PREVALENCE AND CORRELATES OF MATH ANXIETY IN TURKISH HIGH SCHOOL STUDENTS

by

Emine Erol

B.S. in Mathematics, Boğaziçi University, 1982

Submitted to the Institute for Graduate Students in
Social Sciences in partial fulfillment of
the requirements for the degree of
Master of Arts
in
Educational Sciences

Boğaziçi University

1989

ACKNOWLEDGEMENTS

I would like to express my gratitude to Prof.Dr.Necla Öner, who helped, guided and encouraged me with care and enthusiasm. I am deeply grateful for the time and energy she spared in concluding this thesis in a short time. I enjoyed and learned a lot from her careful assistance and constructive criticisms. I profoundly feel the honour of being one of her students.

I wish to express my heartfelt thanks to Doç.Dr.Ali Baykal not only for his help, but also for giving me a chance to pursue an academic career. I deeply appreciate his tolerance and understanding. I am proud to be working with him and constantly learning from him.

I would like to thank Yrd.Doç.Dr.Sevda Bekman for the time she spared for this study and her encouraging attitude. I wish to express how much I enjoyed her lectures and being her student.

I owe my sincere thanks to the principals, the mathematics teachres, the members of the counseling services and the students of Istanbul Lisesi, Kabataş Erkek Lisesi, Özel Boğaziçi Lisesi, Özel Dost Lisesi and Beşiktaş Kız Lisesi for their ready help in administering the tests.

I also thank the members of the Faculty of Education who provided me with judgemental ratings of my scales.

My special thanks are due to Dilek Ardaç for her help, support and wonderful friendship.

I would also like to thank my friends Elif Çetin and Cengiz Alacacı for their valuable help.

I am deeply grateful to my husband Hasip Erol for his help, patience and understanding throughout this study.

Finally, I dedicate this piece of work to my mother who has supported and encouraged me at every level of my education and to whom my indeptedness can never be expressed by words.

Emine Erol

ABSTRACT

This thesis is based on a study investigating the prevalance and correlates of math anxiety among Turkish high school students. It was carried in two phases. First, two scales were developed for the measurement of math anxiety and attitudes toward mathematics; then, the relationships between math anxiety and achievement, test anxiety, sex, vocational choice and math attitudes were studied.

For the development of the two scales, a pilot study was conducted on 150 students of Istanbul Lisesi. The reliabilities of the Math Anxiety Scale (MANX) and the Math Attitude Scale (MATT) were established through alpha and item total correlation coefficients. For the validity of the Math Anxiety Scale (MANX), the Turkish form of Math Anxiety Rating Scale (MARS-A) and the Turkish form of Test Anxiety Inventory (TAI) were administered to the students and their math grades were obtained. Product moment correlation techniques showed that the hypothesized positive correlation between MANX and MARS-A and TAI, and the negative correlation between MANX and grades existed presenting evidence for the validity of MANX. A factor analysis on the MATT as well as judgemental ratings ensured the validity of the MATT.

In the second part of the study, 380 students of lise I from five different schools of Istanbul participated. The subjects were adminstered the MANX, the MATT, the TAI a brief questionnaire for demographic information, and their math grades were obtained. A low level of math anxiety was observed in lise I students in general. Significant correlations were found between math anxiety and math grades, test anxiety and attitudes towards mathematics. There were sex differences in the math anxiety levels and the scores on the Perception of Mathematics as a Male Domain subscale of the MATT. Sex differences also existed in the correlations between math anxiety and various attitudinal variables. Math anxiety was also found to be related to choice of a major and vocational undecidedness in lise I students.

ÖZET

Bu tez, lise I. sınıf öğrencilerinde matematik kaygısı ve ona paralel giden değişkenlerin incelenmesi üzerinedir. Çalışma iki aşamada yürütülmüştür. İlkin, matematik kaygısı ve matematiğe karşı tutum ölçmeye yönelik iki ölçek geliştirilmiş; daha sonra matematik kaygısının, başarı, sınav kaygısı, cinsiyet, meslek seçimi ve matematiğe karşı tutum ile ilişkisi saptanmaya çalışılmıştır.

İki ölçeğin geliştirilmesi için İstanbul Lisesinde okuyan 150 öğrenci üzerinde bir pilot çalışma yapılmıştır. Matematik Kaygı Ölçeği ve Matematiğe Karşı Tutum Ölçeğinin güvenilirlikleri alfa ve item-toplam korelasyon teknikleri ile belirlenmiştir. Matematik Kaygı Ölçeğinin geçerliliğini saptamak amacıyla öğrencilere, Math Anxiety Rating Scale (MARS-A) nin Türkçe formu ve Sınav Kaygısı Envanteri (TAI) uygulanmış, matematik notları öğrenilmiştir. Product Moment korelasyon tekniği sonucunda Matematik Kaygı Ölçeği ile MARS-A, TAI ve notlar arasındaki beklenen korelasyonlar gözlenmiş ve Matematik Kaygı Ölçeğinin geçerliliğine karar verilmiştir. Matematik Tutum Ölçeğinin geçerliliği ise faktör analizi tekniği ve uzmanların değerlendirmelerine başvurularak saptanmıştır.

Çalışmanın ikinci aşamasında, İstanbul'da beş değişik okuldan 380 öğrenci seçilmiştir. Öğrencilere Matematik Kaygı Ölçeği, Matematiğe Karşı Tutum Ölçeği, Sınav Kaygısı Envanteri (TAI) ile demografik bilgiler içeren kısa bir anket verilmiş, matematik notları öğrenilmiştir. Genelde lise I öğrencileri arasında düşük düzeyde matematik kaygısı gözlenmiştir. Matematik kaygısı ile matematik notları, sınav kaygısı ve matematiğe karşı tutum arasında anlamlı korelasyonlar bulunmuştur. Matematik Kaygısı düzeyinde ve Matematiğe Karşı Tutum Ölçeğinin 'Matematiğin Erkeklere ait bir Alan Olarak Algılanması' altölçeğinde cinsiyet farkları gözlenmiştir. Ayrıca matematik kaygısı ile matematiğe karşı tutum değişkenleri arasındaki korelasyonlar kız ve erkek öğrencilerde farklılık göstermiştir. Meslek seçiminin de Matematik Kaygısı ile ilintili olduğu bu çalışmada saptanmıştır.

