Chapter 5
The Effect of Anxiety on Student Achievement

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5.1 Introduction

Anxiety is a feeling that is often experienced in daily life and it has many forms. It is defined as a particular tension, apprehension and increased neural activity perceived at the level of consciousness (Spielberger et al. 1970). According to Sarason (1981), anxiety refers to personal sorrows which emerge from an individual's perceptions of inability. In this context, anxiety is affected by many life factors and it affects many factors as well. By its nature, anxiety creates a continuous low-level uncomfortable mood in humans. This state of discomfort causes many problems in the individual's life. These problems may be psychopathologic (Legerstee et al. 2009) or they may stay at the neurotic level as in the case of test anxiety (Erzen and Odacı 2014). Test anxiety is one of the anxiety types that individuals experience during their education life. Test anxiety, which is the anxiety that occurs during exams or similar testing conditions (Putwain et al. 2010), can influence adolescents' academic outcomes.

Studies have revealed that test anxiety is a factor that creates discomfort in students and it causes failure (Putwain and Best 2011; Wachelka and Katz 1999). In this context, since test anxiety affects the academic life of the individual, it is quite understandable that educational research focuses on test anxiety rather than on state-trait or social anxiety (Burke and Ruppel 2015; Fisher et al. 2004). On the other hand, test anxiety is not the only subject of anxiety research. There are many studies focusing on the anxieties experienced in different fields, such as the anxiety that sports-men/women face in their competition with other athletes (Ivanović et al. 2015), in financial accounting (Dull et al. 2015), in military trainings (Naditch et al. 1975)

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and in musical performance (Kobori et al. 2011). Similarly to test anxiety research, these studies are focused on how anxiety affects individuals' achievement in a particular field.

The relationship between achievement and anxiety is bidirectional and inversely proportional. An increase in achievement causes a decrease in anxiety and an increase in anxiety causes a decrease in achievement. This relationship between achievement and anxiety is related to certain capabilities of human psychology, namely trying to predict the future and processing past information. As they get successful, individuals can code the way of reaching achievement in their minds, eliminate the factors that cause failure and determine the shortest way to success. In other words, as they get successful, individuals develop ways of being even more successful and they can more easily predict the future. This creates a relief eliminating uncertainty about the future and leading to the reduction of anxiety. This functioning of success is expressed in the literature by concepts such as self-efficacy (Bandura et al. 1988) and self-confidence (Gürşen Otacıoğlu 2008). In other words, individuals experience anxiety when they cannot predict the future and they cannot foresee what will happen next. Research on test anxiety has revealed that students experience more anxiety in numeric courses, such as mathematics (Al Mutawah 2015; Hong et al. 2016; Maloney et al. 2015), chemistry (Aris and Siow 2007; Kurbanoğlu 2013) and statistics (Abd-El-Fattah 2005; Macher et al. 2013), which may be due to the fact that the tests of these courses are based on internalized operations rather than on memorization. In other words, such tests, which include different numbers and operations each time instead of certain specific texts to be memorized, prevent the students to predict what they will face next time and students' anxiety level increases. Thus, it is not surprising that the studies which look at the relationship between anxiety and achievement are mostly directed to situations that create anxiety such as the ones mentioned above.

This study investigated the effect of anxiety on achievement. In addition, the factors that are hypothesized to influence the effect size of anxiety on achievement were set as moderators. These moderators are the following: (*i*) the publication year of the research, (*ii*) the publication type of the research, (*iii*) the country (culture) where the research was carried out, (*iv*) the course in which the achievement was measured and (*v*) the level of education.

5.2 Method

5.2.1 Study Design

In this study, the effect of anxiety on student achievement was tested with a meta-analysis design.

5.2.2 Review Strategy and Criteria for Inclusion/Exclusion

To determine the research studies to include in the meta-analysis, the Science-Direct, Proquest and Ebsco academic databases were used to conduct a literature review. For this process, the terms *anxiety* and *student achievement/student success* included in the titles of the studies were used to screen the research studies. The end date for the research studies included in the research was identified as January 2016. Doctoral dissertations and peer-reviewed journals were included in the study.

