Math Anxiety of Students with High Functioning Autism Spectrum Disorder

Alexandra Georgiou

Spyridon-Georgios Soulis

Danai Rapti

Department of Primary Education,
University of Ioannina, 45110 Ioannina
Greece

Katerina Papanikolaou
Department of Child Phychiatry
National and Kapodistrian University of Athens
10679 Athens
Greece

Abstract

It is widely accepted that many students with High Functioning Autism Spectrum Disorder (HF-ASD) experience anxiety which reportedly affects their performance at school and particularly their abilities in mathematics. However, although mathematics is an area of great interest for students with HF-ASD, the degree of their math anxiety is not clear. The present research examined the math anxiety of 32 students with HF-ASD, aged 12 to 17, and 32 typical developing (TD) students who were chosen as a control group. The two groups of students were matched for age, gender and full IQ scale while they were exposed to the same level of mathematics curriculum material. Results showed that students with HF-ASD experience significantly lower math anxiety compared to TD students. Furthermore, in both groups of students, factors such as their grade in mathematics, their attitude towards mathematics and the support they receive significantly affect their math anxiety.

Keywords: Math anxiety, High Functioning Autism Spectrum Disorder

1. Introduction

The negative attitude towards mathematics, commonly known as math anxiety, has been a subject of debate within the mathematical community for many years now. According to Latterell (2005) "math anxiety is an intense fear towards mathematics which affects the mathematical ability of the person" (p. 24). Similarly, Legg and Locker (2009) define math anxiety as a general fear or tension which is related to stressful situations that include interaction with math. A number of old and recent studies have shown that students' math anxiety is negatively related to their grades and their performance in mathematics in general (e.g. Foley et al., 2017; Cargnelutti, Tomasetto & Passolunghi, 2017; Chang & Beilock, 2016; Hembree, 1990; Ma, 1999; Resnick, Viehe, & Segal, 1982; Skaalvik, 2018; Wigfield & Meece, 1988). More specifically, the relationship between math anxiety and performance in mathematics is proved to be interdependent and negative (Carey, Hill, Devine, & Szucs, 2015). Furthermore, apart from their performance in mathematics, students' math anxiety is also significantly related to teachers' math anxiety, classroom activities, parents' math anxiety, the support and expectations of the parents, how students perceive the school environment, their age and gender (Beilock, Gunderson, Ramirez & Levine, 2010; Chang & Beilock, 2016; Vukovic, Roberts & Green Wright, 2013). Generally, several studies regarding the role of the emotions in education have established that there is a correlation between math anxiety and various aspects of learning in mathematics (Ashcraft & Krause, 2007; Ashcraft & Moore, 2009; Stankov, Lee, Luo, & Hogan, 2012). These studies represent considerable progress in the research of math anxiety in typically developing (TD) students. Nonetheless, to our knowledge, there are no systematic studies that explore the math anxiety of students with HF-ASD although they are referred as classmates with TD students who are exposed to the same level of curriculum material (Alevriadou & Lang, 2011).

Specifically, according to the most recent Diagnostic Statistical Manual of Mental Disorders (DSM-5), Autism Spectrum Disorder (ASD) encompasses "disorders previously referred to as early infantile autism, childhood autism, Kanner's autism, high-functioning autism, atypical autism, pervasive developmental disorder not otherwise specified, childhood disintegrative disorder, and Asperger's disorder", with differing levels of severity(American Psychiatric Association [APA], 2013, p. 92). Severity levels of ASD are three (with 3 being the most severe) and are based on social communication impairment and restricted repetitive patterns of behavior. Although the DSM-5 does not list subtypes in ASD, it is accepted as being particularly heterogeneous. Therefore, Low-Functioning and High-Functioning are labels that clinicians and researchers alike use to denote individuals with and without intellectual or language impairments, respectively (Grainger, Williams & Lind, 2014; Keller, 2017).

