Effects of the Math Anxiety of Parents and Teachers on Students

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Abstract
The aim of the study was to demonstrate a relationship between the math anxiety (MA) of parents and teachers and the MA of children and the effects on the children's performance in arithmetic. 286 children aged between 7 and 10 years and their parents and mathematics teachers participated in the study. The instruments used were: Math Anxiety Questionnaire; School Performance Test - Arithmetic subtest; Mathematical Anxiety Scale; and Raven's Colored Progressive Matrices. The results showed that advanced age of the teacher was a predictor of high levels of MA, which influenced the children's performance in arithmetic. Low parental education was associated with high MA, however, there were no correlations between parents' and children's MA. A significant difference was found between the MA mean scores for girls and boys, with the girls presenting higher levels of MA.
Keywords: Math anxiety. Math Performance. Children. Parents. Teachers.

Efeito da Ansiedade Matemática de Pais e Professores em Escolares

Resumo
O objetivo do estudo foi evidenciar a relação entre a ansiedade matemática (AM) dos pais e dos professores com a AM das crianças e o desempenho destas em aritmética. Participaram do estudo 286 crianças com idade entre 7 e 10 anos e seus respectivos pais e professores de matemática. Os instrumentos utilizados foram: Questionário de Ansiedade Matemática, Teste de Desempenho Escolar – Subteste de Aritmética, Escala de Ansiedade Matemática e Matrizes Progressivas Coloridas de Raven. Os resultados mostraram que a idade avançada dos professores é um fator preditor para altos níveis de AM, o que influencia no desempenho das crianças em aritmética. A baixa escolaridade dos pais está associada a alta AM, porém não foram encontradas correlações significativas entre AM de pais e crianças. Também foi encontrada uma diferença significativa entre as médias de AM para o sexo feminino e masculino, evidenciando que meninas possuem maiores níveis de AM.
Palavras-chave: ansiedade matemática; desempenho em matemática; crianças; pais; professores

Efecto de la Ansiedad Matemática de Padres y Profesores en Estudiantes

Resumen
El objetivo del estudio fue resaltar la relación entre la ansiedad matemática (AM) de padres y docentes con la AM de los niños y su desempeño en aritmética y de los niños. Participaron en el estudio 286 niños entre 7 y 10 años y sus respectivos padres y profesores de matemáticas. Los instrumentos utilizados fueron: Cuestionario de AM; Prueba de Rendimiento Escolar: Subprueba aritmética; Escala de AM; Matrices Progresivas Escala Coloreada de Raven. Los resultados mostraron que la edad avanzada de los docentes es un factor predictivo para altos niveles de AM, lo que influye en el rendimiento de los niños en aritmética. La baja educación de los padres se asocia con un alto AM, pero no se encontraron correlaciones significativas entre AM de padres e hijos. Asimismo, se encontró una diferencia significativa entre las medias de AM de niñas y niños, lo que demuestra que las niñas tienen niveles más altos de AM.
Palabras clave: Ansiedad Matemática. Rendimiento en Matemáticas. Niños. Padres. Docentes.

Introduction

Despite its importance, mathematics can assume a threatening character for schoolchildren. Both the family and the school can reinforce opinions that mathematics is a difficult subject and that, despite efforts, not everyone manages to learn it (Carmo & Figueiredo, 2009). Such statements can strengthen negative beliefs in students regarding learning, as well as trigger a condition of Math Anxiety (MA). This is defined by Ashcraft (2002) as negative feelings about the subject that can range from mild discomfort to extreme avoidance behaviors.

Anxiety is an emotional reaction characterized by anticipation of a future threat. This emotion presents itself in events perceived as aversive, triggering cognitive, affective, behavioral and physiological responses. Despite being a common emotion, when frequently present at times that do not present a real danger to the individual, it can interfere with daily functioning and

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provoke reactions of muscle tension, hypervigilance, and caution or avoidance behaviors (American Psychiatric Association [APA], 2013; Barlow, 2002).

When mathematics is perceived as an aversive stimulus, anxiogenic reactions typical of a specific phobia disorder are expected, with avoidance of situations involving manipulation of numbers. Math anxiety is therefore characterized by dysfunctional cognitions about mathematics, negative affective responses, escape or avoidance behaviors, and, at higher levels, physiological reactions typical of anxiety disorders, e.g., sweating, palpitations, hyperventilation or tremors (Ashcraft & Ridley, 2005).

