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Attachment to parents and math anxiety in early adolescence: Hope and perceived school climate as mediators

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Abstract

This study was based on a sequential explanatory mixedmethod research design to build an understanding of the relationships among attachment to parents, hope, perceived school climate, and math anxiety in early adolescents by proposing a multiple mediation model. In the quantitative part, a total of 300 secondary school students (55% girls and 44% boys) participated in the study. The mean age of the adolescents was 12.70 years (SD: 0.78). The participants were recruited from five middle schools in Turkey. In the qualitative part, semi-structured interviews were conducted with 10 students. The qualitative data were analyzed by content analysis. The results showed that there was a positive relationship among attachment to parents, hope, and perceived school climate, and all variables negatively correlated with math anxiety. The findings from the mediational analyses also indicated that the serial multiple mediation of hope and perceived school climate in the hypothetical model was statistically significant. Moreover, it was observed that the qualitative findings supported the established relationships among the variables and the mediational analyses.

Keywords Attachment to parents · Hope · Perceived school climate · Math anxiety

Introduction

Anxiety disorder is a significant problem in the development of children and adolescents. As a cognitive process anxiety refers to negatively evaluated thoughts and images associated with potential threats or dangers (Borkovec 1985). Anxiety is common in children, but in most cases, it is experienced for a short time and then disappears (Craske 1997). On the other hand, the children who are classified as overanxious are more concerned and anxious than other children (Silverman et al. 1995). As intense anxiety can interfere with current and future well-being and the adjustment of children and adolescents (Graczyk et al. 2005) it is important to determine risk and the protective factors for anxiety mood. In this research study, it is aimed to examine protective factors for math anxiety which has crucial effects not only on the academic development of individuals but also on their career choice, employment, and professional success (Ma 1999).

Math Anxiety Math anxiety is defined as "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson and Suinn 1972, p. 551). As it is understood from this definition, although mathematics anxiety is related to general anxiety, it differs from other forms of anxiety and general anxiety. A study reporting brain activity patterns specific to mathematics anxiety illustrated this differentiation (Young et al. 2012). It is critical to examine mathematics anxiety, explained by Tobias (1998) as "I can't syndrome" referring to the feeling of the inability in mathematics or with numbers because it has a power to negatively affect the students' motivation and success (Bekdemir 2010; Zakaria and Nordin 2008). In this respect, it can be stated that mathematics anxiety has cognitive and affective aspects (Ashcraft and Faust 1994; Bessant 1995). Considering its emotional aspects, previous research emphasized the connection of mathematics anxiety with performance-related anxiety (Ashcraft and KirkDowker 2001; Dowker et al. 2016). Mathematics anxiety can fall

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under the classification of state anxiety, i.e. "the unpleasant emotional state or condition which is characterized by activation or arousal of the autonomic nervous system" (Spielberger 1972, p. 482) since it depends on time and case, and enhances in case of perceived dangerous situations (Isiksal et al. 2009; Spielberger 1972). Negative emotional reactions are displayed when an individual engages in mathematical tasks and mathematical reasoning, and these people tend to keep away from the activities and processes related to mathematics (Ashcraft 2002; Ashcraft et al. 2007).

Because of the important effects of mathematics anxiety on students, many studies have been carried out to examine its causes. In the study by Hadfield and McNeil (1994), the reasons for mathematics anxiety were examined in three main groups: environmental, intellectual, and personality traits. In the first group, the intellectual issues are related to negative attitudes towards mathematics, a low level of strength of purpose about mathematical ability, and the doubt about own potential of mathematical performance. In line with this view, hope can be proposed as the main source for the intellectual issues associated with mathematics anxiety. In the second group, that is, the one involving environmental issues, mathematics anxiety is caused by the negative events experienced in classrooms, the parental forcing, the teachers' senseless actions or responses, and the classroom environments not supporting the students' actions and democratic classroom atmosphere. Mathematics anxiety can result from peers, teachers, and their teaching (Stuart 2000; Vinson 2001). Moreover, insufficient and negative family support can cause mathematics anxiety (Stuart 2000). Besides, Harper and Daane (1998) emphasize the factors such as rough classroom norms and atmosphere, pressure about mathematics achievement, non-logical activities, and the problems that students engage in the process of learning mathematics. Moreover, Jackson and Leffingwell (1999) assert that unfriendly teacher behaviors towards students and the pressure of teachers on students to have high achievement, ignoring their potential and individual differences, affect students' mathematics anxiety. In the last group, i.e., the one regarding personality traits, mathematics anxiety can result from being unwilling to ask questions about mathematics due to bashfulness and not having self-respect at the required level. In line with this view, students' beliefs and perceptions can be accepted as personality traits. Hence, the perceptions of students about their teachers, classroom applications, and their peers, which constitute the classroom atmosphere, can cause mathematics anxiety.

Attachment Styles The relationship between children and their parents is crucial in terms of the social and emotional development of children (Maccoby 2007). The attachment theory originating in the work of Bowlby (1969/1982) emphasizes the relationships with important attachment figures. In this theory, "Internal Working Models" (IWMs) refers to "self" and "other perceptions" which develop in the first age. Bowlby (1973) indicated that children develop a secure attachment pattern (sees self as competent and others as trustworthy) when they access caring, responsive, and available attachment figures. In contrast, when infants fail to access the availability and responsiveness of attachment figures, they develop an insecure attachment pattern (sees self as incompetent and others as not trustworthy).

Secure and insecure attachment patterns have a crucial role in children's anxiety. As securely attached children have confidence that the caregiver will respond to their needs and provide a safe haven, they are less prone to develop anxiety (Kerns and Brumariu 2014). Conversely, the failure to develop a secure-based attachment to a caregiver in childhood is an important risk factor for developing anxiety, which was conceptualized as "free-floating anxiety" by Bowlby (1973). Previous studies consistently showed that insecure attachment style is related to anxiety disorders in children and adolescents (Brumariu and Kerns 2013; Muris et al. 2000a; Shamir-Essakow et al. 2005). A meta-analysis study, including 46 studies and 8907 children, conducted by Colonnesi et al. (2011) also revealed that attachment orientation was associated with anxiety.

Parents can be accepted as a prominent factor affecting mathematics performance, interest, and anxiety (Chang and Beilock 2016; Chiu and Xihua 2008; Maloney et al. 2015). A previous study reported that parental involvement in mathematical tasks performed at home could influence the students' mathematics achievement and motivation (Berkowitz et al. 2015). In line with this view, attachment to parents can cause mathematics anxiety. The following factors can affect mathematics anxiety: Attachment styles observed through the parents as role models while students are engaging in mathematical tasks and homework, parenting style, reinforcing or over-controlling the children, parents' mathematics anxiety, and mathematical background, their expectations from children to socialize or represent mathematics achievement (Batchelor et al. 2017; Chiu and Xihua 2008; Macmull and Ashkenazi 2019; Maloney et al. 2015; Vukovic et al. 2013). More specifically, to illustrate the relationship between attachment and math anxiety, the first study was carried out by Bosmans and De Smedt (2015) in the literature. The authors found that insecure attachment pattern correlated with math anxiety. In line with the previous research, the current study aims to examine the roles of hope and perceived school climate in the relationship between attachment and math anxiety.

