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A TAXONOMY OF MATH INSTRUCTOR BEHAVIORS THAT CONTIBUTE TO MATH ANXIETY AS PERCEIVED BY STUDENTS

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A Taxonomy of Math Instructor Behaviors That Contribute to Math Anxiety as Perceived by Students

Math Education, Teacher Education

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Synopsis: The purpose of this phenomenological study was to identify and classify those math instructors' behaviors that are contributors to math anxiety as perceived by students identified with math anxiety. Identifying and classifying potential math instructor behaviors which contribute to students' math anxiety is paramount as universities prepare math teachers as well as for school administrators to address potential issues within the math classrooms.

Abstract

The purpose of this phenomenological study was to identify and classify those math instructors' behaviors that are contributors to math anxiety as perceived by students identified with math anxiety. A total of 82 students had math anxiety that met the established criteria and recorded responses of negative math experiences. Eleven categories emerged along with a taxonomy that included the top four most common categories: Teaching disposition, Teaching methods, Didn't explain and Pace. These categories made up 81% of the responses students gave in the questionnaire for teacher's characteristics they felt had been instrumental in their developing math anxiety.

Keywords: Math anxiety, teacher dispositions, AMAS

Introduction

Few would deny the importance of mathematics for the nation especially as technology becomes exponentially more critical every day. One of the more frequently cited reasons for disliking or having an aversion to math is math anxiety. As Dr. Ken Shore (2017) pointed out, many students avoid the subject because of anxiety. This negatively affects not only students' math performance, but affects their career decision since it particularly leads to a lower interest in STEM majors (Beilock & Maloney, 2015).

Fiore (1999), speaking of the causes of math anxiety, referred to it as abuse, specifically singling out teachers as the source of the abuse. "Teachers and the teaching of mathematics are known to be the roots of mathematics anxiety" (Fiore, 1999, p. 403). Trujillo and Hadfield (1999) did a phenomenological study where they conducted in-depth, scripted interviews of five individuals with high math anxiety as measured by the Revised Mathematics Anxiety Rating Scale (RMARS). Several of the transcribed interviews listed bad experiences with a teacher as one of the major causes of their problems, but the authors did not categorize these responses or do in-depth analyses of the responses.

The purpose of this study is to identify categories for negative classroom experiences that contributed to the development of math anxiety as self-reported by students. Previous studies have indicated that over 50% of students who have math anxiety specifically identify a math instructor's attitudes and behaviors as a major contributing factor (Provost & Rhoads, 2008). Researchers in math anxiety made references to negative math instructors, but few have researched the behaviors and attitudes of these instructors (Patrick, Turner, Meyer, & Midgeley, 2004). This research attempted to fill this void in the study of math anxiety among students by examining the math experiences cited by students and by constructing a taxonomy of these experiences whereby they could be identified. The findings of this study will give insights to educators as to teaching techniques and classroom problems that contribute to math anxiety for some students.

Literature Review

The Mathematics Anxiety Rating Scale (MARS), developed by Richardson and Suinn (1972), has been used in numerous empirical studies involving math anxiety to the point that Hembree (1990) conducted an extensive meta-analysis of 151 studies of math anxiety. This analysis established a direct connection between math anxiety and poor math grades, something that few doubted. The relationship is in the form of a negative correlation; as math anxiety increases, math scores decrease. The original version of the exam has been revised in response to curriculum changes, changes in attitudes toward math, and changes in education as possible influencing factors in the structure of the math anxiety scale. However, Hopko, Mahadevan, Bare, and Hunt (2003) questioned the construct validity, as well as the internal and external validity of the revised measures; the Abbreviated Math Anxiety Scale (AMAS) was therefore created.

While there are other factors and studies related to math anxiety such as self-efficacy towards mathematics (Ahmed, 2012; Clement, 1987; Jameson, 2014; Luo, Hogan, Tan, Kaur, Ng, & Chan, 2010; Nicolaidou & Philippou, 2004), beliefs about mathematics (Hendy, Schorschinskky, and Wade, 2014; Ozgen & Bindaka, 2011;), and motivation theory (Githua & Mwangi, 2003; Wang et al, 2015), the authors focus on student perceptions of math instructor behaviors as contributing to math anxiety.