LIST OF TABLES

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

INTRODUCTION

The teaching and learning of mathematics have always been central concern in educational research. Being one of the oldest organized disciplines of human knowledge, mathematics has been a fundamental topic in school curricula. The sustaining societal interest is based on at least four major themes in its development: 1) The arithmetic of whole numbers and fractions has proven indispensible for recording and ordering commerce and practical affairs. 2) The ideas of algebra, geometry statistics and calculus have provided valuable models for describing and predicting behaviour in the biological and physical world. 3) The aesthetic qualities of mathematical structures are richly embodied in creative works. 4) The pattern of logical reasoning used to prove mathematical propositions are prized as fundamental patterns of thought to be used in many other disciplines (Mitzel, 1982). At the turn of the twenty first century, more than ever, knowledge of mathematics is critical for many occupations including scientific and technical fields, business social sciences and even humanities (Betz, 1978).

Recognized as an important part of education, mathematics is an anxiety provoking discipline. Being 'good' at mathematics implies perfection, certainty, high intelligence, genious and wisdom. It is perceived as a highly specialized

knowledge apart from common sense, monotonous problem solving but key to ultimate truth. It is something antagonistic to humanistic values, a masculine (or certainly an unfeminine) activity. All these connote perfectionism and concerns about sexual acceptability. Such connotations lead to stress and anxiety (Richardson and Woolfolk, 1980).

Many intellectually capable students avoid mathematics courses in high school or college and consequently restrict the range of careers from which they may choose to those that do not require quantitative skills. Many others fail to perform as well in mathematics as they are capable of. As a result they do not attain the mathematical knowledge necessary to expand the range of available career choices to them (Betz, 1978).

Math anxiety as a construct is offered to explain poor mathematical performance and avoidance of mathematics courses. It is used to describe the irrational fear of mathematics. The tension and anxiety this produces interferes with the use of numbers and solving of mathematical problems in a variety of ordinary life and academic situations (Richardson and Suinn, 1972). Intense emotional reactions to numbers, avoidance of mathematics and test anxiety are often associated with math anxiety. It appears to be a reaction to mathematical content as well as the evaluative form of math tests and problem solving activities. In that respect it is something more or different from test anxiety when mathematics is

involved (Richardson and Woolfolk, 1980).

Coined in the mid seventees, math anxiety is now recognized as an important factor in educational and career development. Articles on the subject have appeared in popular press (e.g., Tobias, 1976), as well as in professional literature (e.g., Richardson and Woolfolk, 1980).

Significance of the Study

Math anxiety, as an affective variable, has impact on both the educational and career development of students of all ages and different characteristics. In that respect it should not only be a concern for math educators but also of guidance counselors. When and if prevalance of math anxiety is accepted and its correlates are identified, problems related to students' math underachievement, math avoidance and restriction of career choices and parents' and teachers' attitudes towards mathematics can be dealt with openly and systematically.

Purpose of the Study

The purpose of this study is twofold: first to develop two scales for measuring math anxiety and attitude towards math; secondly to investigate the prevalance and correlates of math anxiety among Turkish adolescents using the two new scales developed, Test Anxiety Inventory (TAI) and math grades and information obtained through a brief questionnaire.

CHAPTER II

CONCEPTUAL BACKGROUND

CONCEPTUAL BACKGROUND

The Concept of Anxiety

Anxiety has been widely recognized as a fundamental emotion and a basic condition of human existence by the behavioral scientists.

Freud, being the first to attempt to investigate anxiety, emphasized the role of impulses in the development of anxiety. According to Freud, anxiety is a signal indicating the presence of a danger situation. If the source of danger is from the external world, anxiety is objective. If the source stems from internal impulses, then anxiety is neurotic (Spielberger, 1966).

Sullivan's definition of anxiety involved social processes. According to Sullivan anxiety arises from experiencing disapproval in interpersonal relations (Spielberger, 1966).

According to Dollard and Miller, Anxiety is a learned drive which begins when pain is associated with a particular stimulus originating from the organisms' basic tendency to avoid it (Levitt, 1967).

May defined anxiety to be the apprehension caused by a threat to some value which the individual holds essential to his existence as a personality (Spielberger, 1966).

According to Spielberger, anxiety is subjective, consciously perceived feelings of apprehension and tension, accompanied by or associated with activation or arousal of the autonomic nervous system (Spielberger, 1966, pp.16-17). He identified two types of anxiety: state and trait anxiety. State anxiety is described as a momentary emotional arousal and trait anxiety as a personality characteristic.

A recent trend in the conceptualization of anxiety brought about the change of focus from general anxiety to situation specific anxieties. For the past two decades math anxiety has been proposed as a specific anxiety. On the other hand, following the distinction between trait anxiety and state anxiety, Morris et al. (1978) conceptualized math anxiety as a situation specific trait anxiety, indicating proneness to experience state anxiety in evaluative situations involving mathematics.

The Concept of Math Anxiety

Math anxiety as a construct is offered to explain poor mathematical performance and avoidance of mathematics courses. It has earlier been stated as "mathemaphobia", and "number anxiety" and finally assessed as "math anxiety". Dreger and Aiken (1957) constructed a three item scale of number anxiety

and defined it as "a syndrome of emotional reactions to arithmetic and mathematics". Fennema and Sherman (1976) claimed that math anxiety was "feelings of anxiety, dread, nervousness and associated bodily symptoms related to doing mathematics". Richardson and Suinn (1972) described math anxiety as involving "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of math problems in a wide variety of ordinary life and academic situations".