Many strategies were used to identify the research studies that were appropriate for the meta-analysis of the study. First, a research study pool (328 research studies) was established; it included all studies with anxiety and student achievement/success in their titles. The abstracts of these studies were reviewed, and all were found to be appropriate to include in the study. In the second stage, all research studies in the pool were examined in detail. The results of the examination found that 151 of the research studies in the pool were appropriate, and 177 were not found to be suitable. The descriptive statistics of the 151 research studies included in the analysis are presented in Table 5.1.

The criteria for inclusion of the research studies in the analysis study were identified as follows:

- To have the statistical information necessary for correlational meta-analysis (*n* and *r,* or R^2 values)
- To be a study measuring the correlation school culture and student achievement/ success.

  Reasons for not including a research study in the meta-analysis:

- Having no quantitative data (qualitative research)
- Not having a correlation coefficient
- Not focusing on student achievement
- Not focusing on anxiety.

5.2.3 Coding Process

The coding process was essentially a data sorting process used to ascertain which data were clear and suitable for the study. In this scope, a coding form was developed before the statistical analysis was conducted, and the coding was conducted according to the form. The main aim was to develop a specific coding system that allowed the study to see the entirety of the research studies in general and that would not miss any characteristics of each individual research study. The coding form developed in the study was comprised of:

Table 5.1 Characteristics of the studies included in the meta-analysis

Options	1	2	3	4	5	6	7	8	Total
Publication year	1955–1966	1967–1976	1977–1986	1987–1996	1997–2006	2007–2016	–	–	
	19	16	7	8	15	86	–	–	
Publication type	Thesis	Article	–	–	–	–	–	–	
	134	17	–	–	–	–	–	–	
Sample group	Horizontal individualism	Vertical collectivism	PISA	–	–	–	–	–	
	91	57	3	–	–	–	–	–	
Course	Education	Statistics	Chemistry	Mathematics	Psychology	Foreign language	Mixed	Other	
	3	6	6	45	8	10	57	16	
Level of education	Primary school	Middle school	High school	University	Mixed	Other	–	–	
	27	16	26	58	11	13	–	–	

- References for the research
- Sample information
- Sample group
- Publication type,
- Course
- Publication year
- Level of education
- Quantitative values.

5.2.4 Statistical Processes

The effect size acquired in meta-analysis is a standard measure value used in the determination of the strength and direction of the relationship in the study (Borenstein et al. 2009). Pearson's correlation coefficient (r) was determined to be the effect size in this study. Because the correlation coefficient has a value between +1 and −1, the r value calculated was evaluated by converting this value into the value as it appears in the z table (Hedges and Olkin 1985). Provided that more than one correlation value is given between the same structure categories in correlational meta-analysis studies, two different approaches are used in the determination of the one to be used in the meta-analysis (Borenstein et al. 2009; Kulinskaya et al. 2008). For this study, (*i*) first, if the correlations were independent, all the related correlations were included in the analysis and were considered to be independent studies, and (*ii*) if there were dependent correlations, then the *highest correlation value* was accepted. A *random effect model* was used for the meta-analysis processes in this study. The *Comprehensive Meta-Analysis* program was used in the meta-analysis process.

5.2.5 Moderator Variables

To determine the statistical significance of the differences between the moderators of the study, only the Q_b values were used. Four moderator variables that were expected to have a role in the average effect size were identified in the study. The first of these considered is the *type of publication* as a moderator in regards to the relationship between anxiety and student achievement. The second is the *sample group* which was thought to have a role on the average impact of school culture on student achievement. The rest are the *school subject*, *years of the studies*, and *class level*.

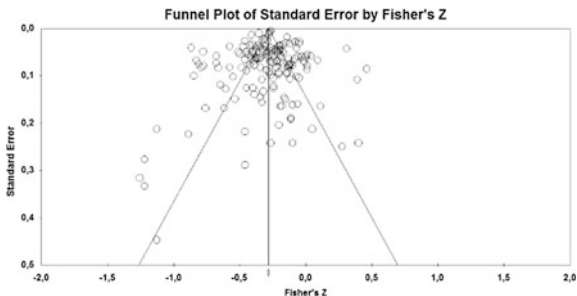**Fig. 5.1** Effect size funnel for publication bias

Table 5.2 Duval, Tweedie's trim and fill test results

	Excluded studies	Point estimate	CI (Confidence interval)		Q
			Lover limit	Upper limit	
Observed values		−.27	−.28	−.27	2087.64
Corrected values	16	−.28	−.29	−.28	2819.55

5.2.6 Publication Bias

A funnel plot for the research studies included in the meta-analysis of can be seen in Fig. 5.1. Evidence that publication bias affected the research studies included in the meta-analysis can be seen in Fig. 5.1. A serious asymmetry would be expected in the funnel plot if there were a publication bias. The concentration of plots on one side under the line of average effect size, particularly in the bottom section of the funnel, suggests the probability of a publication bias in the research studies. Evidence for publication bias was observed for the 151 research studies included in the meta-analysis study.

