also responsible for parental components (e.g., bonding, discipline, education) that fluctuate levels of importance based on individual need (Mowder et al., 1995). Parenting methods predict approximately 30% of the variance (Yaffe, 2015) in educational functioning; findings specified authoritative style as the most effective form of parenting regarding achievement and overall academic efficiency (Durbin et al., 1993; Dyches et al., 2012; Eisenberg et al., 2005; Wigfield, 1994). Researchers also found a mediated relationship between parenting style and mathematics achievement, but further investigation is required to understand the direction of correlation (Ishak et al., 2012; Sessa et al., 2001; Spera, 2005; Yaffe, 2015); the challenges of parent interactions—whether that is being under or over involved—may explain the decrease in math anxiety scores in SNI students in comparison to their peers.

Gender Identity

Our results found adding gender identity to the model explained an additional 13.4% of the variance in math anxiety scores but did not indicate a significant correlation. The link between anxiety levels and gender may be explained by a small spread of interrelated mediators.

Previous findings have indicated general anxiety is a likely mediator when it comes to gender and reported math anxiety levels (Hill et al., 2016; Szczygiel, 2020). General anxiety is an inclination for one to chronically worry about a large variety of happenings (events, behaviors, competencies) unique to that individual (Spence, 1997). Females have indicated a higher level of general anxiety than males (Hill et al., 2016; Núñez-Peña et al., 2016; Zalta & Chambless, 2012). Research of elementary-level students shows that math anxiety exists before the start of formal school despite their lack of experience with math (Carey et al., 2017; Cargnelutti et al., 2017; Ganley & McGraw, 2016; Gierl & Bisanz, 1995; Harari et al., 2013; Hill et al., 2016; Krinzinger et al., 2009; Ramirez et al., 2013, 2016; Szczygiel, 2020; Vukovic et al., 2013; Wu et al., 2012; Young et al., 2012). This determination has been thought to be explained by the individual inclination to general anxiety (Baloglu & Koçak, 2006; Carey et al., 2017; Dew & Galassi, 1983; Hembree, 1990). The gender gap in general anxiety levels indicate females experience more anxiety than males (Ganley & McGraw, 2016), a possible justification for previous research indicating a gender gap. Similarly, high levels of test anxiety have been consistently found in elementary-level females; a combination of test anxiety and general anxiety is thought to be responsible for mediating math anxiety levels (Cargnelutti et al., 2017; Ganley & McGraw, 2016; Hill et al., 2016; Van Mier et al., 2019). Therefore, the nonexistent gender correlation may indicate low levels of predisposed general anxiety and/or test anxiety among the sample.

Stereotypes and expectations that effect self-efficacy levels may also mediate the gender gap relationship (Brown et al., 2020; Devine et al., 2012; Szczygiel, 2020). While the present results do not indicate a significant correlation, these mediators may clarify why previous findings have shown a gender gap. Female students experience stereotype threat and self-efficacy levels of higher impact than male students (Eysenck & Calvo, 1992; Eysenck et al., 2007; Ramirez et al., 2013). The societal expectations about males and their math anxiety or performance can boost self-efficacy levels; this may originate from the pressure and demands put on males to perform better. Males stereotypically are expected to have greater math potential than their female peers—causing anxiety levels of female students to increase (Casad et al., 2015; Niederle & Vesterlund, 2011; Schmader et al., 2004; Thoman et al., 2008). Females have reported feeling more comfortable than their male counterparts when admitting feelings of mathematics anxiety (Ashcraft & Ridley, 2005)—stories regarding math anxiety in males are recognized as socially deviant or shameful (Devine et al., 2012). The gender gap may be mediated by high male self-efficacy levels from societal beliefs about potential or the denial of anxious feelings (Szczygiel, 2020). It is also possible that because females feel more comfortable reporting math anxiety levels and with discussing their struggles with math anxiety. Females may also use their comfort levels on discussing math anxiety to alleviate some worries or potentially decrease reported levels (Brown et al., 2020; Devine et al., 2012; Niederle &

Vesterlund, 2011; Szczygiel, 2020). Females alleviating anxiety levels and high self-efficacy levels in males could explain the present absence of a gender gap.

Other potentially significant mediators of math anxiety and gender are pedagogical methods and gender identity of their educators (Ashcraft, 2002; Cates & Rhymer, 2003; Finlayson, 2014; Jackson & Leffingwell, 1999; Pantoja et al., 2020; Popham, 2009; Stuart, 2000; Tsui & Mazzocco, 2007). As formerly discussed, math anxiety is largely prevalent among elementary level educators (Foley et al., 2017; Ganley et al., 2019; Hembree, 1990) and most attribute their anxiety levels to their early elementary teachers (Cannon & Ginsburg, 2008). Through a combination of stereotypes and teacher gender identity, students are impacted through vicarious learning experiences (Bandura, 1989) and choice of instruction (Pantoja et al., 2020). Because approximately 85% of pre-k – 8th grade educators are predicted to be female (Cvencek et al., 2011), research indicated that female educators could affect learning (in both male and female students), achievement, and math anxiety development in their female students (Beilock et al., 2010). In conjunction with gender identity, teacher behavior has been deemed a prime factor causing math anxiety (Finlayson, 2014). Math anxiety evolves from the way math has been introduced to the students—especially if presented as a “right or wrong” subject that discourages experimentation, risks, or alternative solution methods (Stuart, 2000). Teachers often assume that introduction methods, preferred learning style, and solving times do not differ among students (Boaler, 2002; Finlayson, 2014). Ignoring the looming stereotype or attitude differences that may affect males and female learning, educators can create negative attitudes towards mathematics and mathematics anxiety—potentially explaining gender gap findings (Ashcraft, 2002; Finlayson, 2014; Popham, 2009; Stuart, 2000; Tsui & Mazzocco, 2007). Findings not reflecting a gender gap may indicate a development in elementary teaching techniques that focus on problem-solving and understanding concepts instead of rote memorization or speed (Finlayson, 2014; Popham, 2009; Scarpello, 2007).

Socioeconomic Status

ES added to the model explained an additional 4.1% of variance among math anxiety scores. Our findings did not indicate a significant correlation between SES and mathematics anxiety. SES is comprised from (e.g., parent education, familial income, free/reduced lunch qualification) individually mediate their relationship with mathematics anxiety. As previously discussed, research on the link between these concepts and math anxiety levels is limited; the existing empirical evidence has been used to hypothesize the absent correlation (Bradley, 2001; Singh et al., 1995; Tsui, 2005).

Parent education has been thought to influence behavior, attitudes, and decisions in children (Chevalier, 2004). Parent education background may not only mediate success and motivation in children; SES and education level have also shown to be sufficient indicators of academic support available to the child (Joshi, 1995). Additionally, parents with higher levels of education are more likely to be knowledgeable about emotional regulation. Regulation technique knowledge may have a positive impact on coping skill development that is later used to lessen math anxiety (Geyik, 2015). Other empirical evidence has deemed parent educational background as less important in development and achievement than general parent attitudes and values regarding education (Dini et al., 2019; Hall et al., 1999). The lack of correlation found in the present study may mirror these findings—indicating parent education level is less influential on children than the attitudes, resources, values, and support of parents (Campbell et al., 1992).

A larger body of contradictive research exists regarding family income. Previous investigations have shown income is commonly related to children's cognition, achievement, a higher likelihood of poor performance on standardized testing, and an increased high school dropout rate (Bradley, 2001; Brooks-Gunn et al., 1997; Duncan et al., 1994; McLanahan & Sandefur, 1994; Yeung et al., 2002). Intrigued researchers investigated income levels and math knowledge of children entering early elementary school. Evidence suggests children coming from low-income families are less advantaged in math knowledge development (Duncan et al., 2007; Jordan et al., 2009; Watts et al., 2014); this causes children to not only enter school with deficits but continue their elementary education with weaker knowledge than their peers (Jordan et al., 2009). Some researchers found the relationship between income and performance to be caused by a lack of resources (events, services, etc.), while others argue that there is an indirect effect of low-income. For example, Henretta et al., (2002) concluded that financial hardship can cause parent distress resulting in less involved, attentive, and interested parent-child interactions. Other research notes low-income families may have differing parental beliefs regarding their role in the education of their child, resulting in less involvement (Catsambis & Garland, 1997; Chavkin & Williams, 1993; Connell, 1994; Hoover-Dempsey et al., 1987; Muller & Kerbow, 2018; Rittle-Johnson et al., 2017; Stevenson & Baker, 1987). Because families with limited financial resources may experience parental sacrifice, the sacrificial willingness depends on family size and their outlook on potential for financial return of the educational investment (Becker & Tomes, 1986; Rosenzweig & Schultz, 1982). Due to perceived impact of income levels, researchers chose to examine math anxiety levels. These studies indicate families with low income are more likely to have children with high levels of math anxiety (Geyik, 2015; Richland et al., 2020). However, other exploration into income levels showed no effect on anxiety levels and found parental expectations, attention, and effort impact math anxiety

(Morsanyi et al., 2018; Richland et al., 2020); these findings can provide potential justification for the null correlation we found between SES and math anxiety levels.

Conclusions and Limitations

Findings of the current study indicated a correlation existed between two of four variables, grade level and SNI; these variables had a weak, negative correlation. The other two variables, gender identity and SES, had no correlation. Grade level, SNI, and gender identity were found to be significant predictors of CAMS math anxiety scores, leaving SES as the only variable lacking significance. Variance of the full model was analyzed at 38.2% (grade level: 12.3%, SNI: 8.4%, gender identity: 13. 2%, and SES: 4.1%).

Mediators were identified for each independent variable using existing research. Three mediation themes existed across the variables: parental influences (e.g., homework help, attitudes, effort), educator influences (e.g., gender, pedagogy, training), and attitudes (e.g., existing anxiety, self-efficacy, stereotype threat). These findings solidify the lack of continuity between evidence, indicating future research is necessary; mediators can be used for succeeding studies to form hypotheses or as factors to control for.

Limitations

Current research found a significant portion of math anxiety in elementary students is accounted for by the combination of gender identity, special needs identification, grade level, and socioeconomic status. Even so, limitations to this research could be improved for future projects.

Sample

A concern in this study is the adequacy of the achieved sample; sample size, generalizability, and selection bias point towards limitations that could threaten overall validity.

The sample size ($N = 40$) was smaller than anticipated and lacked proper representation of the target population. Small samples can create difficulty accurately interpreting findings and over-estimating correlations (Hackshaw, 2008). These samples can threaten the statistical power of a study which affects the ability to identify effect sizes and avoid Type II error (i.e., confirming the hypothesis when an alternative hypothesis is true; Field, 2013; Hackshaw, 2008). External validity may also be jeopardized with small accessible samples, as they are not typically reflective of the target population and thus restrict generalizability. Obtaining a larger sample through alternate recruitment methods may mitigate diversity deficits and increase external validity. The sample size also effected the number of independent variables used in the regression analysis. Researchers planned to use seven predictor variables in the hierarchical regression; to avoid an overfit model, variables were reduced to four predictors. Guidelines suggest a minimum of 10 datasets per predictor variable, but 15 or more are desirable for a regression (Field, 2013; Hackshaw, 2008); thus, obtaining a sample size ≥ 60 is advised for study replication. Researchers replicating this study should also be cognizant of the subsequent limitations of methodology.

Methodology

This investigation was the first attempt to administer CAMS through an online platform. Although online distribution has potential to reach a wide range of individuals from a variety of locations, selection bias proposes a threat. While internet access is a common amenity, approximately 8% of the US population does not have access to home broadband internet services or a smartphone with data (Pew Research Center, 2021). With the CAMS only available online, students without internet access did not have equal opportunity to participate. Selection bias was also threatened by distribution via social media groups, limiting the potential sample to those who use particular platforms (e.g., Facebook).

Online administration of the CAMS could not allow researchers to control for extraneous variables that might influence participant responses (e.g., setting, distractions, scale administrator characteristics). While parents/guardians were provided instructions including this information, there were no controls in place to minimize these potential confounding variables. Traditional face-to-face administration is more standardized, including training scale administrators for research purposes.

Implications and Recommendations

These present findings provide meaningful contributions to the field and insights for mitigating math anxiety among elementary-level students in educational and home environments. Study findings continue to support the relevancy of math anxiety awareness, training, and research in elementary level students. Correlational patterns suggest a need for math anxiety assessment and treatment in all grade levels, regardless of special need designation. Findings support higher math anxiety levels occurring in early elementary than in later—suggesting focused intervention on defining and combatting math anxiety should begin immediately in elementary school. Interventions should not only be a normalized practice but widespread—instead of limiting those needing learning accommodations. For example, Response to Intervention (RtI), combining pedagogical practice and strategy, provides early elementary intervention for struggling students based on their individual needs (Fuchs & Fuchs, 2005, 2006).

This multi-teared intervention is designed for student-specific instruction to improve learning outcomes (Brown-Chidsey et al., 2009). This intervention includes alternate pedagogical techniques and supports change in learning environments in accordance to needs of students that would promote individual success (Johnson et al., 2009). Unlike special education or gifted and talented programs, RtI tiers 1 and 2 target all general education students' learning needs (Carlson et al., 2010). Tier 1 focuses on classroom strategies for all, while Tier 2 aims to provide additional support (e.g., tutoring) for struggling students. Tier 3 is more intensive, existing for those students with academic and behavior needs through specialized instructional practices or special education programs (Bender & Shores, 2007; Carlson et al., 2010; Howard & Potts, 2009; Johnson et al., 2009; Wright, 2007). Ideally through RtI and training, educators and families work together in and outside of the classroom to mitigate math anxiety levels and develop coping mechanisms to keep performance impacts minimal.