A more ornate definition was provided by Tobias and Weissbrod (1980) who noted that math anxiety was used to describe "the panic, helplessness, paralysis and mental disorganization that arizes among the people when they are required to solve a mathematical problem". Another conceptualization of math anxiety was provided by Mathison who felt that it was "an irrational fear which interferes with the development or use of mathematical skills". Lazarus clarified that math anxiety was not the same as dyscalculia (inability to perform even the simplest calculations). Hendel and Davis (1978) observed that "one symptom of math anxiety is avoidance of mathematics".

Math anxiety can be perceived as a form of test anxiety. However, "math anxiety is something more, or different from test anxiety when mathematics is involved" (Richardson and Woolfolk, 1980). Math anxiety appears to be a reaction to mathematical content as well as a reaction to the evaluative form of tests and problem solving activities (Richardson and

Woolfolk, 1980). Richardson and Suinn (1972) found that a majority of the students who reported feeling anxious about mathematics indicated that they had no similar anxieties for other subjects.

Measurement of Math Anxiety

Several measurement scales have been developed to assess math anxiety levels of individuals. Most of these instruments were either one item scales or brief questionnaires. Reliability or validity data are lacking for these scales which were rarely used beyond one or two studies (Richardson and Woolfolk, 1980).

Math Anxiety Scale (MAS) developed by Fennema and Sherman (1976) and Math Anxiety Rating Scale (MARS) developed by Richardson and Suinn (1972) are the most widely used instruments to assess math anxiety.

The Fennema-Sherman Math Anxiety Scale (MAS) is a 12-item, 5-point Likert format instrument. The scale was originally used with highschool students. High scores indicate low anxiety. An alpha coefficient of .72 and a two week test-retest reliability of .87 were found for MAS by Dew et al. (1983).

Math Anxiety Rating Scale (MARS) developed by Richardson and Suinn (1972) consists of 98 Likert-type items on brief descriptions of ordinary life and academic situations involving

the manipulation of numbers of solving of mathematical problems that may arouse anxiety. A total math anxiety score is calculated by assigning a numerical value of 1 to 5 (1 being assigned to "not at all" anxious, and 5 to "very much" anxious), and then summing all the values checked to correspond math anxiety score, indicating level of math anxiety (Richardson and Woolfolk, 1980).

An internal consistency reliability coefficient, an alpha (Nunnally, 1967) calculated from the MARS scores of 397 college students by Richardson and Suinn (1972), was .93. A two-week test retest reliability coefficient of .78 and a seven-week test-retest reliability coefficient of .85 were found for two different studies (Richardson and Woolfolk, 1980).

Richardson and Suinn (1972) and Suinn et al. (1972) both obtained data concerning the validity of the MARS by correlating MARS total scores with scores on the Mathematics form of the Differential Aptitude Test (DAT) administered with a 10-minute time limit. These studies found correlations of $-.35$ ($p<.05$) and $-.64$ ($p<.01$) on student samples of 119 and 30, respectively (Rounds and Hendel, 1980).

The MARS-A was adapted into Turkish and revised by Bayraktar (1985). After the translation process MARS-A was administered to 60 students of Anadolu Lisesi in Ankara. Consequently 14 items were removed regarding the difficulty during administration and the comprehensibility of the items. The revised form of MARS-A with 84 items had a two week test retest reliability of .86. A split-half reliability of .93 was found. Normative data on a sample of 389 students were obtained (Bayraktar, 1985).

Prevalence of Math Anxiety

Research shows that math anxiety is a critical factor in a student's educational and vocational decisions for societies in which studies were conducted. The literature indicates that math anxiety is an existing phenomenon in all ages of students from elementary through graduate school for both sexes and of all ethnic and racial backgrounds.

Betz (1978) invetigated prevalance and intensity of math anxiety in college students. Three groups of students, a total of 652 were used in the study from two math courses and a psychology course. Results indicated that "math anxiety occurs frequently among college students and that it is more likely to occur among women than among men and among students with inadequate high school math backgrounds" (Betz, 1978).

Muinos (1988) compared the levels of math anxiety among Black, Hispanic and White college students across various levels of mathematics achievement. The results showed that the lower the achievement level the higher the level of math anxiety. The test results comparing Black with White students did not yield statistically significant results whereas the data comparing Hispanics with white students yielded varying results.

Resnick, Viehe and Segal (1982) investigated the prevalance and correlates of math anxiety among college freshmen and studied the dimensionality based on Math Anxiety Rating

Scale (MARS). Results indicated that most college freshmen reported only low levels of math anxiety, and that there were no large sex differences. Three factors were identified and labeled as Evaluation Anxiety, Arithmetic Computation Anxiety and Social Responsibility Anxiety.

Another dimensionality study for math anxiety was done by Rounds and Hendel (1980) where the math anxiety levels of 350 female participants in a math anxiety program was measured using MARS. Two factors were identified and labeled as Mathematics Test Anxiety and Numerical Anxiety.

Correlates of Math Anxiety

Betz (1978) reported that higher levels of math anxiety were related to lower mathematics achievement test scores, higher levels of test anxiety and higher levels of trait anxiety.

Morris, Kellaway and Smith (1978) administered MARS to 52 psychology and 54 mathematics students. As predicted, psychology students had higher MARS total scores than math students. Math anxiety was significantly and inversely related to performance only for psychology students. The significant positive relationships among MARS and Worry and Emotionality scores suggested that math anxiety could be used as a valid predictor of test anxiety (Morris, Kellaway, Smith, 1978).

Hendel and Darwin (1980) examined the correlates of math anxiety among the 69 15-59 year old females in a program designed to help individuals overcome their fear of mathematics. Subjects were given MARS and other anxiety scales plus a background questionnaire. Results indicated that (1) math anxiety was highly correlated with other academically relevant anxiety scales (2) test anxiety and self estimated mathematics ability were the most important variables in the prediction of math anxiety (3) math anxiety and highschool mathematics preparation were the most important variables in the prediction of arithmetic performance.