The Mediating Role of Hope One individual difference connected to both attachment and anxiety is hope. In Snyder's hope theory, hope is defined as "positive motivational state that is based on an interactively derived sense of successful (a)

agency (goal-directed energy) and (b) pathways (planning to meet goals)" (Snyder et al. 1991a, p. 287). In this definition, *agency* signifies the motivational component including one's appraisal of capacity to pursue a goal. *Pathways thoughts* refer to generating workable routes exemplified as "I'll find a way to get this done!" (Snyder et al. 1998).

Snyder (2000) stated that "high-hope children are social creatures, and their ability to connect appears to come from early strong attachments to primary caregivers." (p. 31). Research has also provided evidence that secure attachment and hopeful thinking are closely associated. For example, Jiang et al. (2013) found, on a sample of 565 middle school students, that attachment and hope correlated positively and also hope had a mediation role between attachment and life satisfaction. A study by Otis et al. (2016) also showed that the pattern of parental attachment contributed to the individual differences in hope scores. Furthermore, the authors reported that hope was negatively associated with stressful life events. In a recent study by Demirtaş (2019), it was also demonstrated that the secure attachment style was associated with the hope scores of early adolescents, and the securely attached and hopeful adolescents had higher self-efficacy beliefs.

Based on a premise that hope is a dispositional cognitive set, it is stated in the theory that the cognitive and emotion-based dispositional measures including anxiety are predicted by the hope scale (Snyder et al. 1991b). Previous studies have also provided evidence that hope and anxiety are negatively interrelated. A longitudinal study by Arnau et al. (2007) showed that *agency* component of hope had a negative effect on later anxiety. Carretta et al. (2014) also found negative correlations between hope and both state and trait anxiety on a sample of mental health patients. A study conducted by Arslan et al. (2018) showed, on a sample of middle school students, that the students with high hope levels had low anxiety scores. These findings suggest that the characteristics of hopeful individuals including goal-oriented agentic and pathways thinking (Snyder et al. 1991b) help them experience less negative emotions. Previous research indicated that the students having a high level of hope were likely to analyze and implement various useful strategies to achieve their goals by being resistant to the difficulties through facing problems and challenging situations (Arnau et al. 2007; Aspinwall and Leaf 2002; Snyder et al. 1991a). These students differentiate from those having mathematics anxiety since the students having mathematics anxiety tend to avoid engaging in mathematical tasks and solving mathematical problems (Gresham 2008; Vinson 2001). At this point, it can be asserted that the students having mathematics anxiety tend to have low levels of hope by avoiding mathematical tasks, and challenges and being an easy quitter in mathematics.

The Mediating Role of Perceived School Climate How does perceived school climate relate to adolescents' attachment to their parents, hopeful thoughts, and math anxiety? School climate is a multi-dimensional construct (Suldo et al. 2012). According to the National School Climate Council (2007), perceived school climate includes "patterns of school life experiences and reflects norms, goals, values, interpersonal relationships, teaching, learning and leadership practices, and organizational structures" (p. 5). A number of studies have demonstrated that perceived quality of school climate is associated with social adjustment (Kuperminc et al. 1997), conduct problems and depressive symptoms (Loukas and Robinson 2004), and self-reported mental health of adolescents (Suldo et al. 2012). In a longitudinal study conducted by Way et al. (2007) on a sample of 1451 early adolescents, it was demonstrated that the decrease in perceived school climate was linked to the decrease in psychological and behavioral adjustment. In another study (Liu 2012), it was demonstrated that the perceptions of high school students about the relationships with their teachers and other students were negatively associated with their test anxiety. Peers, teachers, and classroom applications, which constitute the classroom atmosphere, can be accepted as the sources of mathematics anxiety (Stuart 2000; Vinson 2001). Tough classroom applications and rules, enactment of exams, and teachers' grading strategies can cause mathematics anxiety. In other words, mathematics anxiety can be activated by the experiences acquired through the teachers' own anxiety and rigid applications such as forming a classroom environment based on the traditional teaching strategy featuring high mathematics achievement demands and low cognitive and motivational support (Bekdemir 2010; Turner et al. 2002). Also, the mathematical tasks and problems which are not related to real-life can increase mathematics anxiety (Harper and Daane 1998). In classrooms and schools, the pressure by peers can also increase mathematics anxiety (Stuart 2000).

Attachment theory maintains that, through early intimate relationships, children develop either secure (sees self as competent and others as trustworthy) or insecure (sees self as incompetent and others as not trustworthy) working models (Bowlby 1973). The internal working model of the individuals serves a guide in their expectations and behaviors in terms of the self-in-relationships to others (Allen et al. 2004). Prior research confirms this notion. A study conducted by Shochet et al. (2007) found that the perceptions of school environment and school connectedness were strongly predicted by the adolescents' parent attachment. Oldfield et al. (2016) also reported that parental and peer attachment and school connectedness were interrelated, and these variables were associated with the emotional difficulties of the adolescents.

Hope is another construct associated with perceived school climate. A study conducted by Padilla-Walker et al. (2011) demonstrated that hope served as a mediator in the relationship between child-reported parent-child connectedness and school engagement. You et al. (2008) found that hope

predicted life satisfaction of adolescents via school connectedness. Worrell and Hale (2001) also examined the role of hope in the relationships with school climate and school dropouts and found that the hopeful thoughts predicted dropout versus the graduate status of the students.

The Current Study

Early adolescence is a critical period in lifelong development (Arnett 2000). The relationship between children and their parents affects the social and emotional development of children (Maccoby 2000). Based on the theoretical support and explanations above, the current study predicted that the securely attached adolescents would have high levels of hope, perceive the school climate positively, and, as a result, be less likely to have math anxiety. As the associations between these variables were considered to have crucial effects on math anxiety of early adolescents, it was supposed that hope and perceived school climate could mediate the relationship between attachment to parents and math anxiety (Fig. 1).

In the present study, it was aimed to propose a structural model explaining the relationship among attachment to parents (as a source classified as an environmental issue) and mathematics anxiety with the mediators of hope (as the main source classified as an intellectual issue) and perceived school climate (as a source classified as a personality trait). In other words, by the model proposed and explored in the current study, it is possible to provide insights into the studies related to mathematics anxiety by examining to what extent and how these main factors selected from three sources of mathematics anxiety can predict mathematics anxiety. In this respect, the present study differentiates from the previous research by examining all these issues based on their connections and providing a theoretical base. Moreover, the present study is different from the previous research in that it reports the main sources of mathematics anxiety by focusing on the connections among these sources and the values of these connections to predict mathematics anxiety.