Mathematics is an area of academic interest regarding students with HF-ASD but also an area with conflicting results. More specifically, there are a number of researches which claim that students with HF-ASD have higher and even exceptional skills in math (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001; Baron-Cohen, Wheelwright, Burtenshaw, & Hobson, 2007; Happè & Frith, 2010; Iuculano et al., 2014; Hao & Layton, 2018) and studies that claim they have learning disabilities in mathematics (Bae, Chiang, & Hickson, 2015; Mayes & Calhoun, 2003). Compared to TD students, students with HF-ASD are reported to have a similar or lower performance in mathematics (Aagten-Murphy et al., 2015; Chiang & Lin, 2007; Oswaldetal., 2016). Furthermore, although many of students with HF-ASD may have an adequate or even high performance in mathematics in lower and higher classes of primary school, the same students experience significant difficulties in the learning of mathematics during their transition from junior high school to high school where mathematics involve more abstract concepts and complicated problems (Mayes & Calhoun, 2003; Whitby & Mancil, 2009).
In order to overcome those difficulties, recent research underlines the importance of implementing mathematics interventions in students with HF-ASD (Hart, Barnett & Cleary, 2015; Gevarter et al., 2016; King, Lemons & Davidson, 2016). However, those interventions do not include strategies to manage and overcome math anxiety even though it has been proved that the anxiety of students with HF-ASD can negatively affect their abilities in mathematics (Finnane, 2011). Generally, although recent research shows that students with HF-ASD face great difficulties in mathematics, the suggested mathematics interventions focus on their learning skills in mathematics and not on their attitudes and emotions towards mathematics, such as math anxiety. However, it is worth mentioning that anxiety is the most common psychological disorder among students with HF-ASD (Lopata &Thomeer, 2014; Skokauskas & Gallagher, 2010) which affects the social, emotional and academic aspect of their lives (Valle, 2016). More specifically, according to recent meta-analysis of van Steensel and Heeman (2017), regarding the anxiety levels in children with ASD, the adolescents with HF-ASD are at a great risk for developing anxiety disorders. Furthermore, teachers who participated in recent researches stated that students with HF-ASD suffer from higher anxiety and depression compared to TD students while their performance in mathematics is not on par with their skills and abilities (Ashburner, Ziviani, & Rodger, 2010; Syriopoulou-Delli, Polychronopoulou, Kolaitis, & Antoniou, 2017).

However, despite the emergence of a significant body of literature on the recognition and treatment of anxiety in young people with ASD, practical and conceptual challenges in the measurement of their anxiety remain. The ability of individuals with ASD to self-report symptoms and access their internal thoughts has been the subject of considerable discussion (Lickel, MacLean, Blakeley-Smith, & Hepburn, 2012). Specifically, some studies suggested that people with ASD, under-report the degree of their own symptoms of anxiety compared to parent and clinician reports (White, Schry, & Maddox, 2012) while other studies have shown concordance between parent and child measures regarding children anxiety symptoms (Chalfant, Rapee, & Carroll, 2007; Reaven, Blakeley-Smith, Culhane-Shelburne, & Hepburn, 2011). However, according to Farrugia and Hudson (2006) young people with Asperger's Syndrome scored significantly higher on two of the sub-scales of the Children's Automatic Thoughts Scale (CATS) than a non-clinical control group, and a non-ASD group which suffered from anxiety. They also found that the CATS correlated highly with symptoms of anxiety and externalizing behavior, suggesting that not only are children with ASD able to identify their negative cognitions, but also that these may be related to their anxiety, behavioral problems and life interference. Furthermore, in the study of Ozsivadjian, Hibberd and Hollocks (2013) 30 children with ASD and 21 children without ASD, which were the control group, aged between 10 and 16 years, with an IQ and reading age ≥ 70, completed the Spence Children's Anxiety Scale and the Children's Depression Inventory. Their parents completed the parent version of both questionnaires.

The results of this study revealed that there was an agreement between ASD children and their parents on both measures, suggesting that children with ASD are able to accurately report their anxious and depressed cognitions.

