Fall 2022

UNIVERSITY STUDENT PERCEPTIONS OF MATH IN RELATION TO PERSONALITY, UPBRINGING, AND ONLINE LEARNING AND THE IMPACT OF THOSE PERCEPTIONS ON CAREER CHOICES

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by

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Submitted to the School of Honors Committee

in partial fulfillment

of the requirements for University Honors Scholars

Southeastern University

2022

Dedication

I would like to dedicate this project to my brother, Nathan, who was tragically murdered on October 12, 2021, and to any other families who are dealing with horrific loss. I hope that Nate's favorite Bible verse, Psalm 23:4, serves as a constant reminder for you that "even though I walk through the valley of the shadow of death, I will fear no evil, for you are with me; your rod and your staff, they comfort me" (*English Standard Version Bible*, 2001).

Acknowledgments

First and foremost, I would like to thank my thesis advisor, Dr. Jeremy Denton, for the many hours he put into helping me shape my topic and my survey and for the time he spent editing and revising my thesis. I am grateful for all the time he set aside in his busy schedule to help me through this project. I learned a great deal from his expertise in the area of math education, and I hope that I will be just as proficient at teaching students math as he is.

Secondly, I would like to thank Dr. Thomas Gollery for the significant amount of help he gave me with the statistical analysis of my survey data. I would be lost without him, and I am so thankful for his help.

Additionally, I would like to thank Dr. Gordon Miller, Molly Owen, Kaitlyn Brett, and Amy Beatty for their assistance, advice, and encouragement throughout the entirety of this project. They have all made me feel at home in the School of Honors over the past four years.

Next, I would like to thank all of the professors from Southeastern University's math department – Dr. Jeremy Denton, Matt Almand, Cody Tessler, Dr. Berhane Ghaim, Dr. TaeEun Kim, and Barrett McDonald – for the wisdom, guidance, support, and encouragement that they have instilled in me during my time at Southeastern University. The six of them not only taught me how to be a mathematician but also showed me what genuine care for students looks like. They were all there for me during the most painful time of my life, and for that, I am forever grateful.

Lastly, I would like to thank my parents and my friends for their unwavering love and support throughout this process and for inspiring a love of math in me. If it were not for them and the many times they encouraged me to keep on writing, I may not have undertaken or completed this project. Thank you for everything. I love you all.

Abstract

Students all over the world are developing negative perceptions of the subject of mathematics and shying away from careers in the field of math as a result. The purpose of this study was to determine how various factors, such as students' personalities, upbringings, and experiences with online learning, affected their perceptions of math and resulting career choices. A survey asking participants about these factors in relation to their perceptions of math was sent out through email to Southeastern University (SEU) undergraduate students and math professors. The survey received 200 responses with 194 of them being Southeastern University undergraduate students and the other six being either SEU math professors or graduate students. Study data were analyzed in a preliminary, descriptive statistical manner, and descriptive and inferential statistical techniques were used to address the study's research questions. The results of the study indicated that students were most likely to enjoy mathematics and pursue careers in this field when they had high math self-efficacy beliefs, low math anxiety, perfectionistic or analytical tendencies, effective math teachers whom they had positive relationships with, and supportive parents who expressed the importance of math to their children.

KEY WORDS: math anxiety, self-efficacy, personality, dyscalculia, upbringing, parental involvement, teacher support, career choice, math attitude, online learning, math enjoyment

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Chapter 1: Introduction

Since I was very young, I have loved the study of mathematics and the satisfaction received after solving a difficult problem correctly. I enjoy the black-and-white absolutes involved in math and the fact that there is usually no need for a long, detailed argument explaining why I view my answer as correct. This adoration of math, however, has not been an opinion that many of my classmates over the years have shared. In fact, as seems to be the stereotype across the United States and many other countries around the world, almost every student that I have come into contact with has had a general distaste for the subject. Even when talking to fellow college students, I have often heard math described as their least favorite subject, and, more times than I can count, I have been called “crazy” for pursuing a career in the field. Therefore, as a future high school math teacher, I feel inspired to change this negative perception of math in my own students, so they will love the subject as much as I do and may decide to pursue a career in it as well.

As I researched this topic, I looked into how students’ personalities, upbringings, and experiences with online learning affected their perceptions of math. Because both of my parents are math teachers and are highly skilled in the subject, a fondness for math has been instilled in me from a young age and has only grown over the years. As evidence for this statement, my mom recently found a picture of me as a toddler asleep in a crib with a picture book about numbers open and lying across my chest. She explained to me that even when I was only a few years old, I always seemed intrigued by the concept of numbers and math in general. To add to that, every math teacher that I have had throughout my years of elementary school, middle school, high school, and college has been extremely proficient in teaching and has further developed my love for math. Furthermore, this straightforward subject probably appeals to me because it reflects my own analytical, left-brained personality. All of these factors played huge roles in my current desire to pursue math and, going into this project, I was interested to see how varying factors could affect other students' positive or negative views of the subject and resulting career choices. Now that I have completed this study, I want to utilize my findings to employ various methods in my own classroom through which I can change my students' aversion to the field of mathematics.

The following questions were developed to help guide the research and potential findings of this study:

- To what extent do students perceive themselves as enjoying or disliking mathematics?
- How do emotions that students experience during class, such as math anxiety or frustration, affect their overall views of math?
- How do specific personality traits, such as perfectionism, extraversion, introversion, and being analytical, affect students' perceptions of math?
- How do learning disabilities, such as dyscalculia, affect students' views of math?
- How do parental involvement, parental enjoyment of math, and parental math anxiety affect students' attitudes toward math?
- How do teacher support, teacher self-efficacy, and teacher understanding of math content affect students' perceptions of math?
- How do experiences with online learning affect students' views of math?
- How do students' positive or negative perceptions of math affect their choices to pursue careers in the field of mathematics?

Chapter 2: Literature Review

Introduction

Throughout the modern era, the understanding of mathematics has expanded significantly as mathematicians have discovered new theorems and fields of thought. Recently, however, this exponential increase in comprehension seems to have led to another trend: the general distaste for the subject of math by students all over the world. When asking an upper elementary school, middle school, high school, or even college student what his or her least favorite subject is, he or she will often respond with “math” and maybe even roll his or her eyes at the memory of math class. In fact, according to a 2015 study of a group of high school students in India, only 6% of the students surveyed said that math was their favorite subject, while 88% said that math was their most “hated” subject (Gafoor & Kurukkan, 2015, p. 3). Although the results from this specific study may not be representative of students’ math perceptions all over the world, similar studies in other countries have been conducted and have found the same results.

Numerous theories and possible explanations exist as to why this seemingly shared negative perception of math occurs in students, but some of the most viable factors that contribute to it may be personality and upbringing. The emotions that students feel when working on math problems, learning disabilities such as dyscalculia, and specific personality traits encompass the aspects of personality that contribute to students’ negative views of math. Upbringing can refer to how much teacher and parental support students received growing up, how skilled their teachers and parents were in helping them with math, and how their teachers and parents viewed the subject of math. Additionally, an emerging disdain towards math seems to have occurred recently due to the coronavirus (COVID-19) and the requirements of online learning. Learning through an online format seems to affect students' perceptions of math because it can cause more confusion, frustration, and stress than in-person math classes do.

As a result of this common negative attitude toward the subject of math, there is a continuous low percentage of students who display an interest in math or want to pursue a career in the field after college. In a recent study of 836 undergraduate college students in the eastern United States, only about 9% of the students surveyed selected a career choice in the field of mathematics (Cribbs et al., 2021). Identifying the various factors that lead to this negative perception of math and then developing and implementing methods to change it may inspire more students to pursue math in the future. As a result, the percentage of students selecting a career choice in the field of mathematics will increase in future studies.

Personality

Emotions

The emotions that students feel when in math class or working on math problems and how they feel about their own abilities significantly impact how students view the subject overall. A common emotion that students feel in math class is called math anxiety, which has been defined as "a feeling of worry, fear, or discomfort towards mathematics that impedes mathematics performance" (Ashcraft, 2002, as cited in Huang et al., 2019, p. 622). Along with the psychological impediments, math anxiety can also cause physical reactions in students such as "an increased heart rate, lightheadedness, increased perspiration and clammy hands" (Blazer, 2011, as cited in Kirkland, 2016, p. 11). A student's view of his or her own abilities is typically referred to as self-efficacy; the effects on students of both math anxiety and their own self-efficacy beliefs have been thoroughly studied by professionals. Self-efficacy is defined as "a person's beliefs concerning his or her ability to successfully perform a given task or behavior"

(Akin & Kurbanoglu, 2011, p. 265). Both factors have been closely looked at by experts in the field and correlations have been made between math anxiety, low self-efficacy beliefs, and negative perceptions of math.

Various studies have been conducted to determine the relationships between math anxiety, self-efficacy, and attitudes toward the subject of math. A study in Turkey of 372 college students found that students who experienced math anxiety were much more likely to have low self-efficacy and negative attitudes toward math, while students who had high self-efficacy were more likely to have positive views of math (Akin & Kurbanoglu, 2011). The study also discovered that students who had high self-efficacy beliefs and positive views of math were less likely to experience math anxiety, whereas students who had negative views of math were more likely to deal with math anxiety as a result (Akin & Kurbanoglu, 2011). From these findings, the researchers inferred that students who feel they are incapable of performing well in math class and students who experience high levels of stress while working on math will typically have negative perceptions of the class due to these undesirable emotions (Akin & Kurbanoglu, 2011).

Another recent study of 152 American middle school students from differing math classes sought to identify the correlations between math anxiety, self-efficacy, and student career interest (Huang et al., 2019). In a similar fashion to the Turkish study, these results revealed that students with high self-efficacy beliefs had low math anxiety and were more interested in pursuing careers in the field of math. Students who experienced low math anxiety had a high interest in careers in math, and students with high math anxiety experienced low self-efficacy. Additionally, this study found that female students were more likely to experience math anxiety than male students, and male students had higher self-efficacy beliefs and desires to pursue careers in math than female students (Huang et al., 2019). Girls who experienced math anxiety were much less likely to express interest in careers in math than those who did not experience math anxiety. Boys, on the other hand, were more likely to have an interest in math careers when they were in high-level math classes instead of low-level math classes. Both male and female students who reported feelings of math anxiety were more likely to experience low self-efficacy beliefs, which then negatively affected their interest in math careers (Huang et al., 2019). These results revealed that there are substantial correlations between math anxiety, self-efficacy, and career interest, which also imply that math anxiety and self-efficacy affect students' perceptions of math.

Cribbs et al. (2021) conducted a study of American undergraduate students in the hope of discovering connections between math anxiety, math self-efficacy, attitudes towards math, and interest in the science, technology, engineering, and mathematics (STEM) fields. After surveying 836 students, they found that students who had high self-efficacy beliefs reported low levels of math anxiety. There were also strong correlations between positive views of math, high self-efficacy beliefs, and high STEM career interest; on the contrary, students with low self-efficacy beliefs showed low STEM career interest. Lastly, students who experienced high levels of math anxiety reported low interest in careers in STEM (Cribbs et al., 2021). The results revealed that students are more likely to pursue a career in STEM if they have high self-efficacy, low math anxiety, and a positive attitude toward the field of math.

In 2019, 353 high school students in Mexico were surveyed to determine the extent to which the students were experiencing math anxiety during class (Escalera-Chávez & Rojas-Kramer, 2019). The results of the study found that only 15.4% of the students demonstrated low levels of math anxiety, while 44.3% demonstrated medium levels, and 39.3% demonstrated high levels of math anxiety (Escalera-Chávez & Rojas-Kramer, 2019). No significant difference in math anxiety levels was found between the grade levels, but a significant difference was found between the high level of math anxiety that female students experienced compared to the lower level that male students experienced (Escalera-Chávez & Rojas-Kramer, 2019). Overall, the results of the study showed that despite their grade levels, the majority of students at the high school in Mexico experienced medium or high levels of math anxiety while in their math classes.

A student's attitude towards math can also be affected by how he or she feels when in class or working on problems. Hannula (2002) conducted a case study over a period of four years of a female Finnish middle school student to discern how her attitude towards math would evolve with time and understanding. During the first interview, the student described math as "so stupid," explaining that she could not understand what she was learning and that she did not feel confident in her own math abilities (Hannula, 2002, p. 32). Because of her low self-efficacy beliefs and lack of understanding of the subject, she mostly complained about math class and expressed her negative attitude towards it when she said, "You don't need math in life" (Hannula, 2002, p. 33). While working on a math activity that she did not understand, the student complained that the activity was "really stupid" and that "you don't need those things in life" (Hannula, 2002, p. 38). During another interview a year later, the student explained that "mathematics has been a bit more fun because I've been understanding it a bit more" (Hannula, 2002, p. 39). Over the four years of studying the changes in the student's attitude toward math, Hannula discovered that the student strongly disliked the subject at first due to the frustration she felt at not being able to understand the problems. After she began to grasp the concepts better, however, this attitude became more positive and she actually started to enjoy the subject. This case study revealed that students tend to enjoy the subject of math more when they understand it and feel confident in their knowledge and abilities.

Personality Traits

Just as students' feelings about math and their own abilities affect their views of math, so can specific personality traits influence their perspectives on the subject. Humburg (2017) defines the "Big five" personality traits to be "extraversion, agreeableness, conscientiousness, emotional stability, and openness to experience" (p. 367). In this study, Humburg sought to find correlations between these specific personality traits and the majors that students chose to study in college. The results of surveying 19,391 Dutch college students found that extraversion had a negative correlation with choosing a career in mathematics, meaning that extraverted students were less likely to pursue careers in math (Humburg, 2017). In the same way, students who were considered agreeable, conscientious, open to experience, or had strong verbal skills were less likely to choose careers in math than students who did not show these attributes. On the other hand, students who displayed emotional stability or high math ability were much more likely to choose careers in the field of math than students who did not (Humburg, 2017).

A similar study was conducted by Peklaj et al. (2015), who strove to find the relationships between students' grades in math and their genders, personality traits, previous math knowledge, and personal motivations. After surveying 386 Slovenian high school students, the study found that the only major differences between genders were that male students scored higher on the test for previous math knowledge and were less likely to be considered "agreeable" than female students (Peklaj et al., 2015). When looking at personality traits, students who displayed high amounts of energy or agreeableness were more likely to have a lower final grade in math class, whereas students who had high self-efficacy beliefs or demonstrated conscientiousness were more likely to have a higher final math grade. Students who tended to procrastinate on their assignments often had lower final math grades, but students who got their work done immediately were more likely to have higher final math grades (Peklaj et al., 2015). Furthermore, positive correlations were found between interest in math, high self-efficacy, and getting work done immediately, but students who were easily distracted or procrastinated showed low signs of motivation. The researchers concluded that students who demonstrated high previous math knowledge, high self-efficacy beliefs, high interest in math, conscientiousness, diligence to get work done right away, or high motivation were more likely to enjoy the subject of math and have higher grades at the end of the class. On the contrary, students who had a lot of energy, liked to procrastinate, were considered agreeable, or had low motivation were more likely to dislike the subject of math and have lower final math grades (Peklaj et al., 2015).