The Nature of Math Anxiety- Signs and Symptoms

There are a number of descriptions and definitions of math anxiety. It is important for this study, however, to clearly identify math anxiety as an anxiety condition and not a simple stressor or loss of self-esteem because anxiety is generally attached to four causal factors: personality, family history, genetic factors and traumatic events (DiTomasso, Freeman, Carvajal, & Zabn, 2009). Chronic negative events can be the trigger for anxiety disorders, particularly if the individual already has a genetic susceptibility (DiTomasso, Freeman, Carvajal, & Zabn, 2009; Stein, 2007). One of the reasons that people display different levels of anxiety in response to an anxiety-producing event, such as a math exam, is that people have inherited different levels of genetic susceptibility to anxiety as is also true of depression. Studying genetics, researchers have found a significant difference in the potential for stress

responses (Nasca, Bigio, Zelli, Nicoletti, & McEwen, 2014). Given two students in the same math classroom, one with more susceptibility to anxiety response will be more likely to develop math anxiety in response to a negative math experience. Indeed, the reaction is so severe that it seriously affects the victim's academic and professional success (Ruffins, 2007).

Dr. Carol Warner, Associate Professor of math at Barry University, uses a common definition for math anxiety when she defines it as "an emotional reaction to mathematics based on a past unpleasant experience" (Warner, n.d., para 1). The importance of this last definition for this study is the emphasis on "a past unpleasant experience."

Since Hembree's (1990) meta-analysis of the effects of math anxiety, a clear relationship has been established between math anxiety, lower math grades (Ashcraft, 2002; Ashcraft & Kirk, 2001; Wigfield & Meece, 1988), avoidance of higher math courses (Brown, Brown, & Bibby, 2008; Chipman, Krantz, & Silver, 1992; Ryan, Pintrich, & Midgley, 2001; Xu M. , 2004), and poor performance in high school math courses when taken (Nurez-Penz, Suarez-Pellicioni, & Bono, 2013). The development of math anxiety lowers levels of confidence and motivation (Zakaria & Nordin, 2008) and, in return, achievement striving (Josiah & Adejoke, 2014).

The Nature of Anxiety and how it may be Created in the Math Class

The researchers are arguing that student-reported repeated exposures to unhelpful, sometimes uncaring and angry teachers result in a reaction, which is an important trigger for anxiety, especially given a genetic predisposition (Somers, Goldner, Waraich, & Hsu, 2006). There have been several studies in India and the United States that suggest math anxiety is learned from parents and teachers (Foley, Herts, Borgonovi, Guerriero, Levine, & Beilock, 2017).

Emotional ordeals resulting in a long-term case of anxiety can be caused by a one-time event, such as a natural disaster, horrible accident, or a violent attack (Kinderman, Schwannauer, Pontin, & Tai, 2013). However, trauma-inducing anxiety can also stem from ongoing, relentless stress (McEwen, 2006; Spinhoven et al., 2011). The semester-long turmoil of a math instructor with a bad attitude and temper could become very traumatic. Every day, the student must face the same anxiety-producing

teacher with the same bad attitude and behaviors. There is the constant fear that the teacher will become angry, make hurtful remarks, or call the person to the board, causing humiliation in front of peers. It is a feeling of being helpless and alone. Because humans can remember past experiences and anticipate stressful situations, the anxiety becomes fixated on math (Rachman, 2004; Shalev, 1966).

Teachers as a Source of Math Anxiety

College and University math instructors often see the results of poor math instruction and math teachers who produce math anxiety in their students. One college math instructor was quoted as saying, "Often math anxiety starts at a young age. If a student has a single insensitive math teacher, that can create a recurring anxiety problem which may be difficult to overcome" (Perry, 2004, p. 322). This theme is repeated in other articles (Betdavid, 2018; Hamza, Ahmed, & Hagstrom, 2011).