In order to clearly report the relationships in the present study; gender, an important factor for mathematics anxiety, was identified as a covariate variable. The previous studies have shown that females tend to have a higher level of mathematics anxiety than males and students' mathematics anxiety levels are likely to rise with the age (Devine et al. 2012; Dowker et al. 2012; Hembree 1990). Because of the need for a study examining the effects of gender differences on mathematics anxiety and their ways (Dowker et al. 2016), the variable of gender is placed as a covariate in the analysis. Moreover, the expectations of parents and teachers from males about mathematics performance and interest are higher than those from females (Gunderson et al. 2012). Mothers tend to believe that male students are more successful in mathematics (Yee and Eccles 1988). It can be stated that gender-biased beliefs can affect school climate and attachment to parents as well as mathematics anxiety. Based on the connections of gender with other variables of the present study, gender was accepted as the covariate of the study.

Method

To establish the relationships among attachment to parents, hope, perceived school climate, and math anxiety in early adolescents by proposing a multiple mediation model in detail, the present study was designed based on a sequential explanatory mixed-method research design. In this mixed-method research design, the report was prepared by dominating the quantitative data over the qualitative data to propose a detailed and holistic picture of the mediation model (Creswell

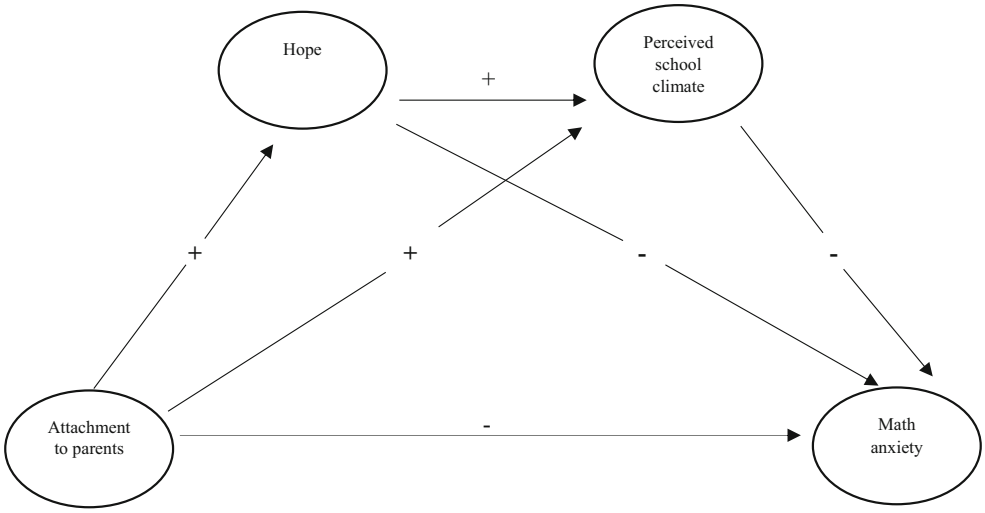

Fig. 1 *Hypothesized Model*

2013). In the quantitative part of the study, the relationships among attachment to parents, hope, perceived school climate, and math anxiety in early adolescents were explored and illustrated by proposing a multiple mediation model. Then, in the qualitative part, the qualitative data were used in order to provide evidence for the relationships among variables and identify the strengths of these relationships.

Participants

In the quantitative part of the present study, a total of 300 middle school students [55% girls and 44% boys, aged 11–14 years] participated in the study. The convenient sampling was used to choose the participants of the research. Cohen et al. (2011) stated that the convenience sampling refers to "choosing the nearest individuals to serve as respondents and continuing that process until the required sample size has been obtained or those who happen to be available and accessible at the time" (p. 155). The participants of the current research were the students enrolled in grades 7 and 8 (7th = 116 students, 8th = 184 students) in 5 different state secondary schools in Antalya, Turkey. The schools are located in Alanya, one of the tourist city on the southern coast of Turkey. Following the principles for research ethics, permission was obtained from the Ministry of Education. All students voluntarily participated in the research in classroom settings at their schools. Afterward, 10 middle level grade students who were selected using the cluster random sampling strategy among the students to whom the scale administered participated in the qualitative part of the present study. They were randomly selected from the list of participants of the quantitative part of the study. Then, they participated in the study when they volunteered to be interviewed. Of these students, 4 were 7th graders and 6 were 8th graders, which was determined based on the ratio of 7th graders in 300 students (approximately 40% of 7th grade and 60% of 8th-grade students) participating in the quantitative part of the study.

Measures

Inventory of Parent and Peer Attachment-Short Form (IPPA-S) The IPPA was originated by Armsden and Greenberg (1987) based on Bowlby's theoretical formulations. The inventory has 3 factors: "communication", "trust", and "alienation". The short form of the inventory was developed by Nada Raja et al. (1992). Selçuk et al. (2005) examined the psychometric properties of this scale on a sample of Turkish university students by using factor analysis, test-retest reliability, Cronbach's alpha reliability, and criterion validity. Although the original three-factor structure did not emerge on the Turkish sample, it was reported that the one-factor structure explained 43.45% of the total variance for the mother form and 46.52% for the father form. Also, Cronbach's alpha reliability coefficients were found as .88 for the mother form and .90 for the father form. As a result of the analyses, it was found that the scale showed a high level of test-retest reliability ($r = .87$, $r = .88$, $p < .01$). Besides, the strong relationship between the mother and father forms of the scale and the positive relationship between self-esteem and attachment to the parent were given as a support for the construct validity of the scale. Bayraktar et al. (2009) also examined the reliability of the scale on an adolescent sample and reported that Cronbach's alpha reliability was .84. The scale includes 12 items for each scale including 6 positive, 6 reverse sentences. In this study, the total score was calculated for each scale. Cronbach's alpha reliability coefficients were found as .76 for the mother form, .83 for the father form in this study.

Children's Hope Scale (CHS) The CHS was composed by Snyder et al. (1997) to evaluate the individual differences in hope. The scale has 6 items, including agency thoughts and pathways thoughts of children. The reliability study was carried out on five samples and the CHS scores were found to range from .72 to .86 (Snyder et al. 1997). Snyder and his colleagues also reported that the CHS presented a convergent, discriminant, and incremental validity. The scale was adapted into Turkish by Atik and Kemer (2009). The authors reported that the Turkish version of the CHS showed good fit indexes likewise the original version (CFA fit index values for two factor structure: X^2 / df = 2.72., RMSA = .004, SRMR = .002, CFI = .99, NFI = .99, AGFI = .98). Cronbach's alpha coefficient was reported as .74 and the test-retest reliability as .57. In the current study, Cronbach's alpha reliability was calculated as .79.