Another personality trait that can affect a student's perception of math is perfectionism. Perfectionism is defined as "extremely high standards for performance and concern about making mistakes and the social costs of not being perfect" (Frost et al., 1990, as cited in Núñez-Peña & Bono, 2021, p. 866). Núñez-Peña and Bono (2021) studied the relationships between perfectionism, math anxiety, and student academic success in the math classroom. The researchers surveyed 251 undergraduate students from Spain, and the results showed that students with high math anxiety also displayed higher perfectionistic tendencies than students with low math anxiety (Núñez-Peña & Bono, 2021). Students with high math anxiety also seemed to worry more about making mistakes on assessments, had less confidence in what they were doing during assessments, and scored lower on the multiple-choice tests in part because they left more answers blank than students with low math anxiety did. The study found that students who experienced doubt in their own abilities left more questions unanswered and scored lower on the assessment than students who had confidence in their abilities (Núñez-Peña & Bono, 2021). When looking at the differences between male and female students, girls displayed more math anxiety and left more answers blank than boys did, but they also scored higher on the multiple-choice exams and were more organized. Altogether, the study determined that perfectionism can negatively affect the math performance of students who are already dealing with math anxiety because it can cause them to doubt their work and leave questions unanswered due to the fear of answering incorrectly (Núñez-Peña & Bono, 2021).

In addition to personality traits, brain chemistry can also affect students' mathematical achievement and influence their attitudes toward mathematics as a result. Park et al. (2014) used magnetic resonance imaging (MRI) on 21 children between the ages of four and seven to ascertain how their brains process numbers and symbols, and how differences in their processing can affect their achievement in math. The study found that when there was greater connectivity between different regions of the children's brains, they tended to score higher on math assessments because their brains could more accurately process the numbers and symbols on the assessments compared to children whose brains did not have as much connectivity between the regions. It was also discovered that the connectivity between regions of the brain increased as the children aged, suggesting that the older children typically scored higher on math assessments than the younger children did (Park et al., 2014). Subsequently, due to the makeup and connectivity of their brains, particular children had inclinations to math that allowed them to score higher on the math assessments than the other children did. Overall, certain personality traits and tendencies such as extraversion, agreeableness, diligence, and perfectionism along with the composition of children's brains can affect their mathematical abilities and attitudes.

Learning Disabilities

In the same way that emotions and personality traits can cause noteworthy effects on students' perceptions of math, so can learning disabilities, even if they are undiagnosed. One specific math learning disability that researchers typically refer to when discussing how learning disabilities affect students' math performances is dyscalculia. Dyscalculia is defined as the "reduced ability of determining numbers and developing a mental number axis" (Lundberg & Sterner, 2009, pp. 20-24, as cited in Andersson & Abdelmalek, 2021, p. 849). Several studies have been conducted to determine how math learning disabilities such as dyscalculia have impacted students' math abilities and career choices.

One study in particular looked at how students' self-efficacy beliefs and future career choices are influenced by math learning disabilities. The study, which included a survey of 3,324 middle and high school students in the United States, found that boys were much more likely than girls to have been diagnosed with learning disabilities and to have failed classes in the past (Crosnoe et al., 2007). The results of the study showed that girls who had failed math classes experienced significant declines in their self-efficacy beliefs and desires to further their mathematics careers. Girls who had failed math classes and had been diagnosed with learning disabilities, however, did not experience these same reductions in self-efficacy beliefs because they typically blamed their failures on their learning disabilities instead of their own perceived incompetence (Crosnoe et al., 2007). Girls who had not failed math classes and had not been diagnosed with learning disabilities were much more likely to express interest in continuing their math careers. On the contrary, boys who were diagnosed with learning disabilities would lose confidence in their own abilities and would not want to study math because they perceived their diagnoses as ineptitude even if they did well in math class (Crosnoe et al., 2007). Furthermore, both male and female students who had been diagnosed with learning disabilities were more likely to have failed classes in the past year than students who did not have diagnoses. Altogether, this study revealed that for female students, self-efficacy beliefs and math career interests were affected more significantly by failing math classes than by being diagnosed with learning disabilities; the self-efficacy beliefs and career interests in math of male students were more highly affected by being diagnosed with learning disabilities than by failing classes (Crosnoe et al., 2007).

In their journal article, Johnson et al. (2021) looked into how math learning disabilities, such as dyscalculia, have been connected to math anxiety. Their research found that students who have been diagnosed with learning disabilities usually experience twice as much math anxiety as typical students do (Johnson et al., 2021). Students with learning disabilities often struggle with memorization, so they have a hard time recalling facts and formulas that are needed to correctly solve certain math problems. As a result, they experience high math anxiety when they are unable to solve problems, which negatively affects their overall performance and final grade (Johnson et al., 2021). The researchers then created both a self-regulated learner framework and a math intervention framework to help students with learning disabilities overcome their math anxiety; their hope is that as students build confidence, their academic achievement will improve as well, especially in the math classroom (Johnson et al., 2021). The researchers explained that students with learning disabilities benefit most when educators use precise instructions and visuals, and when they explain their problem-solving processes out loud (Johnson et al., 2021). The hope behind this research is that teachers will implement these frameworks into their classrooms, so students with learning disabilities can improve their self-efficacy beliefs, lessen their math anxiety, and develop positive perceptions of the subject of math.

Whereas students with learning disabilities tend to struggle with math and may dislike it as a result, students who are mathematically gifted tend to excel in the subject and hold it in the highest regard. O'Boyle (2008) closely examined how the brains of mathematically gifted children work differently from the brains of typical children. The research found that the right hemispheres of the brains of students with giftedness often have been developed more thoroughly than the brains of typical students (O'Boyle, 2008). Their brains also have greater connectivity between the different regions, which helps them solve math problems because they process information quickly and create mental pictures in their minds as they are working on the problems. O'Boyle (2008) suggested that teachers of mathematically gifted students should differentiate their lessons to include visuals, should encourage gifted students to participate in outreach programs with more advanced classes, and should require less work to be shown by these students since they can do all of the calculations in their minds. From the findings of the research, O'Boyle (2008) indicated that students' brains are all wired differently, and their brain compositions have crucial impacts on their mathematical achievement and, therefore, on their perceptions of math.

Upbringing

Parents

As children grow up, their parents play major roles in influencing their beliefs about the world as well as their likes and dislikes. According to psychologists Silver et al. (2021), just as parents shape their children's views on topics such as religion, politics, sports teams, and foods, for example, so can parents shape their children's views of the subject of math. A parent's strong dislike for math class can dramatically shift a child's view of the class in a negative direction even if the child liked the class previously. Also, if parents experience math anxiety or confusion when helping their children with homework, these feelings can arise in the children as well as they sense their parents' confusion. Many studies have been conducted to demonstrate how parental support and parental perceptions of math influence their children's math attitudes.

One specific study strove to find relationships between young children's math achievements and their parents' math anxiety. Silver et al. (2021) surveyed 114 American preschool students and their parents about their math abilities, math beliefs, and math anxiety. The results found that children whose parents taught them that math is important performed much better on math assessments than children whose parents did not (Silver et al., 2021). The study also discovered that math anxiety in parents heightened the effects of their beliefs about math on their children's achievements. In other words, the children of parents who had high math anxiety and high math-importance beliefs performed well on math assessments, and the children of parents who had high math anxiety and low math-importance beliefs performed poorly on math assessments (Silver et al., 2021). Contrary to the researchers' hypothesis that parental math anxiety would cause negative effects on their children's performances, math anxiety in parents actually caused their children to perform better on assessments when they also taught their children how important math is. Silver et al. (2021) concluded that the reasoning behind this finding is that parents with high math anxiety do not want their children to experience these same feelings during math class, so they explain the importance of math often in hopes that their children will perform better in the class than they ever did. In addition to this assumption, the researchers determined from other studies that parental math anxiety does not typically have negative effects on children until the children are at least in elementary school or until their math homework becomes increasingly difficult (Silver et al., 2021). Hence, the 114 preschoolers who were included in this study were most likely too young to have been negatively affected by their parents' math anxiety yet. From these conclusions, the researchers inferred that parents' beliefs about the importance of math significantly impact the math achievement and math perceptions of their children; parental math anxiety, on the other hand, can either positively or negatively affect children's math performances depending on the age of the children and the parents' views of the importance of math (Silver et al., 2021).

Another study identified correlations between parents' beliefs about math, parental involvement in math homework, and student math performance (Rodríguez et al., 2017). The study, which took place in Spain, surveyed 897 elementary school students and their parents to determine the relationships between these factors (Rodríguez et al., 2017). The results indicated that when parents were involved in their children's mathematical tasks by helping them with homework, encouraging them to do their best, and expecting them to do well, the children usually had higher self-efficacy beliefs and a greater understanding of how math can be used in their futures (Rodríguez et al., 2017). Consequently, students who had high self-efficacy beliefs and math-importance beliefs performed better in math class and achieved higher mastery goals (Rodríguez et al., 2017). The study also found that the factors that played the greatest roles in determining student math achievement were parent expectations and high self-efficacy beliefs. Although parental help with homework increased student self-efficacy beliefs, it also caused a decrease in children's math achievements (Rodríguez et al., 2017). A possible explanation for why parents' help with homework caused student math achievement to decline is that the students may have felt more pressure to succeed or judgment from their parents if they were constantly helping them with their homework. Also, too much parental involvement with homework may have caused students to either become too reliant on their help or to doubt their own abilities if their parents felt the need to fix their mistakes consistently (Rodríguez et al., 2017). Overall, this study revealed that when parents expect their children to perform well, encourage them to do their best, and show interest in their mathematical progress, students will achieve more in class due to higher self-efficacy and math-importance beliefs. When parents help them with homework all the time, however, students do not perform as well in class (Rodríguez et al., 2017).

Lee and Simpkins (2021) conducted a study in the United States that examined how parental involvement in student academia can reverse the negative effects that low teacher support has on student self-efficacy beliefs and academic achievement. After analyzing data from the High School Longitudinal Study about 14,580 American high school students, the researchers found that low teacher support during math class negatively predicted how well students performed in math class (Lee & Simpkins, 2021). Students who had high self-efficacy beliefs performed better in math class than students who did not, and students who had high levels of parental support achieved higher grades than students who did not. When looking at the relationships between parental support, teacher support, and student self-efficacy, the results revealed that low teacher support had a negative effect on student achievement when students also had low parental support and low self-efficacy beliefs (Lee & Simpkins, 2021). When students had either high parental support or high self-efficacy beliefs, even if the other factor was low, low teacher support did not have an effect on their academic achievement. The math performance of students who had both high parental support and high self-efficacy beliefs, however, was negatively affected by low teacher support (Lee & Simpkins, 2021). The findings of this study indicated that parental support plays an important role in determining student academic achievement when students either have low self-efficacy beliefs or low teacher support.

A study in China by Li et al. (2021) considered the correlations between parental involvement, teacher support, student learning involvement, and math anxiety in elementary school children. After conducting two surveys of 1,780 Chinese elementary school students and 1,850 students respectively, the results found that when students experienced high parental involvement or high teacher support, they were less likely to experience math anxiety. High parental involvement also predicted high student learning involvement, meaning students put in the effort to learn the material on their own and took responsibility for their learning (Li et al., 2021). Similarly, students who had high teacher support were more likely to have high learning involvement and low math anxiety. Students who had both high teacher support and high parental involvement were more likely to be highly involved in their own learning and less likely to experience math anxiety as a result. When students had low parental involvement and low teacher support, they were less likely to be involved in their own learning and, consequently, experienced more math anxiety (Li et al., 2021). Overall, this study revealed that parental involvement and teacher support can motivate students to become more involved in their own learning, which can lessen their feelings of math anxiety in turn.

Teachers

Teacher support, self-efficacy, content knowledge, and math attitudes can also affect a student’s perspectives on the subject. Teachers who are skilled in math and passionate about the subject often pass along this knowledge and attitude to their students, so it is vital for math teachers to know what they are doing. Also, teachers who are confident in their own abilities to teach math will positively impact their students’ beliefs in their own abilities. If teachers are both supportive of their students and have high math self-efficacy beliefs, then they probably enjoy the subject of math, and their students may also enjoy the subject as a result.

Perera and John (2020) conducted a study of 6,000 Australian fourth-grade students and 450 Australian teachers to consider the connections between teacher self-efficacy beliefs, teacher job satisfaction, and student math achievement. After surveying this sample, the study found that teachers who were more confident in their teaching abilities were more satisfied with their jobs; their students perceived their interactions with the teachers in a more positive light than students who had teachers with low self-efficacy beliefs (Perera & John, 2020). Additionally, teachers with high self-efficacy beliefs were more likely to have students with high math achievement than teachers with low confidence in their abilities to teach math. Students who reported better quality interactions with their teachers were more likely to have higher self-efficacy beliefs themselves, which resulted in them performing better in math (Perera & John, 2020). On the other hand, students who had negative interactions with teachers were more likely to perform poorly in math class. This study revealed that teacher self-efficacy beliefs and support do, in fact, play a positive role in determining student math achievement and self-efficacy (Perera & John, 2020).

Researchers Yu and Singh (2018) conducted a study to analyze how different teacher practices affected student interest in math classes and math achievement. After analyzing data from the High School Longitudinal Study of 2009 about 9,662 American high school students, Yu and Singh (2018) discovered that high perceived teacher support led to an increase in student self-efficacy and interest in math classes, which then resulted in higher student math achievement. Teachers who predominantly taught their students the procedures involved in mathematics negatively impacted their students' math achievement, whereas teachers who predominantly taught their students the concepts behind mathematics positively impacted their students' math achievement (Yu & Singh, 2018). Students who had high self-efficacy beliefs also had a high interest in math classes and performed better in math classes than students who had low self-efficacy beliefs. The findings of this study demonstrated that teacher support and instructional practices, such as using conceptual teaching rather than procedural teaching, can positively affect student self-efficacy, interest in math classes, and mathematics achievement (Yu & Singh, 2018).