Jackson and Leffingwell's (1999) study is one of the most widely cited studies on math anxiety. The biggest drawback to this study, however, is that the researchers never actually tested for math anxiety. The only question that related to math anxiety concerning negative classroom experiences was "Describe your worst or most challenging classroom experience from kindergarten through college" (Jackson & Leffingwell, 1999, p. 583). Although this is beneficial in starting to understand such experiences, a connection between these events and math anxiety is not established. In addition, no comparison was made of other subjects. Finally, Jackson and Leffingwell (1999) end their article with an amazing statement, "Obviously, many of the students in the survey overcame their math anxiety to the point of becoming successful preservice elementary teachers" (p.586). Having not established that any of their teachers had math anxiety in the first place, they now declare that because they are preservice elementary math teachers, they must have overcome their math anxiety. This is not a logical conclusion. The one contribution they made for studying math anxiety among high school students was a shortlist of the specific complaints of a 9th- through 11th-grade group. However, only 40 participants in the sample group had specific teacher complaints.

A second study and one that was, to a large degree, based on Jackson and Leffingwell's research was conducted by Bekdemir (2010). Bekdemir stated the

purpose was to investigate the worst math classroom experiences of students. The study used 167 senior preservice elementary teachers from a small university in north-eastern Turkey. Subjects with math anxiety were identified using the MARS. He then interviewed only 10 participants, who had high levels of math anxiety, using a self-created test which he named Worst Experience and Most Troublesome Mathematics Classroom Experience Reflection Test (WMTMCERT). The test was composed entirely of three open-ended questions.

Bekdemir (2010) stated that the categories by which he separated the responses from his sample were based on Jackson and Leffingwell's (1999) work. Since Jackson and Leffingwell did not test for math anxiety, using these categories could be questionable for Bekdemir to use. However, the list of categories in his paper bears only a passing resemblance to the Jackson and Leffingwell groupings. Finally, although Bekdemir clearly recognizes the impact of a teacher on math anxiety, his sample of 10 is far too small to have high external validity.

Both Jackson and Leffingwell's (1999) and Bekdemir's (2010) lists of categories include anger or hostility. Jackson and Leffingwell's categories, however, included unrealistic expectations by the teachers, gender bias, and intense and uncaring attitudes by the teacher. On the other hand, Bekdemir's categories included inadequate instructors, peer pressure, student personality types, the difficulty of the subject, and the school context. However, Jackson and Leffingwell's (1999) categories all pointed to teachers, which included embarrassing the students, uncaring attitudes, gender bias, unrealistic expectations, and anger. Bekdemir's (2010) categories also included several problems centered on the instructors, including hostility, inadequacy, and to some degree the school and its environment.

Patrick, Turner, Meyer and Midgley (2004) conducted a qualitative study of the use of math avoidance techniques. They were particularly interested in how the educators' teaching techniques and the established psychological environment influenced the student's dislike of mathematics as measured by the use of avoidance strategies. The participants selected for the study were eight sixth-grade teachers who were randomly chosen out of an original pool of twenty volunteers. These teachers were then subjected to unobtrusive observations. The students in their classrooms were

administered multiple math surveys that measured their view of their teacher and the classroom with an emphasis on whether their teacher was supportive of their efforts to learn math. The researchers also measured the students for use of avoidance strategies in math class, whether they sought help and whether they were cheating. Based on these observations, teachers were to be placed into one of two categories: supportive and non-supportive. The results, however, evolved into three categories: supportive, ambiguous, and non-supportive.

The unsupportive category was the one where teachers clearly demonstrated bad attitude and conduct. In the unsupportive classrooms, teachers expressed that they did not expect students to like or succeed in math because it was difficult and offered the students no reason to study math. The teachers that were classified as non-supportive emphasized their power and position and spent more time and energy laying out rules and controlling the classroom than teaching math. They often resorted to belittlement, threats, sarcasm, and mockery of the students' efforts. Making fun of students was not limited to belittling them regarding their math skills, but personal issues as well (Patrick, Turner, Meyer, & Midgeley, 2004). Supportive teachers were those who had the patience to work with a student on problems they did not understand as opposed to becoming impatient and irritated. On the other hand, that ambiguous group, while not showing irritation at the student difficulties, could not be described as supportive or encouraging.