Perceived School Experiences Scale (PSES) The PSES was developed by Anderson-Butcher et al. (2012) to evaluate adolescents' perceptions of school climate in terms of "school connectedness", "academic press", and "academic motivation". The psychometric properties were examined on 387 middle and high school students and it was reported that the 14-item scale including 3 factors showed an acceptable factor structure and test-retest reliability (r = .89). The psychometric properties of the Turkish version of the scale were examined by Baytemir et al. (2015) on a sample of adolescents in terms of construct validity, criterion validity, test-retest reliability and, Cronbach's alpha reliability. The authors reported that the Turkish version of the scale showed a three-factor structure likewise the original version (CFA fit index values: X^2 / df = 2.87, RMSA = .057, SRMR = .039, CFI = .99, NFI = .98, GFI = .94, AGFI = .92). Cronbach's alpha reliability was calculated as .93 and the test-retest reliability was found as .81 for the total score (Baytemir et al. 2015). In the current study,

the total score was calculated. Cronbach's alpha reliability was found as .90.

Math Anxiety Scale for Elementary School Students (MASESS) The MASESS was originated by Bindak (2005) to assess math anxiety of adolescents. The scale was developed on 117 seventh grade students. Bindak (2005) reported that the exploratory factor analysis results showed that the 10-item-scale including one factor explained 51,7% of the total variance in math anxiety, and Cronbach's alpha coefficient was calculated as .84. In the current study, Cronbach's alpha coefficient was found as .89.

Semi-Structured Interview Protocol To examine the students' beliefs about the relationship among the variables examined in the present study and metaphors used by them for school and mathematics, eight interview questions were prepared by the researchers. Of these questions, one asked the metaphor that could be used for the school and another one asked the metaphor used for mathematics. The probing questions for these questions were prepared to make them explain the connection of the school/mathematics with the used metaphor. The remaining questions asked the relationship between the variables of secure attachment, hope, mathematics anxiety, and perceived school experience. All of these interview questions were prepared based on the literature and previous research about these variables. Then, three experts (from the fields of Mathematics Education, Turkish Language Education, and Psychological Counseling and Guidance) different from the researchers of the present study reviewed and evaluated the interview questions. Based on their comments, the questions were revised. Afterward, the revised version of the interview questions was used in the study (see Appendix).

Procedure

The quantitative data were collected by administering the following form/scales to the students: The Inventory of Parent and Peer Attachment- Short Form (IPPA-S), The Children's Hope Scale (CHS), The Perceived School Experiences Scale (PSES) and The Math Anxiety Scale for Elementary School Students (MASESS). The quantitative data collection process lasted approximately 40 minutes. Afterward, the semi-structured interviews (see Appendix) were conducted with 10 volunteer students selected using the cluster random sampling strategy to collect the qualitative data. These students were interviewed in the arranged meetings. Each interview lasted approximately 30 minutes and was recorded using audio-recordings. In these interviews, they were initially informed about the purpose of the study, the content of the interview questions, their rights, and the confidentiality of their explanations. Then, the semi-structured interviews were progressed by asking the questions (see Appendix). They talked about the metaphors related to the school and mathematics, their perceptions and beliefs about their attachment to their parents, school experiences, mathematics anxiety, and hope. After completing the interviews, the audio recordings of the interview processes were transcribed verbatim.

Data Analysis

Statistical Analyses Descriptive statistics, Pearson's correlation method, an approach based on Ordinary Least Squares Regression, and Bootstrapping were used in the analyses of the quantitative data. Although 300 participants completed the instruments, some values were missing because 1 participant did not respond to the mother form and 6 participants did not respond to the father form of the IPPA-S. Mahalanobis distance values were calculated r to determine the outliers and no extreme outliers were found. The values of kurtosis and skewness were calculated to prove normal univariate distribution. As the values of skewness and kurtosis were within the acceptable range of −1.5 to +1.5 (as shown in Table 1), it was concluded that the scores did not significantly deviate from the normal distribution (Tabachnick and Fidell 2013).

PROCESS macro (Hayes 2009) which involves "simultaneous mediation by multiple variables" (Preacher and Hayes 2008, p. 880) was used in this study. There were some justifications for using the PROCESS macro in this study. First, this technique is practical in analyzing many types of models. According to Hayes et al. (2017), "Any SEM program can do path analysis with observed variables as PROCESS does, although most require more code (and the skill to write that code) than what is required to generate many of the statistics that PROCESS produces automatically." (p. 78). Second, Hayes (2013) showed that PROCESS and SEM yielded identical results. Hayes (2009) states, "if zero is not between the lower and upper bound, then the analyst can claim that the indirect effect is not zero with ci% confidence." (p. 412). Also, a contrast test was used to determine the specific indirect of the variables and the strongest mediator in the model. The Bootstrapping analyses of the study were conducted by "Multiple Mediation Model 6" through PROCESS Macro 3 using IBM SPSS 24.0 (Hayes 2017). A p value of <.05 was considered statistically significant.

Qualitative Data Analysis The semi-structured interviews designed for collecting the qualitative data were analyzed using the content analysis technique. The content analysis

Table 1 Descriptive statistics and Pearson correlation coefficients for the variables

Variables	N	Mean	Sd.	Skew	Kur	1	2	3	4	5
1. Attachment to mother	299	59.24	8.79	−1.12	1.44	–				
2. Attachment to father	294	56.78	11.07	−1.11	1.27	.59**	–			
3. Hope	300	27.75	6.24	−.91	.56	.39**	.42**	–		
4. Perceived school climate	300	55.65	10.84	−.70	−.11	.37**	.32**	.68**	–	
5. Math anxiety	300	25.68	10.62	.45	−.83	-.36**	-.31**	-.51**	-.45**	–

**$p < 0.01$

process was performed following the six steps proposed by Marshall and Rossman (1999). In the first step, the qualitative data on the transcripts were organized. In the second step, the researchers having a Ph.D. degree in Mathematics Education and Psychological Counseling and Guidance read and reviewed the transcripts. They explored and identified the significant explanations and quotes to establish the codes related to the patterns on the transcribed data. In the third step, the researchers arranged a meeting and discussed the codes they identified independently. They formed a common list of codes by 98% consistency level calculated by the formula of "[(agreement)/(agreement+dissensus)] × 100" proposed by Miles and Huberman (1994). Through discussion, they directly added the common codes to the list. However, the codes and themes involving dissensus were discussed until the researchers reached a consensus. 2% of the codes and themes were removed and not placed on the list. Afterward, the common list was formed with a consistency level of 98%. In the fourth step, the transcripts were analyzed using this common list by the content analysis. In the fifth step, the patterns and connections among the codes were explored and analyzed. The related codes were put together and placed under the titles of the themes. In the last step, the analysis report was formed and presented in the findings section of the study.

To ensure trustworthiness in the qualitative data analysis part of the study, the qualitative data collected through the semi-structured interviews were analyzed by two researchers. They formed their list of codes independently and then prepared a common list of codes through discussions in a meeting. Then, they analyzed the qualitative data using this list independently. Hence, evidence for trustworthiness was provided using the investigator triangulation technique. Furthermore, an academician who was not one of the researchers taking a role in the processes of preparing the list of codes analyzed and evaluated the content analysis process in terms of its coherence and consistency. Hence, another evidence was provided by taking expert opinion. Moreover, with the help of member-checking strategy, the students were asked about the interpretations made based on the data analysis (Creswell 2013).