Another study investigated how students' relationships with their teachers impacted their math achievement and engagement during class (Roorda et al., 2011). After examining 99 different studies about students in preschool through high school all over the world, the researchers found that students who had positive relationships with their teachers were more likely to be more engaged and more successful in math class. Students who had negative relationships with their teachers were more likely to be less engaged and less successful in math class (Roorda et al., 2011). Teacher-student relationships were more highly predictive of class engagement than math achievement, however, suggesting that positive teacher-student relationships increase student class engagement, which then results in higher student math achievement. The study also found that the longer a negative teacher-student relationship lasts, the more significant the negative impact is on the student's math achievement (Roorda et al., 2011). When comparing the ages of the students who were surveyed, the researchers discovered that positive teacher-student relationships were more important for older students than younger students, even though students typically experience a higher amount of negative interactions with teachers as they get older. On the contrary, younger students experienced greater negative effects from negative relationships with teachers than older students did (Roorda et al., 2011). When comparing the differences between male and female students, it was found that the class engagement of male students is more positively and negatively affected by the types of relationships the male students have with their teachers than female students. On the other hand, female students experienced more significant effects on their math achievement than male students when they had positive relationships with their teachers (Roorda et al., 2011). Altogether, this study showed how important teacher-student relationships are to both student class engagement and student math achievement.

A study conducted by Murray (2009) in the United States examined how students' relationships with their parents and teachers affected both their school engagement and their achievement in various classes. The study found that students who had good relationships with their parents were more engaged during school than students who had poor relationships with their parents. Students who had good relationships with their teachers were also more likely to be engaged during school than students with poor teacher-student relationships (Murray, 2009). Positive teacher-student relationships were correlated with higher achievement and higher grades in math than negative teacher-student relationships. When parents created clear academic expectations for their children, they were more likely to perform well in school; when parents had unclear expectations for their children's academic performances, their achievement in class suffered as a result (Murray, 2009). Students who developed close, trusting relationships with their teachers were more likely to succeed academically than those who did not. Overall, this study revealed that both parent and teacher relationships with students can significantly affect their engagement and achievement during school (Murray, 2009).

COVID-19 and Online Learning

Over the past couple of decades, virtual or online learning has developed drastically because of the simultaneous advancements in technology. With the emergence of the coronavirus (COVID-19) pandemic, the utilization of online learning skyrocketed in an effort to keep people separate and, therefore, slow the spread of the virus. This adjustment has caused problems for math teachers and students due to the difficulties presented when attempting to teach and assess the subject of math in a virtual format. As a result, students may be struggling in online math classes more than they were in in-person math classes, which may negatively affect their perceptions of the subject. Due to the recent nature of these events, there is a limited amount of research on the effects of online learning on students' perceptions of math, but some assumptions can be made from existing studies.

One study was undertaken by Ramadhani et al. (2021) in Indonesia to discover how undergraduate college students have struggled in their online math classes because of the COVID-19 pandemic. The researchers surveyed 500 Indonesian college students who had taken online math classes about their abilities in using technology, their views of online learning, the types of math classes they had taken, and the specifics of how the courses were managed (Ramadhani et al., 2021). The results of the study revealed that students who did not feel comfortable using technology struggled with learning math online and experienced more math anxiety than they had in in-person math classes. The most common problems that students faced when learning math online were technological difficulties and confusion about the material and expectations due to a lack of face-to-face communication with their professors (Ramadhani et al., 2021). Students who demonstrated low abilities in math also struggled with online learning more than students with high abilities because they often lacked the confidence needed to teach themselves the material when the professors failed to. Lastly, the study discovered that learning math online negatively affected most of the students' math performances and caused an overall decline in their perceptions of the subject of math (Ramadhani et al., 2021).

Another study by Barlovits et al. (2021) explored how German and Spanish math teachers taught during the COVID-19 pandemic, the problems they encountered while teaching math, and how they have modified their teaching since then. The researchers surveyed 171 German math teachers and 77 Spanish math teachers; the majority of the teachers from both countries were high school teachers. The results of the study found that both German and Spanish teachers decreased the difficulty levels of their math classes because they were concerned that their students would not understand all of the topics when learning virtually (Barlovits et al., 2021). The major problems that the teachers faced while teaching through online formats were a lack of student motivation, no in-person contact with students, very little available support for students with difficult home environments, a lack of individual support for students, and problems using technology for both the teachers and the students (Barlovits et al., 2021). The teachers also reported that with online learning, it was harder to control and motivate students who did not want to do any work because their learning was largely their own responsibility and they could simply cheat their way through the classes if they wanted to. It also took the teachers much longer to prepare their lessons every day since they had to figure out how to present the material virtually, check for student understanding, and use the necessary technology for the particular lessons (Barlovits et al., 2021). After returning to normal, in-person classes, half of the teachers revealed that they had begun to incorporate more technology into their everyday lessons because of their experiences with online learning during the COVID-19 pandemic. In Germany, many of the teachers explained that their math classes had become hybrid classes where students would complete online assignments even though they were in in-person classes. In Spain, on the other hand, the teachers reported that they had become more appreciative of typical, face-to-face lessons than they were before teaching virtually during the pandemic (Barlovits et al., 2021). The results of this study revealed that students did not learn as much material in online math classes during the COVID-19 pandemic as they would have during normal, in-person math classes; the German and Spanish math teachers also identified many problems that they encountered when trying to teach their students virtually. A decrease in overall student enjoyment of math resulted from the diminishing of the amount of material being taught and a decline in teacher efficacy during the pandemic (Barlovits et al., 2021).

The Impact of Perceptions of Math on Career Choices

As discussed in the studies mentioned above, many factors play into students' perspectives of the subject of math. Variables such as math anxiety and low parent and teacher support can cause students to perform poorly in math class, which also negatively affects their math attitudes. A combination of these factors often leads to students viewing math in such a negative light that they shy away from pursuing careers in mathematics in the future. Many studies have been conducted to evaluate the various reasons students do and do not choose careers in math.

One such study by Ahmed (2018) examined how student math anxiety changed over time and how the presence or absence of math anxiety impacted students' career choices. Ahmed (2018) used data from the Longitudinal Study of American Youth, which surveyed 3,116 American students when they were in seventh grade, again when they were freshmen in college, and again when they were in their mid-thirties to determine how math anxiety would affect students' future career choices. The results revealed that 34.68% of the students demonstrated "consistently low" math anxiety over time, 23.72% demonstrated "decreasing" math anxiety over time, 21.9% had "increasing" math anxiety over time, and 20.12% of students had "consistently high" math anxiety over time (Ahmed, 2018, p. 161). Students were more likely to be in the “increasing” or “consistently high” math anxiety groups if they were “Black” or “Hispanic” or if they had parents who only had a high school education or less; there were no differences found between the likelihood of male and female students to be in the “increasing” or “consistently high” math anxiety groups (Ahmed, 2018, p. 161). According to the study, students who rarely experienced math anxiety throughout middle and high school were “about 7.4 times” more likely to have careers in the field of STEM than students who often experienced math anxiety during this time frame (Ahmed, 2018, p. 163). In a similar way, students who experienced a decrease in math anxiety between middle and high school were “6.4 times” more likely to be employed in STEM careers than students who constantly experienced high math anxiety during school (Ahmed, 2018, p. 163). Students were also less likely to choose STEM careers if they were female, “Black” or “Hispanic,” or if they did not have a parent who worked in STEM (Ahmed, 2018, p. 163). These results illustrated how different variables such as math anxiety can have substantial impacts on whether students choose careers in math or not.

As discussed in previous sections, various demographics, emotions, and personality traits can also significantly impact students’ perceptions of math and resulting career choices. Students with high self-efficacy beliefs are more likely to pursue math careers than students with low self-efficacy beliefs (Huang et al., 2019). Students with low math anxiety are much more likely to choose careers in STEM than students with high math anxiety (Huang et al., 2019). According to the existing literature, male students are more likely to choose careers in math than female students (Huang et al., 2019). Taking high-level math classes rather than low-level math classes can also increase the likelihood of a student choosing a career in math (Huang et al., 2019). Similarly, another study found that students who have positive views of math, high self-efficacy beliefs, or low math anxiety are more likely to express interest in math careers than those with negative views of math, low self-efficacy beliefs, or high math anxiety (Cribbs et al., 2021). Additionally, displaying extraversion, agreeableness, conscientiousness, openness to experience, or strong verbal skills can cause decreases in math career interest for students (Humburg, 2017). On the contrary, emotional stability and high math ability lead to increases in math career interest for students (Humburg, 2017). Overall, many factors should be taken into consideration when identifying reasons for low math career interest.

Conclusion

Elementary school, middle school, high school, and college students in the United States and in many different countries around the world are developing negative perceptions of the subject of math due to various intrinsic and extrinsic factors. Intrinsic variables such as math anxiety, self-efficacy, personality traits, and learning disabilities can impact students' views of math class due to the way they feel about themselves or the subject itself when they are working on math. Extrinsic elements such as parental involvement, teacher support, parent and teacher self-efficacy beliefs, parent and teacher math attitudes, and online learning experiences can also cast positive or negative lights on math for students. As a result, students often exhibit an overall reluctance to pursue careers in the field of math because of their negative perceptions of the subject.

To analyze the correlations between these factors, a study was conducted of undergraduate students at Southeastern University to determine their perceptions of math, the elements that contributed to these perceptions, and the likelihood that they will pursue careers in the field of math after college. These objectives were formed into a survey that each willing student took, and the results and implications were analyzed in detail. Undergraduate students who are majoring in math and math professors were also asked to participate in the study to evaluate the varying aspects that resulted in their interests in the field of math.

Chapter 3: Methodology

For this study, data was collected from a variety of undergraduate students and mathematics professors on the campus of Southeastern University. All the individuals involved in the math department at Southeastern University, specifically math professors and students who are majoring in mathematics or math education, were asked to participate in the survey if they were willing to; the participation of the other undergraduate students was completely voluntary.

To collect data, a survey was created and sent out to the undergraduate student body and to the Southeastern University mathematics department through email. The survey was also posted on the psychology department's SEU SONA Participation System. Students and professors who chose to participate first completed an informed consent waiver, and then they filled out an online survey through Google Forms. Both the email and the informed consent waiver instructed participants about the questions they were going to be asked in the survey, so they were fully informed before they decided to participate. The data collected from this survey was stored on a password-protected Google Drive account on a password-protected computer to ensure complete confidentiality. The demographics of the participants are stated below in Table 1 of the Data Analysis chapter.

The purpose of this survey was to determine the various factors that influence students' and professors' perceptions of math and their decisions to pursue or avoid careers in the field of math. The questions were created based on information learned during the research process of this study's literature review. The questions were divided into four categories: Demographics, Personality, Upbringing, and COVID-19 and Online Learning. The Personality category was further divided into subcategories: Emotions, Personality Traits, and Learning Disabilities; the Upbringing category was further divided into subcategories: Parents and Teachers.

Eleven research questions were developed to guide the data analysis of the survey data. The research questions include:

1. To what degree did study participants perceive themselves as enjoying mathematics?
2. To what degree did study participants perceive themselves as having shown signs of mathematics anxiety?
3. Was there a statistically significant difference in perceptions of mathematics enjoyment by study participant gender?
4. Was there a statistically significant effect on perceptions of mathematics enjoyment by study participant personality type?
5. Was there a statistically significant difference in perceptions of mathematics anxiety by study participant gender?
6. Was there a statistically significant effect on perceptions of mathematics anxiety by study participant personality type?
7. Will perceptions of mathematics enjoyment predict the likelihood of assisting someone with a mathematics assignment?
8. Considering study participant perceptions of brain dominance, which hemispheric identifier is most predictive of mathematics enjoyment?
9. Considering perceptions of teacher efficacy, teacher understanding of mathematics content, and teacher positive impact, which was most predictive of study participant perceptions of enjoyment of mathematics?
10. Considering perceptions of parent assistance in mathematics, parent enjoyment of mathematics, and parent positive impact of view of mathematics, which was most predictive of study participant perceptions of enjoyment of mathematics?

11. Will the study's data adequately explain an SEM Path Model that includes the variables of teacher efficacy and teacher positive impact on perceptions of mathematics enjoyment?

Study data were analyzed in a preliminary, descriptive statistical manner. Descriptive and inferential statistical techniques were used to address the study's research questions. A one-sample *t*-test was used to assess the statistical significance of the mean score perceptions of mathematics enjoyment for Research Question #1. A one-sample *t*-test was used to assess the statistical significance of the mean score perceptions of mathematics anxiety for Research Question #2. A *t*-test of independent means was used to assess the statistical significance of the mean score difference in perceptions of mathematics enjoyment by gender of study participants for Research Question #3. A one-way analysis of variance (1 x 3 ANOVA) was used to evaluate the effect exerted by the study participants' personality types on perceptions of mathematics enjoyment for Research Question #4. A *t*-test of independent means was used to assess the statistical significance of the mean score difference in perceptions of mathematics anxiety by gender of study participants for Research Question #5. A one-way analysis of variance (1 x 3 ANOVA) was used to evaluate the effect exerted by the study participants' personality types on perceptions of mathematics anxiety for Research Question #6. The simple linear regression statistical technique was used to assess the likelihood of assisting someone with a mathematics assignment by perceptions of mathematics enjoyment for Research Question #7. The multiple linear regression (MLR) statistical technique was used to assess the predictive ability of brain dominance by perceptions of mathematics enjoyment for Research Question #8. Multiple linear regression (MLR) was used to assess the predictive abilities of "teacher elements" upon the study participants' perceptions of mathematics enjoyment for Research Question #9. Multiple linear regression (MLR) was used to assess the predictive abilities of “parent elements” upon the study participants’ perceptions of mathematics enjoyment for Research Question #10. A structural equation modeling (SEM) path analysis model was conducted to determine whether the model of regressions accurately describes the study data for mathematics enjoyment for Research Question #11. Then, a maximum likelihood estimation was performed to determine the standard errors for the parameter estimates. The data collected from the survey responses, results, and conclusions will be discussed in the following chapters.

Chapter 4: Data Analysis

Preliminary Descriptive Statistical Findings

Study data were analyzed in a preliminary, descriptive statistical manner. Demographic identifying information was analyzed and reported using frequencies (*n*) and percentages (%). Essential response set items represented on the study's research instrument were analyzed using measures of typicality, variability, standard errors of the mean, and data normality.

Descriptive Statistics: Demographic Information

Table 1 contains a summary of findings for the descriptive statistical analysis of the study's demographic identifying information of gender, educational status, personality type, learning disability status, and Enneagram number for study participants.