Math anxiety may also be related to other types of anxiety, such as evaluation anxiety or general anxiety, although it cannot be explained by them (Hembree, 1990; Dowker et al., 2016). Hembree (1990) investigated the correlation between math anxiety and evaluation anxiety, showing that only 37% of MA can be explained by anxiety at moments of evaluation, while the remaining percentage is attributed to other sources. The correlation between the MA measure and the general anxiety measure was r=.35; p<.01. These results demonstrate that these constructs function independently, as MA appears to encompass a general fear of contact with mathematics, including classes, homework and tests. Furthermore, Dowker et al. (2016) argued that different measures of math anxiety have a greater correlation with each other than with measures of general or evaluation anxiety.

Emotional support exerted by parents has a direct influence on better motivation of students and, consequently, on good performance in mathematics and science, while parental pressure negatively affects both motivation and performance (Koutsoulis & Campbell, 2001). In addition to the family structure, socioeconomic status (Galindo & Sonnenchein, 2015), and engagement in academic tasks performed at home (Fan et al., 2017) are factors that influence mathematics learning.

Parents can contribute to the MA levels present in their children through both behavior and attachment models, as well as through excessive control patterns and dysfunctional expectations (Batchelor et al., 2017). Parental help with math homework can also be an influencing factor, mediated by the parents' own MA level, as well as their education level and discipline model (Fan et al., 2017). When school and family factors are dysfunctional, they can lead to higher levels of insecurity, decreasing self-efficacy and generating negative beliefs about their own learning and the mathematics subject (Haase et al., 2019).

Despite recognizing the importance of mathematics in everyday life, it is common for students with low performance in mathematics to feel dissatisfied or frustrated. Due to not understanding the concepts and the adequate resolution of the problems, they end up getting negative results in the subject (Gunderson et al., 2018). To avoid these situations that increase anxiety, students start to solve exercises quickly and carelessly, or try to be the first to present work related to the subject. Often, they also report forgetting the content even after studying extensively (Carmo & Figueiredo, 2009).

As a consequence of these behaviors linked to anxiety and inattention, individuals with learning difficulties in mathematics are often stigmatized as lazy or not intelligent enough, which ends up influencing their attitudes and beliefs towards the subject (Dorneles, 2019). In addition, the presence of anxiety influences students' future choices and may, for example, limit their professional options to careers that do not involve mathematics (Parsons & Bynner, 2005).

Although not characterized as a learning disorder, math anxiety is linked to cognitive consequences that can influence the performance in mathematical problems. Two main theories are described in the literature to explain the interaction between math anxiety and performance, based on the influence of cognitive factors.

The first, called Processing Efficiency Theory, explains this interaction through the functioning of working memory, an important executive function for solving mathematical problems (Eysenck & Calvo, 1992). According to this theory, the intrusive thoughts and worries generated by anxiety consume the resources needed to perform the mathematical problem. Therefore, the working memory, due to its limited storage capacity, is overloaded and its functioning is impaired.

To complement this explanation, the second theory specifies the inhibitory function as the preponderant process by which math anxiety impacts performance. Attentional Control Theory (Eysenck et al., 2007) explains that high levels of anxiety can deregulate two important attentional processes: top-down (directed toward external or internal stimuli) and bottom-up (directed toward voluntary attention control). This imbalance would explain the dual tendency of individuals with high levels of math anxiety to be distracted by irrelevant stimuli while solving math problems. Accordingly, evidence demonstrates the involvement of important executive functions, such as inhibitory control and working memory, in the relationship between MA and mathematical performance (Figueira & Freitas, 2020; Orbach et al., 2020).

The MA level of teachers, their beliefs and attitudes about the subject are also factors that can influence students' relationship with mathematics (Dowker et al., 2016). Anxiety related to teaching mathematics is associated with real or perceived deficits in the mathematics teaching, and is characterized by high levels of concern about being able to teach correctly and fear that one's teaching method will confuse students (Gresham & Burleigh, 2018). Evidence indicates a gender effect associated with teaching mathematics to children, with a transmission of MA between teachers and students that can negatively influence the students' performance in the subject and their self-efficacy beliefs regarding mathematics (Beilock et al., 2010; Casad et al., 2015).