Supplemental Recommendations

Math anxiety levels can be easily transmitted through words and body language during homework help or everyday math-oriented scenarios (i.e., figuring out a sale discount). Comments like "I'm not a math person" or "math is not for everyone" can add to math anxiety development, even if the intent is to sympathize or console them. Thus, a need exists for family training regarding the importance of math self-concept. It is recommended training discusses gender or cognitive differences in math ability, how to make math fun and enjoyable through playing games or applying math to relevant life (e.g., counting money to buy a toy), and how communicating their students' strengths increases self-efficacy. Research on parent involvement indicates support and expectations are main influencers in creating or minimizing negative attitudes and math performance deficits (Suárez-Pellicioni et al., 2016; Vukovic et al., 2013).

Potentially of greater importance is proper training for educators to mitigate math anxiety effects; empirical evidence indicates origins of math anxiety are classroom experiences (Beilock

& Willingham, 2014; Bekdemir, 2010; Geist, 2010). Students who experience embarrassment, hostility, or messages endorsing stereotype threat are likely to develop math anxiety. Teachers are one of the largest influences on young children (Beilock & Willingham, 2014) and should be provided with training for creating a space where questions are encouraged, mistakes are normalized, and math is viewed as a valuable skill (Ashcraft et al., 2007). Teachers should also be advised on how to approach their own existing math anxiety levels and take actions to prevent transmitting them to their students—especially female educators (Beilock et al., 2010). Training should extend to assessing math anxiety levels multiple times throughout the year and adapt classroom instruction accordingly (e.g., rid timed tests, emphasize positive attitudes, etc.) as math has been linked to avoidance behaviors and performance deficits (Hembree, 1990; LeFevre et al., 2010). Observing the vulnerability of teachers making errors, receiving positive feedback, and adopting attitudes of hard work is the key to mathematic success can all assist in anxiety levels and mitigating math anxiety effects (Suárez-Pellicioni et al., 2016).

Future Research

Math anxiety, especially in children, is an important and timely topic. The CAMS has shown to reliably measure math anxiety ($\alpha = .939$), and the current research continues to support its use assessing math anxiety levels in elementary school children. As such, this field should continue to be researched using the CAMS. Future researchers should consider investigating the following areas:

1. Investigate a larger sample size with a more diverse population to determine possible correlates of math anxiety levels and demographic factors (i.e., familial income, government school funding, parent education, investigating gender as a spectrum, etc.).

2. Explore further validation of the CAMS scale by measuring invariance to ensure the scale accurately measures math anxiety levels among all demographics.
3. Conduct CAMS research by controlling or measuring extraneous variables (e.g., general anxiety, parent anxiety levels, etc.).

References

Ahmed, W., Minnaert, A., Kuyper, H., & van der Werf, G. (2012). Reciprocal relationships between math self-concept and math anxiety. *Learning and Individual Differences*, *22*(3), 385–389. https://doi.org/10.1016/j.lindif.2011.12.004

Aiken, L. R., Jr. (1976). Update on attitudes and other affective variables in learning mathematics. *Review of Educational Research*, *46*(2), 293-311. https://doi.org/10.3102/00346543046002293

Ajuwon, P. M., Lechtenberger, D., Griffin-Shirley, N., Sokolosky, S., Zhou, L., & Mullins, F. E. (2012). General education pre-service teachers' perceptions of including students with disabilities in their classrooms. *International Journal of Special Education*, *27*(3), 100-107. https://doi.org/10.3390/educsci8020080

Allen, J. M. (2009). Valuing practice over theory: How beginning teachers re-orient their practice in the transition from the university to the workplace. *Teaching and Teacher Education*, *25*(5), 647-654. https://doi.org/10.1016/j.tate.2008.11.011

Americans With Disabilities Act of 1990, 42 U.S.C. § 12101 et. seq. (1990) https://www.ada.gov/pubs/adastatute08.htm

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, *84*(3), 261–271. https://doi.org/10.1037/0022-0663.84.3.261

Andrews, A., & Brown, J. (2015). The effects of math anxiety. *Education*, *135*(3), 362-370. https://www.ingentaconnect.com/content/prin/ed/2015/00000135/00000003/art00013#expand/collapse

Archambault, F. X., Jr., Westberg, K. L., Brown, S. W., Hallmark, B. W., Zhang, W., & Emmons, C. L. (1993). Classroom practices used with gifted third and fourth grade students. *Journal for the Education of the Gifted, 16*(2), 103-119. https://doi.org/10.1177/016235329301600203

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current directions in psychological science*, *11*(5), 181-185. http://doi.org/10.1111/1467-8721.00196

Ashcraft, M. H., & Faust, M. W. (1994). Mathematics anxiety and mental arithmetic performance: An exploratory investigation. *Cognition & Emotion*, *8*(2), 97-125. https://doi.org/10.1080/02699939408408931

Ashcraft, M. H., & Kirk, E. P. (2001). The relationships among working memory, math anxiety, and performance. *Journal of Experimental Psychology: General*, *130*(2), 224–237. https://doi.org/10.1037/0096-3445.130.2.224

Ashcraft, M. H., Krause, J. A., & Hopko, D. R. (2007). *Is math anxiety a mathematical learning disability?* In D. B. Berch & M. Mazzocco (Eds.), *Why is math so hard for some children? The nature and origins of mathematical learning difficulties and disabilities* (pp. 329–348). Paul H. Brookes Publishing Co. https://doi.org/10.1097/dbp.0b013e31817aefe8

Ashcraft, M. H., & Moore, A. M. (2009). Mathematics anxiety and the affective drop in performance. *Journal of Psychoeducational Assessmen*t, *27*(3), 197-205. https://doi.org/10.1177/0734282908330580

Ashcraft, M. H., & Ridley, K. S. (2005). Math anxiety and its cognitive consequences. *Handbook of Mathematical Cognition*, (pp. 315-327). Psychology Press. https://doi.org/10.4324/9780203998045-27

Ashcraft, M. H., & Rudig, N. O. (2012). Higher cognition is altered by noncognitive factors: How affect enhances and disrupts mathematics performance in adolescence and young adulthood. In V. F. Reyna, S. B. Chapman, M. R. Dougherty, & J. Confrey (Eds.), *The adolescent brain: Learning, reasoning, and decision making* (pp. 243–263). American Psychological Association. https://doi.org/10.1037/13493-009

Avramidis, E., Bayliss, P., & Burden, R. (2000). A survey into mainstream teachers' attitudes towards the inclusion of children with special educational needs in the ordinary school in one local education authority. *Educational Psychology*, *20*(2), 191-211. https://doi.org/10.1080/713663717

Avramidis, E., & Kalyva, E. (2007). The influence of teaching experience and professional development on Greek teachers' attitudes towards inclusion. *European Journal of Special Needs Education, 22*(4), 367–389. https://doi.org/10.1080/08856250701649989

Baddeley, A. D. (2002). Is working memory still working? *European Psychologist*, *7*(2), 85–97. https://doi.org/10.1027/1016-9040.7.2.85

Baddeley, A. D., & Hitch, G. (1974). Working memory. In *Psychology of learning and motivation* (Vol. 8, pp. 47-89). Academic Press. https://doi.org/10.1016/S0079-7421(08)60452-1

Baloglu, M., & Koçak, R. (2006). A multivariate investigation of the differences in mathematics anxiety. *Personality and Individual Differences*, *40*(7), 1325-1335. https://doi.org/10.1016/j.paid.2005.10.009

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology*, *4*(3), 359-373. https://doi.org/10.1521/jscp.1986.4.3.359

Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist*, *44*(9), 1175-1184. https://doi.org/10.1037/0003-066X.44.9.1175

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, *28*(2), 117–148. https://doi.org/10.1207/s15326985ep2802_3

Bandura, A. (1997). The anatomy of stages of change. *American Journal of Health Promotion: AJHP*, *12*(1), 8-10. https://doi.org/10.4278/0890-1171-12.1.8

Bandura, A. (1999). Social cognitive theory of personality. In D. Cervone & Y. Shoda (Eds.), *The Coherence of Personality: Social-Cognitive Bases Of Consistency, Variability, And Organization* (pp. 185–241). Guilford Press.

Bandura, A., & Locke, E. A. (2003). Negative self-efficacy and goal effects revisited. *Journal of Applied Psychology*, *88*(1), 87–99. https://doi.org/10.1037/0021-9010.88.1.87

Barbaresi, W. J., Katusic, S. K., Colligan, R. C., Weaver, A. L., & Jacobsen, S. J. (2005). Math learning disorder: Incidence in a population-based birth cohort, 1976–82, Rochester, Minn. *Ambulatory Pediatrics*, *5*(5), 281-289. https://doi.org/10.1367/A04-209R.1

Barrett, L. F., Tugade, M. M., & Engle, R. W. (2004). Individual Differences in Working Memory Capacity and Dual-Process Theories of the Mind. Psychological Bulletin, 130(4), 553–573. https://doi.org/10.1037/0033-2909.130.4.553

Battista, M. T. (1986). The relationship of mathematics anxiety and mathematical knowledge to the learning of mathematical pedagogy by preservice elementary teachers. *School Science and Mathematics*, *86*(1), 10-19. https://doi.org/10.1111/j.1949-8594.1986.tb11580.x

Becker, J. R. (1986). Mathematics attitudes of elementary education majors. *The Arithmetic Teacher*, *33*(5), 50-51. https://doi.org/10.5951/AT.33.5.0050

Beilock, S. L., Gunderson, E. A., Ramirez, G., & Levine, S. C. (2010). Female teachers' math anxiety affects girls' math achievement. *PNAS Proceedings of the National Academy of Sciences of the United States of America*, *107*(5), 1860–1863. https://doi.org/10.1073/pnas.0910967107

Beilock, S. L., & Maloney, E. A. (2015). Math anxiety: A factor in math achievement not to be ignored. *Policy Insights from the Behavioral and Brain Sciences*, *2*(1), 4-12. https://doi.org/10.1177/0956797615592630

Beilock, S. L., & Willingham, D. T. (2014). Math anxiety: Can teachers help students reduce it? Ask the cognitive scientist. *American Educator*, *38*(2), 28-32. https://eric.ed.gov/?id=EJ1043398

Bekdemir, M. (2010). The pre-service teachers' mathematics anxiety related to depth of negative experiences in mathematics classroom while they were students. *Educational Studies in Mathematics*, *75*(3), 311-328. https://doi.org/10.1007/s10649-010-9260-7

Benbow, C. P., & Stanley, J. C. (1980). Sex differences in mathematical ability: Fact or artifact?. *Science*, 210(4475), 1262-1264. http://www.doi.org/ 10.1126/science.7434028

Benbow, C. P., & Stanley, J. C. (1983). Sex differences in mathematical reasoning ability: More facts. *Science*, *222*(4627), 1029–1031. https://doi.org/10.1126/science.6648516

Bender, W. N., & Shores, C. (2007). *Response to intervention: A practical guide for every teacher.* Corwin Press. https://apadivision16.org/wp-content/uploads/2015/12/TSP-Vol.-62-No.-1-January-2008.pdf#page=37

Bentz, N. E., & Hacket, G. (1983). The relationship of mathematics self-efficacy expectation to the selection of science-based collage majors. *Journal of Vocational Behavior*, *23*, 329-345. https://doi.org/10.1016/0001-8791(83)90046-5

Betz, N. E. (1978). Prevalence, distribution, and correlates of math anxiety in college students. *Journal of Counseling Psychology*, *25*(5), 441-448. https://doi.org/10.1037/0022-0167.25.5.441

Bieg, M., Goetz, T., Wolter, I., & Hall, N. C. (2015). Gender stereotype endorsement differentially predicts girls' and boys' trait-state discrepancy in math anxiety. *Frontiers in Psychology*, *6*(1), 1-8. https://doi.org/10.3389/fpsyg.2015.01404

Blascovich, J., & Mendes, W. B. (2010). *Social psychophysiology and embodiment*. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *Handbook of Social Psychology* (p. 194–227). John Wiley & Sons, Inc.. https://doi.org/10.1002/9780470561119.socpsy001006

Bleeker, M. M., & Jacobs, J. E. (2004). Achievement in math and science: Do mothers' beliefs matter 12 years later? *Journal of Educational Psychology*, *96*(1), 97–109. https://doi.org/10.1037/0022-0663.96.1.97

Boaler, J. (2002). Paying the price for" sugar and spice": Shifting the analytical lens in equity research. *Mathematical Thinking and Learning*, *4*(2-3), 127-144. https://doi.org/10.1207/s15327833mtl04023_3

Boaler, J. (2014). Research suggests that timed tests cause math anxiety. *Teaching Children Mathematics*, *20*(8), 469-474. https://doi.org/10.5951/teacchilmath.20.8.0469

Bong, M. (2008). Effects of parent-child relationships and classroom goal structures on motivation, help-seeking avoidance, and cheating. *The Journal of Experimental Education*, *76*(2), 191-217. https://doi.org/10.3200/JEXE.76.2.191-217

Bradley, S. J. (2001). Anxiety and mood disorders in children and adolescents: a practice update. *Paediatrics & Child Health*, *6*(7), 459-463. https://doi.org/10.1093/pch/6.7.459

Brooks-Gunn, J., Duncan, G. J., & Maritato, N. (1997). Poor families, poor outcomes: The well-being of children and youth. *Consequences of Growing Up Poor*, *21*(9-10), 1-17. https://www.russellsage.org/sites/all/files/duncan_brooks_chapter1_pdf_0.pdf

Brown, J., Ortiz-Padilla, M., & Soto-Varela, R. (2020). Does mathematical anxiety differ cross-culturally?. *Journal of New Approaches in Educational Research (NAER Journal)*, *9*(1), 126-136. https://doi.org/10.7821/naer.2020.1.464

Brown-Chidsey, R., Bronaugh, L., & McGraw, K. (2009). *RTI in the classroom: Guidelines and recipes for success*. Guilford Press.