Table 1

Descriptive Statistics Summary Table: Demographic Information

Variable	*n*	%	Cumulative %
Gender			
Female	139	69.50	69.50
Male	61	30.50	100.00
Missing	0	0.00	100.00
Educational Status			
Undergraduate Student	194	97.00	97.00
Graduate Student	1	0.50	97.50
Doctoral Student	1	0.50	98.00
Professor	2	1.00	99.00
Missing	2	1.00	100.00
Personality Type			
Introversion	66	33.00	33.00
Extroversion	37	18.50	51.50
Ambiversion	94	47.00	98.50
Missing	3	1.50	100.00
Learning Disability Status			

No	167	83.50	83.50
Yes	32	16.00	99.50
Missing	1	0.50	100.00
Enneagram #			
1	23	11.50	11.50
2	23	11.50	23.00
3	21	10.50	33.50
4	11	5.50	39.00
5	6	3.00	42.00
6	11	5.50	47.50
7	17	8.50	56.00
8	18	9.00	65.00
9	21	10.50	75.50
Missing	49	24.50	100.00

Descriptive Statistics: Preliminary Response Set Findings

Descriptive statistical techniques were used to assess the study's response set data. The study's response set data were addressed using frequencies (*n*), measures of typicality (mean scores), variability (minimum/maximum; standard deviations), standard errors of the mean (SE_M), and data normality (skew; kurtosis).

Table 2 contains a summary of findings for the descriptive statistical analysis of the study's response data for perceptions of mathematics enjoyment and mathematics anxiety by gender of study participants.

Table 2

Descriptive Statistics Summary Table: Study Participant Perceptions of Enjoyment of Mathematics and Mathematics Anxiety by Gender

Variable by Gender	*M*	*SD*	*n*	SE_M	Min	Max	Skew	Kurtosis
Female								
Math Enjoyment	2.91	1.22	139	0.10	1.00	5.00	-0.13	-1.18
Math Anxiety	3.35	1.16	136	0.10	1.00	5.00	-0.36	-0.90
Male								
Math Enjoyment	3.38	1.36	61	0.17	1.00	5.00	-0.47	-1.04
Math Anxiety	2.72	1.31	61	0.17	1.00	5.00	0.35	-1.10

Table 3 contains a summary of findings for the descriptive statistical analysis of the study's response data for perceptions of mathematics enjoyment and mathematics anxiety by personality type of study participants.

Table 3

Descriptive Statistics Summary Table: Study Participant Perceptions of Enjoyment of Mathematics and Mathematics Anxiety by Personality Type

Variable/Personality Type	*M*	*SD*	*n*	SE_M	Min	Max	Skew	Kurtosis
Introversion								
Math Enjoyment	2.92	1.27	66	0.16	1.00	5.00	-0.13	-1.26
Math Anxiety	3.11	1.20	64	0.15	1.00	5.00	0.01	-1.21
Extroversion								
Math Enjoyment	3.22	1.38	37	0.23	1.00	5.00	-0.40	-1.20
Math Anxiety	2.86	1.29	37	0.21	1.00	5.00	0.25	-1.12
Ambiversion								
Math Enjoyment	3.06	1.25	94	0.13	1.00	5.00	-0.19	-1.05
Math Anxiety	3.31	1.22	93	0.13	1.00	5.00	-0.43	-0.89

Table 4 contains a summary of findings for the descriptive statistical analysis of the study's response data for perceptions of "perfectionism" and "analytical" by gender of study participants.

Table 4

Descriptive Statistics Summary Table: Perceptions of "Perfectionism" and "Analytical" by Gender of Study Participant

Variable	*M*	*SD*	*n*	SE_M	Min	Max	Skew	Kurtosis
Female								
Perfectionist	3.65	0.98	136	0.08	1.00	5.00	-0.53	-0.38
Analytical	3.50	1.05	137	0.09	1.00	5.00	-0.58	-0.16
Male								
Perfectionist	3.38	1.24	61	0.16	1.00	5.00	-0.53	-0.65
Analytical	3.79	0.99	61	0.13	2.00	5.00	-0.41	-0.82

Table 5 contains a summary of findings for the descriptive statistical analysis of the study's response data for perceptions of "perfectionism" and "analytical" by personality type of study participants.

Table 5

Descriptive Statistics Summary Table: Perceptions of "Perfectionism" and "Analytical" by Personality Type of Study Participant

Variable	*M*	*SD*	*n*	SE_M	Min	Max	Skew	Kurtosis
Introversion								
Perfectionist	3.77	1.03	64	0.13	1.00	5.00	-0.91	0.57
Analytical	3.73	0.99	66	0.12	1.00	5.00	-0.70	0.26
Extroversion								
Perfectionist	3.08	1.08	36	0.18	1.00	5.00	-0.30	-0.75
Analytical	3.47	1.03	36	0.17	2.00	5.00	-0.08	-1.11
Ambiversion								
Perfectionist	3.62	1.07	94	0.11	1.00	5.00	-0.57	-0.42
Analytical	3.54	1.09	93	0.11	1.00	5.00	-0.58	-0.26

Findings by Research Question

The study's research problem was addressed through the statement of research questions. Descriptive and inferential statistical techniques were used to address the study's research questions. The probability level of $p \leq .05$ was used as the threshold value for findings to be considered statistically significant in the study. Numeric effect sizes achieved in the study's analyses were interpreted using the conventions of effect size interpretation proposed by Sawilowsky (2009).

The findings achieved in the study's research questions are reported as follows:

Research Question #1: To what degree did study participants perceive themselves as enjoying mathematics?

A one-sample *t*-test was used to assess the statistical significance of the mean score perceptions of mathematics enjoyment. As a result, the study participants' mean perceptions of mathematics enjoyment of 3.05 (SD = 1.28) was non-statistically significant ($t_{(199)} = 0.55$; $p = .58$). The magnitude of effect in study participant response to perceptions of mathematics enjoyment was considered trivial at $d = .04$.

Table 6 contains a summary of findings for study participants' perceptions of mathematics enjoyment.

Table 6

Summary Table: Perceptions of Mathematics Enjoyment

Variable	*M*	*SD*	*μ*	*t*	*p*	*d*
Mathematics Enjoyment	3.05	1.28	3	0.55	.58	0.04

Note. Degrees of Freedom for the *t*-statistic = 199. *d* represents Cohen's *d.*

Research Question #2: To what degree did study participants perceive themselves as having shown signs of mathematics anxiety?

A one-sample *t*-test was used to assess the statistical significance of the mean score perceptions of mathematics anxiety. As a result, the study participants' mean perceptions of mathematics anxiety of 3.15 (SD = 1.24) was non-statistically significant at the $p \leq .05$ level (*t*

$_{(196)} = 1.73$; $p = .09$) but statistically significant at the borderline level of $p < .10$. The magnitude of effect in study participant response to perceptions of mathematics anxiety was considered small at $d = .12$.

Table 7 contains a summary of findings for study participants' perceptions of mathematics anxiety.

Table 7

Summary Table: Perceptions of Mathematics Anxiety

Variable	*M*	*SD*	*μ*	*t*	*p*	*d*
Mathematics Anxiety	3.15	1.24	3	1.73	$.09^{t}$	0.12

Note. Degrees of Freedom for the *t*-statistic = 196. *d* represents Cohen's *d.* $^{t}p < .10$

Research Question #3: Was there a statistically significant difference in perceptions of mathematics enjoyment by study participant gender?

A *t*-test of independent means was used to assess the statistical significance of the mean score difference in perceptions of mathematics enjoyment by gender of study participants. As a result, a mean score difference of 0.47 favoring male study participants was statistically significant ($t_{(198)} = 2.42$; $p = .02$). The magnitude of effect in the difference favoring the perceptions of male study participants was considered between small and medium at $d = .36$.

Table 8 contains a summary of findings for the comparison of perceptions of mathematics enjoyment by gender of study participants.

Table 8

Summary Table: Perceptions of Math Enjoyment by Gender of Study Participant

	Female		Male				
Variable	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Mathematics Enjoyment	2.91	1.22	3.38	1.36	2.42	.02*	0.36

Note. N = 200. Degrees of Freedom for the *t*-statistic = 198. *d* represents Cohen's *d.* *$p < .05$

Research Question #4: Was there a statistically significant effect on perceptions of mathematics enjoyment by study participant personality type?

A one-way analysis of variance (1 x 3 ANOVA) was used to evaluate the effect exerted by the study participants' personality types on perceptions of mathematics enjoyment. As a result, the effect of the study participants' personality types upon perceptions of mathematics enjoyment was non-statistically significant (F (2, 194) = 0.63, p = .53), indicating the differences in perceptions of mathematics enjoyment among the levels of the study participants' personality types were all similar (Table 9). The main effect, personality type was non-statistically significant (F (2, 194) = 0.63, p = .53), indicating there were no statistically significant differences in perceptions of mathematics enjoyment by levels of personality type.

The means and standard deviations of the ANOVA analysis are presented in Table 10.

Table 9

Model Summary: Perceptions of Mathematics Enjoyment by Personality Type

Model	*SS*	*df*	*F*	*p*	η_p^2
Personality Type	2.08	2	0.63	.53	0.01
Residuals	318.51	194			

Table 10

Mean, Standard Deviation, and Sample Size for Perceptions of Mathematics Enjoyment by Personality Type

Personality Type	*M*	*SD*	*n*
Introversion	2.92	1.27	66
Extroversion	3.22	1.38	37
Ambiversion	3.06	1.25	94

Research Question #5: Was there a statistically significant difference in perceptions of mathematics anxiety by study participant gender?

A *t*-test of independent means was used to assess the statistical significance of the mean score difference in perceptions of mathematics anxiety by gender of study participants. As a result, a mean score difference of 0.63 favoring female study participants was statistically significant ($t_{(195)} = 3.36$; $p < .001$). The magnitude of effect in the difference favoring the perceptions of female study participants was considered medium at $d = .51$.

Table 11 contains a summary of findings for the comparison of perceptions of mathematics anxiety by gender of study participants.

Table 11

Summary Table: Comparison of Mathematics Anxiety by Gender of Study Participant

	Female		Male				
Variable	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Mathematics Anxiety	3.35	1.16	2.72	1.31	3.36	< .001	0.51

Note. N = 197. Degrees of Freedom for the *t*-statistic = 195. *d* represents Cohen's *d.*

Research Question #6: Was there a statistically significant effect on perceptions of mathematics anxiety by study participant personality type?

A one-way analysis of variance (1 x 3 ANOVA) was used to evaluate the effect exerted by the study participants' personality types on perceptions of mathematics anxiety. As a result, the finding was non-statistically significant (F (2, 191) = 1.83, $p = .16$), indicating the differences in perceptions of mathematics anxiety among the levels of personality type were all similar (Table 12). The magnitude of effect of the study participants' personality types upon perceptions of mathematics anxiety was considered small at $n^2 = .02$.

The means and standard deviations of the ANOVA analysis are presented in Table 13.

Table 12

Model Summary Table: Perceptions of Mathematics Anxiety by Personality Type

Model	*SS*	*df*	*F*	*p*	η^2
Personality Type	5.53	2	1.83	.16	0.02
Residuals	288.52	191			

Table 13

Mean, Standard Deviation, and Sample Size for Perceptions of Mathematics Anxiety by Personality Type

Personality Type	*M*	*SD*	*n*
Introversion	3.11	1.20	64
Extroversion	2.86	1.29	37
Ambiversion	3.31	1.22	93

Research Question #7: Will perceptions of mathematics enjoyment predict the likelihood of assisting someone with a mathematics assignment?

The simple linear regression statistical technique was used to assess the likelihood of assisting someone with a mathematics assignment by perceptions of mathematics enjoyment. The predictive model was statistically significant (F (1,198) = 193.15, $p < .001$, $R^2 = .49$), indicating that 49.38% of the variance in the study participants' likelihood of assisting someone with a math assignment is explainable by perceptions of mathematics enjoyment. Mathematics enjoyment significantly predicted the likelihood of assisting someone with a math assignment (B = 0.75, $t_{(198)} = 13.90$, $p < .001$), indicating that on average, a one-unit increase in perceptions of mathematics enjoyment will increase perceptions of the likelihood of assisting someone with a math assignment by 0.75 units.

Table 14 contains a summary of findings for predicting the likelihood of assisting someone with a mathematics assignment by perceptions of mathematics enjoyment.

Table 14

Model Summary Table: Predicting Perceptions of the Likelihood of Assisting Someone with a Mathematics Assignment by Perceptions of Mathematics Enjoyment

Model	*B*	*SE*	95.00% CI	*β*	*t*	*p*
(Intercept)	1.14	0.18	[0.78, 1.49]	0.00	6.34	< .001
Enjoyment of Mathematics	0.75	0.05	[0.65, 0.86]	0.70	13.90	< .001

Research Question #8: Considering study participant perceptions of brain dominance, which hemispheric identifier is most predictive of mathematics enjoyment?

The multiple linear regression (MLR) statistical technique was used to assess the predictive ability of brain dominance by perceptions of mathematics enjoyment. The predictive model was statistically significant (F (2,196) = 10.09, $p < .001$, $R^2 = .09$), indicating that 9.33% of the variance in mathematics enjoyment is explainable by “Left Brain” and “Right Brain” perceptions of brain dominance. Perceptions of “Left Brain” dominance significantly predicted perceptions of mathematics enjoyment ($B = 0.33$, $t_{(196)} = 3.30$, $p = .001$), indicating that on average, a one-unit increase in perceptions of “Left Brain” dominance will increase perceptions of mathematics enjoyment by 0.33 units.

Table 15 contains a summary of findings for perceptions of brain dominance upon perceptions of mathematics enjoyment.

Table 15

Model Summary: Predicting Mathematics Enjoyment by Perceptions of Brain Dominance

Model	*B*	*SE*	95.00% CI	*β*	*t*	*p*
(Intercept)	2.25	0.56	[1.15, 3.35]	0.00	4.03	< .001
Left Brain	0.33	0.10	[0.13, 0.53]	0.25	3.30	.001
Right Brain	-0.10	0.09	[-0.27, 0.07]	-0.09	-1.21	.23

Research Question #9: Considering perceptions of teacher efficacy, teacher understanding of mathematics content, and teacher positive impact, which was most predictive of study participant perceptions of enjoyment of mathematics?