Results

Descriptive Statistics and Correlations

Pearson's correlation coefficients were utilized to determine the relationships among the variables. The means, standard deviations, and correlations are presented in Table 1.

Table 1 shows that attachment to mother, attachment to father, hope, and perceived school climate are positively correlated. All the variables are negatively correlated with math anxiety.

Mediation Model Analyses.

As presented in Fig. 2, the total effect of attachment to mother on math anxiety is statistically significant ($c = -.43$, SE = .06., $t = -6.37$, $p < .001$) (step 1). The direct effects of attachment to mother on hope ($B = .27$, SE = .03, $t = 7.22$, $p < .001$) and perceived school climate ($B = .14$, SE = .05, $t = 2.62$, $p < .01$), as well as the direct effect of hope (the first mediating variable) on perceived school climate (the second mediating variable) ($B = 1.10$, SE = .07, $t = 14.01$, $p < .001$) are statistically significant (step 2). In addition, the direct effects of hope ($B = -.57$, SE = .11, $t = -4.99$, $p < .001$) and perceived school climate ($B = -.16$, SE = .06, $t = -2.43$, $p < .01$) on math anxiety are also statistically significant (step 3). When attachment to mother and two mediating variables were entered simultaneously into the model (step 4), the significant relationship between attachment to mother and math anxiety decreased, but the significance level did not change ($c' = -.20$, SE = .06, $t = -3.15$, $p < .001$). These results support the mediational hypothesis. The model is statistically significant ($F_{(3–295)} = 32.95$, $p < .001$) and explains approximately 31% of the variance in math anxiety.

Note. $N = 294$, $R^2 = .29$, $F_{(3–290)} = 30.24$, $p < .001$*$p < .05$, **$p < .01$, *** $p < .001$.

As presented in Fig. 3, the total effect of attachment to father on math anxiety is statistically significant ($c = -.29$, SE = .05., $t = -5.51$, $p < .001$) (step 1). The direct effect of attachment to father on hope ($B = .24$, SE = .02, $t = 7.98$,

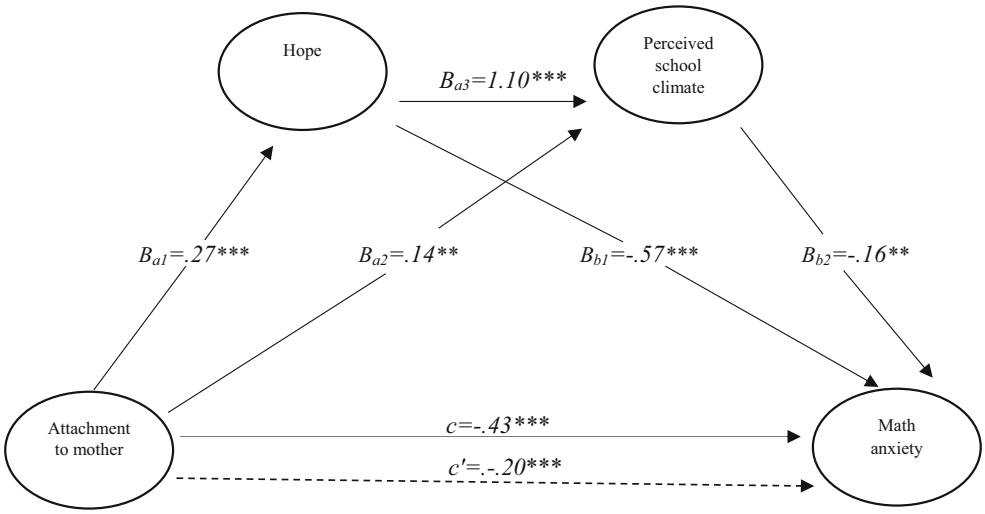

Fig. 2 The serial mediation of hope and perceived school climate in the relationship between attachment to mother and math anxiety

$p < .001$) is statistically significant but its effects on perceived school climate ($B = .03$, SE = .04, $t = 82$, $p > .05$) is not statistically significant. The direct effect of hope (the first mediating variable) on perceived school climate (the second mediating variable) ($B = 1.15$, SE = .08, $t = 13.88$, $p < .001$) is statistically significant (step 2). In addition, the direct effects of hope ($B = -.57$, SE = .12, $t = -4.72$, $p < .001$) and perceived school climate ($B = -.19$, SE = .06, $t = -2.94$, $p < .01$) on math anxiety are also statistically significant (step 3). When attachment to father and two mediating variables were entered simultaneously into the model (step 4), the significant relationship between attachment to father and math anxiety decreased, but the significance level did not change ($c' = -.10$, SE = .05, $t = -1.99$, $p < .05$). These results support the mediational hypothesis. The model is statistically significant ($F_{(3-290)} = 30.24$, $p < .001$) and explains approximately 29% of the variance in math anxiety.

Indirect Effects of Attachment to Parents on Math Anxiety through Hope and Perceived School Climate

The comparison of the direct and specific indirect effects of attachment to parents on math anxiety through hope and perceived school climate is presented in Tables 2 and 3.

The indirect effects were tested using bootstrapping with 10,000 bootstrap samples. The estimates were taken within 95% confidence intervals. The bias-corrected and accelerated results are presented in Table 2. Gender was used as a covariate in the analyses. The total indirect effect (the difference between total and direct effect /c-c') of attachment to mother through hope and perceived school climate on math anxiety was statistically significant (point estimate = −.2304 and 95% BCa CI [−.3109, −.1570]). Besides, the mediators in the hypothesized model were examined individually. The results revealed that the mediation of hope (point estimate = −.1581

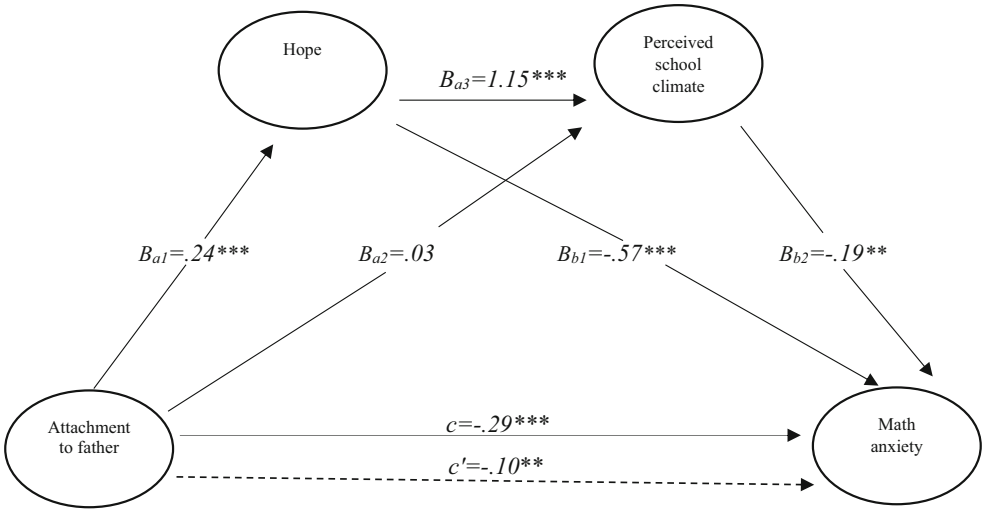

Fig. 3 The serial mediation of hope and perceived school climate in the relationship between attachment to father and math anxiety

Table 2 The comparison of direct and specific indirect effects of attachment to mother on math anxiety through hope and perceived school climate.