Dew, Galassi and Galassi (1983) investigated four basic questions about math anxiety, namely, the degree of math anxiety experienced by males and females, the internal consistency and test-retest reliabilities of three math anxiety measures, MARS, MAS and Sandman's Anxiety Towards Mathematics Scale (ATMS). Results indicated nonequivalent internal consistency and test-retest reliability coefficients for the three math anxiety measures with the ATMS having the lowest coefficients. Small but significant gender differences were found on MARS and MAS. Math anxiety measures were moderately related to each other. But they were more closely related to each other than to test anxiety and its components (Dew et al., 1983).

The relationship between math anxiety and situational test anxiety, performance, physiological arousal and math

avoidance behaviour was investigated by Dew et al. (1984). 63 undergraduate students, 23 males and 40 females participated in the study. The subjects completed MARS, MAS, ATMS and Spielberger's Test Anxiety Inventory prior to completing three math tasks and Deffenbacher's Post Task questionnaire. During the math tasks, heart rate skin conductance level, skin fluctuations and avoidance behaviour were monitored. Consistent with the previous findings (Dew, et al., 1983) math anxiety measures were more closely related to each other than to test anxiety. The physiological and avoidance measures showed little relation to math anxiety (Dew, et al., 1984).

A study on the cognitions of high and low math anxious undergraduates was conducted by Fulkerson, Galassi and Galassi (1984). Students were asked to think aloud while solving math problems. Cognitions generated from this procedure were examined for sex and anxiety related differences and were used to predict performance. Anxiety related differences were not found for performance or the eleven categories of cognitions. No sex differences were found in performance or for linear combinations of cognitions.

Hunsley (1987) explored the functional similarities and differences in the cognitive processes involved in math anxiety and test anxiety. Ninetysix students in an undergraduate psychology statistics course completed test and math anxiety measures. Math anxiety and test anxiety were positively and significantly correlated. In many respects math

anxiety and test anxiety were quite similar but in the context of mathematical examinations, math anxiety had incremental validity in the prediction of many cognitive processes. Subjective ratings of exam importance, post exam performance estimations and ratings of performance satisfaction were related to math anxiety but not to test anxiety.

Llabre and Suarez (1985) investigated the ability of math anxiety to predict grades in an introductory algebra course on a sample of 112 female and 72 male college students. The relation between math anxiety and selected personality and attitude measures was compared between the male and female groups. The MD Scale of Fennema and Sherman was used to measure the extent to which subjects stereotyped mathematics as being a male domain. Sarason's General Anxiety Scale, the revised short form of MARS the Mehrabian Measure of Achieving Tendency were also administered.

The results indicated that after controlling for mathematics aptitude the construct of math anxiety did not significantly improve the prediction of grades. Math anxiety was found to be less specific in men than it was in women. And math anxiety could not be predicted from the MD scale. Math anxiety was more strongly related to general anxiety in men than it was in women.

Hinkle (1986) investigated the relationships among learning style preferences, personality types and math anxiety of college students. Data were collected from seventy five

students of MARS, Kolb's Learning Style Inventory (LSI), Myers Briggs Type Indicator (MBTI), California Achievement Test. Results showed that math anxiety was significantly correlated to reflective observation and negatively correlated to concrete experience. It was also significantly correlated with introversion and feeling.

Preston (1987) in her study tapped the relationship between math anxiety and sex, college major, mathematics background, math achievement, math performance, math avoidance, self rating of math ability and self rating of math anxiety using data gathered on 173 college students in mathematics, education and English classes. Math anxiety was found to be related to choice of college major. Males and females did not differ in math anxiety levels. Math anxiety showed relatively little relationship to math performance and a moderate relationship to math performance and a moderate relationship to mathematics background, achievement and avoidance. Results also indicated that the higher one's level of math anxiety the lower one's self rating of math ability and higher one's self rating of math anxiety.

The math anxiety of Turkish students have been measured in a study conducted in Ankara Yükseliş Lisesi where math anxiety of sixth grade students has been determined and treated through corrective feedback (Bayraktar, 1985).

Math Anxiety and Choice of Career

Hawkins and Bradley and White (1977) investigated whether general anxiety or anxiety about choice of a college major and choice of a vocation were related to educational-vocational decidedness. 427 college students completed the instrument which tapped 10 independent variables including 6 anxiety type scales plus self report demographic information. Of the 10 independent 9 were found to be related to at least one of the dependent variables supporting the relationships hypothesized between anxiety and career decision making (Hawkins et al., 1977).

Fuqua, Seaworth and Newman designed a study to determine if state and trait anxiety relate differentially to various components of career indecision. The results supported previous findings that a substantial relation exists between career indecision and anxiety (Fuqua, Newman, Seaworth, 1988).

Another study by O'Hare and Tamburri (1986) tapped the relations among trait anxiety, coping types, career decision making and state anxiety related to career decision making. Participants were 248 undergraduate students. Trait anxiety and a low sense of personal efficacy were the primary predictors of career undecidedness.

CHAPTER III

METHOD

METHOD

This study consists of two parts. The first part is the pilot study where two scales, namely, Math Anxiety Scale (MANX) and Math Attitude Scale (MATT) were developed and their reliability and validity studies were conducted. The second part is on the prevalance and correlates of math anxiety.

Pilot Study for the Development of Math Anxiety and Math Attitude Scales

Sample

The sample consisted of onehundred and fifty students of Istanbul Lisesi. Istanbul Lisesi, an Anadolu Lisesi, is a special lycee. The language of instruction is German and Turkish. Students enter this school through central entrance examinations. The students of this school represent a high ability group as this school requires a high base score in the entrance exams. The selection of this school as a sample for the pilot study was for practical reasons, since the researcher was doing a one year field study at Istanbul Lisesi at the time of the research.

The students were chosen from two sections each of Orta 3, Lise I and Lise II. As a result, the sample consisted of 113 male and 37 female students with an average age of 16.02.

Instruments

Five different instruments were used in this study. They were: (1) Math Anxiety Scale (MANX), (2) Math Attitude Scale (MATT), (3) The Turkish form of Math Anxiety Rating Scale (MARS-A), (4) The Turkish form of the Spielberger Test Anxiety Inventory and (5) Math grades in the students' report cards.