Multiple linear regression (MLR) was used to assess the predictive abilities of "teacher elements" upon the study participants' perceptions of mathematics enjoyment. The predictive model was statistically significant (F (3,195) = 32.50, $p < .001$, $R^2 = .33$), indicating that 33.33% of the variance in perceptions of mathematics enjoyment is explainable by teacher efficacy, teacher content knowledge, and teacher positive impact on study participants' views of mathematics. Perceptions of teacher positive impact were statistically significant in predicting perceptions of mathematics enjoyment ($B = 0.60$, $t_{(195)} = 5.50$, $p < .001$), indicating that on average, a one-unit increase in perceptions of teacher positive impact will increase the value of perceptions of mathematics enjoyment by 0.60 units.

Table 16 contains a summary of findings for the model used to predict study participants' perceptions of mathematics enjoyment by perceptions of the identified teacher-related elements of mathematics.

Table 16

Model Summary Table: Predicting Study Participant Perceptions of Mathematics Enjoyment by Teacher Elements

Model	*B*	*SE*	95.00% CI	*β*	*t*	*p*
(Intercept)	0.77	0.33	[0.11, 1.42]	0.00	2.30	.02
Teacher Efficacy	0.16	0.13	[-0.11, 0.42]	0.11	1.18	.24
Teacher Content Knowledge	-0.04	0.10	[-0.24, 0.16]	-0.03	-0.41	.68
Teacher Positive Impact	0.60	0.11	[0.39, 0.82]	0.51	5.50	< .001

Research Question #10: Considering perceptions of parent assistance in mathematics, parent enjoyment of mathematics, and parent positive impact of view of mathematics, which was most predictive of study participant perceptions of enjoyment of mathematics?

Multiple linear regression (MLR) was used to assess the predictive abilities of "parent elements" upon the study participants' perceptions of mathematics enjoyment. The predictive model was statistically significant (F (3,189) = 21.43, $p < .001$, $R^2 = .25$), indicating that 25.38% of the variance in perceptions of mathematics enjoyment is explainable by parent mathematics assistance, parent enjoyment of mathematics, and parent positive impact upon study participants' views of mathematics. Parent mathematics assistance was statistically significantly predictive of perceptions of mathematics enjoyment ($B = -0.34$, $t_{(189)} = -3.91$, $p < .001$) indicating that on average, a one-unit increase of parental mathematics assistance will decrease the value of study participants' perceptions of mathematics enjoyment by 0.34 units. Parent positive impact on study participants' views of mathematics statistically significantly predicted participants' mathematics enjoyment ($B = 0.58$, $t_{(189)} = 6.08$, $p < .001$), indicating that on average, a one-unit increase of perceptions of parent positive impact will increase the value of study participants' perceptions of mathematics enjoyment by 0.58 units.

Table 17 contains a summary of findings for the model used to predict study participant perceptions of mathematics enjoyment by perceptions of the identified parent-related elements of mathematics.

Table 17

Model Summary Table: Predicting Study Participant Perceptions of Mathematics Enjoyment by Parental Elements

Model	*B*	*SE*	95.00% CI	*β*	*t*	*p*
(Intercept)	1.91	0.32	[1.28, 2.55]	0.00	5.97	< .001
Parent Math Assistance	-0.34	0.09	[-0.51, -0.17]	-0.27	-3.91	< .001
Parent Math Enjoyment	0.14	0.08	[-0.02, 0.30]	0.13	1.70	.09
Parent Positive Impact	0.58	0.09	[0.39, 0.76]	0.46	6.08	< .001

Research Question #11: Will the study's data adequately explain an SEM Path Model that includes the variables of teacher efficacy and teacher positive impact on perceptions of mathematics enjoyment?

A structural equation modeling (SEM) path analysis model was conducted to determine whether the model of regressions accurately describes the study data for mathematics enjoyment. Maximum likelihood estimation was performed to determine the standard errors for the parameter estimates.

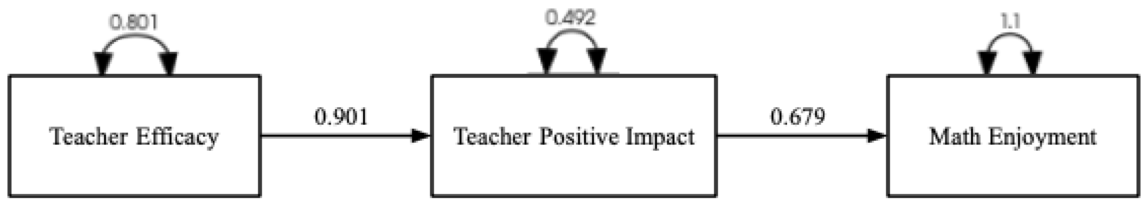
The results of the SEM path analysis model are presented in Table 18.

Table 18

Unstandardized Loadings (Standard Errors), Standardized Loadings, and Significance Levels for Each Parameter in the Path Analysis Model (N = 200)

Parameter Estimate	Unstandardized	Standardized	*p*
Regressions			
Teacher Efficacy → Teacher Positive Impact	0.90(0.06)	0.75	< .001
Teacher Positive Impact → Math Enjoyment	0.68(0.07)	0.57	< .001
Errors			
Error in Math Enjoyment	1.10(0.11)	0.68	< .001
Error in Teacher Efficacy	0.80(0.08)	1.00	< .001
Error in Teacher Positive Impact	0.49(0.05)	0.43	< .001

Path Model Diagram



Model Fit

The Tucker-Lewis index (TLI) was greater than or equal to .95 (TLI = 0.99) indicating that the model is a good fit for the data. The comparative fit index (CFI) was greater than .95 (CFI = 1.00) indicating that the model fit the data well. The root mean square error of approximation (RMSEA) index was less than .08 (RMSEA = 0.06) which is indicative of a good model fit. And the standardized root mean square residual (SRMR) was less than .05 (SRMR = 0.02) indicating that the model fits the data well. A summary of the fit indices is summarized in Table 19.

A chi-square goodness of fit (GOF) test was conducted to determine if the path analysis model fits the data adequately. As a result, the chi-square GOF test was non-statistically significant ($\chi^2(1) = 1.66$, $p = .20$), indicating that the model fits the data well.

Table 19

Summary Table Fit Indices for the Path Analysis Model

NFI	TLI	CFI	RMSEA	SRMR
0.99	0.99	1.00	0.06	0.02

Interpretation of Model Regression Paths

Teacher efficacy significantly predicted teacher positive impact ($B = 0.90$, $z = 16.26$, $p < .001$), indicating a one-unit increase in teacher efficacy will increase the expected value of teacher positive impact by 0.90 units. Teacher positive impact was statistically significant in predicting perceptions of mathematics enjoyment ($B = 0.68$, $z = 9.79$, $p < .001$), indicating a one-unit increase in teacher positive impact will increase the expected value of perceptions of mathematics enjoyment by 0.68 units.

Results

Summary of Preliminary Findings

Table 1 contains a summary of findings for the descriptive statistical analysis of the study's demographic identifying information of gender, educational status, personality type, learning disability status, and enneagram number for study participants. The table reveals that of the 200 survey participants, 139 (69.5%) of them were female and 61 (30.5%) of them were male. When looking at educational status, 194 (97%) of the participants were undergraduate students, one (.5%) participant was a graduate student, one (.5%) was a doctoral student, two (1%) were professors, and two (1%) did not clarify their educational statuses. Of the three personality types (ambiversion, introversion, and extroversion), 94 participants (47%) were ambiverts, 66 participants (33%) were introverts, 37 participants (18.5%) were extroverts, and three participants (1.5%) did not clarify their personality types. When participants were asked if they had learning disabilities, 167 (83.5%) of them responded with "no," 32 (16%) of them responded with "yes," and one (.5%) of them did not clarify his or her learning disability status. When participants were asked what their Enneagram numbers were, 23 participants (11.5%) picked "One," 23 participants (11.5%) picked "Two," 21 participants (10.5%) picked "Three," 11 participants (5.5%) picked “Four,” six participants (3%) picked “Five,” 11 participants (5.5%) picked “Six,” 17 participants (8.5%) picked “Seven,” 18 participants (9%) picked “Eight,” 21 participants (10.5%) picked “Nine,” and 49 participants (24.5%) did not clarify their Enneagram numbers.

Table 2 contains a summary of findings for the descriptive statistical analysis of the study’s response data for perceptions of mathematics enjoyment and mathematics anxiety by gender of study participants. When looking at the study participants' perceptions of mathematics enjoyment on a scale of 1 to 5 where 1 represents a strong dislike of math and 5 represents a strong enjoyment of math, the mean math enjoyment for female participants was 2.91; the mean math enjoyment for male participants was 3.38. When looking at the study participants’ perceptions of mathematics anxiety on a scale of 1 to 5 where 1 represents low math anxiety and 5 represents high math anxiety, the mean math anxiety for female participants was 3.35; the mean math anxiety for male participants was 2.72.

Table 3 contains a summary of findings for the descriptive statistical analysis of the study’s response data for perceptions of mathematics enjoyment and mathematics anxiety by personality type of study participants. When looking at the study participants' perceptions of mathematics enjoyment on a scale of 1 to 5 where 1 represents a strong dislike of math and 5 represents a strong enjoyment of math, the mean math enjoyment for introverts was 2.92, the mean math enjoyment for extroverts was 3.22, and the mean math enjoyment for ambiverts was 3.06. When looking at the study participants’ perceptions of mathematics anxiety on a scale of 1 to 5 where 1 represents low math anxiety and 5 represents high math anxiety, the mean math anxiety for introverts was 3.11, the mean math anxiety for extroverts was 2.86, and the mean math anxiety for ambiverts was 3.31.

Table 4 contains a summary of findings for the descriptive statistical analysis of the study’s response data for perceptions of “perfectionism” and “analytical” by gender of study participants. When looking at the study participants' perceptions of “perfectionism” on a scale of 1 to 5 where 1 represents low levels of “perfectionism” and 5 represents high levels of “perfectionism,” the mean level of “perfectionism” for female participants was 3.65; the mean level of “perfectionism” for male participants was 3.38. When looking at the study participants' perceptions of “analytical” on a scale of 1 to 5 where 1 represents few “analytical” tendencies and 5 represents many “analytical” tendencies, the mean level of “analytical” tendencies for female participants was 3.50; the mean level of “analytical” tendencies for male participants was 3.79.

Table 5 contains a summary of findings for the descriptive statistical analysis of the study’s response data for perceptions of “perfectionism” and “analytical” by personality type of study participants. When looking at the study participants' perceptions of “perfectionism” on a scale of 1 to 5 where 1 represents low levels of “perfectionism” and 5 represents high levels of “perfectionism,” the mean level of “perfectionism” for introverts was 3.77, the mean level of “perfectionism” for extroverts was 3.08, and the mean level of “perfectionism” for ambiverts was 3.62. When looking at the study participants' perceptions of “analytical” on a scale of 1 to 5 where 1 represents few “analytical” tendencies and 5 represents many “analytical” tendencies, the mean level of “analytical” tendencies for introverts was 3.73, the mean level of “analytical” tendencies for extroverts was 3.47, and the mean level of “analytical” tendencies for ambiverts was 3.54.

Summary of Research Questions

Research Question #1: To what degree did study participants perceive themselves as enjoying mathematics? A one-sample *t*-test was used to assess the statistical significance of the mean score perceptions of mathematics enjoyment. As a result, the study participants' mean perceptions of mathematics enjoyment of 3.05 was non-statistically significant. The magnitude of effect in study participant response to perceptions of mathematics enjoyment was considered trivial.

Research Question #2: To what degree did study participants perceive themselves as having shown signs of mathematics anxiety? A one-sample *t*-test was used to assess the statistical significance of the mean score perceptions of mathematics anxiety. As a result, the study participants' mean perceptions of mathematics anxiety of 3.15 was non-statistically significant at the $p \leq .05$ level but statistically significant at the borderline level of $p < .10$. The magnitude of effect in study participant response to perceptions of mathematics anxiety was considered small.

Research Question #3: Was there a statistically significant difference in perceptions of mathematics enjoyment by study participant gender? A *t*-test of independent means was used to assess the statistical significance of the mean score difference in perceptions of mathematics enjoyment by gender of study participants. As a result, a mean score difference of 0.47 favoring male study participants was statistically significant. The magnitude of effect in the difference favoring the perceptions of male study participants was considered between small and medium.

Research Question #4: Was there a statistically significant effect on perceptions of mathematics enjoyment by study participant personality type? A one-way analysis of variance (1 x 3 ANOVA) was used to evaluate the effect exerted by the study participants' personality types on perceptions of mathematics enjoyment. As a result, the effect of the study participants' personality types upon perceptions of mathematics enjoyment was non-statistically significant, indicating the differences in perceptions of mathematics enjoyment among the levels of the study participants' personality types were all similar. The main effect, personality type was non-statistically significant, indicating there were no statistically significant differences in perceptions of mathematics enjoyment by levels of personality type.

Research Question #5: Was there a statistically significant difference in perceptions of mathematics anxiety by study participant gender? A *t*-test of independent means was used to assess the statistical significance of the mean score difference in perceptions of mathematics anxiety by gender of study participants. As a result, a mean score difference of 0.63 favoring female study participants was statistically significant. The magnitude of effect in the difference favoring the perceptions of female study participants was considered medium.

Research Question #6: Was there a statistically significant effect on perceptions of mathematics anxiety by study participant personality type? A one-way analysis of variance (1 x 3 ANOVA) was used to evaluate the effect exerted by the study participants' personality types on perceptions of mathematics anxiety. As a result, the finding was non-statistically significant, indicating the differences in perceptions of mathematics anxiety among the levels of personality type were all similar. The magnitude of effect of the study participants' personality types upon perceptions of mathematics anxiety was considered small.

Research Question #7: Will perceptions of mathematics enjoyment predict the likelihood of assisting someone with a mathematics assignment? The simple linear regression statistical technique was used to assess the likelihood of assisting someone with a mathematics assignment by perceptions of mathematics enjoyment. The predictive model was statistically significant, indicating that 49.38% of the variance in the study participants' likelihood of assisting someone with a math assignment is explainable by perceptions of mathematics enjoyment. Mathematics enjoyment significantly predicted the likelihood of assisting someone with a math assignment, indicating that on average, a one-unit increase in perceptions of mathematics enjoyment will increase perceptions of the likelihood of assisting someone with a math assignment by 0.75 units.

Research Question #8: Considering study participant perceptions of brain dominance, which hemispheric identifier is most predictive of mathematics enjoyment? The multiple linear regression (MLR) statistical technique was used to assess the predictive ability of brain dominance by perceptions of mathematics enjoyment. The predictive model was statistically significant, indicating that 9.33% of the variance in mathematics enjoyment is explainable by "Left Brain" and "Right Brain" perceptions of brain dominance. Perceptions of "Left Brain" dominance significantly predicted perceptions of mathematics enjoyment, indicating that on average, a one-unit increase in perceptions of "Left Brain" dominance will increase perceptions of mathematics enjoyment by 0.33 units.