1.1 Current study

Although anxiety has been reported to be one of the most common psychological disorders among students with HF-ASD which affect their academic outcomes, math anxiety has not been examined as a separate anxiety disorder regarding mathematics. Aim of the present study is the examination of math anxiety of students with HF-ASD as they themselves perceive it. Furthermore, taking into account the inclusion of those students in the general classroom with TD students, another aim of the research is the comparative analysis of the math anxiety between the two groups so as to understand the differences and similarities in the emotions that they experience during math. According to the aforementioned, the questions that the present study poses are the following:

1. What is the level of math anxiety of students with HF-ASD and how does it differ from math anxiety of TD students?
2. How are students' grades for their performance in mathematics related to their math anxiety in both groups?
3. How do factors such as students' gender, the school that they attend (junior high school or high school), their attitude towards the subject and the help that they receive in the learning of mathematics affect their math anxiety in both groups?

2. Methods

2.1 Participants

Two groups of students were the sample of the present research. Students with HF-ASD were the experimental group and TD students were the control group. The prerequisites for the students with HF-ASD to participate in the research were the following: a) all of them had an ASD diagnosis from a certified public diagnostic center according to which they were classified as in level 1 of severity based on the latest Diagnostic and Statistical Manual DSM-5, b) they had been assessed by the personnel of Centers of Diagnosis and Differential Diagnosis and Support as having no language or intellectual impairments (they had a major index score in the Greek version of WISC-III (Wechsler,1991) regarding their IQ over 80) and c) all of them attend the junior high school or general high school without receiving additional educational support (Integration classes or Parallel support) and without having repeated or missed a school year. The selection of the students of the experimental group through random sampling allowed us to have a sample of 32 students with HF-ASD from general high schools and junior high schools in Greece.

In order for TD students to participate in the present research they were initially assessed by an educational psychologist regarding their IQ which according to the Greek version of WISC-III (Wechsler, 1991) should have a major index >80. Furthermore, they had to meet the following entry requirements: a) they had not been diagnosed with a learning difficulty by a public or private diagnostic institution, b) they had not repeated or missed a school year and c) they were not attending integration classes in school. The procedure that was followed in the sampling of TD students was a planned simulation of the control group with the experimental group in terms of the number of students, their age, their grade and their region of residence. Finally, both groups of students attended the same type of school (junior high school or general high school) and were exposed to the same level of mathematics curriculum material.

2.2 Sample Structure

The experimental group was made up of 32 students with HF-ASD, 24 (75%) of which were boys and eight (25%) were girls. Their mean age was 15.09±1.33 years while their mean IQ score was 92.34±6.31. At the time of the research, 16 (50%) of those students attended junior high school and 16 (50%) students attended high school. The highest grade that the students can get in mathematics at school, which reflects their performance in the lesson, is 20. In the sample of the students with HF-ASD, 17 (53.1%) of them had a grade in mathematics between 10 and 13, 10 (31.3%) between 14 and 17 and five (15.6%) between 18 and 20. As far as the question of whether they like the subject of mathematics or not, the majority answered yes (N=22, 68.8%). Moreover, 21 (65.6%) of the students stated that they receive help in the study of mathematics and 11 (34.4%) stated that they study mathematics on their own. The control group included 32 TD students with a mean age of 15.34±1.42 years and a mean IQ score 95.63±7.65. Of those, 24 (75%) were boys and eight (25%) were girls. At the time that the research was conducted, 16 (50%) of the TD students attended junior high school and 16 (50%) attended general high school.

Regarding their grades in the lesson of mathematics at school, 12 (37.5%) of them had a grade in mathematics between 10 and 13, 13 (40.6%) between 14 and 17 and seven (21.9%) between 18 and 20. The majority of those students answered positively to the question of whether they like math or not (N=20, 62.5%). Furthermore, 18 (56.3%) of the TD students stated that they receive help in the study of math at home and 14 (43.7%) of them stated that they study math on their own.

2.3 Measures

The Fennema – Sherman (1976) scale is widely regarded as one of the most important tools for the measurement of math anxiety of secondary school students as well as of college students. The whole scale includes 108 questions, half of which refer to a positive attitude towards mathematics and the other half refers to a negative attitude. The answers are given on a 5 point Likert scale (1 = completely disagree – 5= completely agree). The 108 questions are divided into 9 subscales and each of them contains 12 questions. The reliability of each subscale is high ($a \geq 0.89$) (Fennema & Sherman, 1977).