Math Anxiety Scale (MANX) and Math Attitude Scale (MATT)

These two scales were developed by the researcher during this study. Math Anxiety Scale (MANX) had 45 Likert type items which were to be answered on a four point scale between (1) never, (2) sometimes, (3) often, (4) always.

Math Attitude Scale (MATT) consisted of 70, 4-point Likert-type items for which the students were asked to declare their degree of agreement from (1) not at all to (4) totally. Math Attitude Scale consisted of six subscales namely, 1- Perceived Usefulness of Mathematics, 2- Perceived Attitudes of Parents towards Mathematics, 3- Perception of Mathematics as a Male Domain, 4- Perceived Anxiety, 5- Perceived Ability,

6- Attitude towards Math Lessons, each of which were scored independently.

Math Anxiety Rating Scale (MARS-A): Math Anxiety Rating Scale (MARS-A) developed by Richardson and Suinn (1972) is widely used in measuring Math Anxiety. It consists of 98 Likert type items. They are brief descriptions of ordinary life and academic situations involving the manipulations of numbers, or solving of mathematical problems that may arouse anxiety. Answers are marked on a five point scale with a numerical value of 1 ('not at all' anxious) to 5 ('very' anxious). A total math anxiety score is obtained by summing over all the numerical values that correspond to the responses made on the scale. Possible scores range between 98 and 490. This constitutes the math anxiety score, indicating the level of math anxiety (Richardson and Woolfolk, 1980).

The scale has an internal reliability (alpha) coefficient of .93 obtained from 397 college students. The test-retest reliability coefficients of .78 and .85 were found for two and seven week intervals, respectively (Richardson and Suinn, 1972).

The Turkish adaptation of the Math Anxiety Rating Scale (MARS-A) was revised into an 84-item form. It has a split-half reliability of .93 and a test-retest reliability of .86 (Bayraktar, 1985).

Test Anxiety Inventory (TAI): The Test Anxiety Inventory was developed by Spielberger (1980) and adapted into Turkish by Öner and Kaymak (1985, 1986). It is a self report inventory to measure individual differences in test anxiety as a situation-specific personality trait. It consists of 20 items which are to be answered on a four point scale between (1) almost never, (2) sometimes, (3) often, and (4) almost always. The total scores range between 20 and 80.

The test-retest reliability coefficients reported for the original English form are .80 for a two week and .62 for six month intervals. Alpha coefficients are .92 and higher. The median item remainder correlations reported for the total scale range from .61 to .69.

For the Turkish form (TAI-T), a two week test-retest reliability of .81 was found. The alpha coefficients range from .82 to .92 with the median item remainder correlations ranging between .46 and .53. Moderate significant correlations between the TAI-T and various personality measures as well as academic achievement and the factor analysis of TAI-T support the criterion-related and construct validity of the scale (Öner, 1986).

Procedure

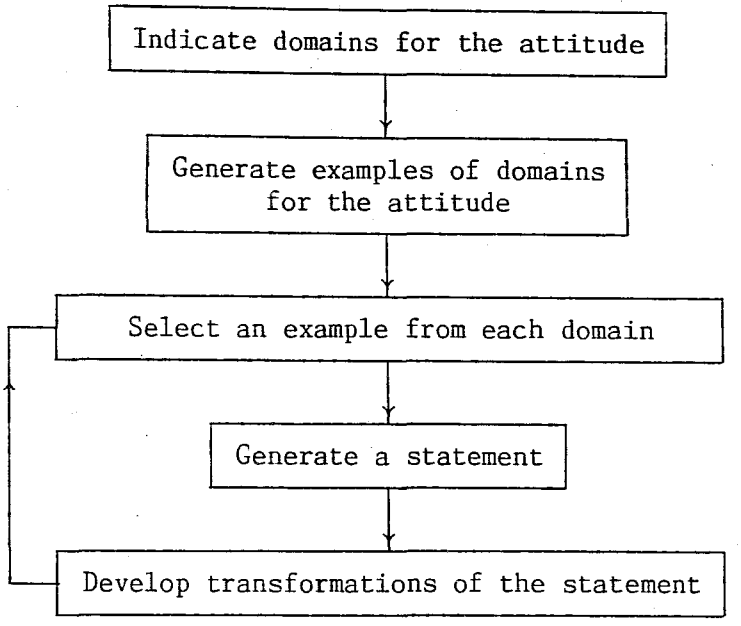
Math Anxiety Rating Scale (MARS-A) was administered to 150 students. For the development of the new Math Anxiety Scale (MANX), the item means were calculated for the upper ten percent of the students scoring the highest on MARS-A. Items with the highest means were determined. Interviews were conducted with students who scored high on MARS-A, those who refused to answer all of the items, and those who were willing to comment on the test. Based on information obtained from MARS-A items with high means, and interviews, a new scale with 45 items was constructed. This scale was named Math Anxiety Scale (MANX).

For the development of an attitude scale for mathematics the Domain Referenced Approach was used. This approach was originally modeled after Hiveley's work in developing domain referenced Achievement tests (Gable, 1986).

The steps for developing an operational definition for an attitude are shown in Figure 1.

Figure 1

Steps for Developing an Operational Definition for an Attitude



As indicated in Figure 1, in order to construct the items of an attitude scale, i.e. developing operational definitions for an attitude, domains for the attitude are determined. To generate examples of domains different verbs and adjectives related with the domain are found. Then an example can be chosen from those generated verbs and adjectives. A statement can then be formed. Transformations of the statement can be developed until the best expression is obtained. Consequently, sentences are generated that are the items of the questionnaire.