Bootstrapping				
	Product of coefficients		95% BCa Confidence Interval	
Effects	Point Estimate	SE	Lower	Upper
Total Indirect Effects	-.2304	.0391	-.3109	-.1570
A.M. ⇨ H. ⇨ M.A.	-.1581	.0413	-.2448	-.0828
A.M. ⇨ P.S.C. ⇨ M.A.	-.0236	.0152	-.0578	.0010
A.M. ⇨ H. ⇨ P.S.C. ⇨ M.A.	-.0487	.0258	-.1034	-.0019
Contrasts				
Model 1 versus Model 2	-.1113	.0416	-.1977	-.0325
Model 1 versus Model 3	-.0905	.0483	-.1888	.0011
Model 2 versus Model 3	.0208	.0175	-.0030	.0641

Note: $N = 299$, $k = 10{,}000$, Control Variables: Gender BCa: Bias corrected and accelerated 10,000 bootstrap samples, A.M. = Attachment to mother, H. = Hope, P.S.C. = Perceived school climate, M.A. = Math anxiety; Model 1 = Attachment to mother – Hope – Math anxiety; Model 2 = Attachment to mother – Perceived school climate – Math anxiety; Model 3 = Attachment to mother – Hope – Perceived school climate – Math anxiety.

and 95% BCa CI [−.2448, −.0828]) and the multiple mediation of hope and perceived school climate (point estimate = −.0487 and 95% BCa CI [−.1034, −.0019]) were also statistically significant. On the other hand, the mediation of perceived school climate (point estimate = −.0236 and 95% BCa CI [−.0578, .0010]) was not statistically significant. Finally, the strengths of the individual indirect effects against each other were compared. Based on a 95% BCa confidence interval, within the statistically significant comparison, model 1 (the mediation of hope) was stronger than model 2 (the mediation of perceived school climate).

The indirect effects were tested using bootstrapping with 10,000 bootstrap samples. The estimates were taken within 95% confidence intervals. The bias-corrected and accelerated results are presented in Table 3. Gender was used as a covariate in the analyses. The total indirect effect (the difference between total and direct effect /c-c') of attachment to father through hope and perceived school climate on math anxiety

Table 3 The comparison of the direct and specific indirect effects of attachment to father on math anxiety through hope and perceived school climate.

Bootstrapping				
	Product of coefficients		95% BCa Confidence Interval	
Effects	Point Estimate	SE	Lower	Upper
Total Indirect Effects	-.1952	.0363	-.2702	-.1277
A.F. ⇨ H. ⇨ M.A.	-.1347	.0367	-.2117	-.0691
A.F. ⇨ P.S.C. ⇨ M.A.	-.0075	.0107	-.0297	.0149
A.F. ⇨ H. ⇨ P.S.C. ⇨ M.A.	-.0530	.0232	-.1020	-.0111
Contrasts				
Model 1 versus Model 2	-.1220	.0036	-.0194	-.0054
Model 1 versus Model 3	-.0077	.0047	-.0172	.0013
Model 2 versus Model 3	.0043	.0024	.0006	.0097

Note: $N = 294$, $k = 10{,}000$, Control Variables: Gender, Bias corrected and accelerated 10,000 bootstrap samples, A.F. = Attachment to father, H. = Hope, P.S.C. = Perceived school climate, M.A. = Math anxiety; Model 1 = Attachment to father – Hope – Math anxiety; Model 2 = Attachment to father – Perceived school climate – Math anxiety; Model 3 = Attachment to father – Hope – Perceived school climate – Math anxiety.

was statistically significant (point estimate = −.1952 and 95% BCa CI [−.2702, −.1277]). Besides, the mediators in the hypothesized model were examined individually. The results revealed that the mediation of hope (point estimate = −.1347 and 95% BCa CI [−.2117, −.0691]) and the multiple mediation of hope and perceived school climate (point estimate = −.0530 and 95% BCa CI [−.1020, −.0111]) were also statistically significant. On the other hand, the mediation of perceived school climate (point estimate = −.0075 and 95% BCa CI [−.0297, .0149]) was not statistically significant. Finally, the strengths of the individual indirect effects against each other were compared. Based on a 95% BCa confidence interval, within the statistically significant comparison, model 1 (the mediation of hope) was stronger than model 2 (the mediation of perceived school climate).

Metaphors for School and Mathematics

The metaphors were analyzed in terms of whether or not they were valid. An explanation can be accepted as a metaphor only if it has content, and resource and there is a connection between these two (Forceville 2002). The expressions meeting this criterion were accepted as valid metaphors. In the content analysis process, all of the metaphors explained by the students were identified as valid metaphors. The metaphors identified school and mathematics are represented in Table 4.

In Table 4, the first four students were 7th graders and the remaining were 8th graders. When the metaphors produced for school and mathematics were examined by comparing, it was observed that the students providing a metaphor based on positive feelings and attitudes for school tended to suggest metaphor positively for mathematics and vice versa. For example, the student using the metaphor of *home* for the school explained "My school is like my home. Because the teachers are like my mother and father, I feel comfortable in school. I share my feelings and beliefs comfortably. They do not judge me." Then, this student used the metaphor of *the sun* for mathematics. He explained "Mathematics is like the sun. The sun lightens the world and we see and understand the world clearly. Like the sun, mathematics enhances our understanding of the world and other lessons since it has a connection to everything." This student expressed positive feelings and beliefs about the metaphors for both school and mathematics. On the other hand, the student using the metaphor of *the jail* stated "The school is like a jail since the prisoners who lost their freedom must stay in jail and spend their time in this closed place likewise I do in my school." This student using the metaphor of *separating the flesh from the nail* expressed "…understanding the mathematical concepts is too difficult for me. It is extremely hard to solve mathematical problems. In mathematics lessons, I feel overwhelmed." Based on the explanations and metaphors, it was observed that this student expressed negative feelings and beliefs about the metaphors for both school and mathematics. The consistency between the metaphors for school and mathematics could support the quantitative finding of the relationship between perceived school experience and mathematics anxiety.

Qualitative Findings

When the students' answers to the question about their attachment to their parents were examined, it was found that 9 students felt comfortable themselves with their mothers while sharing their ideas and feelings, and spending time. On the other hand, a student stated that she had an attachment to her father. Hence, it could be stated that most of the students could construct their secure attachment to their mothers rather than their fathers.