In the present study we used only the subscale which refers to math anxiety. The values of the subscale questions which referred to the negative attitude were reversed (the final score varies from 12 to 60), thus the higher the value is, the less anxiety a student has towards mathematics. These questions, although they cover a small part of the questionnaire (12 out of 108) have been used in many other researches with the same purpose or as a comparative tool in respective researches. For instance, Betz (1978) used only the 12 questions of the Fennema – Sherman scale which refer to math anxiety along with the Spiellberg questionnaire - which is clearly psychological – when she conducted a research in college students in order to explore math anxiety. Furthermore, the same subscale has been used and validated in the Greek context in secondary school students (Feredinos, 2005), in college students (Koleza, Giachristos, & Dafermos, 2001; Troulis, 1995) and in primary school students (Apostolopoulou, 2011) (Cronbach's alpha was over 0.7 in all studies).

2.4 Procedure

The study was conducted during the school year 2017-2018. The sample analysis of students with HF-ASD included children who were identified by Centers of Diagnosis and Differential Diagnosis and Support across the country as students with ASD. Specifically, the personnel of Centers of Diagnosis and Differential Diagnosis and Support informed the parents about the research and gave them the contact information of the researchers in order to communicate with them in case they and their child with ASD were interested to participate. The sample of TD students was recruited through the school district and by word of mouth by informing and taking the permission of the parents first. Prior to data collection, written parental consent and child assent was obtained for each participant. Participants completed the questionnaire in a place that they selected, with the presence of their parents and with the experimenter seated in a one-on-one situation. Participants could read and make questions at the beginning of the procedure but not while they completed the questionnaire.

2.5 Data analyses

The present research was based on quantitative analysis since the data were quantitative. First, the internal consistency of the scales was examined using the Cronbach's alpha which is one of the most widely used reliability tests, also known as internal consistency coefficient (Cronbach, 1951).The Mean (M) and Standard Deviation (SD) were calculated in order to describe the quantitative variables. For the evaluation of the relation between two categorical variables a chi-square independence test was used. For the comparison of mean, parametric tests were used based on the assumption that according to the Central Limit Theorem the distribution of sample means (across independent samples) is normal when the size of the sample is greater to 30 observations. Based on that, in order to examine the means differences parametric stats were used (Smith and Wells, 2006). Specifically, a t-test of independent samples was used to determine the difference between two sample means and for the comparison of the means in three or more independent groups the One-Way Anova ("analysis of variance") was used. The results of the One-Way Anova were analyzed according to the Bonferonni Correction. A 95% confidence level was used as the minimum level of significance in all tests. According to the aforementioned methods of analysis, the SPSS for Windows, version 23.0 was used for the processing and analysis of the research data.

3. Results

The participants' math anxiety was calculated based on the 12 statements of the Fennema – Sherman subscale. At first, the internal consistency of those statements was examined using the Cronbach's alpha (Cronbach, 1951). More specifically, the reliability of the subscale for math anxiety was found to be high for students with HF-ASD (α=.804) as well as for TD students (α=0.814). The lowest value of the Fennema – Sherman subscale which refers to math anxiety is 12 and the highest is 60, as a result the mean is 36. That is to say, values, which are over 36, show that math anxiety is less than average, while values which are below 36 show that math anxiety is more than average. Table 1 indicates that students with HF-ASD have less than average math anxiety (M=41.72, SD=8.90) while TD students have average math anxiety (M=36.63, SD=8.14). Statistical control at a level of significance 5% showed that there are important differences between math anxiety of students with HF-ASD and TD students (t(62)=2.388, p=.020). That is to say, students with HF-ASD show significantly less math anxiety than TD students.