Bryant, D. P. (2009). Working with your child's teacher to identify and address math disabilities. *LD Online,* 197-228. http://www.ldonline.org/article/34659

Bulmahn, B. J., & Young, D. M. (1982). On the transmission of mathematics anxiety. *The Arithmetic Teacher*, *30*(3), 55-56. https://doi.org/10.5951/AT.30.3.0055

Bursal, M., & Paznokas, L. (2006). Mathematics anxiety and preservice elementary teachers' confidence to teach mathematics and science. *School Science and Mathematics*, *106*(4), 173-180. https://doi.org/10.1111/j.1949-8594.2006.tb18073.x

Byrne, B. M., & Shavelson, R. J. (1996). On the structure of social self-concept for pre-, early, and late adolescents: A test of the Shavelson, Hubner, and Stanton (1976) model. *Journal of Personality and Social Psychology, 70*(3), 599–613. https://doi.org/10.1037/0022-3514.70.3.599

Callahan, C. M., & Hertberg-Davis, H. L. (2012). *Fundamentals of gifted education: Considering multiple perspectives*. Publisher: Routledge. https://doi.org/10.4324/9780203848173

Campbell, J. R., & Verna, M. A. (2007). Effective parental influence: Academic home climate linked to children's achievement. *Educational Research and Evaluation*, *13*(6), 501-519. https://doi.org/10.1080/13803610701785949

Campbell, P. H., Strickland, B., & Forme, C. L. (1992). Enhancing parent participation in the individualized family service plan. *Topics in Early Childhood Special Education*, *11*(4), 112-124. https://doi.org/10.1177/027112149201100410

Cannon, J., & Ginsburg, H. P. (2008). "Doing the math": maternal beliefs about early mathematics versus language learning, *Early Education and Development*, *19*(2), 238-260, https://doi.org/10.1080/10409280801963913

Carey, E., Devine, A., Hill, F., & Szűcs, D. (2017). Differentiating anxiety forms and their role in academic performance from primary to secondary school. *PLoS ONE, 12*(3), Article e0174418. https://doi.org/10.1371/journal.pone.0174418

Cargnelutti, E., Tomasetto, C., & Passolunghi, M. C. (2017). How is anxiety related to math performance in young students? A longitudinal study of Grade 2 to Grade 3 children. *Cognition and Emotion*, *31*(4), 755-764. https://doi.org/10.1080/02699931.2016.1147421

Carlson, N. L., Irons, E. J., Monk, P. E., Abernathy, K., Stephens, L., & Allen, D. (2010). Response to intervention: Tiers or tears?. In *National Social Science Proceedings, 44*(1), 53-61. https://www.nssa.us/journals/pdf/nss_proceedings_2010_las_vegas_1.pdf#page=56

Casad, B. J., Hale, P., & Wachs, F. L. (2015). Parent-child math anxiety and math-gender stereotypes predict adolescents' math education outcomes. *Frontiers in Psychology, 6*(1), 1597. https://doi.org/10.3389/fpsyg.2015.01597

Cates, G. L., & Rhymer, K. N. (2003). Examining the relationship between mathematics anxiety and mathematics performance: An instructional hierarchy perspective. *Journal of Behavioral Education, 12*(1), 23–34. https://doi.org/10.1023/A:1022318321416

Catsambis, S., & Garland, J. E. (1997). *Parental Involvement in Students' Education during Middle School and High School*. Report No. 18. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.464.1278&rep=rep1&type=pdf

Chang, H., & Beilock, S. L. (2016). The math anxiety-math performance link and its relation to individual and environmental factors: A review of current behavioral and psychophysiological research. *Current Opinion in Behavioral Sciences*, *10*(1), 33-38. https://doi.org/10.1016/j.cobeha.2016.04.011

Chavez, A., & Widmer, C. C. (1982). Math anxiety: elementary teachers speak for themselves. *Educational Leadership*, *39*(5), 387-388. https://eric.ed.gov/?id=EJ257933

Chavkin, N. F., & Williams, D. L. (1993). Minority parents and the elementary school: Attitudes and practices. *Families and schools in a pluralistic society*, *4*(2), 73-83.

Chen, P. P. I. (2002). *Mathematics self-efficacy calibration of seventh graders*. City University of New York. https://www.proquest.com/docview/276276060/fulltextPDF/D693E763F80940C9PQ/1?accountid=12832

Chevalier, A. (2004). *Parental education and child's education: A natural experiment* (No. WP04/14). Centre for Economic Research Working Paper Series. http://hdl.handle.net/10419/72320

Chipman, S. F., Krantz, D. H., & Silver, R. (1992). Mathematics anxiety and science careers among able college women. *Psychological Science*, *3*(5), 292-296. https://doi.org/10.1111/j.1467-9280.1992.tb00675.x

Connell, R. (1994). Poverty and education. *Harvard Educational Review*, *64*(2), 125-150. https://doi.org/10.17763/haer.64.2.m14947g30k1x5781

Conway, M. A. (2005). Memory and the self. *Journal of Memory and Language*, *53*(4), 594–628. https://doi.org/10.1016/j.jml.2005.08.005

Costa, P. T., Jr., Terracciano, A., & McCrae, R. R. (2001). Gender differences in personality traits across cultures: Robust and surprising findings. *Journal of Percsdaxsonality and Social Psychology*, *81*(2), 322–331. https://doi.org/10.1037/0022-3514.81.2.322

Covington, M. V., & Beery, R. G. (1976). *Self-worth and school learning.* Holt, Rinehart & Winston.

Cvencek, D., Meltzoff, A. N., & Greenwald, A. G. (2011). Math–gender stereotypes in elementary school children. *Child Development, 82*(3), 766–779. https://doi.org/10.1111/j.1467-8624.2010.01529.x

Daches Cohen, L., & Rubinsten, O. (2017). Mothers, intrinsic math motivation, arithmetic skills, and math anxiety in elementary school. *Frontiers in Psychology*, *8*(1), 1-17. https://doi.org/10.3389/fpsyg.2017.01939

Devine, A., Fawcett, K., Szűcs, D., & Dowker, A. (2012). Gender differences in mathematics anxiety and the relation to mathematics performance while controlling for test anxiety. *Behavioral and Brain Functions, 8*(1)*,* 33. https://doi.org/10.1186/1744-9081-8-33

Dew, K. H., & Galassi, J. P. (1983). Mathematics anxiety: Some basic issues. *Journal of Counseling Psychology, 30*(3), 443–446. https://doi.org/10.1037/0022-0167.30.3.443

Dietrich, J. F., Huber, S., Moeller, K., & Klein, E. (2015). The influence of math anxiety on symbolic and non-symbolic magnitude processing. *Frontiers in psychology*, *6*(1), 1621. https://doi.org/10.3389/fpsyg.2015.01621

Dini, E. S., Wardi, Y., & Sentosa, S. U. (2019, April). The Influence of Parent's Attention, Parents' Education Background, Learning Facilities and Learning Motivation toward Student Learning Achievement. In the *2nd Padang International Conference on Education, Economics, Business and Accounting (PICEEBA-2 2018)* (pp. 819-827). Atlantis Press. https://doi.org/10.2991/piceeba2-18.2019.105

Dowker, A. (2005). Early identification and intervention for students with mathematics difficulties. *Journal of Learning Disabilities*, *38*(4), 324-332. https://doi.org/10.1177/00222194050380040801

Dowker, A., Sarkar, A., & Looi, C. Y. (2016). Mathematics anxiety: What have we learned in 60 years?. *Frontiers in Psychology*, *7*, 508. https://doi.org/10.3389/fpsyg.2016.00508

Duncan, G. J., Brooks-Gunn, J., & Klebanov, P. K. (1994). Economic deprivation and early childhood development. *Child Development, 65*(2), 296–318. https://doi.org/10.2307/1131385

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., & Japel, C. (2007). School readiness and later achievement. *Developmental Psychology*, *43*(6), 1428–1446. https://doi.org/10.1037/0012-1649.43.6.1428

Duncan, T. G., & McKeachie, W. J. (2005). The making of the Motivated Strategies for Learning Questionnaire. *Educational Psychologist*, *40*(2), 117–128. https://doi.org/10.1207/s15326985ep4002_6

Durbin, D. L., Darling, N., Steinberg, L., & Brown, B. B. (1993). Parenting style and peer group membership among European-American adolescents. *Journal of Research on Adolescence, 3*(1), 87–100. https://doi.org/10.1207/s15327795jra0301_5

Dweck, C. S., & Reppucci, N. D. (1973). Learned helplessness and reinforcement responsibility in children. *Journal of Personality and Social Psychology*, *25*(1), 109–116. https://doi.org/10.1037/h0034248

Dyches, T. T., Smith, T. B., Korth, B. B., Roper, S. O., & Mandleco, B. (2012). Positive parenting of children with developmental disabilities: A meta-analysis. *Research in Developmental Disabilities*, *33*(6), 2213-2220. https://doi.org/10.1016/j.ridd.2012.06.015

Eccius-Wellmann, C., Lara-Barragán, A. G., Martschink, B., & Freitag, S. (2017). A comparison of mathematics anxiety profiles between Mexican and German students. *Revista Iberoamericana de Educación Superior*, *8*(23), 69-83.

Eccles, J. S. (1984). Sex differences in mathematics participation. *Advances in Motivation and Achievement*, *2*(1), 93-137. https://www.researchgate.net/profile/Jacquelynne-Eccles/publication/233896874_Sex_Differences_in_Mathematics_Participation/links/0046352b8da93b8a41000000/Sex-Differences-in-Mathematics-Participation.pdf

Eccles, J. S. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women Quarterly*, *11*(2), 135–171. https://doi.org/10.1111/j.1471-6402.1987.tb00781.x

Eccles, J. S., Jacobs, J. E., & Harold, R. D. (1990). Gender role stereotypes, expectancy effects, and parents' socialization of gender differences. *Journal of Social Issues*, *46*(2), 183-201. https://doi.org/10.1111/j.1540-4560.1990.tb01929.x

Eddles-Hirsch, K., Vialle, W., Rogers, K. B., & McCormick, J. (2010). “Just Challenge Those High-Ability Learners and They'll Be All Right!” The impact of social context and challenging instruction on the affective development of high-ability students. *Journal of Advanced Academics*, *22*(1), 106-128. https://doi.org/10.1177/1932202X1002200105

Education Commission of the States. (2020, January 14). *Instructional Time Policies.* https://reports.ecs.org/comparisons/instructional-time-policies-01

Egger, H. L., & Angold, A. (2006). Common emotional and behavioral disorders in preschool children: presentation, nosology, and epidemiology. *Journal of Child Psychology and Psychiatry*, *47*(3-4), 313-337. https://doi.org/10.1111/j.1469-7610.2006.01618.x

Egloff, B., & Schmukle, S. C. (2004). Gender differences in implicit and explicit anxiety measures. *Personality and Individual Differences*, *36*(8), 1807–1815. https://doi.org/10.1016/j.paid.2003.07.002

Eisenberg, N., Zhou, Q., Spinrad, T. L., Valiente, C., Fabes, R. A., & Liew, J. (2005). Relations among positive parenting, children's effortful control, and externalizing problems: A three-wave longitudinal study. *Child Development, 76*(5), 1055–1071. https://doi.org/10.1111/j.1467-8624.2005.00897.x

Engel, M. (2013). Problematic preferences? A mixed method examination of principals' preferences for teacher characteristics in Chicago. *Educational Administration Quarterly*, *49*(1), 52-91. https://doi.org/10.1177/0013161X12451025

Engle, R. W. (2002). Working memory capacity as executive attention. *Current Directions in Psychological Science*, *11*(1), 19–23. https://doi.org/10.1111/1467-8721.00160

Eysenck, M. W., & Calvo, M. G. (1992). Anxiety and performance: The processing efficiency theory. *Cognition and Emotion*, *6*(6), 409–434. https://doi.org/10.1080/02699939208409696

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion, 7*(2), 336–353. https://doi.org/10.1037/1528-3542.7.2.336

Fan, W., & Williams, C. M. (2010). The effects of parental involvement on students' academic self-efficacy, engagement and intrinsic motivation. *Educational Psychology*, *30*(1), 53-74. https://doi.org/10.1080/01443410903353302

Faust, M. W. (1996). Mathematics anxiety effects in simple and complex addition. *Mathematical Cognition*, *2*(1), 25–62. https://doi.org/10.1080/135467996387534

Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman mathematics attitudes scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for Research in Mathematics Education*, *7*(5), 324-326. https://doi.org/10.2307/748467

Fennema, E. H., & Sherman, J. A. (1978). Sex-related differences in mathematics achievement and related factors: A further study. *Journal for Research in Mathematics Education*, *9*(3), 189-203. https://doi.org/10.5951/jresematheduc.9.3.0189

Fennema, K., Meyer, D. L., & Owen, N. (1990). Sex of physician: Patients' preferences and stereotypes. *The Journal of Family Practice, 30*(4), 441–446.

Ferguson, A. M., Maloney, E. A., Fugelsang, J., & Risko, E. F. (2015). On the relation between math and spatial ability: The case of math anxiety. *Learning and Individual Differences*, *39*(1), 1–12. https://doi.org/10.1016/j.lindif.2015.02.007

Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics*. SAGE.

Finlayson, M. (2014). Addressing math anxiety in the classroom. *Improving Schools*, *17*(1). 99-115. https://doi.org/10.1177/1365480214521457

Fiske, S. T., & Neuberg, S. L. (1989). Category-based and individuating processes as a function of information and motivation: Evidence from our laboratory. In *Stereotyping and Prejudice* (pp. 83-103). Springer, New York, NY. https://doi.org/10.1007/978-1-4612-3582-8_4

Foley, A. E., Herts, J. B., Borgonovi, F., Guerriero, S., Levine, S. C., & Beilock, S. L. (2017). The math anxiety-performance link: A global phenomenon. *Current Directions in Psychological Science, 26*(1), 52–58. https://doi.org/10.1177/0963721416672463

Friend, M., & Bursuck, W. D. (1999). *Including students with special needs*. Boston: Allyn & Bacon.