The categories about the attachment to mother identified in the content analysis were as follows: *spending most of the time, feeling comfortable, receiving a response to their problems kindly, empathic response, talking safely and comfortably, not being forgetful,* and *keeping secret.* The students

Table 4 The metaphors for school and mathematics

Students	Metaphors for school	Metaphors for mathematics
S_1	Game played with geometric solids	Meaning of life
S_2	Home	Pattern
S_3	Strange place	Growing avalanche
S_4	Home	Funny game
S_5	Home	Sun
S_6	Running track	Deadlock
S_7	Books	Perception
S_8	Ocean	Labyrinth
S_9	Library	Individuals
S_{10}	Prison	Separating the flesh from the nail

emphasizing their secure attachment to their mothers made explanations about these categories. Also, they expressed their insecure attachment to their father with the categories of *responding angrily, forgetting everything, not understanding the reasons for the problem,* and *not spending enough time*.

When the explanations of the students using metaphors for school and mathematics with positive feelings were examined, it was found that they tended to talk about the sufficiency of their mothers' support in facing and handling the problems in school and lessons. For example, a student made the following explanation:

S_4: My mother's support was sufficient and important to me. She always helps me and explains how I can solve my problems. Also, she always encourages me and says, "Do not be sad. We will solve it."

Researcher: Can you give a more specific example about it?

S_4: Last year, I had a problem with my friends. It was too sad for me. I did not want to go to school. My mother said "Do not be upset. Go to school and apologize to him since friendship is always valuable". I had not thought to apologize before my mother suggested. I did as she said. Then, he is my best friend now. My mother provided me a wonderful strategy to solve my problem and told me how to solve it and how to talk to my friend.

This student also emphasized the efficiency of his mother's support when he had difficulty in understanding mathematical concepts and solving mathematical problems. He explained how her mother guided and supported her in handling this difficulty. On the other hand, another student using the metaphor of school and mathematics with negative feelings and beliefs was not likely to emphasize the sufficiency of parental support. For example, S_6 using the metaphors in this way expressed the insufficiency of her mother's support. She explained:

> My mother supports me. I think her support is not sufficient. When I have a problem for example with my friends, she says "You can overcome this problem. Do not let it get to you. They do this since they are just jealous of you." However, these expressions do not make me feel relaxed and safe. It is not sufficient. I wish she solved my problem and talked to them and said to them how sad I was.

This student also made the following explanation about mathematics:

> Understanding mathematics is so difficult for me. The concepts are so complex. My teacher suggests me to study hard but I study. Even if I study hard, I cannot solve mathematical problems. When I talk about this situation with my mother, she says "You can do this. You are strong and clever enough. You just need to study harder and solve more problems." This talk with my mother is not sufficient for me. When I do not understand, this makes me more stressed about mathematics.

When these explanations were examined, it was observed that the students having positive feelings and beliefs about mathematics and school tended to emphasis having hope in dealing with problems. They also expressed how their mothers helped them have hope and handle the problem. Hence, it can be stated that these findings can support the findings of the connection of attachment to parents with hope by considering their relationship to mathematics anxiety and perceived school climate. In other words, the relationships among attachment to parents, hope, perceived school climate, and math anxiety in early adolescents were supported by the qualitative data collected through the semi-structured interviews and metaphors. Moreover, the explanations showed that the relationship between the attachment to parents and the mathematics anxiety could be established and detailed by the connection between the variables of hope and perceived school climate. In this respect, the qualitative findings were also supportive of proposing a multiple mediation model in the quantitative part of the present study.

Discussion

The quantitative results showed that the mediation of hope and perceived school climate between attachment to parents and math anxiety was statistically significant in the model. Also, the mediational hypothesized models were statistically significant and explained approximately 29–31% of the variance in math anxiety. The findings of the model comparisons also revealed that the mediation of hope was stronger than the others. Furthermore, the findings of the hypothesized model were supported by the qualitative data collected through the semi-structured interviews and metaphors.

Most of the studies on mathematics anxiety focus on explanation, definition, sources, symptoms, reasons, and the ways and strategies for decreasing mathematics anxiety (Johnson and VanderSandt 2011; Rossnan 2006; Uusimaki and Nason 2004). However, this field is required to be studied with a theoretical base. With this motivation, the relationship among the sources of mathematics anxiety was examined by providing a structural model based on theory. More specifically, the variables in this model were determined through examining the sources of mathematics anxiety by focusing on the main intellectual issues, environmental issues, and personality traits. In line with this view, the present study is different from the previous studies in that it focuses on the connection among the variables selected from different sources of

mathematics anxiety based on a theory to make predictions about the students' mathematics anxiety related to their mathematics interest and performance.

The Relationship between Attachment and Math Anxiety

In this study, attachment to parents was found to be negatively associated with math anxiety. Although a number of studies have examined the link between attachment and anxiety in children and adolescents (Muris et al. 2000a; Kerns and Brumariu 2014; Shamir-Essakow et al. 2005; Colonnesi et al. 2011), to the best of our knowledge, there is only one study examining the relationship between attachment and math anxiety (Bosmans and De Smedt 2015). The findings of the current research are consistent with those of that single study in which the insecure attachment pattern was found to be correlated with math anxiety. Our qualitative findings also supported our hypothesized model. While the child with a low level of math anxiety emphasized his mother's supportive attitude in dealing with the difficulties faced in understanding mathematical concepts and solving mathematical problems, the child anxious about mathematics did not emphasize the sufficiency of the parental support. The previous studies have provided evidence that the insecurely attached children have high levels of anxiety symptoms and depression (Muris et al. 2000a), higher levels of worry (Muris et al. 2000b) compared to the securely attached children. The study by Sümer and Şendağ (2009) demonstrated that the children securely attached to mother and father with a mean age of 11 had higher positive evaluations about the self-domains including social acceptance, physical appearance, athletic competence, academic self-efficacy, and lower anxiety. One explanation for the association between attachment and anxiety is emotion regulation strategies. It was shown that the insecurely attached children interpreted situations as more catastrophizing and used less active coping (Brumariu et al. 2012). Based on these findings and explanations, it can be concluded that the securely attached children have low math anxiety.

The Mediating Roles of Hope and Perceived School Climate

In the current research, attachment to parents was found to be associated with hopeful thoughts of early adolescents. This finding confirms previous research (Çankaya and Canbulat 2017; Demirtaş 2019; Otis 2015; Welch and Houser 2010). Hopeful thought reflects the belief that one can find pathways to desired goals and become motivated to use those pathways (Snyder et al. 1991a). Snyder (2000) maintains that hopeful thoughts of children come from the early secure based orientations.