Research Question #9: Considering perceptions of teacher efficacy, teacher understanding of mathematics content, and teacher positive impact, which was most predictive of study participant perceptions of enjoyment of mathematics? Multiple linear regression (MLR) was used to assess the predictive abilities of "teacher elements" upon the study participants' perceptions of mathematics enjoyment. The predictive model was statistically significant, indicating that 33.33% of the variance in perceptions of mathematics enjoyment is explainable by teacher efficacy, teacher content knowledge, and teacher positive impact on study participants' views of mathematics. Perceptions of teacher positive impact were statistically significant in predicting perceptions of mathematics enjoyment, indicating that on average, a one-unit increase in perceptions of teacher positive impact will increase the value of perceptions of mathematics enjoyment by 0.60 units.

Research Question #10: Considering perceptions of parent assistance in mathematics, parent enjoyment of mathematics, and parent positive impact of view of mathematics, which was most predictive of study participant perceptions of enjoyment of mathematics? Multiple linear regression (MLR) was used to assess the predictive abilities of "parent elements" upon the study participants' perceptions of mathematics enjoyment. The predictive model was statistically significant, indicating that 25.38% of the variance in perceptions of mathematics enjoyment is explainable by parent mathematics assistance, parent enjoyment of mathematics, and parent positive impact upon study participants' views of mathematics. Parent mathematics assistance was statistically significantly predictive of perceptions of mathematics enjoyment indicating that on average, a one-unit increase in parental mathematics assistance will decrease the value of study participant perceptions of mathematics enjoyment by 0.34 units. Parent positive impact on study participants' views of mathematics statistically significantly predicted participants' mathematics enjoyment, indicating that on average, a one-unit increase in perceptions of parent positive impact will increase the value of study participants' perceptions of mathematics enjoyment by 0.58 units.

Research Question #11: Will the study's data adequately explain an SEM Path Model that includes the variables of teacher efficacy and teacher positive impact on perceptions of mathematics enjoyment? A structural equation modeling (SEM) path analysis model was conducted to determine whether the model of regressions accurately describes the study data for mathematics enjoyment. Maximum likelihood estimation was performed to determine the standard errors for the parameter estimates. The Tucker-Lewis index (TLI) was greater than or equal to .95 indicating that the model is a good fit for the data. The comparative fit index (CFI) was greater than .95 indicating that the model fit the data well. The root mean square error of approximation (RMSEA) index was less than .08 which is indicative of a good model fit. And the standardized root mean square residual (SRMR) was less than .05 indicating that the model fits the data well. A chi-square goodness of fit (GOF) test was conducted to determine if the path analysis model fits the data adequately. As a result, the chi-square GOF test was non-statistically significant, indicating that the model fits the data well. Teacher efficacy significantly predicted teacher positive impact, indicating a one-unit increase in teacher efficacy will increase the expected value of teacher positive impact by 0.90 units. Teacher positive impact was statistically significant in predicting perceptions of mathematics enjoyment, indicating a one-unit increase in teacher positive impact will increase the expected value of perceptions of mathematics enjoyment by 0.68 units.

Discussion

The purpose of this study was to determine various factors from students' personalities, backgrounds, and experiences that contribute to their perceptions of mathematics. Many of these factors were identified as the survey data were analyzed, and some intuitive, unexpected, and interesting results were also discovered during this process. The findings of the present study may be beneficial to parents and mathematics educators who seek to improve their children's and students' perceptions of math.

The first variable that was considered was gender and how it affected student math enjoyment and math anxiety. It was found that of the 139 female and 61 male participants, the mean math enjoyment for female participants was 2.91, and the mean math enjoyment for male participants was 3.38. This result indicates that the average male participant enjoyed math more than the average female participant. Further on in the data analysis, Research Question #3 determined that a mean score difference of 0.47 favoring male participants was statistically significant. When looking at math anxiety, the mean math anxiety for female participants was 3.35, and the mean math anxiety for male participants was 2.72. Therefore, the average male participant also experienced less math anxiety than the average female participant. Research Question #5 of the data analysis determined that a mean score difference of 0.63 favoring female participants was statistically significant. A possible explanation for this discrepancy is that male students typically have higher math self-efficacy beliefs, or confidence in their own math abilities, than female students do, and female students typically have higher math anxiety than male students (Escalera-Chávez & Rojas-Kramer, 2019; Huang et al., 2019). An increase in math self-efficacy beliefs often leads to an increase in math enjoyment and a decrease in math anxiety (Akin & Kurbanoglu, 2011; Huang et al., 2019), which would account for the differences between the male and female participants. These results were expected based on the findings of previous studies.

The second factor analyzed was personality type and how it impacted student math enjoyment and math anxiety. Of the 66 introverted participants, 37 extroverted participants, and 94 ambiverted participants, the mean math enjoyment for introverts was 2.92, the mean math enjoyment for extroverts was 3.22, and the mean math enjoyment for ambiverts was 3.06. This result indicates that introverts enjoyed math the least of the three personality types, and extroverts enjoyed math the most. Later on in the data analysis, Research Question #4 revealed that the effect of participants' personality types upon perceptions of math enjoyment was non-statistically significant, meaning the differences in perceptions of math enjoyment among the levels of participants' personality types were all similar. The main effect was that personality type was non-statistically significant, indicating there were no statistically significant differences in perceptions of math enjoyment by levels of personality type. When comparing perceptions of math anxiety, the mean math anxiety for introverts was 3.11, the mean math anxiety for extroverts was 2.86, and the mean math anxiety for ambiverts was 3.31. This finding reveals that extroverts experienced the least amount of math anxiety, and ambiverts experienced the most amount of math anxiety. Research Question #6 of the data analysis determined that this finding was non-statistically significant, indicating the differences in perceptions of math anxiety among the levels of personality type were all similar. This result was unexpected because, according to the existing literature, extroverts typically have lower math enjoyment, lower math achievement, and lower math career interest than introverts (Humburg, 2017). This seeming contradiction may have resulted from adding "ambiversion" as a personality type option because it drew participants away from the options of "introversion" and "extroversion" as is evinced by the number of participants who chose each personality type. If participants had only had two options, namely "introversion" and "extroversion," the data may have corroborated the findings from the existing literature. Since the existing literature does not include "ambiversion" as a personality type option, the findings about the math enjoyment and math anxiety of ambiverted participants may have added to the existing body of knowledge.

Next, correlations between gender, perfectionism, and analytical tendencies were analyzed. According to the data, the mean level of perfectionism for female participants was 3.65, and the mean level of perfectionism for male participants was 3.38. This outcome reveals that female participants were more likely to describe themselves as perfectionists than male participants, which correlates with existing literature (Núñez-Peña & Bono, 2021), but both groups of participants tended to be perfectionistic. When looking at the participants' analytical tendencies, the mean level of analytical tendencies for female participants was 3.50, and the mean level of analytical tendencies for male participants was 3.79. This result suggests that male participants were more likely to describe themselves as analytical than female participants, but both groups tended to be analytical as well.

Then, the relationships between personality type, perfectionism, and analytical tendencies were examined. The mean level of perfectionism for introverts was 3.77, the mean for extroverts was 3.08, and the mean for ambiverts was 3.62. When comparing the participants' analytical tendencies, the mean level of analytical tendencies for introverts was 3.73, the mean for extroverts was 3.47, and the mean for ambiverts was 3.54. These findings indicate that introverts were the most likely of the three personality types to be perfectionistic and analytical, whereas extroverts were the least likely to be perfectionistic and analytical. None of the literature discussed in this project compared personality types with perfectionism or analytical tendencies, so this discovery may have added to the existing body of knowledge. It can be considered intuitive, however, that introverts would be more perfectionistic and analytical than extroverts.

The next section of the data analysis displayed findings by research question. The analysis of Research Question #1 revealed that the mean math enjoyment of the study's participants was 3.05, which was non-statistically significant. The standard deviation from the mean was high at 1.28, however, indicating that most participants either really enjoyed math or really disliked math. This result was surprising because the hypothesized mean for math enjoyment was much lower than 3.05; the study's participants had a higher enjoyment of math than was predicted. The data for Research Question #2 stated that the mean math anxiety of the study's participants was 3.15, which was non-statistically significant at the $p \leq .05$ level but statistically significant at the borderline level of $p < .10$. The standard deviation for this mean was also high at 1.24, indicating that many participants either experienced very high math anxiety or very low math anxiety. When examined on its own, this result was expected because many students seem to experience math anxiety. When examined with the result of Research Question #1, however, this result is unexpected because both the mean of math enjoyment and the mean of math anxiety were high, indicating that the overall high math anxiety felt by the study's participants did not significantly affect their overall math enjoyment.

Research Questions #3, #4, #5, and #6 were addressed at the beginning of this section.

Research Question #7 examined correlations between math enjoyment and the likelihood of assisting someone with a math assignment. The predictive model was statistically significant, indicating that 49.38% of the variance in participants' likelihood of assisting someone with a math assignment is explainable by perceptions of math enjoyment. Math enjoyment significantly predicted the likelihood of assisting someone with a math assignment, indicating that on average, a one-unit increase in perceptions of math enjoyment will increase perceptions of the likelihood of assisting someone with a math assignment by 0.75 units. In other words, students were much more likely to help others with math assignments when they enjoyed math themselves. This result was expected and may confirm the findings of past studies that students who enjoyed math had higher math self-efficacy beliefs than students who disliked math since they were confident enough in their own math abilities to help others with their assignments (Cribbs et al., 2021). This finding may also indicate that students who enjoyed math were more likely to pursue careers in math since they enjoyed it enough to spend their free time helping others with their assignments, which would align with the existing literature (Cribbs et al., 2021).

Research Question #8 analyzed how perceptions of brain dominance predicted math enjoyment in participants. The predictive model was statistically significant, indicating that 9.33% of the variance in math enjoyment is explainable by “Left Brain” and “Right Brain” perceptions of brain dominance. Perceptions of “Left Brain” dominance significantly predicted perceptions of math enjoyment, indicating that on average, a one-unit increase in perceptions of “Left Brain” dominance will increase perceptions of math enjoyment by 0.33 units. That is to say, students who were left-brain dominant, meaning they were logical, analytical, and objective, were more likely to enjoy math than students who were right-brain dominant, meaning they were creative, thoughtful, and subjective. This result was intuitively expected, but it may also align with the discovery that particular children have inclinations to math which allow them to score higher on math assessments than other children due to the makeup and connectivity of their brains (Park et al., 2014). Overall, connections between brain dominance and perceptions of math enjoyment were not examined in the existing literature, however. As a result, this finding was interesting, and it may have added to the existing body of knowledge about perceptions of math enjoyment.

Research Question #9 investigated relationships between teacher efficacy, teacher content knowledge, teacher positive impact, and participant math enjoyment. The data analysis signified that the predictive model was statistically significant, indicating that 33.33% of the variance in perceptions of math enjoyment is explainable by teacher efficacy, teacher content knowledge, and teacher positive impact on study participants’ views of math. Perceptions of teacher positive impact were statistically significant in predicting perceptions of math enjoyment, indicating that on average, a one-unit increase in perceptions of teacher positive impact will increase the value of perceptions of math enjoyment by 0.60 units. This outcome reveals that the study’s participants were more likely to enjoy math when they had good relationships with effective, successful teachers who positively impacted their perceptions of math. This result was expected because students tend to perform better and engage more in math class when they have positive interactions with their teachers (Murray, 2009; Perera & John, 2020; Roorda et al., 2011). Participants were more likely to dislike math when they had teachers with high content knowledge because, as one participant stated, “My teacher had a good understanding of the topic she was teaching, but had difficulty transferring her knowledge to us.” Many other participants expressed similar sentiments about teachers with high content knowledge saying that their teachers were “very condescending,” would “constantly make fun of students,” would “[act] like we were stupid and should’ve known the answer,” “would get very frustrated,” or would make them “feel incompetent.” One participant even explained that his or her teacher’s frustration with the struggling students “emotionally shut me down to asking [questions] all together [*sic*]” because he or she “felt very much a burden” to the teacher. The existing literature did not include much discussion about teacher content knowledge in relation to student math enjoyment, so this finding was unexpected but rational. The result also may have contributed to the existing body of knowledge about teachers’ impacts on students’ perceptions of math.

Research Question #10 considered how parent math assistance, parent math enjoyment, and parent positive impact predicted participant math enjoyment. The data analysis revealed that the predictive model was statistically significant, indicating that 25.38% of the variance in perceptions of math enjoyment is explainable by parent math assistance, parent enjoyment of math, and parent positive impact on study participants’ views of math. Parent math assistance was statistically significantly predictive of perceptions of math enjoyment indicating that on average, a one-unit increase in parental math assistance will decrease the value of study participant perceptions of math enjoyment by 0.34 units. Parent positive impact on the study participants' views of math statistically significantly predicted participant math enjoyment, indicating that on average, a one-unit increase in perceptions of parent positive impact will increase the value of study participants' perceptions of math enjoyment by 0.58 units. In other words, participants were more likely to enjoy math when their parents also enjoyed math and positively impacted their views of math, but students were more likely to dislike math when their parents were constantly trying to help them with their math homework. According to the existing literature, these findings were expected because high parental involvement is beneficial when parents are supportive of their children, encourage them, have high academic expectations for them, and show interest in what they are learning; high parental involvement can be detrimental as students get older, however, if parents do not give their children the independence that they need to take ownership of their work by consistently trying to help them complete their work or just doing it for them (Lee & Simpkins, 2021; Rodríguez et al., 2017).

The seminal finding of the present study was revealed in Research Question #11, which was the final research question. The purpose of this question was to examine whether a path analysis model could be constructed to relate teacher efficacy, teacher positive impact, and participant math enjoyment, which were also discussed in Research Question #9. The path analysis model fit the data well, meaning that the model of regressions accurately described the study data for math enjoyment. Teacher efficacy significantly predicted teacher positive impact, indicating a one-unit increase in teacher efficacy will increase the expected value of teacher positive impact by 0.90 units. Teacher positive impact was statistically significant in predicting perceptions of math enjoyment, indicating a one-unit increase in teacher positive impact will increase the expected value of perceptions of math enjoyment by 0.68 units. Corresponding with the results of Research Question #9, this result indicated that high teacher efficacy led to positive impacts on participants' perceptions of math, which then resulted in increased participant math enjoyment. Again, this finding was expected due to the existing literature discussed with Research Question #9 (Murray, 2009; Perera & John, 2020; Roorda et al., 2011), but it was also a significant discovery because none of the researched journal articles conducted a path analysis model to examine how teacher efficacy affects teacher positive impact and student math enjoyment. As a result, this finding added to the existing body of knowledge about teachers' impacts on students' perceptions of math.