Frost, R. O., Marten, P., Lahart, C., & Rosenblate, R. (1990). The dimensions of perfectionism. *Cognitive Therapy and Research*, *14*(5), 449-468. https://doi.org/10.1007/BF01172967

Fuchs, D., & Fuchs, L. S. (2005). Peer-assisted learning strategies: Promoting word recognition, fluency, and reading comprehension in young children. *The Journal of Special Education, 39*(1), 34–44. https://doi.org/10.1177/00224669050390010401

Fuchs, D., & Fuchs, L. S. (2006). Introduction to response to intervention: What, why, and how valid is it? *Reading Research Quarterly, 41*(1), 93–99. https://doi.org/10.1598/RRQ.41.1.4

Furner, J., & Berman, B. (2005). Confidence in their ability to do mathematics: The need to eradicate math anxiety so our future students can successfully compete in a high-tech globally competitive world. *Dimensions in Mathematics*, *18*(1), 28-31. http://socialsciences.exeter.ac.uk/education/research/centres/stem/publications/pmej/pome18/furner_math_anxiety_2.htm

Furner, J. M., & Duffy, M. L. (2002). Equity for all students in the new millennium: Disabling math anxiety. *Intervention in School and Clinic*, *38*(1), 67–74. https://doi.org/10.1177/10534512020380020101

Gallagher, J., Harradine, C. C., & Coleman, M. R. (1997). Challenge or boredom? Gifted students' views on their schooling, *Roeper Review*, *19*(3), 132-136, https://www.doi.org/., 10.1080/02783199709553808

Gallagher, J. J. (2002). Gifted education in the 21st century. *Gifted Education International*, *16*(2), 100-110. https://doi.org/10.1177/026142940201600203

Ganley, C. M., & McGraw, A. L. (2016). The development and validation of a revised version of the Math Anxiety Scale for young children. *Frontiers in Psychology*, *7*(1), 1181. https://doi.org/10.3389/fpsyg.2016.01181

Ganley, C. M., Schoen, R. C., LaVenia, M., & Tazaz, A. M. (2019). Construct validation of the Math Anxiety Scale for Teachers. *Grantee Submission*, *5*(1), 1-16. https://doi.org/10.1177/2332858419839702

García-Santillán, A., Escalera-Chávez, M. E., Moreno-García, E., & del Carmen Santana-Villegas, J. (2016). Factors that explain student anxiety toward mathematics. *Eurasia Journal of Mathematics, Science and Technology Education*, *12*(2), 361-372. https://doi.org/10.12973/eurasia.2016.1216a

Geary, D. C. (1994). Children's mathematical development: Research and practical applications. (pp. 37-93). Washington, DC, US: American Psychological Association. https://doi.org/10.1037/10163-000

Geary, D. C., Bailey, D. H., Littlefield, A., Wood, P., Hoard, M. K., & Nugent, L. (2009). First-grade predictors of mathematical learning disability: A latent class trajectory analysis. *Cognitive Development*, *24*(4), 411–429. https://doi.org/10.1016/j.cogdev.2009.10.001

Geist, E. (2010). The anti-anxiety curriculum: Combating math anxiety in the classroom. *Journal of Instructional Psychology, 37*(1), 24–31.

Gershenson, S. (2016). Linking teacher quality, student attendance, and student achievement. *Education Finance and Policy*, *11*(2), 125-149. https://doi.org/10.1162/EDFP_a_00180

Geyik, S. K. (2015). The effects of parents' socio-economic status on mathematics anxiety among social sciences students in turkey. *International Journal of Education and Research*, *3*(1), 311-324. http://www.ijern.com/journal/2015/January-2015/26.pdf

Gierl, M. J., & Bisanz, J. (1995). Anxieties and attitudes related to mathematics in grades 3 and 6. *The Journal of Experimental Education*, *63*(2), 139-158. https://doi.org/10.1080/00220973.1995.9943818

Ginsburg, G. S., & Bronstein, P. (1993). Family factors related to children's intrinsic/extrinsic motivational orientation and academic performance. *Child Development*, *64*(5), 1461-1474. https://doi.org/10.1111/j.1467-8624.1993.tb02964.x

Gorgorió, N., & Planas, N. (2000). Researching multicultural classes: A collaborative approach. https://eric.ed.gov/?id=ED476753

Gottfried, A. E. (1985). Academic intrinsic motivation in elementary and junior high school students. *Journal of Educational Psychology*, *77*(6), 631–645. https://doi.org/10.1037/0022-0663.77.6.631

Gottfried, A. E. (1990). Academic intrinsic motivation in young elementary school children. *Journal of Educational Psychology*, *82*(3), 525–538. https://doi.org/10.1037/0022-0663.82.3.525

Gray, E. M., & Tall, D. O. (1994). Duality, ambiguity, and flexibility: A "proceptual" view of simple arithmetic. *Journal for Research in Mathematics Education*, *25*(2), 116–140. https://doi.org/10.2307/749505

Greenwood, J. (1984). Soundoff: My anxieties about math anxiety. *The Mathematics Teacher*, *77*(9), 662-663. https://doi.org/10.5951/MT.77.9.0662

Greisen, M., Hornung, C., Baudson, T. G., Muller, C., Martin, R., & Schiltz, C. (2018). Taking language out of the equation: The assessment of basic math competence without language. *Frontiers in Psychology*, 9(1), 1076. https://doi.org/10.3389/fpsyg.2018.01076

Gresham, G. (2008). Mathematics anxiety and mathematics teacher efficacy in elementary pre-service teachers. *Teaching Education*, *19*(3), 171-184. https://doi.org/10.1080/10476210802250133

Gross, S. (1988). *Participation and performance of women and minorities in mathematics: Vol. 1. Findings by gender and racial/ethnic group*. Rockville, MD: Montgomery County Public Schools, Carver Educational Services Center.

Gunderson, E. A., Park, D., Maloney, E. A., Beilock, S. L., & Levine, S. C. (2018). Reciprocal relations among motivational frameworks, math anxiety, and math achievement in early elementary school. *Journal of Cognition and Development*, *19*(1), 21–46. https://doi.org/10.1080/15248372.2017.1421538

Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2012). The role of parents and teachers in the development of gender-related math attitudes. *Sex Roles*, *66*(3), 153-166. https://www.doi.org/10.1007/s11199-011-9996-2

Hackshaw, A. (2008). Small studies: strengths and limitations. *The European Respiratory Journal*, 32(5), 1141-1143.

Hall, C. W., Davis, N. B., Bolen, L. M., & Chia, R. (1999). Gender and racial differences in mathematical performance. *The Journal of Social Psychology*, *139*(6), 677-689. https://doi.org/10.1080/00224549909598248

Halpern, D. F., Benbow, C. P., Geary, D. C., Gur, R. C., Hyde, J. S., & Gernsbache, M. A. (2007). The science of sex differences in science and mathematics. *Psychological Science in the Public Interest*, *8*(1), 1–51. https://doi.org/10.1111/j.1529-1006.2007.00032.x

Harari, R. R., Vukovic, R. K., & Bailey, S. P. (2013). Mathematics anxiety in young children: An exploratory study. *The Journal of Experimental Education*, *81*(4), 538-555. https://doi.org/10.1080/00220973.2012.727888

Harper, N. W., & Daane, C. J. (1998). Causes and reduction of math anxiety in preservice elementary teachers. *Action in Teacher Education*, *19*(4), 29-38. https://doi.org/10.1080/01626620.1998.10462889

Harre, R., & Gillett, G. (1994). Emotional words and emotional acts. In *The Discursive Mind* (pp. 144-161). Thousand Oaks, CA: Sage.

Harris, K., Marcus, R., McLaren, K., & Fey, J. (2001). Curriculum materials supporting problem-based teaching. *School Science and Mathematics*, *101*(6), 310-318. https://doi.org/10.1111/j.1949-8594.2001.tb17962.x

Heilbronner, R. L., Sweet, J. J., Morgan, J. E., Larrabee, G. J., & Millis, S. R. (2009). American Academy of Clinical Neuropsychology consensus conference statement on the neuropsychological assessment of effort, response bias, and malingering. *The Clinical Neuropsychologist*, *23*(7), 1093–1129. https://doi.org/10.1080/13854040903155063

Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for Research in Mathematics Education*, *21*(1), 33-46. https://doi.org/10.5951/jresematheduc.21.1.0033

Henretta, J. C., Grundy, E., & Harris, S. (2002). The influence of socio-economic and health differences on parents' provision of help to adult children: a British–United States comparison. *Ageing & Society*, *22*(4), 441-458. https://doi.org/10.1017/S0144686X02008735

Hiebert, J., & Grouws, D. A. (2007). The effects of classroom mathematics teaching on students' learning. *Second Handbook of Research on Mathematics Teaching and Learning*, *1*(1), 371-404. https://www.doi.org/10.1.1.405.3591

Hill, F., Mammarella, I. C., Devine, A., Caviola, S., Passolunghi, M. C., & Szűcs, D. (2016). Maths anxiety in primary and secondary school students: Gender differences, developmental changes and anxiety specificity. *Learning and Individual Differences*, *48*, 45-53. https://doi.org/10.1016/j.lindif.2016.02.006

Hoover-Dempsey, K. V., Bassler, O. C., & Brissie, J. S. (1987). Parent involvement: Contributions of teacher efficacy, school socioeconomic status, and other school characteristics. *American Educational Research Journal*, *24*(3), 417-435. https://doi.org/10.3102/00028312024003411

Hopko, D. R., Ashcraft, M. H., Gute, J., Ruggiero, K. J., & Lewis, C. (1998). Mathematics anxiety and working memory: Support for the existence of a deficient inhibition mechanism. *Journal of Anxiety Disorders*, *12*(4), 343–355. https://doi.org/10.1016/S0887-6185(98)00019-X

Hopko, D. R., Mahadevan, R., Bare, R. L., & Hunt, M. K. (2003). The Abbreviated Math Anxiety Scale (AMAS). *Assessment*, *10*(2), 178–182. https://doi.org/10.1177/1073191103010002008

Hopko, D. R., McNeil, D. W., Zvolensky, M. J., & Eifert, G. H. (2001). The relation between anxiety and skill in performance-based anxiety disorders: A behavioral formulation of social phobia. *Behavior Therapy*, *32*(1), 185-207. https://doi.org/10.1016/S0005-7894(01)80052-6

Howard, L., & Potts, E. A. (2009). Using co-planning time: Strategies for a successful coteaching marriage. *TEACHING Exceptional Children Plus*, *5*(4), 2. http://escholarship.bc.edu/education/tecplus/vol5/iss4/art2

Hyde, J. S., Fennema, E., & Lamon, S. J. (1990). Gender differences in mathematics performance: A meta-analysis. *Psychological Bulletin*, *107*(2), 139–155. https://doi.org/10.1037/0033-2909.107.2.139

Ishak, Z., Low, S. F., & Lau, P. L. (2012). Parenting style as a moderator for students' academic achievement. *Journal of Science Education and Technology*, *21*(4), 487-493. https://doi.org/10.1007/s10956-011-9340-1

Jackson, C. D., & Leffingwell, R. J. (1999). The role of instructors in creating math anxiety in students from kindergarten through college. *The Mathematics Teacher*, *92*(7), 583-586. https://doi.org/10.5951/MT.92.7.0583

Jacobs, J. E. (1991). Influence of gender stereotypes on parent and child mathematics attitudes. *Journal of Educational Psychology*, *83*(4), 518–527. https://doi.org/10.1037/0022-0663.83.4.518

Jacobs, J. E., & Eccles, J. S. (1992). The impact of mothers' gender-role stereotypic beliefs on mothers' and children's ability perceptions. *Journal of Personality and Social Psychology*, *63*(6), 932–944. https://doi.org/10.1037/0022-3514.63.6.932

Jain, S., & Dowson, M. (2009). Mathematics anxiety as a function of multidimensional self-regulation and self-efficacy. *Contemporary Educational Psychology*, *34*(3), 240-249. https://doi.org/10.1016/j.cedpsych.2009.05.004

Jameson, M. M. (2013). The development and validation of the Children's Anxiety in Math Scale. *Journal of Psychoeducational Assessment*, *31*(4), 391-395. https://doi.org/10.1177/0734282912470131

Jameson, M. M. (2014). Contextual factors related to math anxiety in second-grade children. *The Journal of Experimental Education*, *82*(4), 518-536. https://doi.org/10.1080/00220973.2013.813367

Jameson, M. M., & Fusco, B. R. (2014). Math anxiety, math self-concept, and math self-efficacy in adult learners compared to traditional undergraduate students. A*dult Education Quarterly*, *64*(4), 306-322. https://doi.org/10.1177/0741713614541461

Jansen, A. S., Van Nguyen, X., Karpitskiy, V., Mettenleiter, T. C., & Loewy, A. D. (1995). Central command neurons of the sympathetic nervous system: basis of the fight-or-flight response. *Science*, *270*(5236), 644-646. https://doi.org/10.1126/science.270.5236.644

Jansen, B. R., Schmitz, E. A., & Van der Maas, H. L. (2016). Affective and motivational factors mediate the relation between math skills and use of math in everyday life. *Frontiers in Psychology*, *7*(1), 513. https://doi.org/10.3389/fpsyg.2016.00513

Johnson, E. S., Smith, L., & Harris, M. L. (2009). *How RTI works in secondary schools*. Corwin Press.

Johnston-Wilder, S., Brindley, J., & Dent, P. (2014). *A survey of mathematics anxiety and mathematical resilience among existing apprentices*. London: The Gatsby Foundation.

