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The relationship between mathematical achievement, mathematical anxiety, perfectionism and metacognitive abilities in Italian students

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Abstract

Background: The literature shows that mathematical achievement can be influenced by affective factors, metacognitive abilities, and personality traits. The aim of the present study is to investigate the relationship between mathematical achievement, mathematical anxiety, perfectionism, and metacognitive abilities in a sample of secondary school students.

Method: The sample was composed of 272 students of secondary school, 43.8% males, and 56.3%, with an average age of 12.08 (SD=.89). The Evaluate Metacognition, Negative Attitudes, and Mathematics Anxiety, and the Almost Perfect Scale were administered, while the data on academic performance in mathematics was based on the average scores earned on written tests across all participants during the current school year. Correlational and path analyses were performed.

Results: The results showed significant correlations between the variables investigated. Furthermore, mathematics achievement was positively predicted by control in performing, mathematics attitudes, beliefs related to mathematics, and adaptive perfectionism, while it was negatively predicted by math anxiety, and maladaptive perfectionism.

Conclusion: This study has important educational implications for teachers as it highlights the role of metacognitive, affective, and personality factors in the learning and achievement of mathematics.

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1. Introduction

In the school environment, a problem common to many students of every order and degree concerns weak performance in mathematics. The literature indicated several factors that can influence mathematical performance and, consequently, mathematical achievement. Among

these are affective factors, such as mathematical anxiety and attitude toward mathematics (Ajisuksmo & Saputri, 2017; Barroso et al., 2020), metacognitive abilities (Ajisuksmo & Saputri, 2017), and personality traits, such as perfectionism (Sumpter, 2017).

Mathematical anxiety has been defined as a complex construct characterized by the cognitive, affective, and behavioral responses of an individual who perceives a threat to his/her self-esteem when he/she is in situations involving mathematics (Byrd, 1982). Therefore, it refers to a set of negative emotions that interfere with number processing and mathematical problem-solving tasks in a variety of situations at school and in ordinary life (Byrd, 1982; Gabriel et al., 2020; Pourmoslemi et al., 2013; Richardson & Suinn, 1972). The literature suggested that poor performance in mathematics is associated with mathematical anxiety (Puteh & Khalin, 2016; Zakaria & Nordin, 2008; Zhou et al., 2020). Moreover, students with high levels of mathematical anxiety get significantly lower scores in motivation than students with lower or absent levels of mathematical anxiety (Tapia & Marsh, 2004).

In examining the variables involved in mathematical anxiety, the literature has shown that it is influenced by personality features, such as high levels of perfectionism (Besharat & Shahid, 2010; Frost & Marten, 1990; Sumpter, 2017; Tsui & Mazzocco, 2007), which also have negative effects on mathematical performance (Soleymani & Rekabdar, 2010).

Stoeber (2015) defined perfectionism as a "personality trait characterized by striving for flawlessness and setting exceedingly high standards of performance accompanied by overly critical evaluations of one's behavior" (Stoeber, 2015, p. 611). However, it must be specified that perfectionism plays a fundamental role in the development of anxiety only in its negative form (see Frost & Marten, 1990). There are several theoretical approaches to perfectionism across various fields. For example, clinical psychology states that perfectionism is a personality trait associated with psychopathology; conversely, researchers who study personality and individual differences consider perfectionism as a multidimensional disposition with positive and negative aspects (Stoeber, 2018).

Positive perfectionism is defined as "adaptive," while negative perfectionism is defined as "maladaptive" (Hamachek, 1978; Rice et al., 1998; Stoeber & Otto, 2006; Stumpf & Parker, 2000). Maladaptive perfectionists are strongly self-critical of their own mistakes. In addition, since they have exceedingly high expectations and feelings of anxiety and a fear of failure, they perceive a strong discrepancy between their performance and their expectations (Filippello et al., 2017; Rice & Preusser, 2002; Slaney & Ashby, 1996). The perceived discrepancy between their own standards of performance and the results achieved would increase their anxiety and depression and reduce their self-esteem (Filippello et al., 2019b; Park, 2009; Slaney et al., 2001;

Wang et al., 2007). In fact, several studies have shown that maladaptive perfectionism is associated with psychological distress (Costa et al., 2016; Frost et al., 1990; Hewitt & Flett, 1991; Muyan & Chang, 2015; Slaney et al., 2001) and low academic achievement (Madigan, 2019; Soleymani & Rekabdar, 2010; Sumpter, 2017; Yurtseven & Akpur, 2018). Instead, adaptive perfectionism is associated with positive attitudes toward mathematics and mathematical achievement (Ajisuksmo & Saputri, 2017; Seipel & Apigian, 2005; Soleymani & Rekabdar, 2010; Stornelli et al., 2009). Moreover, a previous study (Mills & Blankstein, 2000) showed that maladaptive perfectionism was associated with a lower use of metacognition strategies, while adaptive perfectionism was associated with a better use of metacognitive strategies (Mills & Blankstein, 2000).

Some researchers found that individuals with high degrees of mathematical anxiety tended to avoid mathematics because they felt they did not have the metacognitive skills (beliefs related to mathematics and control in performing) essential for solving mathematical tasks (Caponi et al., 2012).

Metacognition consists both of the individual's knowledge on his own thought processes, and of his capacity for elaboration, choice and application of problem solving, control and self-regulation strategies (Filippello et al., 2016b). Therefore, these are the processes that have the purpose of regulating, influencing and verifying cognitive activity (Palincsar & Brown, 1990). For example, when performing a task, an individual can know the strategies suitable for its realization and be able to evaluate the difficulty, estimate their own abilities and personal resources, examine possible strategies, plan, monitor, etc. (Cornoldi et al., 2001).