Table 1: Independent Samples t-test to compare the means of math anxiety in the two groups

Variable	Sample	Mean	SD	t	df	p-value
Math Anxiety	TD	36.63	8.14	2.388	62	**.020**
	HF-ASD	41.72	8.90			

However, the two groups did not have an important difference in terms of their grades for their performance in mathematics at school. A chi-square test of independence was performed to examine the relation between grade in mathematics and group of students. The relation between these variables was not significant, ($\chi^2(2)=1.587$, p >.05). (Table 2)

Table 2 : Crosstabulation of Grade and the group of students - Chi Square test

			TD	HF -ASD	X^2	df	p-value
Grade in mathematics	10-13	Count	12	17	1.587	2	.452
		% of Total	18.8%	26.6%			
	14-17	Count	13	10			
		% of Total	20.3%	15.6%			
	18-20	Count	7	5			
		% of Total	10.9%	7.8%			

Later on, the relationship between math anxiety and students grades for their performance in mathematics at school was examined. Table 3 shows that, at a level of significance 5%, the effect that the grades of students with HF-ASD in mathematics lesson at school have on their math anxiety is statistically important (F(2,29)=4.997, p=.014). Post hoc analysis using the Bonferroni correction indicated that the mean score of math anxiety for the students with HF-ASD who have grade 10 to 13 (M = 37.59, SD = 8.83) was significantly lower from the mean score of math anxiety for the students with HF-ASD who have grade 14 to 17 (M = 45.80, SD = 7.32) and from the mean score of math anxiety for the students with HF-ASD who have grade 18 to 20 (M = 47.60, SD = 4.98). Consequently, it is observed that students with HF-ASD who have low grade regarding their performance in mathematics at school have higher math anxiety than students with HF-ASD who have average or high grade.

What is more, table 3 shows that, with a level of significance 1%, the effect that TD students' grades in mathematics lesson at school have on their math anxiety is statistically important (F(2,29)=7.568, p=.002). Post hoc analysis using the Bonferroni correction indicated that the mean score of math anxiety for the TD students who have grade 18 to 20 (M = 45.43, SD = 5.22) was significantly higher from the mean score of math anxiety for the TD students who have grade 14 to 17 (M = 33.54, SD = 6.53) and from the mean score of math anxiety for the TD students who have grade 10 to 13 (M = 34.83, SD = 7.84). As a result, it can be observed that in both groups of students the lower their grades in mathematics are the more math anxiety they present.

Table 3: One-Way ANOVA test for the relationship of math anxiety and the students' grades in math

Variable	Groups	N	Mean	SD	F	df	p-value
Math Anxiety of TD students	10-13	12	34.83	7.84	7.568	2(29)	**.002**
	14-17	13	33.54	6.53			
	18-20	7	45.43	5.22			
Math Anxiety of HF-ASD students	10-13	17	37.59	8.83	4.997	2(29)	**.014**
	14-17	10	45.80	7.32			
	18-20	5	47.60	4.98			

Table 4 shows the results of the rest of the effect that various parameters have on math anxiety. More specifically, the math anxiety of students with HF-ASD is significantly affected by whether they like the subject or not (t(30)=3.800, p=.001) and by the help that they receive during the studying of mathematics (t(30)=2.318, p=.027). More specifically, students with HF-ASD who stated that they like mathematics (M=45.33, SD = 6.83) show significantly less math anxiety than students with HF-ASD who stated that they do not like mathematics (M=34.82, SD = 8.52). Furthermore, students with HF-ASD who receive help during the studying of mathematics (M=45.19, SD = 8.73) have significantly lower math anxiety than students with HF-ASD who stated that they study mathematics on their own at home (M=37.00, SD = 7.46). Regarding the math anxiety of TD students it is significantly affected only by whether they like the subject or not (t(30)=2.556, p=.016). Specifically, similarly to students with HF-ASD, TD students who stated that they like mathematics (M=39.25, SD = 6.69) have significantly lower math anxiety than TD students who stated that they do not like mathematics (M=32.25, SD = 8.71) (Table 4).

Table 4: Independent Samples t-test to compare the means of the questionnaire scales with the students' demographic and personal characteristics

Variables	Sample	Characteristics	N	Mean	SD	t	df	p-value
Gender	TD	Boy	28	37.50	8.76	1.055	30	.300
		Girl	8	34.00	5.55			
	HF-ASD	Boy	24	41.04	8.82	-.740	30	.465
		Girl	8	43.75	9.40			
School	TD	Junior High School	16	37.93	7.60	.909	30	.370
		High School	16	35.31	8.69			
	HF-ASD	Junior High School	16	39.68	9.62	1.305	30	.202
		High School	16	43.75	7.89			
Do you like the subject of mathematics?	TD	Yes	20	39.25	6.69	2.556	30	**.016**
		No	12	32.25	8.71			
	HF-ASD	Yes	21	45.33	6.83	3.800	30	**.001**
		No	11	34.82	8.52			
Receiving help during the studying of math	TD	Yes	18	37.24	9.32	.582	30	.565
		No	14	35.45	5.41			
	HF-ASD	Yes	21	44.19	8.73	2.318	30	**.027**
		No	11	37.00	7.46			