Jordan, N. C., Kaplan, D., Locuniak, M. N., & Ramineni, C. (2007). Predicting first-grade math achievement from developmental number sense trajectories. *Learning Disabilities Research & Practice*, *22*(1), 36–46. https://doi.org/10.1111/j.1540-5826.2007.00229.x

Jordan, N. C., Kaplan, D., Ramineni, C., & Locuniak, M. N. (2009). Early math matters: Kindergarten number competence and later mathematics outcomes. *Developmental Psychology, 45*(3), 850–867. https://doi.org/10.1037/a0014939

Joshi, R. N. (1995). Why our students fail math achievement?. *Education*, *116*(1), 65-71. https://link.gale.com/apps/doc/A17855140/AONE?u=anon~aa2b77dc&sid=googleScholar&xid=b59ef81f

Kahveci, N. G., & AkgÜl, S. (2014). Gifted and talented students' perceptions on their schooling: a survey study, *Gifted and Talented International*, *29*(2), 79-91, https://doi.org/10.1080/15332276.2014.11678431

Kandemir, M. A., Jameson, M. M., & Palestro, J. J. (2016). Translating the Children's Anxiety in Math Scale to Turkish for use with Turkish children. *British Journal of Education, Society & Behavioural Science*, *15*(1), 1-10. https://www.doi.org/ 10.9734/BJESBS/2016/24496

Kauffman, J. M., & Badar, J. (2013). How we might make special education for students with emotional or behavioral disorders less stigmatizing. *Behavioral Disorders*, *39*(1), 16-27. https://doi.org/10.1177/019874291303900103

Keller, C. (2001). Effect of teachers' stereotyping on students' stereotyping of mathematics as a male domain. *The Journal of Social Psychology*, *141*(2), 165–173. https://doi.org/10.1080/00224540109600544

Kelly, W. P., & Tomhave, W. K. (1985). A study of math anxiety/math avoidance in preservice elementary teachers. *The Arithmetic Teacher*, *32*(5), 51-53. https://doi.org/10.5951/AT.32.5.0051

Klados, M. A., Pandria, N., Micheloyannis, S., Margulies, D., & Bamidis, P. D. (2017). Math anxiety: Brain cortical network changes in anticipation of doing mathematics. *International Journal of Psychophysiology*, *122*(1), 24-31. https://doi.org/10.1371/journal.pone.0071800

Koutsoulis, M. K., & Campbell, J. R. (2001). Family processes affect students' motivation, and science and math achievement in Cypriot high schools. *Structural Equation Modeling*, *8*(1), 108-127. https://doi.org/10.1207/S15328007SEM0801_6

Kramarski, B., & Michalsky, T. (2010). Preparing preservice teachers for self-regulated learning in the context of technological pedagogical content knowledge. *Learning and Instruction*, *20*(5), 434–447. https://doi.org/10.1016/j.learninstruc.2009.05.003

Krinzinger, H., Kaufmann, L., & Willmes, K. (2009). Math anxiety and math ability in early primary school years. *Journal of Psychoeducational Assessment*, *27*(3), 206–225. https://doi.org/10.1177/0734282908330583

Kuyini, A. B., & Desai, I. (2007). Principals' and teachers' attitudes and knowledge of inclusive education as predictors of effective teaching practices in Ghana. *Journal of Research in Special Educational Needs*, *7*(2), 104-113. https://doi.org/10.1111/j.1471-3802.2007.00086.x

Kuyini, A. B., & Desai, I. (2008). Providing Instruction to Students with Special Needs in Inclusive Classrooms in Ghana: Issues and Challenges. *International Journal of Whole Schooling*, *4*(1), 22-39. https://link.gale.com/apps/doc/A218658423/AONE?u=anon~3a065dd&sid=googleScholar&xid=1aa5285f

LeFevre, J.-A., Fast, L., Skwarchuk, S.-L., Smith-Chant, B. L., Bisanz, J., Kamawar, D., & Penner-Wilger, M. (2010). Pathways to mathematics: Longitudinal predictors of performance. *Child Development*, *81*(6), 1753–1767. https://doi.org/10.1111/j.1467-8624.2010.01508.x

Levine, D. U., & Ornstein, A. C. (1983). Sex differences in ability and achievement. *Journal of Research & Development in Education*, *16*(2), 66–72. https://www.eric.ed.gov/EJ277400

Liebert, R. M., & Morris, L. W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. *Psychological Reports*, *20*(3), 975–978. https://doi.org/10.2466/pr0.1967.20.3.975

Lopez, F. G., & Lent, R. W. (1992). Sources of mathematics self-efficacy in high school students. *The Career Development Quarterly*, *41*(1), 3–12. https://doi.org/10.1002/j.2161-0045.1992.tb00350.x

Lopez, O. S. (2007). Classroom diversification: A strategic view of educational productivity. *Review of Educational Research*, *77*(1), 28-80. https://doi.org/10.3102/003465430298571

Lummis, M., & Stevenson, H. W. (1990). Gender differences in beliefs and achievement: A cross-cultural study. *Developmental Psychology*, *26*(2), 254–263. https://doi.org/10.1037/0012-1649.26.2.254

Luo, W., Hogan, D., Tan, L. S., Kaur, B., Ng, P. T., & Chan, M. (2014). Self-construal and students' math self-concept, anxiety and achievement: An examination of achievement goals as mediators. *Asian Journal of Social Psychology*, *17*(3), 184–195. https://doi.org/10.1111/ajsp.12058

Luttenberger, S., Wimmer, S., & Paechter, M. (2018). Spotlight on math anxiety. *Psychology Research and Behavior Management*, *11*(1), 311-322. http://doi.org/10.2147/PRBM.S141421

Lyons, I. M., & Beilock, S. L. (2012). When math hurts: math anxiety predicts pain network activation in anticipation of doing math. *PloS One*, *7*(10), e48076. https://doi.org/10.1371/journal.pone.0048076

Ma, X. (1999). A meta-analysis of the relationship between anxiety toward mathematics and achievement in mathematics. *Journal for Research in Mathematics Education, 30*(5), 520–540. https://doi.org/10.2307/749772

Ma, X., & Xu, J. (2004). The causal ordering of mathematics anxiety and mathematics achievement: a longitudinal panel analysis. *Journal of Adolescence*, *27*(2), 165-179. https://doi.org/10.1016/j.adolescence.2003.11.003

Malinsky, M., Ross, A., Pannells, T., & McJunkin, M. (2006). Math anxiety in pre-service elementary school teachers. *Education*, *127*(2), 274-280. https://eric.ed.gov/?id=EJ765826

Maloney, E. A., & Beilock, S. L. (2012). Math anxiety: Who has it, why it develops, and how to guard against it. *Trends In Cognitive Sciences*, *16*(8), 404-406. https://doi.org/10.1016/j.tics.2012.06.008

Maloney, E. A., Ramirez, G., Gunderson, E. A., Levine, S. C., & Beilock, S. L. (2015). Intergenerational effects of parents' math anxiety on children's math achievement and anxiety. *Psychological Science*, *26*(9), 1480-1488. https://doi.org/10.1177/0956797615592630

Maloney, E. A., Risko, E. F., Ansari, D., & Fugelsang, J. (2010). Mathematics anxiety affects counting but not subitizing during visual enumeration. *Cognition*, *114*(2), 293-297. https://doi.org/10.1016/j.cognition.2009.09.013

Markovits, Z. (2011). Beliefs hold by pre-school prospective teachers toward mathematics and its teaching. *Procedia-Social and Behavioral Sciences*, *11*(1), 117-121. https://doi.org/10.1016/j.sbspro.2011.01.045

Matthews, C. R., Vaserstein, L. N., & Weisfeiler, B. (1984). Congruence properties of Zariski-dense subgroups I. *Proceedings of the London Mathematical Society*, *3*(3), 514-532. https://doi.org/10.1112/plms/s3-48.3.514

McCarty, R. (2016). The fight-or-flight response: A cornerstone of stress research. In G. Fink (Ed.), *Stress: Concepts, Cognition, Emotion and Behavior* (pp. 33–37). Elsevier Academic Press. https://doi.org/10.1016/B978-0-12-800951-2.00004-2

McLanahan, S., & Sandefur, G. (1994). *Growing up with a single parent. What hurts, what helps*. Cambridge, MA: Harvard University Press

McLeod, B. D., Wood, J. J., & Weisz, J. R. (2007). Examining the association between parenting and childhood anxiety: A meta-analysis. *Clinical Psychology Review*, *27*(1), 155–172. https://doi.org/10.1016/j.cpr.2006.09.002

McMullan, M., Jones, R., & Lea, S. (2012). Math anxiety, self-efficacy, and ability in British undergraduate nursing students. *Research in Nursing & Health*, *35*(2), 178-186. https://doi.org/10.1002/nur.21460

Meece, J. L., Parsons, J. E., Kaczala, C. M., & Goff, S. B. (1982). Sex differences in math achievement: Toward a model of academic choice. *Psychological Bulletin*, *91*(2), 324–348. https://doi.org/10.1037/0033-2909.91.2.324

Meece, J. L., Wigfield, A., & Eccles, J. S. (1990). Predictors of math anxiety and its influence on young adolescents' course enrollment intentions and performance in mathematics. *Journal of Educational Psychology*, *82*(1), 60-70. doi:10.1037/0022-0663.82.1.60

Midgley, C., Feldlaufer, H., & Eccles, J. S. (1989). Change in teacher efficacy and student self- and task-related beliefs in mathematics during the transition to junior high school. *Journal of Educational Psychology*, *81*(2), 247–258. https://doi.org/10.1037/0022-0663.81.2.247

Mihalko, J. C. (1978). The answers to the prophets of doom: mathematics teacher education. In D. B. Aichele, *Mathematics Teacher Education: Critical Issues and Trends* (pp. 36–41). Washington: National Education Association.

Miller, C. F., Trautner, H. M., & Ruble, D. N. (2006). The role of gender stereotypes in children's preferences and behavior. In L. Balter & C. S. Tamis-LeMonda, *Child Psychology: A Handbook of Contemporary Issues* (pp. 293–323). Psychology Press.

Milosevic, I., & McCabe, R. (2015). Fight-or-flight response. *Phobias: The Psychology of Irrational Fear: The Psychology of Irrational Fear*, *196*, 176-179. https://doi.org/10.5860/choice.191658

Miyake, A., & Shah, P. (Eds.). (1999). *Models of working memory: Mechanisms of active maintenance and executive control*. Cambridge University Press. https://doi.org/10.1017/CBO9781139174909

Morsanyi, K., Prado, J., & Richland, L. E. (2018). The role of reasoning in mathematical thinking. *Thinking & Reasoning*, *24*(2), 129-137. https://doi.org/10.1080/13546783.2018.1435425

Moseley, B. J., Okamoto, Y., & Ishida, J. (2007). Comparing US and Japanese elementary school teachers' facility for linking rational number representations. *International Journal of Science and Mathematics Education*, *5*(1), 165-185. https://doi.org/10.1007/s10763-006-9040-0

Mowder, B. A. (2005). Parent development theory: Understanding parents, parenting perceptions and parenting behaviors. *Journal of Early Childhood and Infant Psychology*, *1*, 45-65. https://link.gale.com/apps/doc/A220766550/AONE?u=anon~694a93de&sid=googleScholar&xid=78cd61a

Mowder, B. A., Harvey, V. S., Moy, L., & Pedro, M. (1995). Parent role characteristics: Parent views and their implications for school psychologists. *Psychology in the Schools, 32*(1), 27–37. https://doi.org/10.1002/1520-6807(199501)32:1<27::AID-PITS2310320106>3.0.CO;2-M

Muller, C., & Kerbow, D. (2018). Parent involvement in the home, school, and community. In *Parents, Their Children, and Schools* (pp. 13-42). Routledge. https://doi.org/10.4324/9780429498497-2

Murayama, K., Pekrun, R., Lichtenfeld, S., & Vom Hofe, R. (2013). Predicting long-term growth in students' mathematics achievement: The unique contributions of motivation and cognitive strategies. *Child Development*, *84*(4), 1475-1490. https://doi.org/10.1111/cdev.12036

Namkung, J. M., Peng, P., & Lin, X. (2019). The relation between mathematics anxiety and mathematics performance among school-aged students: a meta-analysis. *Review of Educational Research*, *89*(3), 459-496. https://doi.org/10.3102/0034654319843494

Nash, A., & Grossi, G. (2007). Picking Barbie™'s brain: Inherent sex differences in scientific ability?. *Journal of Interdisciplinary Feminist Thought*, *2*(1), 1-23.