A publication bias was observed in the funnel plot, and the results of *Duval and Tweedie's trim and fill test*, which was applied to determine the effect size related to partiality in the publications that was acquired with the meta-analysis using the random effect model, are shown in. As seen in Table 5.2, there is a difference between the observed effect size and the virtual effect size established to correct the effect of the publication bias. The reason for the difference is the asymmetry of the concentration on both sides of the center line and the studies plotted to the left of and above the center line, skewing the symmetry.

5.3 Findings

Table 5.3 shows the results of the meta-analysis about the relationship between anxiety and achievement. The findings supported hypothesis H_1 which formulated that there is a negative relationship between anxiety and achievement. The effect

Table 5.3 Findings of the correlations between anxiety and achievement: Results of meta-analysis

Variable	k	N	r	CI		Q	Q_b
				Lower limit	Upper limit		
Kaygı	151	115086	−.28*	−.30	−.25	2087.64*	
Moderator [Publication year]							27.01*
1955–1966	19		−.22*	−.29	−.15		
1967–1976	16		−.20*	−.28	−.12		
1977–1986	7		.03	−.12	.18		
1987–1996	8		−.30*	−.40	−.19		
1997–2006	15		−.30*	−.38	−.23		
2007–2016	86		−.31*	−.34	−.28		
Moderator [Publication type]							**4.23***
Article	134		−.28*	−.31	−.26		
Thesis	17		−.19*	−.28	−.11		
Moderator [Country]							2.35
Horizontal individualism	91		−.29*	−.33	−.26		
Vertical collectivism	57		−.26*	−.29	−.22		
PISA	3		−.23***	−.41	−.03		
Moderator [Course]							7.39
Education	3		−.28***	−.51	−.03		
Statistics	6		−.17***	−.31	.02		
Mixed	57		−.28*	−.32	−.23		
Chemistry	6		−.21**	−.35	−.07		
Mathematics	45		−.30*	−.35	−.25		
Psychology	8		−.33*	−.45	−.20		
Foreign language	10		−.23*	−.33	−.12		
Other	16		−.29*	−.37	−.21		
Moderatör [Level of education]							3.64
Primary school	27		−.25*	−.32	−.19		
Mixed	11		−.31*	−.39	.21		
High School	26		−.25*	−.31	−.19		
Secondary school	16		−.33*	−.40	−.26		
University	58		−.27*	−.32	−.23		
Other	13		−.28*	−.38	−.17		

*$p < .001$
**$p < .01$
***$p < .05$

size of anxiety on achievement was calculated as $-.28$, which showed that anxiety has a low level negative effect (Cohen 1988) on student achievement.

The research supported hypothesis H_2 hypothesis which formulated that the publication year of the studies examined plays a moderator role in the effect of anxiety on achievement. As a result of the moderator analysis, the difference between the effect sizes of the different publication years was found to be statistically significant ($Q_b = 27.01$, $p < .001$). In this context, according to the studies published between 1955 and 1966 [$r = -.22$], in 1967–1976 [$r = -.20$] and in 1987–1996 [$r = -.23$] the effect of anxiety on achievement was at a low level, whereas according to those published between 1997 and 2006 [$r = -.30$] and in 2007–2016 [$r = -.31$] this effect was at a medium level. At the same time, the effect of anxiety on achievement was not found to be statistically significant in the studies published between 1977 and 1986.

The findings of this research supported hypothesis H_3 which formulated that the publication type plays a moderator role in the effect size of anxiety on student achievement ($Qb = 4.23$, $p < .05$). Accordingly, it was found that anxiety has a low level effect on achievement in both papers [$r = -.28$] and theses [$r = -.19$].