It is clear that metacognition plays a very important role in the learning process as it includes numerous determinants of academic success: the knowledge acquired, preserved and recovered; the mechanisms activated to improve the execution of tasks; ideas and thoughts about one's cognitive abilities; the actions taken to achieve the objectives (Flavell et al., 1995); knowledge about one's cognitive processes and self-regulation of one's cognitive activities; the ability to make predictions about one's own performance, to monitor in progress the cognitive activities and to evaluate the effectiveness of the strategies applied (Brown, 1978); declarative knowledge ("I know there is a strategy"), procedural ("I know how to apply it") and conditionals ("I know the conditions in which it is advantageous to apply it") (Paris et al., 1983). According to Borkowski and Muthukrishna (1992), when learning is self-regulated, the ability to determine one's own learning improves; consequently, self-regulation and self-efficacy are reinforced.

Metacognition is deeply involved in mathematical learning for its two knowledge components, cognition and planning, along with monitoring and evaluation skills (Lucangeli et al., 1995).

Metacognitive awareness in mathematics implies the ability to know which strategies can be adopted to solve a problem and reach a goal. Epistemological beliefs about mathematics include whole thing of knowledge, self-efficacy beliefs, awareness of strategies, and activation of control processes, which students develop during the study of mathematics in the school context. All these variables can play an important role in the execution of mathematical tasks in a positive way, reducing anxiety and leading students to success in their tasks or, conversely, hindering their performance (Caponi et al., 2012). Several studies (Ashcraft & Krause, 2007; Garofalo & Lester, 1985; Sarıçam & Ogurlu, 2015) have shown a correlation between high metacognitive skills and the ability to solve mathematical problems. Moreover, Legg and Locker (2009) showed that individuals with high metacognitive skills and high self-efficacy obtained better results in mathematical tasks than those with low metacognitive abilities and high levels of mathematical anxiety. The authors, in fact, found that metacognition played a moderating role in mathematical anxiety. That is, performance decreased as anxiety increased, except at high metacognition levels. Moreover, metacognition played a predictor role in confidence in accuracy; individuals with higher metacognitive processing abilities were more confident in their ability to correctly solve the mathematical tasks (Legg & Locker, 2009).

1.1 The Present Study

The above studies have shown correlations between mathematical achievement, mathematical anxiety, and metacognition; between maladaptive and adaptive perfectionism and mathematical achievement; and between maladaptive and adaptive perfectionism and mathematical anxiety, obtaining results that give a partial explanation of the influence of the factors involved in mathematical performance. Despite the importance of these studies, no research has investigated the relationship between all these variables together. Instead, this would be useful in order to identify which factor plays a predictive role on both the mathematical performance and the metacognitive abilities involved. Furthermore, it would be advisable to analyze which variables are major predictors of anxiety since it negatively affects learning processes. Indeed, the study of the relationships between these variables has important educational implications for teachers as it highlights the role of metacognitive, affective, and personality factors in the learning and achievement of mathematics.

Therefore, the purpose of the present study is to investigate the relationships between mathematical achievement, mathematical anxiety, perfectionism, and metacognitive abilities (mathematics attitudes and beliefs related to mathematics and control in performing) in a sample of secondary school students. The choice of the sample is justified by the fact that, although the relationship between perfectionism and academic achievement has been demonstrated, the

understanding of these relationships in academic contexts is still limited because it is mostly investigated in samples of university students (Damian et al. (2014). Instead, it has been shown that the relationship between perfectionism and individual variables related to academic success (e.g., anxiety and depression manifestations, dominance of motivational tendencies for success or avoidance of failure) is complex and deserves to be investigated as early (see Vavilova, 2018). It is hypothesized that mathematical achievement is negatively correlated with mathematical anxiety, maladaptive perfectionism, and low metacognitive abilities; conversely, it is hypothesized that mathematical achievement is positively correlated with adaptive perfectionism, high metacognitive abilities, and low levels of mathematical anxiety. Furthermore, it is hypothesized that adaptive perfectionism is a positive predictor of metacognitive abilities and that metacognitive abilities are positive predictors of mathematical achievement and negative predictors of mathematical anxiety. Conversely, it is hypothesized that maladaptive perfectionism is a positive predictor of mathematical anxiety and a negative predictor of mathematical achievement.

2. Method

2.1 Participants

The sample was composed of 272 students of secondary school, 119 males (43.8%) and 153 females (56.3%), with an average age of 12.08 (*SD*=.89). The participants were selected from the secondary schools in the city of Messina, Sicily (Italy), 95.6% of the students were of Italian nationality, and all participants were Italian speakers.

With regard to SES, 18% of the students belonged to a low SES (one or both parents attained a lower secondary education diploma), 41.5% belonged to a medium SES (one or both parents attained a high school diploma), and 13.2% belonged to a high SES (one or both parents attained a university degree), while 27.23% of students did not provide this information.

2.2 Measures

The Demographic Questionnaire collected basic demographic information on the participants, including age, gender, national original, educational level/academic class, and SES.

The Italian version of Almost Perfect Scale-Revised (APS-R; Filippello et al., 2016a) was used to measure personal adaptive and maladaptive perfectionism. In this study, we used the high standard and discrepancy subscales. The high standard subscale assesses positive aspects of personal perfectionism and consists of six items (e.g., I set very high standards for myself), whereas the discrepancy subscale assesses negative elements of personal perfectionism and consists of 10 items (e.g., I often feel frustrated because I can't meet my goals). Participants

responded on a 7-point Likert-type scale, ranging from 1 (strongly disagree) to 7 (strongly agree). Exploratory and confirmatory factor analyses have provided support for the APS-R factor structure (Aydin, 2013; Filippello et al., 2016a; Park, 2009; Slaney et al., 2001) among samples from different countries. The reliability and validity of the APS-R have been demonstrated in previous research (Filippello et al., 2016a, 2017, 2019b; Grzegorek et al., 2004; Rice & Slaney, 2002; Suddarth & Slaney, 2001). In this study the internal consistency (Cronbach's *a*) of the scales was .60 for adaptive perfectionism, and .79 for maladaptive perfectionism.