4. Discussion

The present research explored the math anxiety of students with HF-ASD as well as the various parameters that influence it. More specifically, the main research question is the evaluation of math anxiety of students with HF-ASD and a comparative analysis with the math anxiety of TD students. For that purpose, a self-reported measure was used, the reliability of which was high for both groups. This finding is in line with previous studies that reported that students with HF-ASD are able to self-report their feelings of anxiety (Chalfant et al., 2007; Ozsivadjian et al., 2013; Reaven et al., 2011). Regarding the first research question of the present study, the findings indicated that math anxiety of students with HF-ASD is lower than average and differs greatly from the math anxiety of TD students which is on an average level. In the sample of TD students, those findings are in line with researches that point out that math anxiety in on an average level for TD students in secondary education (Ameen, Baig & Khaliq, 2016; Zakaria & Noh, 2008; Puteh & Khalin, 2016; Geist, 2010; Furner, 2016). Nonetheless, recent data from the PISA program, (Program for International Student Assessment) which evaluated the academic performance of 15-year-old TD students in countries which are members of the OECD (Organization for Economic Cooperation and Development), reveal that students from 63 out of the 64 participant countries have high math anxiety (Organization for Economic Cooperation and Development [OECD], 2013).In agreement with the findings of this program are a plethora of recent researches regarding math anxiety of TD students from primary and secondary education (Beilock & Willingham, 2014; Chinn, 2009; Ma, 1999; Passolunghi, 2011; Warwick, 2008; Warwick & Howard, 2016). Yet, it is important to point out that, to our knowledge, there are not any research data related to math anxiety of students with HF-ASD. The main part of the research in mathematics education of students with HF-ASD focuses on their mathematics skills or difficulties as well as on mathematics interventions in order to overcome those difficulties.

The math anxiety that is caused by their interaction with mathematics has not been studied as a separate anxiety disorder although anxiety is the most common psychological disorder that they face (Lopata & Thomeer, 2014; Skokauskas & Gallagher, 2010) and a disorder that influences their social, emotional and academic aspect of their lives (Valle, 2016).More specifically, anxiety has been proven to negatively affect the academic skills of students with HF-ASD (Tait, 2013) and has been linked to their poor school performance(Lopata & Thomeer, 2014; Morgan, 2006). In a research by Ashburner et al. (2010) the teachers that participated stated that the anxiety of students with HF-ASD negatively affects their performance in school and that this performance is not equivalent to their abilities. However, according to the findings of the present research, the math anxiety of students with HF-ASD is not particularly high. As a result, the emotions of students with HF-ASD, which are related exclusively to mathematics, are not particularly negative and, in fact, they are more positive than the emotions of TD students.

A possible explanation of this finding can probably be linked with the statement that students with HF-ASD under-report the degree of their own symptoms of anxiety (White et al., 2012), and as a result they under-report their math anxiety. However, taking into account the fact that students with HF-ASD have higher skills in understanding their self, compared to students with low functioning ASD (Huang et al., 2017), we come to the conclusion that the result of our research is accurate and that students with HF-ASD do present lower math anxiety than the average. This finding is probably linked to the higher abilities that students with HF-ASD have in mathematics compared to other subjects (Baron-Cohen et al. 2007; Happè & Frith, 2010; Iuculano et al., 2014; Layton &Hao, 2017) and which reinforce their positive attitude towards the subject.