Brady and Bowd (2005) described teachers as hostile and impatient when faced with a student who is having trouble. They pointed out that a common occurrence when students develop math anxiety because of bad math teachers is for the teacher to tell a pupil that he or she simply cannot do math. The pupils accept, believe, and act out the label (Perry, 2004). If teachers have math anxiety themselves, they may well pass it on to their students (Brush, 1981; Maloney & Beilock, 2012; Williams, 1988). "Similar to how social mores are passed down from one generation to another, negative math attitudes seem to be transmitted from teacher to student" (Maloney & Beilock, 2012, p. 404).

Summary of Literature Review

Several studies have highlighted the fact that students have bad experiences with teachers. One study indicated that the clear majority of students had bad experiences. However, only two studies have attempted to describe and categorize these experiences. One of those studies did not test for math anxiety, and both had very small samples. Although such experiences with a math teacher are indicated as a significant cause of math anxiety, the experiences themselves have not been studied, categorized or analyzed. This study uncovers the need for better understanding of how math anxiety develops.

Methodology

In this phenomenological study, the lived experience is a negative interaction with a math instructor that is perceived to have helped cause math anxiety. The researchers are attempting to discover what the individual with math anxiety experienced by identifying and describing specific behaviors of teachers perceived to be contributory to math anxiety.

The participants were given the Abbreviated Math Anxiety Scale (AMAS) and were asked to fill out a questionnaire (Math Anxiety Instructor Questionnaire) that investigated the causes of their math anxiety. Across two institutions in Arkansas, 359 copies of the survey and the AMAS test were administered. For the purpose of isolating those participants whose results would become part of this study, math anxiety was operationalized as a score on the AMAS (Alexander & Martray, 1989, Hopko, Mahadevan, Bare, & Hunt, 2003; Richardson & Suinn, 1972; Suinn & Winston, 2003). For this study, and based on the work of Hopko, Mahadevan, Bare and Hunt (2003), those students whose score fell in the 2nd standard deviation above the mean or higher (for males >26.4 and females > 28.8) were classified as having math anxiety.

Results of the questionnaires entered into the SPSS Text Analysis Program were only of those identified as having math anxiety and attributing their anxiety in any extent to a negative math classroom experience. The data from 82 participants who were identified as having math anxiety associated with classroom experiences were used in this study.

Data analysis

The results were categorized to reduce the descriptions to a set of unique observations with specific descriptors. For example, some participants might describe their math teacher's behavior as screaming at them, and others might describe their math teacher as yelling. These two would be considered unique observations, but given one descriptor. These descriptors formed the classification for the taxonomy of negative math classroom experiences. The analysis of the vocabulary was performed using Text Analytics for Surveys produced by IBM SPSS. This program enables researchers to use unstructured verbal descriptions in qualitative research. The program takes the verbal statements in the form of sentences and automatically categorizes the contents of the responses finding patterns of attitudes, beliefs, and opinions (Deaton, 2006; Jones, 2007).

The participant statements were also given independently to two college math instructors with approximately 40 years of combined teaching experience to categorize the statements independently. The two independent evaluators were given a statement of instruction to the evaluation process. The first step was to produce their own categorization of the participants' statements without prior knowledge of the other evaluator's or the researcher's categorizations. The second step was to compare their categories to the researcher's and respond after each participant statement with one of three responses: VSR (virtually the same as the researcher) meaning while their words may differ the meaning was the same, CR (change to researcher) meaning the evaluator decided that the researcher categorized the statement more accurately, or DR (disagree with researcher) meaning the evaluator decided that his/her categorization was more accurate to the statement than the researcher's.

It was decided that if both independent evaluators gave a DR response or disagreed with the researcher on the same statement, then the researcher would change the classification. If only one independent evaluator gave a DR or disagreed on any given statement, then the researcher would, upon further examination and communication with the independent evaluators, decide if the category for that statement should be changed in the research.

Results

In all, 380 of the questionnaires and the AMAS test were administered with 359 being viable. Two hundred and nineteen of the 359 participants had no math anxiety. Of the 140 participants with math anxiety, 58 did not feel they could name any events that contributed to the anxiety. A total of 82 had math anxiety and recorded responses of negative math experiences, thereby meeting the criteria established by this researchers, namely those students whose score fell in the 2nd standard deviation above the mean for the AMAS or higher and recorded negative math classroom experiences. The average math anxiety score for those included in the study was 30.99 with a standard deviation of 4.05.