The Evaluate Metacognition, Negative Attitudes and Mathematics Anxiety (MeMa; Caponi et al., 2012) was used to measure mathematics attitudes. The instrument consists of 15 items, which describe 15 situations that students may experience when doing their mathematical homework (e.g., "in mathematics, I like to proceed with patience and tranquility"). Participants responded on a 4-point Likert scale, ranging from 1 (never or almost never) to 3 (often). High scores indicate an emotional and motivational experience related to the mathematics functional to its learning. The reliability and validity of the instruments have been documented in previous research (Caponi et al., 2006, 2012). In the present study, internal consistency (Cronbach's α) of this scale was .67.

The Evaluate Metacognition, Negative Attitudes and Mathematics Anxiety (MeMa; Caponi et al., 2012) was used to measure the beliefs related to mathematics. The instrument consists of nine items concerning common beliefs about solving mathematical tasks (e.g., "If I do wrong in mathematics, I [will] think I'm stupid"). Participants indicate whether each statement is true or false. Regarding the attribution of scores, two points are awarded for each correct answer. High scores indicate the presence of a belief system on mathematical learning functional to its learning. The reliability and validity of the instruments have been documented in previous research (Caponi et al., 2006, 2012). In this study, the internal consistency (Cronbach's *a*) of the scale was .60.

The Evaluate Metacognition, Negative Attitudes and Mathematics Anxiety (MeMa; Caponi et al., 2012) was used to measure control in performing exercises and problems. The instrument is composed of nine items that concern the control processes in mathematics (prediction, planning, and evaluation). In this section, students complete mathematical exercises, problems, and operations; in some cases, they only need to predict the degree of difficulty of the task, while in others, they have to solve it according to precise indications and then answer some questions. High scores indicate adequate ability to self-control the process of solving problems and mathematical exercises. The reliability and validity of the instruments have been

documented in previous research (Caponi et al., 2006, 2012). In this study, the internal consistency (Cronbach's *a*) of the scale was .62.

The MeMa Mathematical Anxiety Scale (Caponi et al., 2012) was used to evaluate mathematical anxiety. The scale consists of 30 items (e.g., "Having to do many difficult problems at home"). Students must imagine that they are in the situations described and indicate their corresponding emotional response using a 4-point Likert scale, ranging from 1 (little fear / anxiety) to 4 (fear / high anxiety). High scores indicate high levels of mathematics anxiety. The reliability and validity of the MeMa Mathematical Anxiety Scale have been documented in previous research (Caponi et al., 2012; Conti et al., 2017). In the present study, internal consistency (Cronbach's *a*) was .88.

The data on academic performance in mathematics was based on the average scores earned on written tests across all participants during the current school year. Several studies consider the average scores obtained in the written tests as a good indicator of academic achievement (Filippello et al., 2019a, 2020b; Sorrenti et al., 2015a, 2015b).

2.3 Procedure

This study received ethical approval and was performed in accordance with the ethical standards of the Declaration of Helsinki as revised in 2013. The protocol was approved by the Ethics Committee of the Centre for Research and Psychological Intervention (CERIP) of the University of Messina (protocol number: 30465).

Participants completed all the questionnaires in a single session with previously informed consent of their parents. Their privacy and the anonymity of their answers were guaranteed. Their participation required about 50 minutes.

2.4 Data Analyses

IBM SPSS19.0 (2010) was used to conduct descriptive statistics, Cronbach's alpha, and correlations for all variables in the study. Eqs 6 (Bentler, 1995) was used to carry out the path analysis, with observed variables. Several indexes of fit were examined: the Chi-square (χ^2) value; the incremental indices CFI (Comparative Fit Index) in which values equal to or greater than .90 are considered acceptable (Bentler, 1990); the SRMR index (Standardized Root Mean Square Residual), in which values lower than .05 indicate a good fit (Hu & Bentler, 1999). Additionally, we included gender and age as control variables in this model.

3. Results

Table 1 shows the means, standard deviations, skewness, kurtosis, Cronbach's alpha values, and correlations for all variables considered in this study. The descriptive analysis showed that all scales had good symmetry and kurtosis scores. Regarding the reliability of the instruments used, all of the scales showed acceptable Cronbach's alpha values, with the exception of the adaptive perfectionism scale and beliefs related to mathematics.

The correlation showed that mathematical achievement was positively correlated with adaptive perfectionism, mathematics attitudes, and beliefs related to mathematics and control in performing, while it was negatively correlated with maladaptive perfectionism and mathematical anxiety. Furthermore, mathematical anxiety was negatively correlated with adaptive perfectionism, mathematics attitudes, and beliefs related to mathematics and control in performing; in addition, mathematical anxiety was positively correlated with maladaptive perfectionism. Finally, mathematics attitudes were positively correlated with adaptive perfectionism, while mathematics attitudes, and beliefs related to mathematics and control in performing were negatively correlated with maladaptive perfectionism (tab. 1).

Table 1. Descriptive statistics and correlation among variables

	M	*SD*	*Skew*	*Kurt*	1	2	3	4	5	6	7
1 Adaptive Perfectionism	5.06	.88	-.28	.10	*a* =.60						
2 Maladaptive Perfectionism	4.03	1.08	.16	-.36	.12*	*a* =.79					
3 Mathematics Attitudes	2.35	.28	-.48	-.10	.28**	-.29**	*a* =.67				
4 Beliefs related to mathematics	1.41	.36	-.85	.92	.07	-.18**	.26**	*a* = .60			
5 Control in performing	1.34	.69	.16	-.61	.10	-.13*	.32**	.18**	*a* = .62		
6 Mathematical anxiety	2.13	.46	.11	-.33	-.17**	.29**	-.48**	-.17**	-.24**	*a* = .88	
7 Mathematical Achievement	6.67	1.45	.31	-.64	.23**	-.29**	.46**	.32**	.44**	-.37**	-