The domains for the Math Attitude Scale (MATT) were determined to be (1) Perceived Usefulness of Mathematics, (2) Perceived Attitudes of Parents towards Math, (3) Perception of Math as a Male Domain, (4) Perceived Anxiety, (5) Perceived Ability, (6) Attitude towards Math Lessons. Interviews with high school students were used as sources of different verbs and adjectives. Ninenty eight sentences generated thus were then evaluated by fifteen judges from the Faculty and graduate students of Faculty of Education of Boğaziçi University. These judges were asked to classify the items under six previously determined domains by this researcher. They were also asked to indicate how well each item fit into each domain by giving a score from 1 (possible) to 3 (definitely so). For each domain, items with means greater than 2.5 were selected. This way the initial pool of 98 items were reduced to 70, and six subscales were formed. This new scale consisting of 70 items and six subscales was named Math Attitude Scale (MATT).

Math Anxiety Scale (MANX), Math Attitude Scale (MATT) and Test Anxiety Inventory (TAI) were administered to the 150 students during two different class hours. Students' math grades for the first semester were obtained from the counselling service.

Statistical Analysis

For the reliability of the Math Anxiety Scale (MANX) and the Math Attitude Scale (MATT), internal consistencies of the total scores (and subtest scores of MATT) were assessed by use of Kuder-Richardson Formula 20 and item-total correlation techniques.

For the validity of MANX, Pearson Product Moment correlations were calculated between MANX and MARS-A TAI and math grades. The validity of the Math Attitude Scale was determined by the ratings of judges, and factor analysis. The latter was carried out in order to be able to compare the factors with the domains obtained through the evaluations obtained from the judges.

The Study on the Prevalance and Correlates of Math Anxiety

Sample

The sample consisted of 380 students of Lise I from five different schools of Istanbul. These schools are: Istanbul Lisesi, Kabataş Erkek Lisesi, Özel Boğaziçi Lisesi, Özel Dost Lisesi and Beşiktaş Kız Lisesi.

Two sections of Istanbul Lisesi which did not participate in the pilot study were chosen for the main study on prevalence and correlates of math anxiety.

Özel Boğaziçi Lisesi and Özel Dost Lisesi are private coeducational schools. The language of instruction is English and Turkish. Mostly the SES of the students is high.

Kabataş Erkek Lisesi is an all boy and Beşiktaş Kız Lisesi is an all girl state school. The language of instruction is Turkish. The SES of students is lower than those of the other three schools.

The total sample, boys and girls, and distribution of students according to schools are shown in Table 1. The age range is between 14 and 19 with a mean of 15.79.

Table 1

The Sample Schools and Students of the Main Study

Name of School	No. of Students		
	Boys	Girls	Total
Istanbul Lisesi	46	10	56
Kabataş Erkek Lisesi	95	-	95
Özel Boğaziçi Lisesi	30	21	51
Özel Dost Lisesi	55	45	100
Beşiktaş Kız Lisesi	-	78	78
Total	226	154	380

Procedure

Math Anxiety Scale (MANX), Math Attitude Scale (MATT), Test Anxiety Inventory (TAI) and a questionnaire for demographic information were administered during several class hours either by the researcher herself, by math teachers or by the school counselors. Math grades were obtained from the school administration.

Statistical Analysis

Pearson Product Moment correlations, t-tests, analysis of variance and multiple regression techniques were used in data analyses.

To determine the correlates of math anxiety correlations were computed for the Math Anxiety Scale (MANX), the Math Attitude Scale (MATT) and its subscales, the Test Anxiety Inventory (TAI) and math grades.

Analysis of variance was computed, for school differences on the level of math anxiety, and also for different vocational choices and the level of math anxiety.

Regression analyses were done on math anxiety, test anxiety, achievement, sex and attitudes towards mathematics, taking math anxiety and achievement as dependent variables respectively.

Sex differences in math anxiety level and attitude towards math as in Perception of Mathematics as a Male domain subscale of MATT, were assessed through t-tests. A difference of math anxiety levels between groups of students who have different choices of concentration in lise II (Science or Literature) were checked using independent group t tests.

CHAPTER IV

FINDINGS AND DISCUSSION

FINDINGS AND DISCUSSION

In this chapter data are presented in two sections. In the first section, findings of the pilot study for the development of the Math Anxiety Scale (MANX), and the Math Attitude Scale (MATT); in the second section, findings related to the prevalance and correlates of math anxiety are reported and discussed.

The Pilot Study

This particular study is aimed to demonstrate the reliability and the validity of two scales: (1) Math Anxiety Scale (MANX), and (2) Math Attitude Scale (MATT) and its sub-scales.

Math Anxiety Scale (MANX)

For an overall picture of MANX item means and standard deviations of the 45-item MANX form obtained from the sample of 145 students of Istanbul Lisesi are presented (Table 2). The total mean and standard deviation values were 81.03, and 16.29 respectively. Highest and lowest possible total scores were 45 and 180.

Table 2

Means and Standard Deviations of the 45 Items of MANX Obtained from the Pilot Study Sample

Item number	Mean	Standard dev.
1	1.91	.73
2	1.51	.61
3	2.46	.80
4	2.17	.95
5	1.99	.85
6	1.59	.64
7	1.57	.80
8	1.19	.59
9	1.08	.29
10	3.14	1.08
11	1.18	.50
12	1.36	.64
13	2.32	.99
14	1.66	.74
15	1.50	.74
16	1.31	.62
17	1.40	.64
18	1.50	.67
19	2.23	.94
20	1.97	1.06
21	2.33	.97
22	1.57	.61
23	1.78	.90
24	1.22	.58
25	1.34	.61
26	1.19	.43
27	2.29	1.07
28	2.74	.92
29	1.27	.60
30	1.41	.67
31	1.53	.79
32	2.38	1.04
33	1.91	.90
34	1.83	.57
35	2.72	.98
36	1.59	.77
37	1.74	.94
38	1.31	.65
39	1.58	.84
40	3.13	.84
41	1.92	.68
42	2.22	.94
43	1.95	1.08
44	1.43	.63
45	1.61	.83
Total Score	81.03	16.29

Reliability

The reliability of MANX was determined by use of alpha and item total correlations. The analyses for the internal consistency of the Math Anxiety Scale were based on the scores obtained from 145 students of Istanbul Lisesi. For this, an alpha coefficient of .91 was obtained using a generalized form of the Kuder-Richardson Formula 20.