After running those 82 responses through IBM SPSS modeler 18.2 Text Analysis, 13 categories eventually emerged (See table 1).

Table 1

Teacher Characteristics Producing Math Anxiety

	Description	**Example**
Teacher's disposition	Included teachers who yelled or screamed at students, teachers who humiliated and or belittled students and a teacher described as "depressed."	She was not patient with the students who did not understand. The teacher screamed and yelled at me if I made a mistake.
Teaching methods	The student specifically cited the teacher's methods or lack thereof.	My teacher would assign work and expect us to know it on our own without being taught.
Language problems	Teacher's native language was not English, and the student said they had difficulty understanding.	My teacher did not speak English well and did not understand the challenge for us.

Assumed previous knowledge	Teacher assumed the student had learned certain math concepts in a prior grade, and they had not.	The teacher moved through the subject material at very quick rates because the teacher tended to assume the students retained all their knowledge gained from previous classes.
Favorites	Teacher had favorites in the class.	My teacher had favorites.
Didn't explain	Teacher did not explain concepts well enough for the student to understand the first time.	The teacher did not spend time going over things that were not clear
Didn't answer	This category is about whether the teacher was willing to answer questions, in or outside of class.	I did not grasp the information, but I didn't ask questions because no one else did.
Taught beyond level	Teacher taught beyond the student's level.	My math teacher was extremely difficult throughout high school and taught above our level of understanding.
Education or lack of training	Teacher was not trained in math or didn't seem to be.	I had a substitute teacher who did not know math for half of my 7th-grade year. I did not learn fundamentals I should have learned.
Pace	Teacher moved too fast and covered too much material	The teacher tries to rush things and cram too much information into one test.

Class control	Class was out of control.	The classroom was very rowdy, and the teacher did not have control of the class.
Didn't teach	Seemed to imply the teacher was absent or did not teach when he/she was there.	She didn't teach. She just passed out worksheets.
Parents Involvement	Father or mother became involved.	Teacher called my dad.

There were very clear overlaps of the characteristics given in the student responses. For example, "My teacher moved too fast for me to take notes and keep up. I expressed my confusion, and the teacher made me feel small because she was rude to me." The student expresses both the teacher's rapid pace and the teacher's disposition to make the student feel bad.

The second process by which the data was analyzed was by having two independent evaluators also categorize the statements made by the participants in the sample. After the evaluators had created their categories, they were shown the researchers' categories and asked to compare their own category to the researchers' and either label it VSR (virtually the same as the researcher, CR (see researcher category as correct) or DR (disagreed with the researcher). The results of the two independent evaluators was a 94% and a 95% agreement with the researcher. The final classification that resulted from the data analysis including the independent evaluators' input yielded eleven teacher charcteristics categories (See table 2).

Table 2

Categories After Changes Due to Independent Evaluator's Suggestions

Category	Number	Percent
Teacher's disposition	26	25%
Teaching methods	25	24%
Didn't Explain	19	18%
Pace	16	14%
Education or training lacking	7	7%
Didn't answer	5	5%
Language problem	2	2%
Didn't teach	1	2%
Assumed previous knowledge	2	1%
Class control	2	1%
Favorites	2	1%