Note: N=272; **p<.01; *p<.05

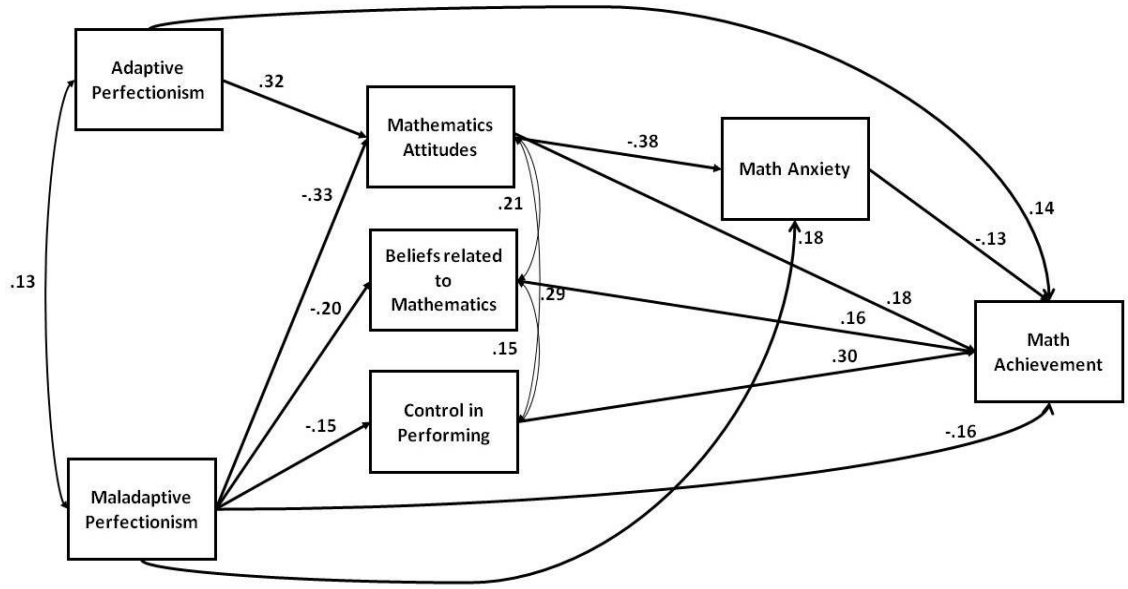
3.1 Path Analyses

The hypothesized model was tested using the following paths: metacognitive abilities (mathematics attitudes and beliefs related to mathematics and control in performing) were predicted by perfectionism (maladaptive and adaptive); mathematical anxiety was predicted by metacognitive abilities (mathematics attitudes and beliefs related to mathematics and control in performing) and perfectionism (maladaptive and adaptive); and mathematical achievement was

predicted by mathematical anxiety, metacognitive abilities (mathematics attitudes and beliefs related to mathematics and control in performing), and perfectionism (maladaptive and adaptive). To control for the effects of age and gender, direct paths were added from age and gender to all of the study variables (maladaptive perfectionism and adaptive perfectionism, mathematics attitudes, beliefs related to mathematics and control in performing, mathematical anxiety, and mathematical achievement). Finally, covariants between the variables were allowed for the discrepancy and high standard subscales, mathematics attitudes, and beliefs related to mathematics and control in performing.

The results from the hypothesized model (Figure 1) showed good fit indices, $\chi^2(1) = .48$, $p = .48$, $CFI = 1.00$, $SRMR = .01$, and indicated that adaptive perfectionism was a positive predictor of mathematics attitudes ($\beta = .32$), while maladaptive perfectionism was a negative predictor of mathematics attitudes ($\beta = -.33$), beliefs related to mathematics ($\beta = -.20$), and control in performing ($\beta = -15$). Furthermore, mathematics attitudes were a negative predictor of mathematical anxiety ($\beta = -38$), while maladaptive perfectionism was a positive predictor of mathematical anxiety ($\beta = .18$). Finally, adaptive perfectionism ($\beta = .14$), mathematics attitudes ($\beta = .18$), beliefs related to mathematics ($\beta = .16$), and control in performing ($\beta = .30$) were positive predictors of mathematical achievement, while maladaptive perfectionism ($\beta = -.16$) and mathematical anxiety ($\beta = -.13$) were negative predictors of mathematical achievement.

Figure 1. Path Diagram Depicting the relationships among study variables



Note: Only significant paths are shown

4. Discussion

In the school environment, several factors can influence mathematical achievement (Ajisuksmo & Saputri, 2017; Sumpter, 2017). The aim of this study was to investigate the relationship between mathematical achievement, mathematical anxiety, adaptive and maladaptive perfectionism, and metacognitive abilities. According to our hypothesis, the results showed significant relations between these variables. Specifically, mathematical achievement was positively correlated with adaptive perfectionism and metacognitive abilities (mathematics attitudes and beliefs related to mathematics and control in performing) and negatively correlated with mathematical anxiety and maladaptive perfectionism. These results are consistent with previous studies, which indicated that students with adaptive perfectionism and high metacognitive skills showed adequate mathematical performance (Ashcraft & Krause, 2007; Cornoldi, 2003; Garofalo & Lester, 1985; Lucangeli et al., 1997; Sarıçam, 2016; Soleymani & Rekabdar, 2010), and students with high levels of mathematical anxiety and unrealistic standards of performance showed low mathematical performance (Ashcraft, 2002; Soleymani & Rekabdar, 2010; Tsui & Mazzocco, 2007). Indeed, as several studies have shown, maladaptive perfectionism is associated with psychological distress (Costa et al., 2016; Frost et al., 1990; Hewitt & Flett, 1991; Muyan & Chang, 2015; Slaney et al., 2001), low academic achievement (Madigan, 2019; Soleymani & Rekabdar, 2010; Sumpter, 2017; Yurtseven & Akpur, 2018) and a lower use of metacognition strategies (Mills & Blankstein, 2000). Furthermore, our results are in line with studies that have demonstrated the positive relationship between adaptive perfectionism and positive attitudes toward mathematics and mathematical achievement (Ajisuksmo, & Saputri, 2017; Stornelli et al., 2009), and a better use of metacognitive strategies (Mills & Blankstein, 2000).