Further information about the internal consistency was obtained from the item-total statistics. Corrected item total correlation coefficients presented in Table 3 are in the form of item-remainder correlations. It can be seen from this table that all correlations, except for Item 10, and Item 13, are greater than or equal to .21. The median item remainder correlation is .43. These coefficients provide evidence for the internal consistency of MANX.

Table 3

Item-Remainder Correlation Coefficient for MANX Scores Obtained from the Pilot Study Sample

Item Number	Item remainder correlation coefficient
1	.54
2	.58
3	.42
4	.50
5	.43
6	.43
7	.42
8	.33
9	.21
10	.03
11	.50
12	.48
13	.13
14	.64
15	.25
16	.54
17	.41
18	.63
19	.48
20	.38
21	.37
22	.61
23	.56
24	.38
25	.63
26	.48
27	.38
28	.25
29	.40
30	.66
31	.48
32	.38
33	.36
34	.55
35	.32
36	.44
37	.64
38	.52
39	.59
40	.29
41	.42
42	.33
43	.39
44	.46
45	.51
Median	.43

Validity

In order to assess the validity of MANX, Pearson Product Moment correlations between MANX and (1) Math Anxiety Rating Scale (MARS), (2) Test Anxiety Inventory (TAI) and (3) Achievement (Mathematics grades) were computed. These correlation coefficients are given in Table 4.

Table 4

Pearson Product Moment Correlation Coefficients between MANX and MARS, TAI and Grades

	MARS	TAI	GRADE
MANX	.45* N=119	.43* N=113	-.39* N=140
MARS		.53* N=101	-.12 N=121
TAI			-.12 N=114

* $p < .0001$

As it can be seen from Table 4, the Pearson Product Moment correlation coefficient between MANX and MARS in .45, significant at the .0001 level supporting the construct validity of MANX. It was hypothesized that a correlation coefficient of .43 between MANX and TAI, significant at .0001 level, provides evidence for validity. A significant negative correlation of -.39 between MANX and grades was used as proof for

the criterion related validity of MANX considering previous research findings showing negative correlations between Math Anxiety and achievement (Betz, 1978; Rounds and Hendel, 1980).

Math Attitude Scale (MATT)

The Math Attitude Scale consists of six subscales. The six MATT subscales were initially determined and items were developed accordingly. Judgemental validity was obtained when fifteen experts from the faculty and graduate students of the Faculty of Education of Boğaziçi University grouped and rated the items according to the given subscales. Judgemental validity was thus assessed. This led to a 70-item MATT form that was used in pilot study.

Reliability

The reliability of the Math Attitude Scale and its subscales were also determined by use of alpha and item total correlations. The analyses for the internal consistency of MATT were based on the scores of 150 students from Istanbul Lisesi. Table 5 shows the alpha coefficients for the total MATT scale and its subscales as computed by a generalized form of the Kuder-Richardson Formula 20.

Table 5

Alpha Coefficients for the MATT and Subscales

S c a l e	No. of items	N	alpha
Math Attitude Scale (MATT) total	70	118	.93
Perceived Usefulness of Mathematics Subscale	16	139	.82
Perceived Attitude of Parents towards Math. Subscale	16	133	.84
Perception of Mathematics as a Male domain Subscale	6	142	.78
Perceived Anxiety Subscale	6	148	.79
Perceived Ability Subscale	10	138	.83
Attitude towards Math. Lessons Subscale	16	147	.87

As shown in Table 5, the alpha coefficient for total MATT was .93. For the six subscales alpha coefficients ranged from .78 to .87. These are quite high and thus provide evidence for internal consistency.

Item-total correlations were also computed for each MATT subscale. Corrected item total correlation coefficients are shown in Table 6 in the form of item remainder correlations.

Table 6

Item Remainder Correlation Coefficients for the Subscales of MATT Obtained from the Pilot Study Sample

Name of Subscale	Item Number	Item Remainder Correlation Coefficient
Perceived Usefulness of of Mathematics	1	.59
	6	.13
	7	.11
	16	.43
	17	.47
	18	.55
	38	.61
	39	.65
	40	.49
	41	.47
	43	.62
	44	.45
	45	.42
	46	-.03
	59	.49
	60	.55
Perceived Attitudes of Parents towards Math	11	.49
	12	.48
	24	.45
	27	.47
	28	.58
	36	.31
	37	.35
	49	.29
	50	.30
	56	.40
	57	.52
	61	.48
	62	.53
	68	.57
	69	.55
	70	.58
Perception of Mathematics as a Male Domain	2	.46
	15	.61
	33	.44
	34	.57
	42	.69
	47	.46

Table 6

Item Remainder Correlation Coefficients for the Subscales of MATT Obtained from the Pilot Study Sample

Name of Subscale	Item Number	Item Remainder Correlation Coefficient
Perceived Anxiety	5	.56
	10	.62
	20	.63
	22	.48
	25	.70
	26	.33
Perceived Ability	4	.65
	13	.76
	14	.66
	21	.45
	23	.36
	29	.53
	35	.16
	55	.66
	58	.56
	63	.54
Attitude Towards Math. Lessons	3	.53
	8	.58
	9	.42
	19	.38
	30	.47
	31	.62
	32	.12
	48	.57
	51	.61
	52	.53
	53	.57
	65	.67
	66	.46
	67	.42
	54	.61
	64	.64

As it can be observed from Table 6, item remainder correlation coefficients of almost all of the items were satisfactory (> .15) (Nunnally, 1967, p.285).

In the Perceived Usefulness of Mathematics subscale, item remainder correlation coefficients for Items 6, 7 and 46 were .13, .11 and -.03, respectively. Item 32 of the Attitude towards Math Lessons subscale had a correlation coefficient of .12. Consequently these four items were deleted from the scale to be used in the main study which investigated the correlates of math anxiety.

Validity

Apart from the judgemental ratings assessing the conceptual validity of MATT, a factor analysis was carried out in order to obtain further information about the composition of this scale.