The results of moderator analysis did not support hypothesis H_4 which formulated that the country (culture) where the research was carried out plays a moderator role in the effect of anxiety on achievement. Although the effect size differences were not found to be statistically significant ($Qb = 2.35$, $p > .05$), anxiety has a low level significant effect on achievement in both vertical-collectivist cultures [$r = -.26$] and horizontal individualistic culture [$r = -.29$]. On the other hand, some of the studies included in the research pool ($N = 3$) have been conducted using PISA data. These studies were also included in the moderator analysis. The findings showed that anxiety has a low level significant effect on achievement in the countries where PISA data was collected.

The results of the moderator analysis did not support hypothesis H_5 which formulated that different courses play a moderator role in the effect size of anxiety on achievement. Although the effect size differences were not statistically significant ($Qb = 7.39$, $p > .05$), the studies featuring education [$r = -.28$], statistics [$r = -.17$], chemistry [$r = -.21$], foreign language [$r = -.23$], mixed [$r = -.28$] and other [$r = -.29$] courses showed that anxiety has a low level significant effect on achievement. Moreover, it was found that in the studies conducted for mathematics [$r = -.30$] and psychology [$r = -.33$] courses anxiety has a medium level significant effect.

In this study, the level of education was taken as the last moderator variable. The results of the analysis did not support hypothesis H_6 which formulated that the level of education plays a moderator role in the effect of anxiety on achievement. Although the effect size difference was not found to be statistically significant ($Qb = 3.64$, $p > .05$), it was found that anxiety has a low level significant effect on achievement at primary school [$r = -.25$], high school [$r = -.25$], university [$r = -.27$] and other education levels [$r = -.28$], whereas it has a medium level significant effect at secondary school [$r = -.33$] and mixed [$r = -.31$] levels.

5.4 Conclusion

In this study, a meta-analysis was conducted in order to determine the effect size of anxiety on achievement. Thus, the general results obtained from previous theses and articles have been reviewed. In addition, it was examined whether the variables of publication year, publication type, the country (culture) where the research was carried out, the course and the level of education have a moderator role in the effect of anxiety on achievement.

The findings showed that anxiety has a negative and significant effect on achievement although the effect size is low. The significant effect of anxiety on achievement was an expected result. By its nature, anxiety is nourished from the uncertainties present in the life of individuals. Anxiety feelings include not knowing what to face next, not being able to foresee future results and negativity. In this context, the negative relationship identified between achievement and anxiety is natural. The state of uncertainty experienced for an issue where there is an expectation of success affects achievement negatively, a phenomenon which was also mentioned in social learning theory. Explaining the prediction capacity of the self-efficacy concept, Bandura (1989) noted that the belief of individuals that they would be successful, in other words their self-efficacy, is directly related to predicting how the events will finally unfold. In other words, if individuals can foresee that they will be successful in the future and believe that they will succeed while undertaking a task, this increases their motivation (Bandura 2001a, b).

Regarding the significant differences among the publication years, which was set as a moderator variable for the study, it was found that there are significant differences in the effect of anxiety on achievement in all years, except for the studies published between 1977 and 1986. In addition, from 1955, which is the starting year for the studies examined, until today a negative increase is observed in the effect size of the studies. In other words, the negative effect of anxiety on achievement is increasing every year. There are several possible reasons for this fact. First of all, the need and demand for education has increased as the population increased. Tests could determine the direction of one's life (for instance, getting a job). As a result of this fact, tests became more eliminative and they have started being applied even in the earlier stages of education. This is causing more intense anxiety to students and it might have led to the research result mentioned previously. In addition, the changes made in the content of the courses might have resulted in the negative increase of the effect of anxiety on achievement over the years. Another possible reason is that the number and importance of the tests that students face increase every year. For example, in 2015 around 603 thousand people have taken the exams run for teacher assignment in Turkey (OSYM 2015). Before 2002, however, the existence of such a test was out of question. The number of test takers who took the test for entering into the teaching profession was 173 thousand in 2005 (OSYM 2005), whereas this number increased to around 280 thousand in 2010 (OSYM 2010). In summary, this strengthening relationship

between test anxiety and achievement seems to be a result of the changing conditions in today's world.