Furthermore, to verify the relationships between the variables considered, a path analysis was carried out. According to our hypothesis, the results showed that adaptive perfectionism was a stronger positive predictor of mathematics attitudes and a weaker predictor of mathematical achievement. These results suggest that students with high standards of performance have positive attitudes toward mathematical learning, indicating the functional behavior to solve problems (Mills & Blankstein, 2000). Thus, students with adaptive perfectionism are more motivated and more committed to school, have the confidence to succeed in studying mathematics, and achieve good mathematical performance. These results are consistent with previous studies, which indicated positive relationships between adaptive perfectionism, attitudes toward mathematics, and mathematical achievement (Ajisuksmo, & Saputri, 2017; Seipel & Apigian, 2005; Soleymani & Rekabdar, 2010; Stornelli et al. 2009). Furthermore, mathematical achievement was strongly predicted by control in performing and weakly

predicted by mathematics attitudes and beliefs related to mathematics. That is, students who had adequate skills to monitor, plan, and evaluate their learning processes; experienced positive emotions; and had a system of functional beliefs about mathematics achieved better performance in mathematical tasks. These results are confirmed by previous studies (Ajisuksmo & Saputri, 2017; Ashcraft & Krause, 2007; Cornoldi, 2003; Garofalo & Lester, 1985; Guner, 2012; Legg & Locker, 2009; Lucangeli et al., 1997; Sarıçam, 2016), which showed a positive relationship between metacognitive abilities and mathematical achievement. This is consistent with other studies (Ashcraft & Krause, 2007; Sarıçam & Ogurlu, 2015) who have shown a correlation between high metacognitive skills and the ability to solve mathematical problems. Moreover, Legg and Locker (2009) showed that individuals with high metacognitive skills and high self-efficacy most properly perform mathematical tasks than those with low metacognitive abilities. Moreover, metacognition plays a predictive role in confidence in one's ability to perform mathematical tasks correctly; in fact, individuals with greater metacognitive processing skills are more confident in their mathematical skills (Legg & Locker, 2009).

Meanwhile, the results showed that maladaptive perfectionism was a predictor of metacognitive abilities. In particular, maladaptive perfectionism was a stronger negative predictor of mathematics attitudes, while beliefs related to mathematics and control in performing and mathematical achievement were weakly predicted by maladaptive perfectionism. Moreover, maladaptive perfectionism was a positively weak predictor of mathematical anxiety. These results are consistent to Mills and Blankstein (2000), suggesting that the students with unrealistic standards show an emotional-motivational experience related to mathematics not functional to its learning; this indicates the presence of a system of negative dysfunctional beliefs on mathematical learning and low planning, monitoring, and evaluation skills during the execution of mathematical tasks. Furthermore, perfectionist students with unrealistically high standards for themselves are never satisfied with their performance and tend to avoid tasks and situations where they are unsure of excelling for fear of being negatively evaluated (Kurtovic et al., 2019). This could explain the low mathematical achievement and high levels of mathematical anxiety in maladaptive perfectionist students. Our results are confirmed by previous studies, which indicated that maladaptive perfectionism was a predictor of low achievement (Madigan, 2019; Soleymani & Rekabdar, 2010; Sumpter, 2017; Yurtseven & Akpur, 2018) and mathematical anxiety (Moore 2010; Tsui & Mazzocco, 2007). Indeed, the perceived discrepancy between their own standards of performance and the results achieved would increase anxiety and depression and reduce self-esteem (Filippello et al., 2019a; Park, 2009; Slaney et al., 2001; Wang et al., 2007).

5. Limitations and Directions for Future Research

This study has some limitations that could direct future research. First, the correlational nature of the study does not allow conclusions to be drawn on the causal direction of the variables examined but only on the relations between them. Second, self-report scales were used to evaluate the study variables. Among the evaluation instruments used, the scale of adaptive perfectionism and the scale of beliefs related to mathematics showed inadequate internal reliability. Therefore, regarding perfectionism, future research should use a validated psychometric measure of adaptive perfectionism for pre-adolescents because answering self-report scales requires a certain level of self-awareness and reflection. Regarding the scale of beliefs related to mathematics, although it was built on a sample of elementary and middle school children and used for research purposes, further validation studies on Italian samples are needed. Another limitation is that the sample was limited to middle school students, which does not allow for the generalization of the obtained results. Future research could use a more heterogeneous sample, including students of different school grades.

Overall, these results contribute to the literature on factors that can influence mathematical achievement in students, indicating that perfectionism (maladaptive and adaptive) can influence metacognitive abilities related to mathematics, mathematical anxiety, and mathematical achievement. Furthermore, the results of this study have educational implications as they stimulate teachers to pay attention to these factors, such as the educational style, that play an important role during the learning process. For example, it has been shown that a controlling and non-supportive educational style negatively affects academic performance (Filippello et al., 2018, 2020b), and can induce perfectionism because communicates to students that appreciation is conditioned by the excellence of the results (Filippello et al., 2017, 2019a, 2020a). In the case of failure to achieve the highest standards of performance, the student may feel a sense of guilt and shame which can have negative effects on self-regulation of learning and, consequently, on self-efficacy (Borkowski & Muthukrishna, 1992). Therefore, it may be of importance to inform teachers explicitly about ways to implement an autonomy-supportive style in their interaction with students, through intervention and prevention programs. Teachers should use a supportive style, structuring learning activities to promote greater autonomy, considering students' perspectives, welcoming students' contributions, and increasing students' self-regulation skills (Reeve, 2009). Instead, teachers who express their appreciation to students only when they are able to reach the standards imposed (Sierens et al., 2010), could contribute to the development of maladaptive perfectionism. The consequences of this dysfunctional process could be even more negative. Indeed, previous studies has shown that maladaptive perfectionism is associated with helplessness in school environment, confirming the negative consequence of this type of

perfectionism such as internalizing problems, such anxiety, low self-esteem and depression (Park, 2009; Slaney et al., 2001; Wang et al., 2007). In fact, if students perceive a discrepancy between the excessive demands of their teacher and failures they face, they may develop feelings of inadequacy that would further the development of learned helplessness (Filippello et al., 2017).

Regarding the students, it is necessary to implement training aimed at developing adequate personal beliefs and avoiding the formation of dysfunctional thoughts, thus preventing the risk of developing emotionally stressful conditions that can affect academic performance (Sorrenti et al., 2015a, 2015b). Furthermore, it is important to plan programs aimed at improve the students' metacognitive skills of knowledge and awareness of strategies, and activation of control processes, since they play such an important role in the learning process.