National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the National Mathematics Advisory Panel*. Washington, DC: U.S. Department of Education

Niederle, M., & Vesterlund, L. (2011). Gender and Competition. *Annual Review of Economics*, *3*(1), 601-630. https://doi.org/10.1146/annurev-economics-111809-125122

Nienkemper, B., & Grotlüschen, A. (2019). Using PIAAC data to learn more about the literacy practices of adults. *International Journal of Lifelong Education*, *38*(4), 393-405. https://doi.org/10.1080/02601370.2019.1596171

No Child Left Behind Act of 2001, P.L. 107-110, 20 U.S.C. § 6319 (2002). https://www.congress.gov/bill/107th-congress/house-bill/1

Núñez-Peña, M. I., Bono, R., & Suárez-Pellicioni, M. (2015). Feedback on students' performance: A possible way of reducing the negative effect of math anxiety in higher education. *International Journal of Educational Research*, *70*(1), 80-87. https://doi.org/10.1016/j.ijer.2015.02.005

Núñez-Peña, M. I., & Suárez-Pellicioni, M. (2014). Less precise representation of numerical magnitude in high math-anxious individuals: an ERP study of the size and distance effects. *Biological Psychology*, *103*(1), 176-183. https://doi.org/10.1016/j.biopsycho.2014.09.004

Núñez-Peña, M. I., Suárez-Pellicioni, M., & Bono, R. (2016). Gender differences in test anxiety and their impact on higher education students' academic achievement. *Procedia-Social and Behavioral Sciences*, *228*, 154-160. https://doi.org/10.1016/j.sbspro.2016.07.023

Onwuegbuzie, A. J., & Wilson, V. A. (2003). Statistics Anxiety: Nature, etiology, antecedents, effects, and treatments--a comprehensive review of the literature. *Teaching in Higher Education*, *8*(2), 195-209. https://doi.org/10.1080/1356251032000052447

Özyürek, R. (2005). Informative sources of math-related self-efficacy expectations and their relationship with math-related self-efficacy, interest, and preference. *International Journal of Psychology*, *40*(3), 145–156. https://doi.org/10.1080/00207590444000249

Pajares, F. (1997). Current directions in self-efficacy research. In Maehr, M. & Pintrich, P. *Advances in Motivation and Achievement*, *10*(149), (pp. 1-49). Greenwich, CT: JAI Press

Pajares, F., & Graham, L. (1999). Self-efficacy, motivation constructs, and mathematics performance of entering middle school students. *Contemporary Educational Psychology*, *24*(2), 124–139. https://doi.org/10.1006/ceps.1998.0991

Pantoja, N., Schaeffer, M. W., Rozek, C. S., Beilock, S. L., & Levine, S. C. (2020). Children's math anxiety predicts their math achievement over and above a key foundational math skill. *Journal of Cognition and Development*, *21*(5), 709-728. https://doi.org/10.1080/15248372.2020.1832098

Park, D., Ramirez, G., & Beilock, S. L. (2014). The role of expressive writing in math anxiety. *Journal of Experimental Psychology: Applied*, *20*(2), 103–111. https://doi.org/10.1037/xap0000013

Parsons, J. E., Adler, T. F., & Kaczala, C. M. (1982). Socialization of achievement attitudes and beliefs: Parental influences. *Child Development*, *53*(2), 310–321. https://doi.org/10.2307/1128973

Passolunghi, M. C., Rueda Ferreira, T. I., & Tomasetto, C. (2014). Math–gender stereotypes and math-related beliefs in childhood and early adolescence. *Learning and Individual Differences*, *34*(1), 70–76. https://doi.org/10.1016/j.lindif.2014.05.005

Patall, E. A., Cooper, H., & Robinson, J. C. (2008). Parent involvement in homework: A research synthesis. *Review of Educational Research*, *78*(4), 1039–1101. https://doi.org/10.3102/0034654308325185

Peng, C. K., & Terng, C. L. (2016). Minimal hypersurfaces of spheres with constant scalar curvature. *Annals of Math. Studies*, *103*(1), 177-198.
https://doi.org/10.1515/9781400881437-010

Pew Research Center. (2021). *Internet & Technology - Research and data from the Pew Research Center*. https://www.pewresearch.org/topic/internet-technology/.

Pizzie, R. G., & Kraemer, D. J. (2017). Avoiding math on a rapid timescale: Emotional responsivity and anxious attention in math anxiety. *Brain and Cognition*, *118*(1), 100-107. https://doi.org/10.1016/j.bandc.2017.08.004

Plucker, J. A., & Callahan, C. M. (2014). Research on giftedness and gifted education: Status of the field and considerations for the future. *Exceptional Children*, *80*(4), 390-406. https://doi.org/10.1177/0014402914527244

Pomerantz, E. M., & Ruble, D. N. (1998). The role of maternal control in the development of sex differences in child self-evaluative factors. *Child Development*, *69*(2), 458-478. https://doi.org/10.2307/1132178

Popham, W. J. (2009). Assessment literacy for teachers: Faddish or fundamental?. *Theory into practice*, *48*(1), 4-11. https://doi.org/10.1080/00405840802577536

Primi, C., Busdraghi, C., Tomasetto, C., Morsanyi, K., & Chiesi, F. (2014). Measuring math anxiety in Italian college and high school students: Validity, reliability and gender invariance of the Abbreviated Math Anxiety Scale (AMAS). *Learning and Individual Differences*, *34*(1), 51–56. https://doi.org/10.1016/j.lindif.2014.05.012

Purcell, J. H., & Eckert, R. D. (2006). *Designing services and programs for high-ability learners: A guidebook for gifted education*. Corwin Press. https://doi.org/10.4135/9781483329307

Quach, A. S., Epstein, N. B., Riley, P. J., Falconier, M. K., & Fang, X. (2015). Effects of parental warmth and academic pressure on anxiety and depression symptoms in Chinese adolescents. *Journal of Child and Family Studies*, *24*(1), 106-116. https://www.doi.org/10.1007/s10826-013-9818-y

Ramani, G. B., Rowe, M. L., Eason, S. H., & Leech, K. A. (2015). Math talk during informal learning activities in Head Start families. *Cognitive Development*, *35*(1), 15–33. https://doi.org/10.1016/j.cogdev.2014.11.002

Ramirez, G., & Beilock, S. L. (2011). Writing about testing worries boosts exam performance in the classroom. *Science, 331*(6014), 211-213. https://doi.org/10.1126/science.1199427

Ramirez, G., Chang, H., Maloney, E. A., Levine, S. C., & Beilock, S. L. (2016). On the relationship between math anxiety and math achievement in early elementary school: The role of problem-solving strategies. *Journal of Experimental Child Psychology*, *141*(1), 83–100. https://doi.org/10.1016/j.jecp.2015.07.014

Ramirez, G., Gunderson, E. A., Levine, S. C., & Beilock, S. L. (2013). Math anxiety, working memory, and math achievement in early elementary school. *Journal of Cognition and Development*, *14*(2), 187–202. https://doi.org/10.1080/15248372.2012.664593

Ramirez, G., Shaw, S. T., & Maloney, E. A. (2018). Math anxiety: Past research, promising interventions, and a new interpretation framework. *Educational Psychologist*, *53*(3), 145-164. https://doi.org/10.1080/00461520.2018.1447384

Reis, S. M. (2002). Gifted females in elementary and secondary school. *The Social and Emotional Development of Gifted Children: What Do We Know*, 125-135. https://doi.org/10.1177/001698620004400302

Reis, S. M., & McCoach, D. B. (2002). Underachievement in gifted and talented students with special needs, *Exceptionality*, *10*(2), 113-125. https://doi.org/10.1207/S15327035EX1002_5

Reis, S. M., & Renzulli, J. S. (2010). Is there still a need for gifted education? An examination of current research. *Learning And Individual Differences*, *20*(4), 308-317. https://doi.org/10.1016/j.lindif.2009.10.012

Richardson, F. C., & Suinn, R. M. (1972). The mathematics anxiety rating scale: psychometric data. *Journal of Counseling Psychology*, *19*(6), 551-554. https://doi.org/10.1037/h0033456

Richland, L. E., Naslund-Hadley, E., Alonzo, H., Lyons, E., & Vollman, E. (2020). Teacher and students' mathematics anxiety and achievement in a low-income national context. *Mind, Brain, and Education*, *14*(4), 400-414. https://doi.org/10.1111/mbe.12253

Rittle-Johnson, B., Fyfe, E. R., Hofer, K. G., & Farran, D. C. (2017). Early math trajectories: Low-income children's mathematics knowledge from ages 4 to 11. *Child Development, 88*(5), 1727–1742. https://doi.org/10.1111/cdev.12662

Robbins, J. I., VanTassel-Baska, J., & Little, C. A. (2011). Adapting science curricula for high-ability learners. *Content-based Curriculum for High-ability Learners*, 437-465.

Robinson, N. M., & Noble, K. D. (1991). Social-emotional development and adjustment of gifted children. In M. C. Wang, M. C. Reynolds, & H. J. Walberg (Eds.), *Handbook of Special Education: Research and Practice, 4.* (pp. 57–76). Pergamon Press.

Rodarte-Luna, B., & Sherry, A. (2008). Sex differences in the relation between statistics anxiety and cognitive/learning strategies. *Contemporary Educational Psychology*, *33*(2), 327-344. https://doi.org/10.1016/j.cedpsych.2007.03.002

Rosenzweig, M. R., & Schultz, T. P. (1982). Child mortality and fertility in Colombia: individual and community effects. *Health Policy and Education*, *2*(3-4), 305-348. https://doi.org/10.1016/0165-2281(82)90015-7

Rubenstein, R. N., & Thompson, D. R. (2012). Reading visual representations. *Mathematics Teaching in the Middle School*, *17*(9), 544-550. https://doi.org/10.5951/mathteacmiddscho.17.9.0544

Rubinsten, O., Eidlin, H., Wohl, H., & Akibli, O. (2015). Attentional bias in math anxiety. *Frontiers in Psychology*, *6*(1), 1539. https://doi.org/10.3389/fpsyg.2015.01539

Rubinsten, O., & Tannock, R. (2010). Mathematics anxiety in children with developmental dyscalculia. *Behavioral and Brain Functions*, *6*(1), 1-13. https://doi.org/10.1186/1744-9081-6-46

Sak, R., Şahin Sak, İ. T., & Yerlikaya, İ. (2015). Behavior management strategies: Beliefs and practices of male and female early childhood teachers. *European Early Childhood Education Research Journal*, *23*(3), 328-339. https://doi.org/10.1080/1350293X.2015.1043807

Şakar, B. E., Gökbay, İ. Z., & Karahoca, A. (2015). Assessment of readiness for learning and academic success on computer assisted learning: A study on computer integrated manufacturing with lathe. *Global Journal of Information Technology: Emerging Technologies*, *6*(1), 94-106. https://doi.org/10.18844/gjit.v6i1.396

Scarpello, G. (2007). Helping students get past math anxiety. *Techniques: Connecting Education and Careers*, *82*(6), 34-35. https://eric.ed.gov/?id=EJ775465

Schmader, T., Johns, M., & Barquissau, M. (2004). The Costs of Accepting Gender Differences: The Role of Stereotype Endorsement in Women's Experience in the Math Domain. *Sex Roles: A Journal of Research, 50*(11-12), 835–850. https://doi.org/10.1023/B:SERS.0000029101.74557.a0

Schmidt, W. H., & Buchmann, M. (1983). Six teachers' beliefs and attitudes and their curricular time allocations. *The Elementary School Journal*, *84*(2), 162-171. https://doi.org/10.1086/461353

Schunk, D. H. (1982). Effects of effort attributional feedback on children's perceived self-efficacy and achievement. J*ournal of Educational Psychology*, *74*(4), 548–556. https://doi.org/10.1037/0022-0663.74.4.548

Scott, B. J., Vitale, M. R., & Masten, W. G. (1998). Implementing instructional adaptations for students with disabilities in inclusive classrooms: A literature review. *Remedial And Special Education*, *19*(2), 106-119. https://doi.org/10.1177/074193259801900205

Scruggs, T. E., & Mastropieri, M. A. (2000). The effectiveness of mnemonic instruction for students with learning and behavior problems: An update and research synthesis. *Journal of Behavioral Education, 10*(2-3), 163–173. https://doi.org/10.1023/A:1016640214368

Seigel, M. T. (2012). Consensus building revisited: lessons from a Japanese experience. *Global Change, Peace & Security*, *24*(3), 331-349. https://doi.org/10.1080/14781158.2012.714767

Sessa, F. M., Avenevoli, S., Steinberg, L., & Morris, A. S. (2001). Correspondence among informants on parenting: Preschool children, mothers, and observers. *Journal of Family Psychology, 15*(1), 53–68. https://doi.org/10.1037/0893-3200.15.1.53

Shell, D. F., Murphy, C. C., & Bruning, R. H. (1989). Self-efficacy and outcome expectancy mechanisms in reading and writing achievement. *Journal of Educational Psychology, 81*(1), 91–100. https://doi.org/10.1037/0022-0663.81.1.91

Shi, Z., & Liu, P. (2016). Worrying thoughts limit working memory capacity in math anxiety. *PLoS One*, *11*(10), e0165644. https://doi.org/10.1371/journal.pone.0165644

Shukla-Mehta, S., & Albin, R. W. (2003). Twelve practical strategies to prevent behavioral escalation in classroom settings. *Preventing School Failure: Alternative Education for Children and Youth*, *47*(4), 156-161. https://doi.org/10.1080/10459880309603361

Singh, K., Bickley, P. G., Keith, T. Z., Keith, P. B., Trivette, P., & Anderson, E. (1995). The effects of four components of parental involvement on eighth-grade student achievement: Structural analysis of NELS-88 data. *School Psychology Review*, *24*(2), 299-317. https://doi.org/10.1080/02796015.1995.12085769

Skwarchuk, S.-L., Sowinski, C., & LeFevre, J.-A. (2014). Formal and informal home learning activities in relation to children's early numeracy and literacy skills: The development of a home numeracy model. *Journal of Experimental Child Psychology*, *121*(1), 63–84. https://doi.org/10.1016/j.jecp.2013.11.006

Sloan, T. R. (2010). A quantitative and qualitative study of math anxiety among preservice teachers, *The Educational Forum*, *74*(3), 242-256, https://doi.org/10.1080/00131725.2010.483909

Smith, E. E., & Jonides, J. (1999). Storage and executive processes in the frontal lobes. *Science*, *283*(5408), 1657–1661. https://doi.org/10.1126/science.283.5408.1657

Sorvo, R., Koponen, T., Viholainen, H., Aro, T., Räikkönen, E., Peura, P., Tolvanen, A., & Aro, M. (2017). Math anxiety and its relationship with basic arithmetic skills among primary school children. *British Journal of Educational Psychology*, *87*(3), 309-327. https://doi.org/10.1111/bjep.12151

Spence, S. H. (1997). Structure of anxiety symptoms among children: A confirmatory factor-analytic study. *Journal of Abnormal Psychology, 106*(2), 280–297. https://doi.org/10.1037/0021-843X.106.2.280

Spencer, S. J., Logel, C., & Davies, P. G. (2016). Stereotype threat. *Annual Review of Psychology*, *67*(1), 415-437. https://doi.org/10.1146/annurev-psych-073115-103235

Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype threat and women's math performance. J*ournal of Experimental Social Psychology*, *35*(1), 4-28. https://doi.org/10.1006/jesp.1998.1373

Spera, C. (2005). A Review of the Relationship Among Parenting Practices, Parenting Styles, and Adolescent School Achievement. *Educational Psychology Review, 17*(2), 125–146. https://doi.org/10.1007/s10648-005-3950-1

Stajkovic, A. D., & Luthans, F. (1998). Self-efficacy and work-related performance: A meta-analysis. *Psychological Bulletin*, *124*(2), 240–261. https://doi.org/10.1037/0033-2909.124.2.240

Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test-performance of African-Americans. *Journal of Personality and Social Psychology*, *69*(5): 797-811. https://doi.org/10.1037/0022-3514.69.5.797

Steele, C. M., Spencer, S. J., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. In *Advances in Experimental Social Psychology*, *34*. (pp. 379-440). Academic Press. https://doi.org/10.1016/S0065-2601(02)80009-0

Stephens, J. C., Hernandez, M. E., Roman, M., Graham, A. C., & Scholz, R. W. (2008). Higher education as a change agent for sustainability in different cultures and contexts. *International Journal of Sustainability in Higher Education*, *9*(3), 317-338. https://doi.org/10.1108/14676370810885916

Stevenson, D. L., & Baker, D. P. (1987). The family-school relation and the child's school performance. *Child Development, 58*(5), 1348–1357. https://doi.org/10.2307/1130626

Stevenson, H. W., Hofer, B. K., & Randel, B. (2000). Mathematics achievement and attitudes about mathematics in China and the West. *Journal of Psychology in Chinese Societies*, *1*(1), 1-16.