In Brazil, sociodemographic educational data indicate a female prevalence in teaching positions for all levels of school education, especially in preschool (96.4% being female) and elementary school (88.1% being female) (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira [INEP], 2021). These data indicate the need to investigate the effect of gender stereotypes on the MA levels of teachers and students, and to design effective interventions for the condition, for both adults and schoolchildren.

It is common for many teachers to lack knowledge about learning disabilities in mathematics or about intervention methods needed to facilitate the learning process (Fritz et al., 2019). Evidence highlights the ineffectiveness of the use of aversive methods in the teaching process, such as threats or reinforcement of beliefs about the difficulty of mathematics. It is important to create a positive environment during mathematics teaching to decrease MA levels and increase motivation for learning (Olson & Stoehr, 2019).

Considering the evidence regarding the role that parents and teachers can play in the emergence and reinforcement of negative beliefs and attitudes towards mathematics, it is important to investigate the possible consequences of high levels of MA in parents and teachers for their children/students. Accordingly, this study aimed to test the correlational effect of MA of parents and teachers on the MA levels and arithmetic performance of children aged 7 to 10 years.

Method

This study had a quantitative, cross-sectional and correlational design. For this, the correlation between the MA levels of parents, teachers and children and their relationship with the children's performance in arithmetic were investigated.

Participants

The study included 415 children aged between 7 and 10 years, of both sexes, students from the 1st to the 5th year of Elementary Education in public and private schools in Vitória da Conquista, Bahia. Children who had uncorrected sensory impairments or a diagnosis of a developmental disorder were not included in the sample. From the results obtained through the Raven's Colored Progressive Matrices test (Angelini et al., 1999), 97 children with intelligence test results below the 10th percentile were excluded. Another exclusion criterion for this study was the lack of completion of the Mathematical Anxiety Scale - MAS (Carmo et al., 2008), 32 children were excluded considering this criterion. After these exclusions, the final number of study participants was 286 children and their parents/guardians, as well as their mathematics teachers (49 teachers). Of the parents who participated in the study, 90.2% (258) were female, with 25.0% (72) having completed high school, composing the most frequent education level. The mean age of the parents was 36.72 years (SD = 8.23 years). The mean age of the teachers was 40.35 years (SD = 8.97 years).

Regarding the personal and professional data of the participating teachers: 91.8% were female, and 59.2% taught in public schools. Concerning the undergraduate level, 91.8% had completed higher education, and 46.9% did not have any type of postgraduate degree. Regarding the time since graduation, 28.6% had concluded it more than 10 years previously, 26.6% between 5 and 10 years previously, and 26.5% less than 5 years previously, while 8.2% had not completed higher education.

The distribution of children was 52.1% (149 children) female, with 197 (68.9%) children from public schools and the mean age of 8.45 years (SD = 1.14 years). The distribution of schooling was 24 children (8.4%) in the first year, 72 children (25.2%) in the second, 73 children (25.5%) in the third, 65 children (22.7%) in the fourth, and 52 children (18.2%) in the fifth year of elementary education.

Instruments

Math Anxiety Questionnaire - MAQ (Thomas & Dowker, 2000; Haase et al., 2012; Wood et al., 2012): Composed of 24 items to assess the presence of math anxiety in participating children, the items can be

combined into four subscales: (A) self-perceived performance in relation to mathematics; (B) attitudes in mathematics; (C) unhappiness related to problems in mathematics; and (D) anxiety related to problems in mathematics. Items are answered according to four types of questions: (A) "Are you good at..."; (B) "How much do you like..."; (C) "How happy or unhappy do you feel if you have problems with..."; and (D) "How worried are you if you have problems with…". Each question must be answered considering six different math-related categories: general math, easy calculations, hard calculations, written calculations, mental calculations, and math homework.

School Performance Test (SPT) – Arithmetic Subtest (Stein, 1994): Composed of arithmetic calculations corresponding to the arithmetic content for elementary education, which aims to assess the performance index in arithmetic of the participating children.

Mathematical Anxiety Scale - MAS (Carmo et al., 2008)*:* Used to measure the level of math anxiety of parents and teachers, the MAS is composed of 24 items that represent everyday school situations related to mathematics, whether in or out of the classroom. Participants must choose one of the five anxiety levels for each situation: *no anxiety*; *low anxiety*; *moderate anxiety*; *high anxiety*; *extreme anxiety*. For the participants who no longer had contact with learning mathematics, they were asked to recall the time when they studied the subject and respond according to how they felt in the situations described in the scale.