References

1. Ajisuksmo, C.R., & Saputri, G.R. (2017). The Influence of Attitudes towards Mathematics, and Metacognitive Awareness on Mathematics Achievements. *Creative Education, 8, 486-497*. https://doi.org/10.4236/ce.2017.83037
2. Ashcraft, M.H., & Krause, J.A. (2007). Working memory, math performance, and math anxiety. *Psychonomic bulletin & review*, *14*(2), 243-248. https://link.springer.com/article/10.3758/BF03194059
3. Barroso, C., Ganley, C. M., McGraw, A. L., Geer, E. A., Hart, S. A., & Daucourt, M. C. (2020). A meta-analysis of the relation between math anxiety and math achievement. *Psychological Bulletin*. Advance online publication. https://psycnet.apa.org/doi/10.1037/bul0000307
4. Bentler, P.M. (1990). Comparative fit indexes in structural models. *Psychological bulletin*, *107*(2), 238. https://psycnet.apa.org/doi/10.1037/0033-2909.107.2.238
5. Bentler, P.M. (1995). *EQS structural equations program manual* (Vol. 6). Encino, CA: Multivariate software.
6. Besharat, M.A., & Shahid, S. (2010). Perfectionism, anger, and anger rumination. *International Journal of Psychology, 45*(6), 427-434. https://doi.org/10.1080/00207594.2010.501336
7. Borkowski, J.G., & Muthukrishna, N. (1992). *Moving metacognition into the classroom: "Working models" and effective strategy teaching*. In M. Pressley & K.R. Guthrie (Eds.), *Promoting academic literacy: Cognitive research and instructional innovation* (pp. 477-501). Orlando, FL: Academic Press.
8. Brown, A.L. (1978). *Knowing when, where, and how to remember: A problem of metacognition*. In R. Glaser (Ed.), *Advances in instructional psychology* (pp. 77-165). Hillsdale, NJ: Erlbaum.
9. Byrd, P. (1982). *A descriptive study of mathematics anxiety: Its nature and antecedents*. Unpublished doctoral dissertation, Indiana University.
10. Caponi, B., Cornoldi, C., Falco, G., Focchiatti, R., & Lucangeli, D. (2012). Test MeMa. *Valutare la metacognizione, gli atteggiamenti negativi e l'ansia in matematica. Trento: Centro Studi Erickson.*
11. Conti, M., Gallani, A., Viola, F., Ghiotti, L., & Mammarella, I. C. (2017). Un progetto di screening-intervento per le abilità di calcolo nella scuola primaria [A screening-intervention project for computing skills in primary school]. XXVI National Congress AIRIPA Learning Disorders, Conegliano (Italy), 29-30 September 2017.
12. Cornoldi, C., De Beni, R., & Gruppo MT (2001). *Imparare a studiare 2 [Learning to study 2]*. Trento: Erickson.
13. Costa, S., Coppolino, P., & Oliva, P. (2016). Exercise dependence and maladaptive perfectionism: The mediating role of basic psychological needs. *International Journal of Mental Health and Addiction*, *14*(3), 241-256. https://doi.org/10.1007/s11469-015-9586-6
14. Damian, L. E., Stoeber, J., Negru, O., & Băban, A. (2014). Perfectionism and achievement goal orientations in adolescent school students. *Psychology in the Schools*, *51*(9), 960-971. https://doi.org/10.1002/pits.21794
15. Filippello, P., Buzzai, C., Costa, S., & Sorrenti, L. (2019a). School Refusal and Absenteeism: Perception of Teacher Behaviors, Psychological Basic Needs, and Academic Achievement. *Frontiers in Psychology,* 10:1471. https://doi.org/10.3389/fpsyg.2019.01471
16. Filippello, P., Buzzai, C., Costa, S., Orecchio, S., & Sorrenti, L. (2020a). Teaching style and academic achievement: the mediating role of Learned Helplessness and Mastery Orientation. *Psychology in the Schools*, *57*(1), 5-16. https://doi.org/10.1002/pits.22315