Stipek, D., & Gralinski, J. H. (1996). Children's beliefs about intelligence and school performance. *Journal of Educational Psychology*, *88*(3), 397-407. https://www.doi.org/10.1037/0022-0663.88.3.397

Stuart, V. (2000). Math curse or math anxiety?. *Teaching Children Mathematics*, *6*(5), 330-335. https://doi.org/10.5951/TCM.6.5.0330

Suárez-Pellicioni, M., Núñez-Peña, M. I., & Colomé, À. (2016). Math anxiety: A review of its cognitive consequences, psychophysiological correlates, and brain bases. *Cognitive, Affective & Behavioral Neuroscience, 16*(1), 3–22. https://doi.org/10.3758/s13415-015-0370-7

Suinn, R. M., & Edwards, R. (1982). The measurement of mathematics anxiety: The mathematics anxiety rating scale for adolescents—MARS-A. *Journal of Clinical Psychology*, *38*(3), 576-580. https://doi.org/10.1037/t54079-000

Suinn, R. M., Taylor, S., & Edwards, R. W. (1988). Suinn mathematics anxiety rating scale for elementary school students (MARS-E): Psychometric and normative data. *Educational and Psychological Measurement*, *48*(4), 979-986. https://doi.org/10.1177/0013164488484013

Suinn, R. M., & Winston, E. H. (2003). The Mathematics Anxiety Rating Scale, a brief version: Psychometric data. *Psychological Reports, 92*(1), 167–173. https://doi.org/10.2466/PR0.92.1.167-173

Swars, S. L., Daane, C. J., & Giesen, J. (2006). Mathematics anxiety and mathematics teacher efficacy: What is the relationship in elementary preservice teachers?. *School Science and Mathematics*, *106*(7), 306-315. https://doi.org/10.1111/j.1949-8594.2006.tb17921.x

Szczygiel, M. (2020). More evidence that math anxiety is specific to math in young children: The correlates of the Math Anxiety Questionnaire for Children (MAQC). *International Electronic Journal of Elementary Education*, *12*(5), 429-438. https://www.iejee.com/index.php/IEJEE/article/view/1115

Tankersley, K. (1993). Teaching Math Their Way. *Educational Leadership*, *50*(8), 12-13. https://eric.ed.gov/?id=EJ462450

Thoman, D. B., White, P. H., Yamawaki, N., & Koishi, H. (2008). Variations of gender-math stereotype content affect women's vulnerability to stereotype threat. *Sex Roles: A Journal of Research, 58*(9-10), 702–712. https://doi.org/10.1007/s11199-008-9390-x

Thompson, R. J., Napoli, A. R., & Purpura, D. J. (2017). Age-related differences in the relation between the home numeracy environment and numeracy skills. *Infant and Child Development*, *26*(5). https://doi.org/10.1002/icd.2019

Tiedemann, J. (2000). Gender-related beliefs of teachers in elementary school mathematics. *Educational Studies in Mathematics*, *41*(2), 191-207. https://doi.org/10.1023/A:1003953801526

Tiedemann, J. (2002). Teachers' gender stereotypes as determinants of teacher perceptions in elementary school mathematics. *Educational Studies in Mathematics*, *50*(1), 49-62. https://doi.org/10.1023/A:1020518104346

Timmerman, H. L., Toll, S. W., & Van Luit, J. E. (2017). The relation between math self-concept, test and math anxiety, achievement motivation and math achievement in 12 to 14-year-old typically developing adolescents. *Psychology, Society, & Education*, *9*(1), 89-103. https://doi.org/10.25115/psye.v9i1.465

Tomlinson, C. A. (1995). Deciding to differentiate instruction in middle school: One school's journey. *Gifted Child Quarterly*, *39*(2), 77-87. https://doi.org/10.1177/001698629503900204

Tomlinson, C. A. (1997). Good teaching for one and all: Does gifted education have an instructional identity?. *Journal for the Education of the Gifted*, *20*(2), 155-174. https://doi.org/10.1177/016235329602000201

Tsui, J. M., & Mazzocco, M. M. M. (2007). Effects of math anxiety and perfectionism on timed versus untimed math testing in mathematically gifted sixth graders. *Roeper Review: A Journal on Gifted Education, 29*(2), 132–139. https://doi.org/10.1080/02783190709554397

Tsui, M. (2005). Family income, home environment, parenting, and mathematics achievement of children in China and the United States. *Education and Urban Society*, *37*(3), 336-355. https://doi.org/10.1177/0013124504274188

Turner, S. L., Steward, J. C., & Lapan, R. T. (2004). Family factors associated with sixth-grade adolescents' math and science career interests. *The Career Development Quarterly*, *53*(1), 41-52. https://doi.org/10.1002/j.2161-0045.2004.tb00654.x

Uusimaki, S. L., & Nason, R. (2004). Causes underlying pre-service teachers' negative beliefs and anxieties about mathematics. *In Proceedings of the Psychology in Mathematics Education PME28 Conference* (pp. 369-376). Bergen University College.

Valentine, J. C., DuBois, D. L., & Cooper, H. (2004). The relation between self-beliefs and academic achievement: A meta-analytic review. *Educational Psychologist*, *39*(2), 111–133. https://doi.org/10.1207/s15326985ep3902_3

Valli, L., & Buese, D. (2007). The changing roles of teachers in an era of high-stakes accountability. *American Educational Research Journal*, *44*(3), 519–558. https://doi.org/10.3102/0002831207306859

Van Mier, H. I., Schleepen, T. M. J., & Van den Berg, F. C. G. (2019). Gender differences regarding the impact of math anxiety on arithmetic performance in second and fourth graders. *Frontiers in Psychology, 9,* Article 2690. https://doi.org/10.3389/fpsyg.2018.02690

Vaughn, S., & Schumm, J. S. (1995). Responsible inclusion for students with learning disabilities. *Journal of Learning Disabilities, 28*(5), 264–270, 290. https://doi.org/10.1177/002221949502800502

Vukovic, R. K., Kieffer, M. J., Bailey, S. P., & Harari, R. R. (2013). Mathematics anxiety in young children: Concurrent and longitudinal associations with mathematical performance. *Contemporary Educational Psychology*, *38*(1), 1-10. https://doi.org/10.1016/j.cedpsych.2012.09.001

Walczyk, J. J., & Griffith-Ross, D. A. (2007). How important is reading skill fluency for comprehension?. *The Reading Teacher*, *60*(6), 560-569. https://doi.org/10.1598/rt.60.6.6

Wang, Z., Lukowski, S. L., Hart, S. A., Lyons, I. M., Thompson, L. A., Kovas, Y., Mazzocco, M. M. M., Plomin, R., & Petrill, S. A. (2015). Is math anxiety always bad for math learning? The role of math motivation. *Psychological Science*, *26*(12), 1863–1876. https://doi.org/10.1177/0956797615602471

Watts, T. W., Duncan, G. J., Siegler, R. S., & Davis-Kean, P. E. (2014). What's past is prologue: Relations between early mathematics knowledge and high school achievement. *Educational Researcher*, *43*(7), 352-360. https://doi.org/10.3102/0013189X14553660

Wigfield, A. (1994). Expectancy-value theory of achievement motivation: A developmental perspective. *Educational Psychology Review, 6*(1), 49–78. https://doi.org/10.1007/BF02209024

Wigfield, A., Eccles, J. S., Yoon, K. S., Harold, R. D., Arbreton, A. J. A., Freedman-Doan, C., & Blumenfeld, P. C. (1997). Change in children's competence beliefs and subjective task values across the elementary school years: A 3-year study. *Journal of Educational Psychology*, *89*(3), 451–469. https://doi.org/10.1037/0022-0663.89.3.451

Wilkins, W. E. (1976). The concept of a self-fulfilling prophesy. *Sociology of Education*, *49*(2), 175–183. https://doi.org/10.2307/2112523

Wood, E. F. (1988). Math anxiety and elementary teachers: What does research tell us?. *For The Learning of Mathematics*, *8*(1), 8-13. FLM Publishing Association: Edmonton, Canada.

Wood, J. J., McLeod, B. D., Sigman, M., Hwang, W., & Chu, B. C. (2003). Parenting and childhood anxiety: Theory, empirical findings, and future directions. *Journal of Child Psychology and Psychiatry*, *44*(1), 134–151. https://doi.org/10.1111/1469-7610.00106

Wright, J. (2007). *RTI toolkit: A practical guide for schools*. National Professional Resources Inc./Dude Publishing. https://doi.org/10.1037/e723732011-001

Wu, S., Amin, H., Barth, M., Malcarne, V., & Menon, V. (2012). Math anxiety in second and third graders and its relation to mathematics achievement. *Frontiers in Psychology*, *3*(1), 162. https://doi.org/10.3389/fpsyg.2012.00162

Wu, S. S., Willcutt, E. G., Escovar, E., & Menon, V. (2014). Mathematics achievement and anxiety and their relation to internalizing and externalizing behaviors. *Journal of Learning Disabilities*, *47*(6), 503-514. https://doi.org/10.3389/fpsyg.2012.00162

Yaffe, Y. (2015). Parenting styles, parental involvement in school, and educational functioning of children with special needs integrated into mainstream education. *Journal of Studies in Education*, *5*(4), 258-277. http://dx.doi.org/10.5296/jse.v5i4.8588

Yee, D. K., & Eccles, J. S. (1988). Parent perceptions and attributions for children's math achievement. *Sex Roles: A Journal of Research*, *19*(5-6), 317–333. https://doi.org/10.1007/BF00289840

Yeo, J. K. K. (2005). Anxiety and performance on mathematical problem solving of secondary two students in Singapore. *The Mathematics Educator*, *8*(2), 71-83. https://doi.org/10.1142/9789812833761_0014

Yeung, W. J., Linver, M. R., & Brooks-Gunn, J. (2002). How money matters for young children's development: Parental investment and family processes. *Child Development, 73*(6), 1861–1879. https://doi.org/10.1111/1467-8624.t01-1-00511

Young, C. B., Wu, S. S., & Menon, V. (2012). The neurodevelopmental basis of math anxiety. *Psychological Science*, *23*(5), 492-501. https://doi.org/10.1177/0956797611429134

Zalta, A. K., & Chambless, D. L. (2012). Understanding gender differences in anxiety: The mediating effects of instrumentality and mastery. *Psychology of Women Quarterly, 36*(4), 488–499. https://doi.org/10.1177/0361684312450004

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology*, *25*(1), 82–91. https://doi.org/10.1006/ceps.1999.1016

APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

DATE: April 17, 2019

TO: Melissa Flowerdew, Psychology, BA
FROM: University of Northern Colorado (UNCO) IRB

PROJECT TITLE: [1315749-3] Invariance of the Children's Anxiety of Math Scale (CAMS)SUBMISSION TYPE: Amendment/Modification

ACTION: APPROVE
D APPROVAL DATE: April 17, 2019
EXPIRATION DATE: November 16, 2019
REVIEW TYPE: Expedited Review

Thank you for your submission of Amendment/Modification materials for this project. The University ofNorthern Colorado (UNCO) IRB has APPROVED your submission. All research must be conducted inaccordance with this approved submission.

This submission has received Expedited Review based on applicable federal regulations.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee priorto initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTEDadverse events must be reported promptly to this office.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of November 16, 2019.

Please note that all research records must be retained for a minimum of three years after the completionof the project.

If you have any questions, please contact Nicole Morse at 970-351-1910 or nicole.morse@unco.edu. Please include your project title and reference number in all correspondence with this committee.

Thank you for providing clear and thorough amendments/modifications. These revised protocols and materials are approved and you may proceed with your participant recruitment and data collection accordingly.

Best wishes with your research.

Sincerely,

Dr. Megan Stellino, UNC IRB Co-Chair

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Northern Colorado (UNCO) IRB's records.

APPENDIX B

INFORMED CONSENT

PARENTS/GUARDIANS:

The purpose of this survey is to determine if math attitudes can be measured well in children from all different backgrounds and personal characteristics. There are two parts to the survey: the first part you fill out about your child, and the second part you read to your child and they record their responses.