Due to the large number of factors included in the present study's literature review and survey, only a few of these factors could be analyzed in the data analysis. There were additional findings that were not included in the data analysis because they were either intuitive or because the results were non-statistically significant. For example, it was found that participants who were perfectionistic, analytical, or displayed both of these attributes were more likely to enjoy math than participants who displayed neither of these attributes. This finding was intuitive and expected because, according to the existing literature, students tend to enjoy math more when they are logical and display emotional stability (Humburg, 2017). This finding did contradict the discoveries of one journal article that found that perfectionism can negatively affect the math performance of students who are already dealing with math anxiety, however (Núñez-Peña & Bono, 2021). Another intuitive outcome that was not included in the data analysis was that participants who experienced high math anxiety were less likely to enjoy math than participants who experienced low math anxiety. Similar trends were discussed in the existing literature about how students who experience math anxiety are much more likely to have negative attitudes toward math and low math career interest (Akin & Kurbanoglu, 2011; Cribbs et al., 2021; Huang et al., 2019).

Some of the results that were not included in the data analysis because they were non-statistically significant were correlations between Myers-Briggs Type Indicator (MBTI) personality types, Enneagram personality types, and participant enjoyment of math. In other words, MBTI personality types did not impact participants' perceptions of math, and Enneagram personality types also did not impact participants' perceptions of math. No relationships were established between participants' learning disabilities and perceptions of math since very few participants actually had learning disabilities, and there was a wide range of types of learning disabilities for those participants who had been diagnosed. Similarly, no correlations were found between participants' experiences with online learning and their perceptions of math. The present study may have prematurely analyzed this factor before it had a chance to significantly affect students' perceptions of math. In the coming years, however, there may be more findings about how COVID-19 and online learning have negatively impacted students' math achievement and views of math since at least one study has already discovered this trend (Ramadhani et al., 2021). Lastly, connections between participant career choices and perceptions of math were not examined as thoroughly as was hoped for since so many other factors had already been discussed. In a future study, these correlations should be examined in depth.

Chapter 5: Conclusion

Because of the considerable number of students who hold math in low regard, this study was conducted to analyze what factors from their personalities and backgrounds contribute to these low perceptions of math. After a thorough statistical analysis of the survey data, it was concluded that students are most likely to enjoy math and pursue careers in this field when they have high math self-efficacy beliefs, low math anxiety, perfectionistic or analytical tendencies, effective math teachers whom they have positive relationships with, and supportive parents who express the importance of math to their children. For the most part, these findings aligned with the results of the existing literature, but there were also discoveries made in the present study which added to the existing body of knowledge about the many factors that impact students' perceptions of mathematics.

Strengths

Some strengths of this study include receiving 200 survey responses because this healthy sample size resulted in the statistical significance of many of the data analysis results. Another strength of this study was its ability to find correlations between math enjoyment and many different variables such as math anxiety, certain personality traits, and parent and teacher elements. The study's survey was lengthy because it was thorough in collecting information about the various factors from students' personalities and backgrounds. The findings of this study added to the existing body of knowledge about perceptions of math, which is beneficial for parents and teachers because they can make the necessary modifications to their parenting and teaching styles to increase their children's math enjoyment. Specifically, the discoveries discussed in the literature review about how learning disabilities affect students' views of math will be advantageous for teachers of students with special needs because they can create specific accommodations to increase their students' math enjoyment based on their specific needs and gender. Lastly, the discovery of the path analysis model about how teacher efficacy impacts student math enjoyment was a major strength of this study because it emphasized the importance of positive teacher-student relationships, effective teaching strategies, and teacher support in the classroom.

Limitations

A limitation of this study was the initial assumption that the majority of survey participants were going to display negative perceptions of mathematics, when, in fact, the majority of the participants actually expressed enjoyment of math. While this statistic was a positive finding for the well-being of the students surveyed, it slightly discounted the expectation that the majority of students all around the world would have negative perceptions of math if surveyed. It should be noted that although the survey received a healthy sample size, these findings are not representative of students everywhere because this study only surveyed a sample of students from Southeastern University's campus, so assumptions cannot be made for every student based on this data. Additionally, the ability of this study to examine many potential factors that influence math perceptions was beneficial, but it also prevented these factors from being analyzed in depth. For the sake of brevity, some of the intuitive findings and non-statistically significant results of the data analysis were not included in the study. This exclusion of certain results, however, provides an opportunity for future research to be conducted on the areas that this study did not analyze or expand upon.

Future Studies

Moving forward, future studies should be conducted on how to counteract negative perceptions of math in the classroom and how to simultaneously increase parent enjoyment of math for the good of the student. Another study should determine practical ways for teachers to improve their students' math attitudes in the classroom and methods that parents can implement at home to increase their children's math enjoyment. Furthermore, the connections between learning disabilities and perceptions of math and experiences with online learning and views of math should be analyzed in subsequent studies since this study was unable to formulate significant connections between these factors. In the future, thorough examinations should also be made of the relationships between the present study's participant perceptions of math and career choices. Ultimately, a path analysis model of this data may reveal that certain factors from the participants' backgrounds impacted their views of math, which then influenced their current career choices.

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Appendix A

Institutional Review Board Approval Letter

SOUTHEASTERN UNIVERSITY

NOTICE OF EXEMPTION FOR HUMAN RESEARCH

DATE:	March 8th, 2022
TO:	Jeremy Denton, Elizabeth Davison
FROM:	SEU IRB
PROTOCOL TITLE:	Students Negative Perception of Math in Relation to Personality, Upbringing and Online Learning, and Their Effects on Careers in Math.
FUNDING SOURCE:	NONE
PROTOCOL NUMBER:	2022 NS 01
APPROVAL PERIOD:	Approval Date: March 8th, 2022, Expiration Date: March 7th, 2023

Dear Investigator(s),

The Institutional Review Board (IRB) for the protection of human subjects has reviewed the protocol entitled, Students Negative Perception of Math in Relation to Personality, Upbringing and Online Learning, and Their Effects on Careers in Math. The project has been approved for the procedures and subjects described in the protocol.

Any changes require approval before they can be implemented as part of your study. If your study requires any changes, the proposed modifications will need to be submitted in the form of an amendment request to the IRB to include the following:

- Description of proposed revisions;
- *If applicable,* any new or revised materials;
- *If applicable,* updated letters of approval from cooperating institutions

If there are any adverse events and/or any unanticipated problems during your study, you must notify the IRB within 24 hours of the event or problem.

At present time, there is no need for further action on your part with the IRB. This approval is issued under Southeastern University's Federal Wide Assurance 00006943 with the Office for Human Research Protections (OHRP). If you have any questions regarding your obligations under the IRB's Assurance, please do not hesitate to contact us.

Sincerely,

Rustin Lloyd
Chair, Institutional Review Board
irb@seu.edu

1000 Longfellow Blvd. Lakeland, FL 33801-6034 863.667.5000 toll free 800.500.8760 fax 863.667.5200 SEU.edu

Appendix B

CITI Training Certificates

CITI PROGRAM

Completion Date 13-Oct-2021
Expiration Date 12-Oct-2024
Record ID 45463870

This is to certify that:

Elizabeth Davison

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

Social & Behavioral Research - Basic/Refresher
(Curriculum Group)
Social & Behavioral Research
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

Southeastern University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wc12ad5ed-6289-4bbf-84b3-c30e708ddb3d-45463870

CITI PROGRAM

Completion Date 15-Feb-2022
Expiration Date 14-Feb-2025
Record ID 47448009

This is to certify that:

Jeremy Denton

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

Social & Behavioral Research - Basic/Refresher
(Curriculum Group)
Social & Behavioral Research
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

Southeastern University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w345e469b-e9ee-4707-bd60-83eab948138f-47448009

Appendix C

Recruitment Email

Good afternoon!

My name is Elizabeth Davison, and I am a junior majoring in secondary math education at Southeastern University. I am currently writing my undergraduate School of Honors thesis about students' negative perceptions of math, what factors play into this view, and how this perspective affects students' decisions when choosing careers.

I want to specifically look at how factors such as personality, upbringing, and online learning have contributed to students' positive or negative views of math. I also hope to find correlations between students' views of math and their decisions to pursue or avoid careers in the field of math.

In order to obtain data about students' perceptions of math, a survey has been created and attached to this email. If you are willing to participate in this study, you will be asked questions about your demographics, personality, upbringing, and experiences with online learning. The survey should take no longer than fifteen minutes to complete. Your willingness to participate in this study will provide insight, so teachers can develop methods to change these negative views and inspire future students to develop an appreciation for math that they never would have had before!

If you have any questions about the study or the survey, please email the following people:
Professor Jeremy Denton: jmdenton@seu.edu
Elizabeth Davison: egdavison@seu.edu

You can take the survey here: https://forms.gle/tMNYHZQdejXJRLZB9

Thank you so much for your time and consideration!

Sincerely,

Elizabeth Davison
School of Honors Thesis Candidate
College of Natural and Health Sciences, College of Education
Southeastern University

Appendix D

Consent Waiver

PARTICIPANT INFORMATION

SOUTHEASTERN UNIVERSITY

Title: Students' Negative Perceptions of Math in Relation to Personality, Upbringing, and Online Learning, and Their Effects on Careers in Math

Investigator(s): Jeremy Denton, M.Ed., Elizabeth Davison

Purpose: The purpose of the research study is to determine the various factors that influence students' and professors' perceptions of math and decisions to pursue or avoid careers in the field of math. You must be 18 years or older to participate.

What to Expect: This research study is administered online. Participation in this research will involve the completion of one questionnaire. The questionnaire will ask questions about the following four categories: Demographics, Personality, Upbringing, and COVID-19 and Online Learning. The Personality category is further divided into subcategories: Emotions, Personality Traits, and Learning Disabilities; the Upbringing category is further divided into subcategories: Parents and Teachers. You may skip any questions that you do not wish to answer. You will be expected to complete the questionnaire once. It should take you about ten minutes to complete.

Risks: There are no risks associated with this project that are expected to be greater than those ordinarily encountered in daily life.

Benefits: There are no direct benefits to you. However, you may gain an appreciation and understanding of how research is conducted.

Compensation: There are no means of compensation for participating in this study.

Your Rights and Confidentiality: Your participation in this research is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this project at any time.

Confidentiality: The only personal identifiers that will be collected during the study are participants' genders and majors/professions. This information will be translated into code to protect your identity. The records of this study will be kept private. Any written results will discuss group findings and will not include information that will identify you. Research records will be stored on a password-protected Google Drive account on a password-protected computer and only researchers and individuals responsible for research oversight will have access to the records. Data will be destroyed two years after the study has been completed.

Contacts: You may contact any of the researchers at the following email addresses, should you desire to discuss your participation in the study and/or request information about the results of the study: Jeremy Denton: jmdenton@seu.edu, Elizabeth Davison: egdavison@seu.edu. If you have questions about your rights as a research volunteer, you may contact the IRB Office: IRB@seu.edu.

If you choose to participate: Please, click NEXT if you choose to participate. By clicking NEXT, you are indicating that you freely and voluntarily agree to participate in this study and you also acknowledge that you are at least 18 years of age.

It is recommended that you print a copy of this consent page for your records before you begin the study by clicking below.

Appendix E

Thesis Survey

Demographics

1. What is your gender?
    a. Male
    b. Female
    c. Prefer not to say
    d. Other, ________
2. What is the highest degree or level of education you have completed?
    a. Preschool to 8th grade
    b. Some high school, no diploma
    c. High school graduate, diploma, or the equivalent (GED)
    d. Some college credit, no degree
    e. Trade/technical/vocational training
    f. Associate degree
    g. Bachelor's degree
    h. Master's degree
    i. Doctorate degree
3. Are you currently an undergraduate student, a master's student, a doctoral student, a professor, or other? Check all that apply:
    a. An undergraduate student
    b. A master's student
    c. A doctoral student

   d. A professor
   e. Other, _______

4. What is/was your field of study during your undergraduate program?
   a. Broadcasting
   b. Church Music
   c. Communication
   d. Communication & Mass Media
   e. Creative Writing
   f. Digital Journalism
   g. Digital Media & Design
   h. English
   i. Film Production
   j. Graphic Design
   k. History
   l. Language, Culture & Trade
   m. Media Ministry
   n. Music
   o. Music Business
   p. Public Relations
   q. Visual Arts
   r. Worship Studies
   s. Criminal Justice
   t. Human Services

u. Psychology

v. Social Work & Criminal Justice

w. Social Work

x. Aviation Management

y. Business & Professional Leadership (Professional Pilot)

z. Professional Pilot

aa. Biblical Studies

bb. Children, Youth, and Family Ministries

cc. Humanitarian Compassion

dd. Intercultural Studies

ee. Ministerial Leadership

ff. Multidisciplinary Studies

gg. Practical Ministries

hh. Theological Studies

ii. Kinesiology/Exercise Science

jj. Kinesiology/Physical Education

kk. Kinesiology/Pre-Occupational Therapy

ll. Kinesiology/Pre-Athletic Training

mm. Kinesiology/Pre-Physical Therapy

nn. Sport Management

oo. Accounting

pp. Business & Professional Leadership

qq. Business Administration

rr. Business Studies

ss. Finance

tt. International Business

uu. Legal Studies

vv. Management

ww. Marketing

xx. Organizational Leadership

yy. Tourism & Hospitality Management

zz. Communication Sciences and Disorders

aaa. Early Childhood Education

bbb. Elementary Education (K-6)

ccc. Exceptional Student Education (ESE)

ddd. Music Education

eee. Political Science

fff. Secondary Biology

ggg. Secondary English

hhh. Secondary Mathematics

iii. Secondary Social Science

jjj. Mathematics

kkk. Mathematics – Actuarial Science

lll. Mathematics – Biostatistics

mmm. Biochemistry

nnn. Biochemistry – Research

ooo. Biology/Dentistry

ppp. Biology/Medical Sciences

qqq. Biology/Pharmacy

rrr. Biology/Veterinary

sss. Nursing (BSN)

ttt. RN to BSN

uuu. Other

vvv. Not applicable

5. What is/was your field of study during your master's program?

    a. Broadcasting
    b. Church Music
    c. Communication
    d. Communication & Mass Media
    e. Creative Writing
    f. Digital Journalism
    g. Digital Media & Design
    h. English
    i. Film Production
    j. Graphic Design
    k. History
    l. Language, Culture & Trade
    m. Media Ministry
    n. Music