17. Filippello, P., Buzzai, C., Messina, G., Mafodda, A.V., & Sorrenti, L. (2020b). School refusal in students with low academic performances and Specific Learning Disorder. The role of self-esteem and perceived parental psychological control. *International Journal of Disability, Development and Education, 67*(6), 592-607. 10.1080/1034912X.2019.1626006.
18. Filippello, P., Buzzai, C., Sorrenti, L., Costa, S., Abramo, A., & Wang, K.T. (2019b). The Italian Version of the Family Almost Perfect Scale: Psychometric Characteristics and Relationships with Academic Engagement, Self-Esteem, and Personal Perfectionism. *Applied Developmental Science*. https://doi.org/10.1080/10888691.2019.1647106
19. Filippello, P., Harrington, N., Costa, S., Buzzai, C., & Sorrenti, L. (2018). Perceived Psychological Control and School Learned Helplessness: the role of frustration intolerance as a mediator factor. *School Psychology International*, *39*(4), 360-377. 10.1177/0143034318775140
20. Filippello, P., Larcan, R., Sorrenti, L., Buzzai, C., Orecchio, S., & Costa, S. (2017). The mediating role of maladaptive perfectionism in the association between psychological control and learned helplessness. *Improving Schools*, *20*(2), 113-126. https://doi.org/10.1177/1365480216688554
21. Filippello, P., Sorrenti, L., Buzzai, C., & Costa, S. (2016a). The Almost Perfect Scale-Revised: An Italian adaptation. *Giornale italiano di psicologia*, *43*(4), 911-932. https://doi.org/10.1421/85584
22. Filippello, P., Spadaro, L., Sorrenti, L., Mafodda, A. V., Drammis, L. (2016b). Processi metacognitivi e di pianificazione in bambini con disortografia [Metacognitive Processes and Planning in Children with Dysorthography]. *Psicologia clinica dello sviluppo, 1,* 83-102. 10.1449/83131
23. Flavell, J.H., Green, F.L., & Flavell, E.R. (1995). *Young children's knowledge about thinking.* Monographs of the Society for the Research in Child Development, 60(1)[243], v–96. https://doi.org/10.2307/1166124
24. Frost, R.O., & Marten, P.A. (1990). Perfectionism and evaluative threat. *Cognitive Therapy and Research*, *14*(6), 559-572. https://doi.org/10.1007/BF01173364
25. Frost, R.O., Marten, P.A., Lahart, C., & Rosenblate, R. (1990). The dimensions of perfectionism. *Cognitive therapy and research*, *14*(5), 449-468. https://doi.org/10.1007/BF01172967
26. Gabriel, F., Buckley, S., & Barthakur, A. (2020). The impact of mathematics anxiety on self-regulated learning and mathematical literacy. *Australian Journal of Education*, *64*(3), 227-242. https://doi.org/10.1177%2F0004944120947881
27. Garofalo, J., & Lester, F.K. (1985). Metacognition, cognitive monitoring, and mathematical performance. *Journal for research in mathematics education, 16*(3), 163-176. https://doi.org/10.2307/748391
28. Grzegorek, J.L., Slaney, R.B., Franze, S., & Rice, K.G. (2004). Self-Criticism, Dependency, Self-Esteem, and Grade Point Average Satisfaction Among Clusters of Perfectionists and Nonperfectionists. *Journal of Counseling Psychology*, *51*(2), 192. https://psycnet.apa.org/buy/2004-12243-006
29. Guner, N. (2012). Using Metaphor Analysis to Explore High School Students' Attitudes towards Learning Mathematics. *Education, 133*, 39-48. https://www.ingentaconnect.com/content/prin/ed/2012/00000133/00000001/art00005
30. Hamachek, D. E. (1978). Psychodynamics of normal and neurotic perfectionism. *Psychology: A Journal of Human Behavior*, *15*(1), 27-33. https://psycnet.apa.org/record/1979-08598-001

31. Hewitt, P. L., & Flett, G. L. (1991). Dimensions of perfectionism in unipolar depression. *Journal of abnormal psychology*, *100*(1), 98-101. https://psycnet.apa.org/doi/10.1037/0021-843X.100.1.98.
32. Hu, L.T., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1–55. https://doi.org/10.1080/10705519909540118
33. IBM SPSS (2010). *Statistics for Windows, Version 19.0*. Armonk, NY: IBM Corp.
34. Kurtovic, A., Vrdoljak, G., & Idzanovic, A. (2019). Predicting Procrastination: The Role of Academic Achievement, Self-efficacy and Perfectionism. *International Journal of Educational Psychology*, *8*(1), 1-26. http://dx.doi.org/10.17583/ijep.2019.2993
35. Legg, A.M., & Locker Jr, L. (2009). Math performance and its relationship to math anxiety and metacognition. *North American Journal of Psychology*, *11*(3), 471-486.
36. Lucangeli, D., Galderisi, D., & Cornoldi, C. (1995). Specific and general transfer effects following metamemory training. *Learning Disabilities Research & Practice*, *10*(1), 11–21. https://psycnet.apa.org/record/1995-35039-001
37. Madigan, D. J. (2019). A meta-analysis of perfectionism and academic achievement. *Educational Psychology Review*, 1-23. https://doi.org/10.1007/s10648-019-09484-2
38. Mills, J.S., & Blankstein, K.R. (2000). Perfectionism, intrinsic vs extrinsic motivation, and motivated strategies for learning: A multidimensional analysis of university students. *Personality and Individual Differences*, *29*(6), 1191-1204. https://doi.org/10.1016/S0191-8869(00)00003-9
39. Moore, K.A. (2010). Gender and the differential effects of active and passive perfectionism on mathematics anxiety and writing anxiety. *Cognition, Brain, & Behavior: An Interdisciplinary Journal, 14*(4), 333–345.
40. Muyan, M., & Chang, E. C. (2015). Perfectionism as a predictor of suicidal risk in Turkish college students: Does loneliness contribute to further risk?. *Cognitive Therapy and Research*, *39*(6), 776-784. https://doi.org/10.1007/s10608-015-9711-7
41. Palincsar, A.S., & Brown, D.A. (1990). *Metacognizione e disabilità di apprendimento [Metacognition and learning disability]*. In D. Ianes (Ed.), *Ritardo mentale e apprendimenti complessi [Mental retardation and complex learning]* (pp.109-133). Trento: Erickson.
42. Paris, S.G., Cross, D.R., Jacobs, J.E., Oka, E.R., DeBritto, A.M., & Saarnio, D.A. (1984). Improving children's metacognition and reading comprehension with classroom instruction. In *Research colloquium presented at the annual meeting of the American Educational Research Association, New Orleans, LA.*
43. Park, H.J. (2009). Validation of the almost perfect scale-revised. *Korean Journal of Counseling and Psychotherapy*, *21*, 131-149.
44. Pourmoslemi, A., Erfani, N., & Firoozfar, I. (2013). Mathematics anxiety, mathematics performance and gender differences among undergraduate students. *International Journal of Scientific and Research Publications*, *3*(7), 1-6.
45. Puteh, M., & Khalin, S. Z. (2016). Mathematics anxiety and its relationship with the achievement of secondary students in Malaysia. *International Journal of Social Science and Humanity*, *6*(2), 119-122. https://doi.org/10.7763/IJSSH.2016.V6.630