The following questions ask about your child's background and personal characteristics. Please answer all questions accurately, as they help us make sure that different backgrounds are represented. These questions should take less than 10 minutes to complete. The questions that your child will answer should take approximately 15 minutes to complete.

By continuing to the next page you are granting your consent to participate in this study. Your responses are completely confidential and voluntary. Any data from this study will be presented as large group data, with no chance of your child being identified. You may stop at any time without penalty.

If you have any questions regarding this research, please contact Master's student Melissa Flowerdew, at flow5532@bears.unco.edu or her faculty sponsor, Dr. Molly Jameson, at molly.jameson@unco.edu

This study has been approved by the University of Northern Colorado Institutional Review Board. If you have any concerns about your selection or treatment as a research participant, please contact the Office of Research, Kepner Hall, University of Northern Colorado Greeley, CO 80639; 970-351-1910

APPENDIX C

DEMOGRAPHIC QUESTIONNAIRE

Who is answering these questions about your child? Please check all that apply.

- ◯ Child's Biological/Adopted Father
- ◯ Child's Biological/Adopted Mother
- ◯ Child's Biological/Adopted Grandparent
- ◯ Child's Caretaker
- ◯ Child's Foster Parent
- ◯ Child's Second Father
- ◯ Child's Second Mother
- ◯ Child's Stepfather
- ◯ Child's Stepmother
- ◯ ______ My role is not listed. (Please describe your role here.)

In what country does your child live?

- ◯ United States
- ◯ ______ Country other than United States (Please type country here.)

If your child lives in the United States, in what region does your child live?

- ◯ New England (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, & Vermont)
- ◯ Mid-Atlantic (New Jersey, New York, & Pennsylvania)
- ◯ East North Central (Illinois, Indiana, Michigan, Ohio, & Wisconsin)
- ◯ West North Central (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, & South Dakota)
- ◯ South Atlantic (Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, District of Columbia, & West Virginia)
- ◯ East South Central (Alabama, Kentucky, Mississippi, & Tennessee)
- ◯ West South Central (Arkansas, Louisiana, Oklahoma, & Texas)
- ◯ Mountain (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, & Wyoming)
- ◯ Pacific (Alaska, California, Hawaii, Oregon, & Washington)

In what type of environment does your child live?

- ◯ City (an urban area with a population between 100,000 -- 1,000,000)
- ◯ Exurban/Commuter Town (an urban community that is primarily residential, from which most of the workforce commute out of the community to earn their livelihood)
- ◯ Metropolis (an urban area with a population over 1,000,000)
- ◯ Rural/Country (sparsely populated area outside of towns and cities)
- ◯ Suburban (a residential area on the outskirts of a city)

What type of school does your child attend?

- ◯ Boarding school
- ◯ Montessori school
- ◯ My child's school type is not listed. (Please describe your child's school type.) [ ]
- ◯ Parochial school
- ◯ Private language immersion school
- ◯ Private special education school
- ◯ Public charter elementary school--For example, a school of choice operating more independently than other district schools
- ◯ Public classical elementary school--For example, a school that provides a challenging liberal arts curriculum.
- ◯ Public magnet school--For example, a school that specializes in a specific subject area such as STEM or dual language immersion
- ◯ Public neighborhood elementary school--For example, the school based on your neighborhood location within the district
- ◯ Reggio Emilia school
- ◯ Religious school
- ◯ Traditional private school

In what grade is your child currently enrolled? If you are answering during a break between grades, please answer what grade your child will enroll in next academic year.

1st	2nd	3rd	4th	5th	6th
◯	◯	◯	◯	◯	◯

How old is your child?

- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10
- ○ 11
- ○ 12
- ○ 13

What is your child's birth date? Please enter as MM-DD-YYYY (For example, April 12, 2010 would be entered as 04-12-2010).

____

What is your child's gender identity? (check all that apply)

- ☐ Genderfluid
- ☐ Female
- ☐ Non-binary gender
- ☐ Male
- ☐ My child's gender identity is not listed. (Please describe your child's identity here.) __________
- ☐ Transgender
- ☐ I prefer not to say.

Which categories describe your child? Select all that apply to your child:

- ☐ American Indian or Alaska Native--For example, Navajo Nation, Blackfeet Tribe, Mayan, Aztec, Native Village of Barrow Inupiat Traditional Government, Nome Eskimo Community
- ☐ Asian--For example, Chinese, Filipino, Asian Indian, Vietnamese, Korean, Japanese
- ☐ Black or African American--For example, Jamaican, Haitian, Nigerian, Ethiopian, Somalian
- ☐ Hispanic, Latino, Latina, Latinx, or Spanish Origin--For example, Mexican or Mexican American, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian
- ☐ Middle Eastern or North African--For example, Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian
- ☐ My child's race, ethnicity, or origin is not listed. My child's race/ethnicity is: __________
- ☐ Native Hawaiian or Other Pacific Islander--For example, Native Hawaiian, Samoan, Chamorro, Tongan, Fijian, Marshallese
- ☐ White--For example, German, Irish, English, Italian, Polish, French
- ☐ I prefer not to answer.

What is your child's primary language spoken at home?

[ ]

Does your child speak another language? If so, what language?

- ○ No
- ○ [ ] Yes

Has your child been identified as having special needs by the school? If so, select all that apply.

- ☐ My child has not been identified as having special needs.
- ☐ Attention/Hyperactive Disorders
- ☐ Autism Spectrum Disorder
- ☐ Behavioral Disorder
- ☐ Communication Disorder
- ☐ Dyscalculia
- ☐ Dysgraphia
- ☐ Dyslexia
- ☐ Emotional Disorder
- ☐ Hearing Impairment
- ☐ Intellectual Disability
- ☐ Visual Impairment
- ☐ Academically Gifted/Talented
- ☐ Mathematically Gifted/Talented
- ☐ Nonverbally Gifted/Talented
- ☐ Verbally Gifted/Talented

Does your child have an Individualized Education Program (IEP), an Advanced Learning Program (ALP), or a 504c?

- ○ My child does not have an IEP, ALP, or 504c.
- ○ Individualized Education Program (IEP)
- ○ Advanced Learning Program (ALP)
- ○ 504c
- ○ My child has both an IEP and an ALP.

Please describe the highest level of education attained by the child's first parent/guardian.

- ○ Less than 12th grade and No GED
- ○ GED
- ○ High school diploma
- ○ Some college
- ○ Associate's degree--For example, AA, AS, AAA, AAS
- ○ Bachelor's degree--For example, BA, BS, BFA
- ○ Master's degree--For example, MA, MS, MBA, MFA
- ○ Doctoral degree/Professional degree--For example, PhD, PsyD, EdD, JD

Please describe the highest level of education attained by the child's second parent/guardian (if applicable).

- ○ Less than 12th grade and No GED
- ○ GED
- ○ High school diploma
- ○ Some college
- ○ Associate's degree-For example, A.A., A.S., A.A.A., A.A.S.
- ○ Bachelors degree--For example, B.A., B.S., B.F.A
- ○ Master's degree--For example, M.A., M.S., M.B.A., M.F.A
- ○ Doctoral degree/Professional degree--For example, Ph.D., Psy.D., Ed.D., J.D.

How would you describe your family's household income? Total family income is:

- ○ Under $15,000
- ○ $15,000-$24,999
- ○ $25,000-$34,999
- ○ $35,000-$49,999
- ○ $50,000-$74,999
- ○ $75,000-$99,999
- ○ $100,00-$149,999
- ○ $150,000-$199,999
- ○ $200,000 or more

Does your child qualify for free/reduced lunch at school?

- ○ Yes
- ○ No

APPENDIX D

CHILDREN'S ANXIETY IN MATH SCALE

PARENTS/GUARDIANS:
The next page of questions are for your child. Please read the information and each item to your child. You will read them a total of 16 questions, and for each one your child will select the face that is most like how they feel about that math activity.

We are trying to know how different kinds of kids feel about math. If you would like to help us, you will be read some things about math, and you will need to pick a face that is most like how you feel about that math thing. If you decide that you do not want to answer questions anymore, you can stop at any time.

Don't worry, there are no right or wrong answers and this is not a test.

First we are going to just look at the faces and what they mean.

This face with the big frown feels **really upset**:

This face with the little frown feels a **little upset**:

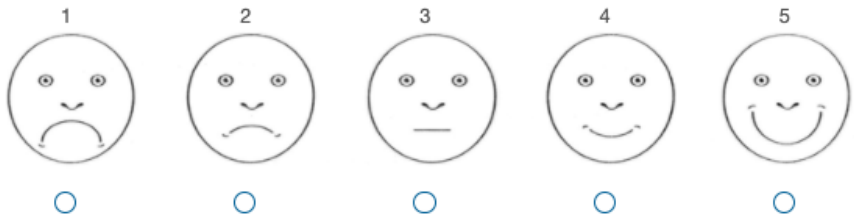
This face with the flat mouth **does not feel upset or excited**:

This face with the little smile feels **excited**:

This face with the big smile feels **really excited**:

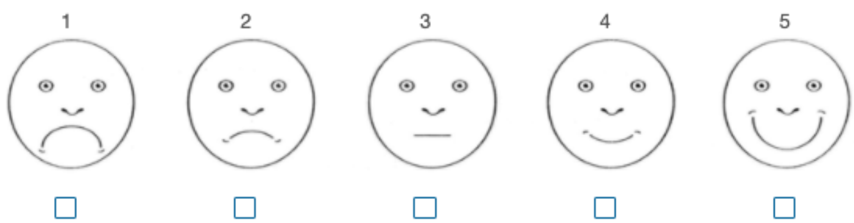
Now we are going to answer questions about how math makes you feel.

When I solve math problems, I feel:

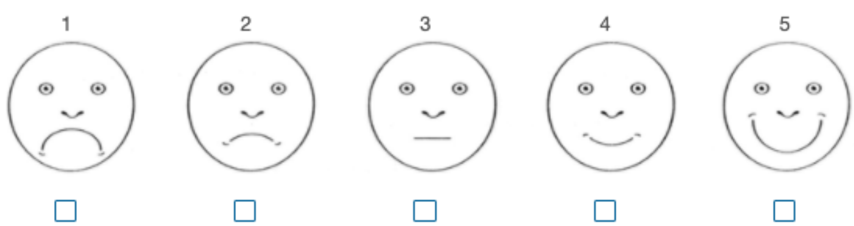


When I think about doing math, I feel:

When I am working on math problems that are difficult and make me think hard, I feel:



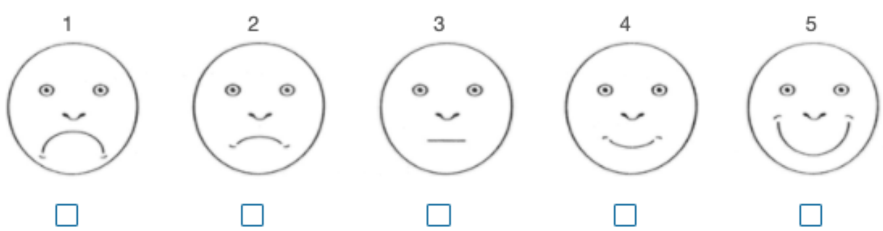
Compared to other school subjects, math makes me feel:



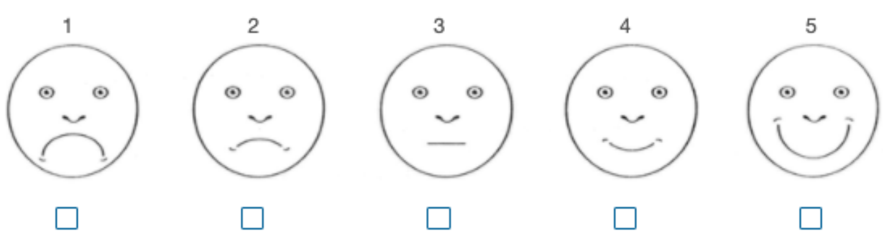
When I solve math puzzles, I feel:

When I have a hard math question, I feel:

When the teacher calls on me to answer a math problem, I feel:



When the teacher is showing the class how to solve a math problem, I feel:



If I have to add up numbers on the whiteboard or Smartboard in front of the class, I feel:

1 2 3 4 5

☐ ☐ ☐ ☐ ☐

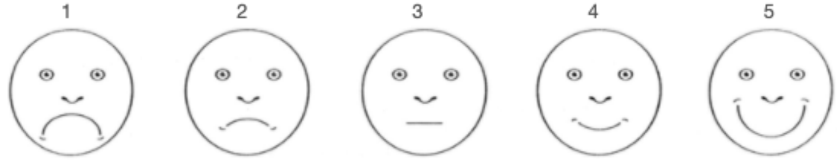
When I make mistakes in math, I feel:

1 2 3 4 5

☐ ☐ ☐ ☐ ☐

Thinking about working on math in class makes me feel:

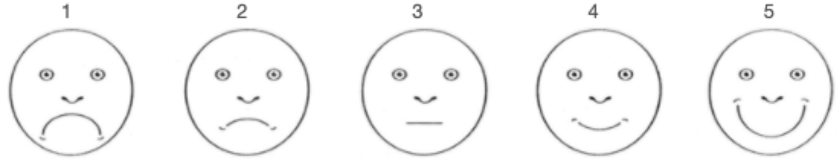
1 2 3 4 5



☐ ☐ ☐ ☐ ☐

Working on math at home makes me feel:

1 2 3 4 5



☐ ☐ ☐ ☐ ☐

When the teacher gives the class a math problem I don't understand, I feel:

1 2 3 4 5

When my teacher says that he or she is going to give me a math problem on the whiteboard or Smartboard, I feel:

1 2 3 4 5

When I know that my class will be working on math at school, I feel:

1 2 3 4 5

When I know that I am going to have a math test, I feel:

1 2 3 4 5

Thank you for helping us understand how different kids feel about math. We are very thankful for your help!