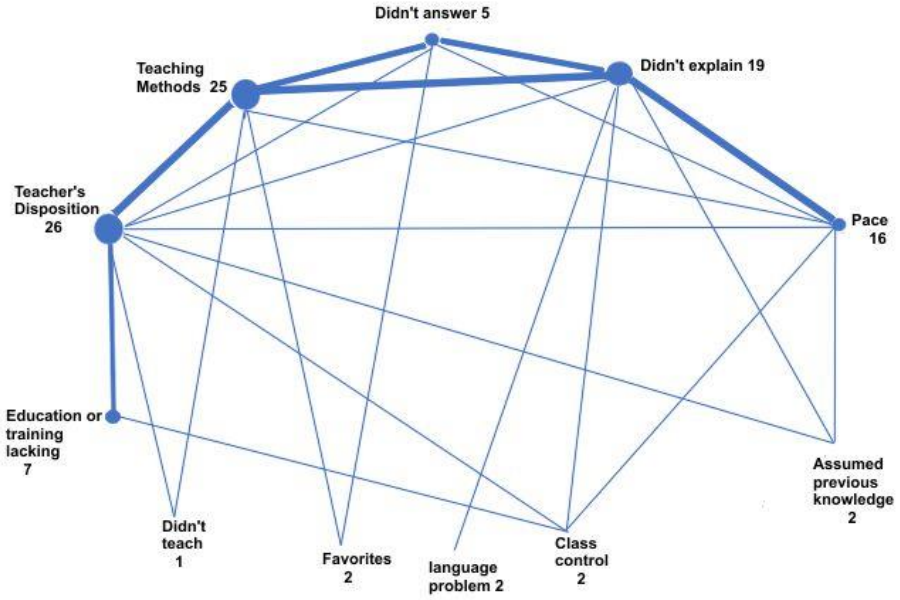
A category web created by SPSS Text Analytics shows the relation between these sixteen concepts (see Figure 1). The three most common categories were Teacher's disposition, Teaching methods and Didn't explain. The top four most common categories: Teacher's disposition, Teaching methods, Didn't explain and Pace, made up 81% of the descriptions students gave in the questionnaire for characteristics that had been instrumental in their developing math anxiety.

The results were then graphed to show the frequency of occurrence and relations between the categories (See Figure 1). The number given by the category is the number of responses that fit in that category. The higher the number, the more

responses that were given in that category. Thicker lines between categories show a stronger co-occurrence of those conditions. For example, when students described a teacher as having a bad disposition, they were also likely to describe the teacher as having poor teaching methods. A light line indicates only one to two associations.

Figure 1

Associations Between Categories



Thus, a teacher who had one characteristic the student reported, such as Teaching disposition often had two or three more characteristics. For example:

> My math teacher was extremely difficult throughout high school and taught above our level of understanding. She would put 50-75 questions on an exam, some of which we hadn't learned, and I would make terrible grades resulting in a math-induced meltdown. My teacher when asked "why," she would always answer "it just is." I believe if the teacher would have slowed down and explained, given various examples, I would have a better understanding resulting in less math anxiety.

This student's response contains several characteristics of the math teacher: The teacher taught above the student's level of understanding, included material on tests that had not been taught, gave an answer to a question that was dismissive and needed to slow down.

Table 3 shows the top six combinations and gives examples from the participants' papers (See Table 3). As pointed out earlier, certain combinations were more common and several of the more prominent co-occurred. The top three, Teaching Dispositions, Teaching Methods and Didn't Explain, all had strong links with each other (see Figure 1).

Table 3

Top Six Co-Occurrences

Top Six Combinations	Frequency	Example
Teacher's disposition & Teaching method	8	My teacher taught by calling people to the board to work problems. If we didn't know the answer quickly, the teacher would become frustrated with us.
Teacher's disposition & Didn't explain	5	Had a professor who treated everyone, even smart kids, like idiots; told us we would never amount to anything. Wouldn't explain because he said we should have gotten it the first time.
Teaching methods & Didn't explain	4	I have the most math anxiety when a teacher does not use the board or any visuals to help teach math. I had a teacher who verbally talked out math problems rather than writing them out. She also was not very good at explaining, so it was hard to follow her logic.

Teacher's disposition & Pace	4	The teacher had a temper and chose favorites in the class. The teacher called people stupid if they didn't understand things. The teacher moved very fast through the chapters.
Teacher's disposition & Didn't answer	2	My teacher became frustrated if I asked too many questions.
Teaching methods & Pace	2	My teacher was careless, fast-paced with new content, and did not explain things in simple terms.

Discussion

The results of this study were both fascinating and complex. From the beginning, this study on the causes of math anxiety sought to find teacher characteristics that seemed to be associated with math anxiety. The math anxiety group used for this study had an average AMAS score of 30.99 as compared to 21.1 for the nation (Hopko, Mahadevan, Bare, & Hunt, 2003). The four most common categories recalled by students as being significant in their development of math anxiety were: Teacher's Disposition, Teaching Methods, Didn't Explain and Pace. This is not to say that certain styles of teaching are the only possible cause of math anxiety. However, the results suggest that specific styles of teaching and the disposition of the teacher can have a long-term negative effect on a student's ability to perform math problems or use math in general.