Raven's Colored Progressive Matrices (Angelini et al., 1999): Assesses general intelligence by measuring children's non-verbal reasoning. Logical reasoning tasks that increase in complexity throughout the test are used.

Collection Procedures

The present study was approved by the Research Ethics Committee of Federal University of Bahia, under authorization number 3.082.420, and the mandatory ethical standards for research with human subjects were used (Resolution 446/2012 of the National Health Council). Data collection was performed at a meeting for parents and teachers, who completed the Mathematical Anxiety Scale (MAS), after signing the consent form.

The session with the authorized children was carried out individually and after the signature of the consent form by the guardians and the assent term by the child, expressing their consent to participate in the study. The evaluation with the children lasted 80 minutes.

Data analysis

For the data analysis within an inferential model, the following tools were used: (1) Descriptive analysis to characterize the participants; (2) Correlation analysis, using Pearson's coefficient, to verify the relationship between the parents' and teachers' anxiety and the children's anxiety and mathematical performance. (3) Mediation and moderation analyses, in the AMOS Package, version 24, to investigate whether the teachers' age and education of the parents/guardians act as mediators or moderators for the children's anxiety levels and performance in arithmetic; and (4) Student's *t*-test to investigate differences in children's MA levels comparing female and male groups.

Results

From the descriptive analysis of the sample, it was possible to obtain the means, standard deviations and intervals for the measures used in the study. The Math Anxiety Questionnaire (MAQ) is composed of four subscales that refer to: self-perceived performance (MAQ – A), attitudes in mathematics (MAQ – B), unhappiness related to problems in mathematics (MAQ – C) and anxiety related to problems in mathematics (MAQ – D). The MA profile found for the children demonstrated a higher level of anxiety for category D of the Math Anxiety Questionnaire (MAQ – D). For the teachers, the MA level was lower than the mean found for the parents (see Table 1).

Pearson's correlation analyses are shown in Table 2. A moderate and significant negative correlation (r = -.35; p <.001) was evidenced for the MA level presented by the teachers in relation to the performance of their students in the SPT - Arithmetic. Two significant although weak correlations were found between the children's MA levels and their performance in mathematics. The correlations were for the categories MAQ – C (r = .24; p < .001) and MAQ – D (r = .14; p <.05), being positive, that is, demonstrating that higher scores in these categories equate to higher performance in mathematics.

To explore the relationship between the profile of the parents and teachers and the children's levels of MA and arithmetic performance, an analysis was carried out to investigate possible mediation or moderation relationships. As the MAQ – C presented the strongest correlation among the significant correlations highlighted, this factor was used as a parameter to measure the MA of the children.

Table 1.
Descriptive Data referring to the anxiety profile of teachers, parents and children

Instruments	*M*	*SD*	Min-Max
MAS - Teachers	43.02	17.78	23 – 90
MAS - Parents	58.00	22.78	24 – 111
MAQ - A	12.74	4.06	6 – 28
MAQ - B	13.42	5.46	6 – 29
MAQ - C	16.42	5.42	6 – 29
MAQ - D	18.09	5.17	6 –30

Legend: *M* = Mean; *SD* = Standard Deviation; Min-Max = Minimum and Maximum; MAS = Mathematical Anxiety Scale; MAQ = Math Anxiety Questionnaire.

Table 2.
Pearson's Correlations between Teachers, Parents and Children's Math Anxiety and Arithmetic Performance

	MAS – Teachers	MAS – Parents	MAQ –A	MAQ – B	MAQ – C	MAQ-D
SPT	-.35**	-.10	.07	.10	.24**	.14*
MAS-Teachers		.14*	-.07	-.08	-.15*	-.05
MAS - Parents			.05	-.05	-.06	.05

MAS-PR = Mathematical Anxiety Scale answered by teachers; MAS-Parents = Mathematical Anxiety Scale answered by parents/guardians; MAQ = Math Anxiety Questionnaire; SPT = School Performance Test - arithmetic subtest.