46. Reeve, J. (2009) Why teachers adopt a controlling motivating style toward students and how they can become more autonomy supportive. *Educational Psychologist*, *44*(3), 159–175. 10.1080/00461520903028990
47. Rice, K.G., Ashby, J.S., & Slaney, R.B. (1998). Self-esteem as a mediator between perfectionism and depression: A structural equations analysis. *Journal of counseling psychology*, *45*(3), 304-314. https://psycnet.apa.org/doi/10.1037/0022-0167.45.3.304
48. Rice, K.G., & Preusser, K.J. (2002). The adaptive/maladaptive perfectionism scale. *Measurement and evaluation in Counseling and Development*, *34*(4), 210-223.
49. Rice, K.G., & Slaney, R.B. (2002). Clusters of perfectionists: Two studies of emotional adjustment and academic achievement. *Measurement and Evaluation in Counseling and Development*, *35*(1), 35.
50. Richardson, F.C., & Suinn, R.M. (1972). The Mathematics Anxiety Rating Scale: Psychometric data. *Journal of Counseling Psychology*, *19*(6), 551- 554. https://psycnet.apa.org/doi/10.1037/h0033456
51. Saricam, H., & Ogurlu, Ü. (2015). Metacognitive Awareness and Math Anxiety in Gifted Students. *Cypriot Journal of Educational Sciences*, *10*(4), 338-348. https://eric.ed.gov/?id=EJ1140948
52. Seipel, S., & Apigian, C. (2005). Perfectionism in Students: Implications in the Instruction of Statistics, Journal of Statistics Education Volume 13, Number 2, Retrieved July 12, 2007, from: ww.amstat.org/publications /jse/v13n2/seipel.html.
53. Sierens, E., Vansteenkiste, M., Goossens, L., Soenens, B., & Dochy, F. (2010). The synergistic relationship of perceived autonomy support and structure in the prediction of self-regulated learning. *British Journal of Educational Psychology*, *79*(1), 57–68. 10.1348/000709908X304398
54. Sirin, S.R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of educational research*, *75*(3), 417-453. https://doi.org/10.3102%2F00346543075003417
55. Slaney, R.B., & Ashby, J.S. (1996). Perfectionists: Study of a criterion group. *Journal of Counseling & Development*, *74*(4), 393-398. https://doi.org/10.1002/j.1556-6676.1996.tb01885.x
56. Slaney, R.B., Rice, K.G., Mobley, M., Trippi, J., & Ashby, J.S. (2001). The revised almost perfect scale. *Measurement and evaluation in counseling and development*, *34*(3), 130.
57. Soleymani, B., & Rekabdar, G. (2010). The relationship between perfectionism dimensions and mathematics performance in Iranian students. *Procedia-Social and Behavioral Sciences*, *8*, 453-457. https://doi.org/10.1016/j.sbspro.2010.12.062
58. Sorrenti, L., Filippello, P., Costa, S., & Buzzai, C. (2015a). A psychometric examination of the Learned Helplessness Questionnaire in a sample of Italian school students. *Psychology in the Schools, 52*(9), 923–941. 10.1002/pits
59. Sorrenti, L., Filippello, P., Buzzai, C., & Costa, S. (2015b). Tolleranza alla frustrazione e benessere psicologico: quale relazione? [Frustration tolerance and psychological well-being: what relation?]. *Psicologia della Salute, 3,* 65-86. 10.3280/PDS2015-00300
60. Stoeber, J. (2015). How other-oriented perfectionism differs from self-oriented and socially prescribed perfectionism: Further findings. *Journal of Psychopathology and Behavioral Assessment*, *37*(4), 611-623. https://doi.org/10.1007/s10862-013-9397-7

61. Stoeber, J., & Otto, K. (2006). Positive conceptions of perfectionism: Approaches, evidence, challenges. *Personality and social psychology review*, *10*(4), 295-319. https://doi.org/10.1207%2Fs15327957pspr1004_2
62. Stornelli, D., Flett, G., & Hewitt, P. (2009). Perfectionism, achievement, and affect in children: A comparison of students from gifted, arts, and regular programs. *Canadian Journal of School Psychology, 24*, 267–283. 10.1177/0829573509342392
63. Stumpf, H., & Parker, W.D. (2000). A hierarchical structural analysis of perfectionism and its relation to other personality characteristics. *Personality and individual differences*, *28*(5), 837-852. https://doi.org/10.1016/S0191-8869(99)00141-5
64. Suddarth, B.H., & Slaney, R.B. (2001). An investigation of the dimensions of perfectionism in college students. *Measurement and Evaluation in Counseling and development*, *34*(3), 157.
65. Sumpter, L. (2017). What Is Perfectionism in Mathematical Task Solving?. In *Teaching and Learning in Maths Classrooms* (pp. 243-252). Springer, Cham.
66. Tapia, M., & Marsh, G. E. (2004). The relationship of math anxiety and gender. *Academic Exchange Quarterly*, *8*(2), 130-134. http://www.higher-ed.org/AEQ/5may2690l4.htm
67. Tsui, J. M., & Mazzocco, M. M. (2007). Effects of math anxiety and perfectionism on timed versus untimed math testing in mathematically gifted sixth graders. *Roeper Review*, *29*(2), 132-139. https://doi.org/10.1080/02783190709554397
68. Vavilova, A. (2018). The Typology of Perfectionism in Adolescents. *Problems of modern psychology, 42*, 31-49. https://doi.org/10.32626 2227-624.2018-42.3
69. Zakaria, E., & Nordin, N. M. (2008). The Effects of Mathematics Anxiety on Matriculation Students as Related to Motivation and Achievement. *Eurasia Journal of Mathematics, Science & Technology Education*, *4*(1), 27-30.
70. Yurtseven, N., & Akpur, U. (2018). Perfectionism, Anxiety and Procrastination as Predictors of EFL Academic Achievement: A Mixed Methods Study. *Novitas-ROYAL (Research o.n Youth and Language)*, *12*(2), 96-115. https://eric.ed.gov/?id=EJ1195277
71. Wang, K.T., Slaney, R.B., & Rice, K.G. (2007). Perfectionism in Chinese university students from Taiwan: A study of psychological well-being and achievement motivation. *Personality and Individual Differences*, *42*(7), 1279-1290. https://doi.org/10.1016/j.paid.2006.10.006
72. Zhou, D., Du, X., Hau, K. T., Luo, H., Feng, P., & Liu, J. (2020). Teacher-student relationship and mathematical problem-solving ability: mediating roles of self-efficacy and mathematical anxiety. *Educational Psychology*, *40*(4), 473-489. https://doi.org/10.1080/01443410.2019.1696947

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