As a result of the moderator analysis, it was found that publication type plays a moderator role in the effect of anxiety on achievement. The review of the outcomes showed that there are significant differences between papers and theses. The theses have lower publication bias risk than the papers and this has allowed for the differentiation in the effect size of the two publication types. Most of the studies included in the meta-analysis are published works which tend to result in only specific findings, whereas this concern is much lower for theses. This clustering of the findings at one side is called publication bias in the literature (Borenstein et al. 2009). This study, which considers publication type as a moderator, shows that the type of the analyzed studies may create a difference in the effect of anxiety on achievement. The findings show that more negative values were obtained in papers compared to theses. Although this fact seems to support the suspicions about publication bias, the examination of the samples shows that data was collected from large samples, such as PISA, and from many different sources. Given that the data from sources like PISA includes a high number of samples without any publishing concerns, it can be argued that the small and insufficient sample size of the theses might have caused this difference. A detailed review of the findings shows that the number of theses is low and after the 2000s the number theses is scarce, whereas the number of studies increases. In other words, the significant differences in the effect sizes of theses and other studies (articles and papers) in a course of almost 20 years seems understandable.

Although it was not a moderator in this study, the differentiation of the countries and cultures where the research was carried out has a significant effect on the anxiety-achievement relationship. In other words, the anxiety that horizontal-individualistic and vertical-collectivist cultures experience has significant effects on their achievement. The results showed that this effect is similar in both the studies conducted in vertical-collectivist communities, which we can roughly call as the Eastern cultures, and in the studies conducted in horizontal-individualistic communities, which we can describe as Western cultures; the effect varies, however, within each culture. In general, in horizontal-individualistic communities people get credit for their success, whereas in vertical-collectivist communities the credit is given to their community (Triandis et al. 1988). This phenomenon is associated with the individual's self-identification type. In the literature, this concept is called self-construal. The research about achievement and self-construal showed that individualistic communities are academically more successful (İlhan 2009), whicle collectivist communities get better results in terms of handling and solving problems (Yavuz 2013). However, when the issue is the effect of anxiety on achievement the results clearly show that the influence of culture is eliminated, which points towards the universality of human psychology in terms of anxiety.

The conducted analysis revealed that the course in which the achievement was measured does not have a moderator role in the effect of anxiety on achievement. On the other hand, a significant effect was observed for each course. This shows that the effect size of anxiety on achievement differed for each course. On the other

hand, all the effect sizes obtained in the various course groups are at a low and medium level and they are close to each other. According to this result, students get anxious when they are tested in verbal content courses, such as psychology (Ruthig et al. 2004) as well as in numeric content courses, such as maths or chemistry (Hart et al. 2016), and this affects student achievement negatively. This shows that anxiety affects achievement negatively in both the courses containing verbal knowledge that has to be memorized and the numeric courses that do not require memorization. Therefore, practitioners may reduce the high level of uncertainty and anxiety experienced in the courses by focusing on students getting the required skills through practice and performance instead of focusing on testing theoretical knowledge.

The analysis revealed that the level of education does not play a moderator role in the effect of anxiety on achievement. On the other hand, it was observed that the effect size of each education level was significant. In other words, the level of education is not a moderator for the effect of anxiety on achievement but the various education levels differ from each other. In other words, anxiety affects achievement negatively in each education level separately and the effect sizes of the education levels are low or medium. The results are similar in the "other" group which includes graduates, disabled students, athletes and artists and in the "mixed" group which includes the studies that have been conducted at two or more education levels simultaneously. This shows that the anxiety experienced during the education life is a variable affecting achievement regardless the education level. Whether in a formal educational institution or in a more independent area, such as sports (Ivanović et al. 2015; Yamada et al. 2012) or art (Kobori et al. 2011), when people get anxious their achievement is affected negatively. A careless point of view may misinterpret the validity of the results arguing that "unconcerned people can't be successful, anxiety is required". However, what is required for achievement is not "anxiety" but rather a reasonable level of "stress". Stress is a variable that affects the achievement of an individual negatively if it is too high or too low. But when it is at the optimum level it provides then a positive and motivating power (As cited in Muse et al. 2003). On the other hand, a high level of anxiety creates uncertainty (as cited in Çelebi 2015) which restricts the foreseeing of individuals and, therefore, its effects on achievement are very negative.

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Note. "*" References marked with an asterisk indicate studies included in the meta-analysis. The in-text citations to studies selected for meta-analysis are not followed by asterisks.

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