*p<.05; **p<.001

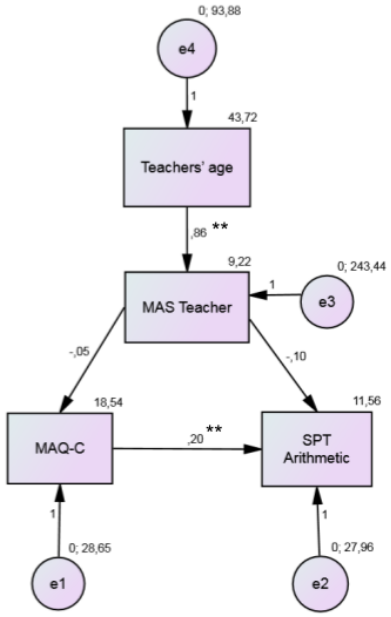
It was found that the higher the age of the teachers, the higher their level of MA (Figure 1). The results showed that the MA presented by the teachers negatively influenced the arithmetic performance of their students. Consistent with the results of the regression analysis, it was found that the MA level of the teachers was negatively related to the MA level of their students, however this result presented a weak intensity, and only for category C of the Math Anxiety Questionnaire (Figure 1).

Regarding the relationship between the profile of parents/caregivers and the level of MA of the children, the results showed that the lower the education of those responsible, the higher their MA levels. Descriptive data on the parents' schooling are shown in Table 3. Negative correlations were found between parents' MA and the children's performance in mathematics, and between parents' MA and category C of the MAQ, however, these were not significant (Figure 2).

For the comparison of groups considering the hypothesis of differences in the MA and performance in arithmetic according to sex, the results of Student's *t*-test showed a significant difference between female and male children for categories A, C and D of the MAQ, indicating a higher level of MA for girls in most of the scales investigated. The same pattern was not found for performance in arithmetic, which indicates that the girls, despite having a higher level of MA, did not present a lower performance in arithmetic compared to the boys of the same age and school grade (see Table 4).

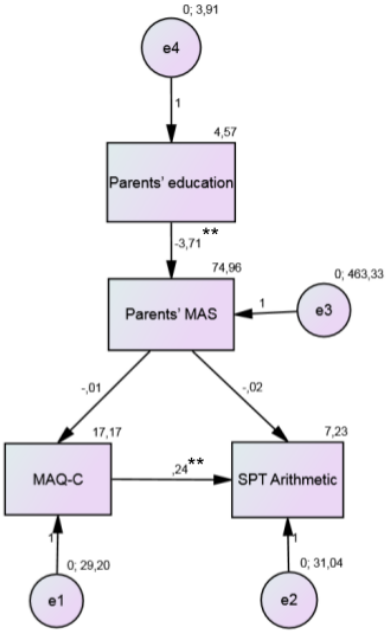
Discussion

Parents and teachers play a significant role in the learning process of children, especially in the early years of schooling. Interaction in the home environment can include the parenting style that will act by providing support in carrying out school tasks as well as the availability of models that arouse interest in mathematics. The aim of this study was to investigate the effect of fear presented by parents and teachers in relation to mathematics as an influencing factor for similar responses in children.



Legend: MAS teacher: Mathematical Anxiety Scale answered by teachers; MAQ - C: Category C of the Math Anxiety Questionnaire; SPT Arithmetic: School Performance Test - Arithmetic Subtest.

Figure 1. Effect of the teachers' age on their MA level, and on the students' MA and performance.



Legend: MAS parent: Math Anxiety Scale answered by the parents; MAQ - C: Category C of the Math Anxiety Questionnaire; SPT Arithmetic: School Performance Test - Arithmetic Subtest.

Figure 2. Effect of parental education on their level of MA, and on their children's MA and performance.

The results of the Math Anxiety Questionnaire (MAQ) showed that the highest mean was for category D (MAQ-D). However, categories C and D were the only correlations that, despite being weak, were significant in relation to the children's performance in arithmetic. The correlations found were positive, indicating that higher MA scores equated to higher performance in arithmetic.

Meta-analysis studies have shown, over the years, a negative correlation of weak or moderate intensity in the relationship between MA and mathematical performance (Hembree, 1990; Namkung et al., 2019; Barroso et al., 2021). Despite this, positive effects of MA on performance have been found in other studies, especially for the subscales that assess a cognitive dimension of MA. The result found, although analyzed with caution, agrees with the results of Krinzinger et al. (2007), who found no effect for MA on math performance in schoolchildren, and the result by Haase et al. (2012), who found positive effects for the more cognitive dimensions of MA.