What was also interesting in the results was the co-occurrence of certain descriptions. For example, as indicated in figure 1, there were three strong categories of characteristics: Teacher's Disposition, Teaching Methods and Didn't Explain. The strongest predictors seemed to be Teacher's Disposition and Teaching Methods, which also had a strong occurrence with each other. In other words, the math teacher with a

negative disposition also tended to have poor teaching methods and vice versa. By contrast, there were some characteristics that had very little to no correlation with others. For example, two students complained that their math teacher had favorite students in the class. Figure 1 Graph shows only a thin line between "favorites" and "didn't answer" which indicates that if a teacher had favorites the class, then this teacher was also likely to demonstrate the quality of not answering questions; however, those two traits did not have a strong correlation.

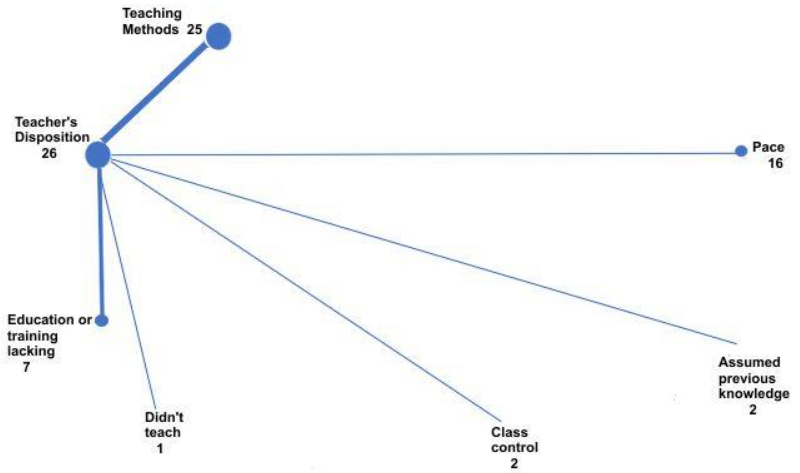
Conclusions

Three epicenters emerged in the graph of the results: one that centered on Teacher's Disposition, one that centered on Teaching Methods and one that centered on Didn't Explain. These traits seem to be grouped together, forming clusters of teachers' behaviors that lead to math anxiety.

For the first epicenter, Teacher's Disposition, the student responses included such descriptions as: "the teacher yelled or screamed," "the teacher made fun of me," "the teacher was impatient," and "the teacher was irritated with me." The teachers with disposition problems also were frequently described as having poor teaching methods, being fast-paced, lacking the training needed to teach math, assuming the student had previous knowledge or having trouble controlling the class (See Figure 2).