As far as the grades are concerned, there was no important difference in the grades of students with HF-ASD and TD students regarding their performance in mathematics at school. Therefore, we can assume that the two groups do not present important differences regarding their school performance in mathematics. This finding is in keeping with recent research according to which the performance of students with HF-ASD is similar to that of TD students (Aagten-Murphy et al., 2015; Chiang & Lin, 2007; Layton & Hao, 2017) and in contrast with other researches which report that students with HF-ASD have higher or even exceptional skills in mathematics (Baron-Cohen et al., 2001; Baron-Cohen et al. 2007; Happè & Frith, 2010; Iuculano et al., 2014; Layton & Hao, 2017). However, in order to be precise regarding the performance of students with HF-ASD in mathematics, various methods and mathematical tests should be conducted.

Moreover, another finding was that in both groups the lower the students' grades are the higher the math anxiety that they experience. Furthermore, if we assume that their grades reflect their actual performance in mathematics we can assume that the relationship between math anxiety and performance in mathematics is negative for both groups of students. However, although a number of researches on TD students from secondary education claim that math anxiety and performance in mathematics are negative related (Carey et al. 2015; Hembree, 1990; Ma, 1999; Resnick et. al., 1982; Wigfield & Meece, 1988) there are no evidences regarding the direction of that relationship. That is, whether the performance in mathematics can predict the math anxiety or the opposite.

A similar affect has the negative or positive attitude towards mathematics in both groups. More specifically, students with HF-ASD and TD students who said that they liked mathematics had significantly less math anxiety than their classmates who said that they do not like mathematics. Consequently, the positive attitude of TD students and of students with HF-ASD towards mathematics can significantly affect their math anxiety. This finding is in accordance with the results of many researches which point out that having a positive attitude towards mathematics and especially being interested in mathematics defines anxiety, performance and generally the quality of learning (Baumert & Schnabel, 1998; Frenzel, Goetz, Pekrun, & Watt, 2010; Korhonen, 2016; Schiefele, Krapp, &Winteler, 1992).Generally, being interested in mathematics can be considered as a variable which affects positively the motives and the cognitive skills in mathematics(Mitchell & Gilson, 1997). Yet, the motivation of students with HF-ASD is a crucial but, nonetheless, a difficult challenge. It is crucial because by definition students with HF-ASD have limited and recurrent interests (APA, 2013) and difficult because these students are vulnerable to various factors that affect their motives. Those factors include sudden changes in the environment where they study (noise, smell, etc) which affect their attention, their studying and performance (Stuart, 1996). As a result, the effect that their attitude towards mathematics has on their math anxiety is particularly important as it can be included in the ways to motivate those students and can contribute to the increase in the class involvement and improvement of their learning in mathematics.

Furthermore, a particularly interesting finding is the fact that students with HF-ASD who receive help during the studying of mathematics show less math anxiety than students with HF-ASD who study mathematics on their own. In other words, the additional educational support in the subject of mathematics is crucial for their mathematical education and evolvement. As a result, the support of students with HF-ASD must not be limited to their social and interpersonal relationships but it must extend in their education as well.

4.1 Limitations

This study has some limitations that should be noted when interpreting the results. First of all, due to the small size of the sample there cannot be a generalization of the results. Furthermore, student's grade in the subject of mathematics at school was taken into account in the present research regarding their performance in mathematics. However, this cannot be an objective measure for assessing their performance in mathematics. Therefore, to expand this study more examinations with more students with HF-ASD, assessed in various mathematical subjects are needed. Finally, a self-report questionnaire was used for the assessment of math anxiety in the participants. It is possible that if their math anxiety is assessed with other methods, such as clinical interviews of the child versus the parent or the teacher it would yield different results.

4.2 Conclusion

Overall, the findings of the present research show similarities and differences in the math anxiety of students with HF-ASD and TD students. The important difference is in the level of math anxiety since the students with HF-ASD have significantly lower anxiety compared to TD students. However, the students' grades in mathematics at school and their attitude towards the subject are factors which play an important role in math anxiety for both groups. Based on that, it would be interesting to further explore what is the direction between the mathematics performance and the math anxiety of students with HF-ASD. Furthermore, the present study highlights how important it is for students with HF-ASD to receive help in the studying of mathematics. Generally, as the school system moves towards the direction of students with HF-ASD attending the same school as TD ones, their similarities and differences in the learning of mathematics are particularly important and should be taken into account by their teachers in order to be able to help them achieve their academic goals in mathematics.

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