Studies that assess cultural aspects of this relationship present evidence that, in the Far East, despite the excellent performance shown in mathematics, high levels of math anxiety are found. The hypothesis to explain these results may be linked to parental and social pressure to perform in mathematics (Chang et al., 2019; Lee, 2009). On the other hand, studies in Brazil and Turkey found lower levels of math anxiety despite poor math performance (Lee, 2009). Therefore, finding a positive relationship between MA and performance is not entirely surprising. It is possible to verify that studies are still needed on the outcomes of MA for the mathematics performance of children in the first years of schooling.

For the investigation of the difference in the MA profile between boys and girls, the results indicated a significant difference between the means of categories A, C and D, indicating that girls have higher levels of MA in most of the dimensions measured. The same pattern was not found for the measure of performance in arithmetic, which demonstrates that even with a high level of MA, the girls did not perform worse in mathematics compared to the boys.

A number of variables can influence performance in mathematics, such as cognitive, affective, environmental and cultural factors (Haase et al, 2019). These results raise the discussion of why girls feel more anxious about mathematics even though they do not perform poorly. We then start from the hypothesis of the influence of possible gender stereotype effects,

Table 3.
Descriptive Data regarding the education of the parents/guardians

Schooling	*n*	Percentage (%)
Incomplete Elementary Education	67	23.4
Complete Elementary Education	25	8.7
Incomplete High School Education	28	9.8
Complete High School Education	71	24.8
Incomplete Higher Education	10	3.5
Complete Higher Education	51	17.8
Not reported	17	5.9

Legend: *n* = number of parents

Table 4.
Comparison of MA and performance in Arithmetic between groups of male and female children

	Female		Male			
	Mean	*SD*	Mean	*SD*	*t*	*p*
SPT – Arithmetic	10.06	5.41	9.79	6.15	0.39	.69
MAQ – score A	13.63	4.30	11.78	3.56	3.97	.00**
MAQ – score B	13.98	5.54	12.81	5.32	1.82	.07
MAQ – score C	17.12	5.29	15.65	6.48	2.30	.02*
MAQ – score D	18.73	5.05	17.39	5.23	2.20	.02*

SPT – Arithmetic = School Performance Test – Arithmetic Subtest; MAQ = Math Anxiety Questionnaire. *p<.05; **p<.001

considering that most professionals who teach mathematics for the initial years are female, as well as our sample being predominantly female.

Evidence shows that female teachers have high levels of MA and that these levels are negatively related to their effectiveness in teaching (Beilock et al., 2010; Gresham, 2008). Beilock et al. (2010) demonstrated a possible gender effect on this relationship when studying the levels of math anxiety in female teachers and its possible effects on students. In their results, it was found that, at the end of the school year, the higher the MA of female teachers, the more female students presented lower performance in mathematics, while the same effect was not found for male students (Beilock et al., 2010).

One of the aspects that must be considered is the effect of expectations that can be triggered by teachers' negative experiences with mathematics. If teachers have MA, they may consider girls to have less potential to learn mathematics. Teachers' expectations about their students' performance act as a mechanism that contributes to increasing positive interaction between teachers and students in the classroom, favoring student performance (Good, 1987; Urhahne, 2015). Therefore, the more positive expectations the teachers have of their students' performance, the greater the interaction and attention given to them, which can affect their motivation and self-efficacy beliefs (Good, 1987; Urhahne, 2015).

This effect can be found in relation to mathematics teaching and teachers' MA levels seem to play an important role in this relationship. The study by Mizala et al. (2015) demonstrated that teachers with high math anxiety have lower expectations for the math performance of girls than for that of boys. Furthermore, the results also showed that high levels of MA can affect the teacher's ability to develop an inclusive learning environment in the classroom.

Studying these effects is relevant, since beliefs of low self-efficacy in mathematics influence levels

of motivation and engagement in activities involving this subject. Accordingly, people with these difficulties tend to avoid choosing professions that involve mathematics, as well as being more likely to face financial difficulties in the future. Furthermore, individuals who fear mathematics are severely restricted in their career choice (Ashcraft & Ridley, 2005; Parsons & Bynner, 2005).