Figure 2

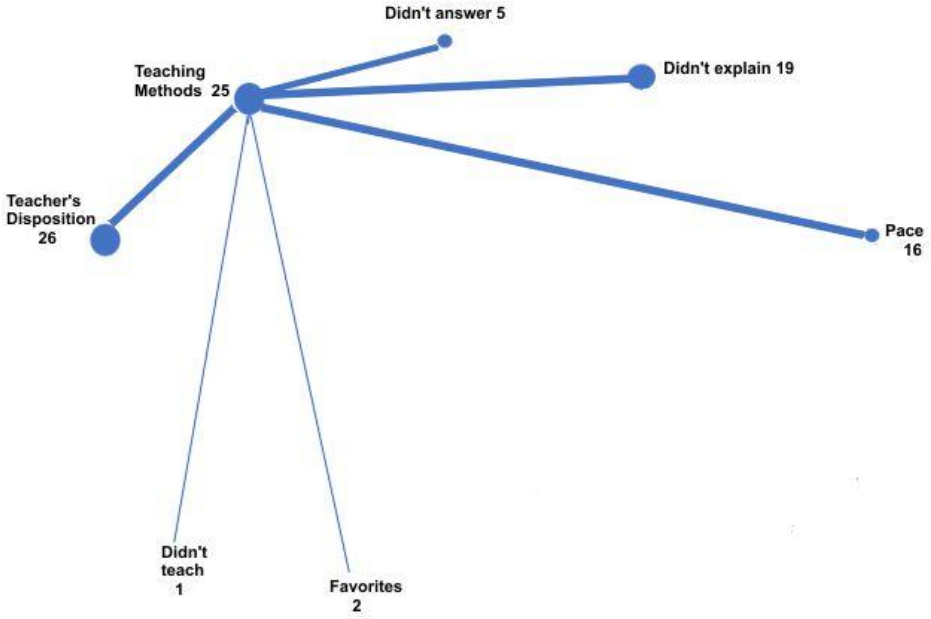
Epicenter of Teaching disposition



The second epicenter focused on Teaching Methods (See Figure 3). The students attributed their math anxiety to the teaching methods of instructors. This category had student responses such as "I have the most math anxiety when a teacher does not use the board or any visuals to help teach math," "I had a teacher who verbally talked out math problems rather than writing them out." Other responses were "Instead of explaining, my teacher passed out worksheets and assigned homework" or "My teacher taught by calling people to the board to work problems."

Figure 3

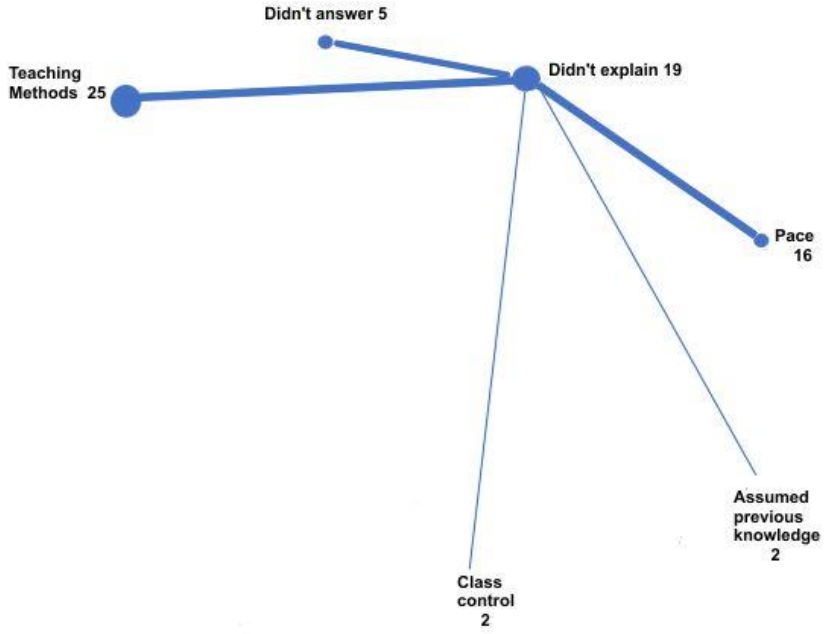
Epicenter of Teaching Method



The third epicenter was Didn't Explain (See Figure 4). Two of the sets of responses may sound alike: Didn't Explain and Didn't Answer. However, the categories were very different. It is, therefore, no surprise that this category has a strong co-occurrence with Teaching Methods. Didn't explain refers to the teacher not adequately explaining the material the first time through. Didn't answer is the teacher not answering questions afterward about things the students didn't understand. An example of Didn't answer questions would be "She did not help me outside of class," whereas an example of Didn't Explain would be "The teacher does not know math well and does not give adequate explanation."

Figure 4

Epicenter of Didn't Explain



The authors of this study believe that teachers who contribute to math anxiety in their students are inclined to demonstrate a cluster of traits. This is not to say that all math teachers who cause math anxiety in students must demonstrate all the traits described in this study. This study merely suggests that if a math teacher has a certain negative trait or quality, then this instructor will likely have at least one other negative trait or quality. The result is that all those traits or qualities are likely to contribute to math anxiety in a student. The most obvious implication is that teachers with certain dispositional traits, such as shouting, short tempers, and personal problems that affect their ability to respond professionally in the classroom should be provided with professional development to better understand the impact of such behaviors on the math efficacy of students. If educators knew more about the causes of math anxiety, it would be easier to tackle the problem before it even gets started (Turner, Midgley, Meyer, Gheen, Anderman, & Kang, 2002).

A second obvious implication is that pre-service teacher training programs in the colleges and universities have an obligation to set high standards not only in

methodology and content, but also in disposition. Additionally, pre-service teachers should be assessed for math anxiety and for math efficacy.

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