o. Music Business

p. Public Relations

q. Visual Arts

r. Worship Studies

s. Criminal Justice

t. Human Services

u. Psychology

v. Social Work & Criminal Justice

w. Social Work

x. Aviation Management

y. Business & Professional Leadership (Professional Pilot)

z. Professional Pilot

aa. Biblical Studies

bb. Children, Youth, and Family Ministries

cc. Humanitarian Compassion

dd. Intercultural Studies

ee. Ministerial Leadership

ff. Multidisciplinary Studies

gg. Practical Ministries

hh. Theological Studies

ii. Kinesiology/Exercise Science

jj. Kinesiology/Physical Education

kk. Kinesiology/Pre-Occupational Therapy ll. Kinesiology/Pre-Athletic Training

mm. Kinesiology/Pre-Physical Therapy

nn. Sport Management

oo. Accounting

pp. Business & Professional Leadership

qq. Business Administration

rr. Business Studies

ss. Finance

tt. International Business

uu. Legal Studies

vv. Management

ww. Marketing

xx. Organizational Leadership

yy. Tourism & Hospitality Management

zz. Communication Sciences and Disorders

aaa. Early Childhood Education

bbb. Elementary Education (K-6)

ccc. Exceptional Student Education (ESE)

ddd. Music Education

eee. Political Science

fff. Secondary Biology

ggg. Secondary English

hhh. Secondary Mathematics

iii. Secondary Social Science

jjj. Mathematics

kkk. Mathematics – Actuarial Science

lll. Mathematics – Biostatistics

mmm. Biochemistry

nnn. Biochemistry – Research

ooo. Biology/Dentistry

ppp. Biology/Medical Sciences

qqq. Biology/Pharmacy

rrr. Biology/Veterinary

sss. Nursing (BSN)

ttt. RN to BSN

uuu. Other

vvv. Not applicable

6. What is/was your field of study during your doctoral program?

   a. Broadcasting

   b. Church Music

   c. Communication

   d. Communication & Mass Media

   e. Creative Writing

   f. Digital Journalism

   g. Digital Media & Design

   h. English

i. Film Production

j. Graphic Design

k. History

l. Language, Culture & Trade

m. Media Ministry

n. Music

o. Music Business

p. Public Relations

q. Visual Arts

r. Worship Studies

s. Criminal Justice

t. Human Services

u. Psychology

v. Social Work & Criminal Justice

w. Social Work

x. Aviation Management

y. Business & Professional Leadership (Professional Pilot)

z. Professional Pilot

aa. Biblical Studies

bb. Children, Youth, and Family Ministries

cc. Humanitarian Compassion

dd. Intercultural Studies

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ii. Kinesiology/Exercise Science

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kk. Kinesiology/Pre-Occupational Therapy

ll. Kinesiology/Pre-Athletic Training

mm. Kinesiology/Pre-Physical Therapy

nn. Sport Management

oo. Accounting

pp. Business & Professional Leadership

qq. Business Administration

rr. Business Studies

ss. Finance

tt. International Business

uu. Legal Studies

vv. Management

ww. Marketing

xx. Organizational Leadership

yy. Tourism & Hospitality Management

zz. Communication Sciences and Disorders

aaa. Early Childhood Education

bbb. Elementary Education (K-6)

ccc. Exceptional Student Education (ESE)

ddd. Music Education

eee. Political Science

fff. Secondary Biology

ggg. Secondary English

hhh. Secondary Mathematics

iii. Secondary Social Science

jjj. Mathematics

kkk. Mathematics – Actuarial Science

lll. Mathematics – Biostatistics

mmm. Biochemistry

nnn. Biochemistry – Research

ooo. Biology/Dentistry

ppp. Biology/Medical Sciences

qqq. Biology/Pharmacy

rrr. Biology/Veterinary

sss. Nursing (BSN)

ttt. RN to BSN

uuu. Other

vvv. Not applicable

7. If your major or profession is related to the field of math (examples: actuary, math educator, statistician, engineer…), which of the following factors influenced your decision to pursue a career in this field? Check all that apply:

a. Salary
b. Job benefits
c. Personality (analytical, perfectionist…)
d. A "love" for math
e. High self-efficacy in math (belief in one's own abilities)
f. Received a quality math education
g. Inspired by past math teachers
h. Inspired by parents
i. Not applicable
j. Other, _______

8. If your major or profession is not related to the field of math, which of the following factors influenced your decision not to pursue a career in this field? Check all that apply:
   a. Salary
   b. Job benefits
   c. Math anxiety
   d. A "dislike" of math
   e. Low self-efficacy in math (belief in one's own abilities)
   f. Math education was lacking
   g. Disliked previous math teachers
   h. Parents were not able to help with math much or at all
   i. Not applicable
   j. Other, _______

Personality

Emotions

This section addresses one's attitudes and emotions towards math.

9. To what extent do you agree or disagree with the following statement: "I enjoy the subject of math."
    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly agree
10. To what extent do you agree or disagree with the following statement: "I dislike the subject of math."
    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly agree
11. To what extent do you agree or disagree with the following statement: "Throughout my academic career, I have shown signs of math anxiety when in math class or working on math homework."
    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree

d. Agree

e. Strongly agree

12. To what extent do you agree or disagree with the following statement: “Math anxiety has negatively impacted my view of math.”

a. Strongly disagree

b. Disagree

c. Neither agree nor disagree

d. Agree

e. Strongly agree

f. Not applicable

13. Which of the following words most accurately describe how you felt in math class? Check all that apply:

a. Energized

b. Excited

c. Confident

d. Accomplished

e. Stressed

f. Angry

g. Frustrated

h. Discouraged

i. Other, _______

14. How likely are you to help someone with a math assignment?
    a. Very unlikely
    b. Somewhat unlikely
    c. Neither likely nor unlikely
    d. Somewhat likely
    e. Very likely

Personality Traits

This section addresses one’s way of thinking.

15. If you have ever taken the Myers-Briggs Type Indicator (MBTI) personality test, what were your results? The four categories are Introversion (I, energized by being alone) vs. Extraversion (E, energized by being with people), Sensing (S, realistic, focus on facts and details) vs. Intuition (N, innovative, focus on possibilities and the big picture), Thinking (T, make decisions objectively using logical analysis) vs. Feeling (F, make decisions based on values and how others will be affected), and Judging (J, organized, prepared, stick to plans) vs. Perceiving (P, open-minded, spontaneous, flexible with plans).
    a. ISTJ
    b. ISFJ
    c. ISTP
    d. ISFP
    e. INTJ
    f. INFJ
    g. INTP
    h. INFP

i. ESTJ

j. ESFJ

k. ESTP

l. ESFP

m. ENTJ

n. ENFJ

o. ENTP

p. ENFP

q. Not applicable

16. If you have ever taken the Enneagram personality test, what was your highest number?

a. 1 - The Perfectionist: rational, idealistic, principled, purposeful, self-controlled

b. 2 - The Helper: caring, interpersonal, generous, people-pleasing, possessive

c. 3 - The Achiever: success-oriented, pragmatic, adaptive, driven, image-conscious

d. 4 - The Individualist: sensitive, withdrawn, expressive, dramatic, temperamental

e. 5 - The Investigator: intense, cerebral, perceptive, innovative, secretive, isolated

f. 6 - The Loyalist: committed, security-oriented, engaging, responsible, anxious

g. 7 - The Enthusiast: busy, fun-loving, spontaneous, versatile, distractible, scattered

h. 8 - The Challenger: powerful, dominating, self-confident, decisive, willful, confrontational

i. 9 - The Peacemaker: easygoing, self-effacing, receptive, reassuring, agreeable

j. Not applicable

17. If you have ever taken the Enneagram personality test, what was your highest wing number? (The wing is typically your second-highest number, and it is the number either directly before or directly after your highest number. Example: A person who is a 1 has either a 9 or a 2 as his or her wing.)
    a. 1 - The Perfectionist: rational, idealistic, principled, purposeful, self-controlled
    b. 2 - The Helper: caring, interpersonal, generous, people-pleasing, possessive
    c. 3 - The Achiever: success-oriented, pragmatic, adaptive, driven, image-conscious
    d. 4 - The Individualist: sensitive, withdrawn, expressive, dramatic, temperamental
    e. 5 - The Investigator: intense, cerebral, perceptive, innovative, secretive, isolated
    f. 6 - The Loyalist: committed, security-oriented, engaging, responsible, anxious
    g. 7 - The Enthusiast: busy, fun-loving, spontaneous, versatile, distractible, scattered
    h. 8 - The Challenger: powerful, dominating, self-confident, decisive, willful, confrontational
    i. 9 - The Peacemaker: easygoing, self-effacing, receptive, reassuring, agreeable
    j. Not applicable
18. To what extent do you agree or disagree with the following statement: “I am a perfectionist.”
    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly agree

19. To what extent do you agree or disagree with the following statement: "I am an analytical person."
    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly agree
20. Do you consider yourself to be an introvert, an extrovert, or an ambivert (someone who shows both introvert and extrovert tendencies)?
    a. An introvert
    b. An extrovert
    c. An ambivert
    d. I'm not sure
21. On a scale of 1 to 5, how left-brained (logical, analytical, and objective) do you consider yourself to be?
    a. 1 - Not at all
    b. 2
    c. 3
    d. 4
    e. 5 - Very much so

22. On a scale of 1 to 5, how right-brained (creative, thoughtful, and subjective) do you consider yourself to be?
    a. 1 - Not at all
    b. 2
    c. 3
    d. 4
    e. 5 - Very much so

Learning Disabilities

This section addresses one's learning disabilities related to math.

23. Have you ever been diagnosed with a learning disability?
    a. Yes
    b. No
24. If your answer to the previous question was "yes," which learning disability were you diagnosed with? If your answer was "no," choose "Not applicable." Check all that apply:
    a. Specific Learning Disability (SLD)
    b. Autism Spectrum Disorder (ASD)
    c. Emotional & Behavioral Disorder (EBD)
    d. Intellectual Disability (IND)
    e. Other Health Impairment (OHI) (heart conditions, epilepsy, etc.)
    f. Attention Deficit Disorder/Attention Deficit-Hyperactivity Disorder (ADD/ADHD)
    g. Speech/Language Disorder (SI, LI)
    h. Deaf/Hard of Hearing (D/HH)

i. Blind/Visually Impaired (B/VI)

j. Physical Disability (PI) (Cerebral Palsy, Spina Bifida, Muscular Dystrophy, etc.)

k. Orthopedic Impairment (OI)

l. Dyslexia

m. Dysgraphia

n. Dyscalculia

o. Not applicable

p. Other, _______

25. If you have been diagnosed with a learning disability, how often did it affect your performance in math class?

a. Never

b. Rarely

c. Sometimes

d. Most of the time

e. Always

f. Not applicable

26. To what extent do you agree or disagree with the following statement: "My learning disability has negatively impacted my view of math."

a. Strongly disagree

b. Disagree

c. Neither agree nor disagree

d. Agree

e. Strongly agree

f. Not applicable

Upbringing

Parents

This section addresses one's parents' attitudes and abilities related to math.

27. What is the highest degree or level of education your parent(s) or guardian(s) have completed? (If they have different levels of education, choose the higher level.)
    a. Preschool to 8th grade
    b. Some high school, no diploma
    c. High school graduate, diploma, or the equivalent (GED)
    d. Some college credit, no degree
    e. Trade/technical/vocational training
    f. Associate degree
    g. Bachelor's degree
    h. Master's degree
    i. Doctorate degree
28. When you were growing up, how often were your parent(s) or guardian(s) able to help you with math homework?
    a. Never
    b. Rarely
    c. Sometimes
    d. Most of the time

e. Always

f. Not applicable

29. To what extent do you agree or disagree with the following statement: "Growing up, at least one of my parents or guardians consistently explained the importance of the subject of math."

    a. Strongly disagree

    b. Disagree

    c. Neither agree nor disagree

    d. Agree

    e. Strongly agree

    f. Not applicable

30. To what extent do you agree or disagree with the following statement: "At least one of my parents or guardians showed signs of math anxiety when helping me with math homework."

    a. Strongly disagree

    b. Disagree

    c. Neither agree nor disagree

    d. Agree

    e. Strongly agree

    f. Not applicable

31. To what extent do you agree or disagree with the following statement: “At least one of my parents or guardians enjoyed the subject of math.”
    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly agree
    f. Not applicable
32. To what extent do you agree or disagree with the following statement: “My parent(s) or guardian(s) have positively impacted my view of math.”
    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly agree
    f. Not applicable
33. To what extent do you agree or disagree with the following statement: “My parent(s) or guardian(s) have negatively impacted my view of math.”
    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree

e. Strongly agree

f. Not applicable

Teachers

This section addresses one's teachers' attitudes and abilities related to math.

34. In your opinion, how effective have your math teachers been throughout your academic career?
    a. Not very effective
    b. Somewhat effective
    c. Mostly effective
    d. Very effective
35. To what extent do you agree or disagree with the following statement: "Throughout my academic career, my math teachers have had a good understanding of the content they were teaching."
    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly agree
36. To what extent do you agree or disagree with the following statement: "Throughout my academic career, my math teachers have positively impacted my view of math."
    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree

d. Agree
e. Strongly agree

37. To what extent do you agree or disagree with the following statement: “Throughout my academic career, my math teachers have negatively impacted my view of math.”
    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly agree
38. If you have had a negative experience due to a particular math teacher, what grade or class was it in and what factors contributed to making it negative? _______________
    ____

COVID-19 and Online Learning

39. Have you ever had to take a math class online due to COVID-19 or for any other reason? (If your class was conducted virtually, such as through Zoom, answer "yes.")
    a. Yes
    b. No
40. To what extent do you agree or disagree with the following statement: “I enjoy taking online math classes more than in-person math classes.”
    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree

e. Strongly agree

f. Not applicable

41. To what extent do you agree or disagree with the following statement: “Taking an online math class has positively impacted my view of math.”

    a. Strongly disagree

    b. Disagree

    c. Neither agree nor disagree

    d. Agree

    e. Strongly agree

    f. Not applicable

42. To what extent do you agree or disagree with the following statement: “Taking an online math class has negatively impacted my view of math.”

    a. Strongly disagree

    b. Disagree

    c. Neither agree nor disagree

    d. Agree

    e. Strongly agree

    f. Not applicable

43. If you have had a negative experience due to taking an online math class, what grade or class was it in and what factors contributed to making it negative? _______________

    ____

I appreciate you taking the time to participate in this math study!