The relationship found between MA and good performance may also indicate the need to analyze the effects of the coping strategies used by children to minimize MA impairments. Anxiety symptoms may vary according to the different coping strategies employed. Children who use strategies linked to ignoring problems or asking for help to solve them tend to experience more anxiety, while children who use more active coping strategies show fewer anxious symptoms (Skaalvik, 2018).

Another theoretical perspective that can help to explain the positive effect found between MA and performance is based on the concepts of affect and meta-affect. For problem solving to occur, we rely on several representation systems, among them, affect. This system involves emotions, attitudes, beliefs, morals, values and ethics, and has effects on mathematical learning (Debellis & Goldin, 2006). Furthermore, the perception and monitoring of this affect during problem solving can also influence this relationship, with this aspect called meta-affect (Goldin, 2002; Comelli & Manrique, 2019).

From this perspective, the way students feel about emotions and their cognition, and how they perceive and monitor them, can be one of the moderating or mediating factors between the relationship between MA and performance and the process of solving mathematical problems (Tzohar-rozen & Kramarski, 2017). Therefore, the hypothesis must also be considered that even students with high levels of anxiety can monitor and perceive their emotions in a functional way, triggering positive effects in their performance. For future studies, it is important to use affect and meta-affect measures and to more objectively investigate the role that these factors may be playing.

In relation to the parents and teachers, the mean level of MA was higher for the parents than for the teachers. However, the relationship between teachers' MA and students' arithmetic performance showed a level of significance with a moderate correlation (r = -.35; p <.001), with this relationship being evidenced by the mediation and moderation analyses. These results are consistent with the literature, which highlights teachers' MA levels as important for their students' performance, as well as for the self-efficacy of their teaching methods and their knowledge of mathematics (Mizala et al., 2015; Beilock et al., 2010).

The results of the present study showed a strong relationship between parents' education and their MA levels, indicating that parents who had high MA levels had low education. Consistent with the literature, it is possible to show that difficulties in mathematics are related to fewer years of schooling (Richie & Bates, 2013), higher rates of school dropout and professional training with lower qualifications (Parsons & Bynner, 2005).

It is possible, then, to consider that MA in elementary education teachers influences children's mathematical performance. In addition, the children's MA was also related to their academic performance in mathematics. These results suggest that high levels of MA in teachers compose one of the factors that generate effects in the teaching and learning process.

Basso (2019) gathered evidence in order to analyze the relationship between teachers' beliefs and attitudes about mathematics, and how they can influence the teaching process. A previous negative relationship with their former mathematics teachers, the tendency of teachers that present MA to employ authoritarian and traditional teaching methods, and the difficulties of teachers with MA in creating an inclusive classroom environment are some examples of the effects of the MA of teachers on the teaching practices (Basso, 2019).

In summary, there is evidence in the literature of an intergenerational effect between MA levels presented by adults and children (Maloney et al., 2015; Mizala et al., 2015; Beilock et al., 2010). Foley (2017) argues that providing tools for teachers and parents to understand the mechanisms of how their anxiety levels can affect students is one way to prevent these effects. In addition, considering that MA is a multifactorial framework, together with interventions aimed at parents and teachers, protocols that cover the cultural, cognitive, behavioral and physiological components involved in the framework should be investigated and structured.

In accordance with the aim of the study, the effect of the MA of parents and teachers on the MA levels and on the arithmetic performance of the participating children was tested. The results found showed that high levels of MA in mathematics teachers had negative effects on children's performance in arithmetic. No

significant correlations were found between the MA of parents and children, indicating the possibility of investigating the other potential moderating or mediating effects of this relationship in future studies.

This study contributes to directing attention toward the future consequences of both the presence of math anxiety and low performance in mathematics. Furthermore, the results contribute to the understanding of possible factors responsible for differences in math performance between boys and girls, and whether math anxiety has a role in these differences.

The limitations of the study, such as the low number of teachers and a convenience sample, suggest caution in interpreting the results and the importance of continuing the research. It is also important to consider that, when completing the MAS, teachers were instructed to record their perceptions from the time they were students until today. This leads to limitations as the teachers' perception of MA was retrospective and not exclusively current, with the teachers' level of anxiety possibly no longer being the same when compared to their experiences as students in the past.

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