The present results also revealed that while the predictor role of attachment to mother on perceived school climate was statistically significant, the predictor role of attachment to father on perceived school climate was found to be not statistically significant. As early attachment orientation is supposed to have a prototype role for later relationships, we assume that attachment to both mother and father influence the relationships with others at school. This hypothesis was confirmed in our study only in terms of mother-child attachment. The study by Lieberman et al. (1999) showed that the quality of friendship of the children was related to attachment to both mother and father. On the other hand, some researchers claim that attachment security with mother and father may affect relationships with others in a different way (Ducharme et al. 2002). Bowlby (1969/1982) stated that "a young child's experience of an encouraging, supportive, and cooperative mother, and a little later father, gives him a sense of worth, a belief in the helpfulness of others, and a favorable model on which to build future relationships" (p. 378). Bretherton (2010) suggests that the roles of mothers and fathers as attachment figures and their influences on child outcomes may be different and complementary. In a study by Doğan (2016) based on the data obtained from a large sample group in Turkey, it was found that some regional differences existed in the attachment to parents. One explanation for our result is that cultural differences may influence the interactions differently. In some provinces of Turkey, the mothers generally spend more time and take responsibilities for their children, thus have a greater role in their personality development.

It was also found that hope and perceived school experiences were interrelated in a positive way. This finding supports the previous studies which also found positive relationships between hope and school experiences. For example, the study by You et al. (2008) demonstrated that hope predicted school connectedness scores of the students in grades 5 to 12. Dixson et al. (2017) found meaningful relationships between hope and the school related variables involving academic and psychological adjustment. Gilman et al. (2006) also demonstrated that the high-hope students had a higher school adjustment.

This study also revealed that hope and math anxiety negatively correlated. This finding is consistent with the views of Snyder et al. (2003) suggesting the fundamentals of hope theory for the school psychology. Because of agency and pathways thoughts, the hopeful students have perceived competence and adaptive coping strategies which, in turn, bring along the achievement in lessons (Snyder et al. 1997).

In the current research, the predictor role of perceived school experiences on math anxiety was found to be statistically significant. This result is not surprising, as the students' perceptions about school climate shape their attitudes and cognitions about themselves and, in turn, contribute to their outcomes (Loukas and Robinson 2004).

The results also revealed that the mediation of hope and the multiple mediation of hope and perceived school climate were statistically significant and the mediation of hope was stronger than the multiple mediation of hope and perceived school climate. On the other hand, the mediation of perceived school climate was not statistically significant. This finding is consistent with our hypothesized model. We propose that securely attached children have a high perceived school climate and low math anxiety because of their hopeful thoughts based on their secure relationships with their mothers and fathers. In this model, perceived school climate is an important variable in the relationship with hope. It was reported in the literature that hopeful individuals probably make adaptive interpretations of both their surrounding environment and internal physiological arousal (Michael 2000). The cognitive impacts of secure attachment on hope allow the individuals to consider their conditions from a positive point of view (Quick et al. 1996). Consequently, they have a sense of safety at school.

Finally, the analysis of the variance showed that attachment to mother had a greater variance than attachment to father in explaining math anxiety. This result is consistent with the notion that the roles of mothers and fathers as attachment figures and their influences on child outcomes may be different and complementary (Bretherton 2010). Our qualitative findings also support this finding emphasizing the efficiency of the mothers' support when the children have difficulty in understanding mathematical concepts and solving mathematical problems. The findings of previous studies differ in terms of the predictive power of attachment to mother and father. Particularly, depending on the predicted variable, the attachments to mother and father have different patterns (Sümer and Şendağ 2009). This finding may be explained by the notion that mothers are the primary caregivers and more involved in the care process than fathers.

Implications and Limitations

It can be stated that the students' mathematics anxiety may increase as they progress from elementary to high school. Hence, it is important to identify the factors that might cause and increase mathematics anxiety. By eliminating these factors, mathematics anxiety can be decreased. The present study focused on the connection of mathematics anxiety with attachment to parents, hope, and perceived school climate in early adolescence. Moreover, it can be stated that mathematics anxiety is not only related to individual factors such as hope and learning but also connected to the interaction with people. Hence, teachers should carefully design learning environments by eliminating the possible occasions that can cause mathematics anxiety. Moreover, since mathematics anxiety can increase over the years, attachment to mother and father is important to face it. It is required to organize and provide confident, competen,t and good opportunities and environments to reduce the students' mathematics anxiety. While teachers and school administrators should design well-equipped environments supporting the teaching process and the interest and efficacy of students in mathematics, parents and caregivers should promote the students' positive feelings, intellectualness, and interaction. In other words, parents and caregivers should also make an effort to decrease the students' mathematics anxiety by assisting them in finding learning opportunities, acquiring experience in their schools, facing the obstacles to learning and solving their problems. It can be claimed that the school experiences and the support of parents and caregivers can have impact on the students' mathematics anxiety. In other words, the classroom climate and the interaction among the students and their parents can affect the students' performances; so, the social and emotional aspects of school and mathematics lessons can enhance their potential to remove the challenge situations in learning mathematics and their anxiety, especially the mathematics anxiety. Hence, the support of parents and caregivers, their attachment style, hope, and positive school experiences are important in decreasing the students' mathematics anxiety. Moreover, the teachers' skills to respond sensitively to the insecurely attached children having mathematics anxiety can be improved by the in-service teacher training programs to be organized considering the interaction among the variables explained in this present study. Moreover, it can be asserted that mathematics anxiety cannot be reduced only by focusing on students alone but rather by also considering the ties with others including parents and teachers.

Further research is recommended to establish the paths for the parents, caregivers, teachers, and school administrators to help the students cope with their mathematics anxiety. It can be stated that experiences can be the causes of the students' mathematics anxiety. In line with this view, teachers and school administrators should be advised to carefully and consciously organize physical environments and learning opportunities in the schools. Hence, further research is required to find out how teachers and school administrators can perform this task in collaboration with parents. Moreover, further study is suggested to examine the direct effects of attachment to parents, hope perceived school climate on mathematics anxiety to make definitive explanations about the causality and their roles in mathematics anxiety. Hence, the results can be extended to explain to what extent these variables impact mathematics anxiety. Moreover, a longitudinal study is required to provide evidence for the findings of the present study to establish the effects of factors on mathematics anxiety more clearly. In the present study, the findings were based on the data collected from the students. In order to extend the findings, the data can also be collected from parents, teachers, and school administrators. Moreover, training programs can be designed based on the roles and impacts of the variables proposed in the model for teachers and students to decrease

the students' mathematics anxiety. Parents can also participate in training programs and accept support from the experts in order to design effective learning environments at home. Thus, they can help their children meet the high expectations about mathematics achievement, perform their tasks and responsibilities in mathematics, and by doing so decrease mathematics anxiety.

Appendix

Semi-structured Interview Protocol

1. Please complete the following sentence: "The school is….." (Probing Question: Why?)

2. Do you feel closer to your mother or father? (Probing Question: Do you trust your mother or father more?) Why?

3. Does your mother/father support you in studying your lessons or fulfilling your responsibilities at school? How? To what extent?

4. Does your mother/father motivate you to overcome the problems you face? How? To what extent?

5. Is the support you get from your mother/father effective in solving problems you have at school or in your classes? How? To what extent?

6. Please complete the following sentence: "The mathematics is….." (Probing Question: Why?)

7. Is the support you get from your mother/father effective in overcoming your problems or fear of mathematics? How? To what extent?

8. Does your mathematics teacher affect you to like/dislike mathematics? How? To what extent?

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