The responses of 150 students of Istanbul Lisesi were evaluated in a factor analysis using the SPSS-X principal factors method with the varimax rotation and non-orthogonal oblique rotation to explore if the factorial structure was consistent with the grouping of the subscales. The number of factors to be rotated was initially estimated as six, since it was composed of six subscales. The eigenvalues for the first through the sixth factors were 14.58, 6.85, 4.37, 2.93, 2.82 and 2.32, respectively.

The six factor solution was rotated to both a direct oblimin and a varimax criterion. The varimax solution provides a more parsimonious representation of these results than the direct oblimin solution; therefore the former was chosen for presentation here.

Factors obtained and salient factor loadings (.35 and above) for the 70-MATT items are reported in Table 7 with item means and standard deviations.

Table 7

Means Standard Deviations and Factor Loadings* for the 70-item MATT form Derived from the Pilot Study Sample

Item	Item Mean	Item S.D.	Factor I	Factor II	Factor III	Factor IV	Factor V	Factor VI
1	3.38	.74		.54				
2	1.52	.98					.55	
3	2.69	.85	.66					
4	2.84	.81	.66					
5	3.34	.80	.46					
6	3.47	.94			.57			
7	2.94	1.01						
8	3.19	.88	.54					
9	2.84	.96			.39			
10	3.51	.81			.62			
11	3.27	.85				.47		
12	2.65	.94				.60		
13	2.80	.84	.76					
14	2.90	.74	.69					
15	1.97	1.12					.59	
16	3.00	.98		.56				
17	2.92	.88		.61				
18	2.94	.92		.61				
19	3.34	.80						.42
20	3.36	.84	.59					
21	3.32	.70			.52			
22	3.29	.81			.47			
23	3.48	.89						
24	2.75	1.04				.58		
25	3.18	.87			.46			
26	2.16	1.07						.54
27	3.01	.86				.71		

Table 7

Means Standard Deviations and Factor Loadings* for the 70-item MATT form Derived from the Pilot Study Sample

Item	Item Mean	Item S.D.	Factor I	Factor II	Factor III	Factor IV	Factor V	Factor VI
28	3.00	.87				.74		
29	2.76	.77	.54					
30	2.47	1.04	.58					
31	3.13	1.01	.62					
32	2.47	1.04						
33	2.05	1.12					.64	
34	2.21	1.23					.61	
35	3.19	.94						
36	3.57	.80					.48	
37	3.51	.82					.48	
38	3.29	.81		.76				
39	3.41	.60		.72				
40	3.28	.90		.52				
41	3.44	.80						.54
42	2.11	1.07					.75	
43	2.97	.92		.60				
44	3.36	.80						.56
45	3.25	.79						.57
46	2.72	1.04				.36		
47	2.88	1.15					.50	
48	2.70	.99	.66					
49	3.67	.70			.74			
50	3.72	.63			.81			
51	2.96	.88	.62					
52	3.17	.86		.46				
53	3.31	.80		.44				
54	3.17	.91	.69					
55	2.74	.96	.71					
56	2.19	.81				.64		
57	2.34	.85				.62		
58	2.94	.88	.66					
59	3.49	.86			.59			
60	3.26	.80		.54				
61	3.07	.80		.53				
62	3.09	.85		.57				
63	3.45	.79	.45					
64	3.27	.96	.60					
65	2.71	.98	.74					
66	3.53	.75						.49
67	3.12	.98	.38					
68	2.76	.89		.50				
69	2.86	.83		.56				
70	3.02	.87				.45		
* varimax rotation Eigenvalues			14.58	6.85	4.37	2.93	2.82	2.32
Unrotated variance			20.8%	9.8%	6.2%	4.2%	4.0%	3.3%

As seen from Table 7, Factor I consisted of 14 MATT items with factor loading >.35. Factor II consisted of 15 items with similar factor loadings. Factor III had 9 items with factor loadings >.35 and 2 items with factor loadings <.35 which were items no. 23 and 7. Factor IV consisted of 9 items with salient factor loadings. Factor V had 8 items with loadings >.35 and one item loading (item 35) smaller than .35. Finally factor VI had six items with factor loadings >.35 and one item (Item 32) with a factor loading <.35.

The MATT items were tabulated in order to observe the congruence between the six factors obtained from the factor analysis, and the original MATT subscale (Table 8).

It is seen from this table that 9 items out of 16 of the Perceived Usefulness of Mathematics Subscale belong to Factor II. Three out of the remaining subscale items (items 6, 7, and 46) which are to be deleted because of unsatisfactory (low) item total correlation coefficients, fall under Factors III and IV. When these are taken out, Perceived Usefulness falls under Factors II and VI. But more generally one can conclude that Subscale Perceived Usefulness of Mathematics corresponds fairly closely to Factor II.

Table 8

Items of MATT according to the Factor and Subscale in which they belong

	FACTOR I	FACTOR II	FACTOR III	FACTOR IV	FACTOR V	FACTOR VI
Subscale 1		38 39 17 18 43 16 60 1 40	59 6 7	46		45 44 41
Subscale 2		62 69 61 68	50 49	27 28 56 57 12 24 11 70	36 37	
Subscale 3					42 33 34 15 2 47	
Subscale 4	20 5		10 22 25			26
Subscale 5	13 55 14 58 4 29 63		21 23		35	
Subscale 6	64 54 48 3 51 31 64 30 8 67	52 53	9			66 19 32

Subscale 1 : Perceived Usefulness of Math
2 : Perceived Attitudes of Parents towards Math
3 : Perception of Math as a Male Domain
4 : Perceived Anxiety
5 : Perceived Ability
6 : Attitude towards Math Lessons

Eight out of 16 items of the Perceived Attitudes of Parents towards Math subscale belong to Factor IV. All of the Perception of Mathematics as a Male Domain subscale items are under factor V. Items no 36 and 37 which also belong to Factor V but covered under the Perceived Attitudes of Parents towards Math subscale had been said to belong to Perception of Mathematics as a Male Domain scale by some judges. Therefore, it can be considered that Factor V and subscale 'Perception of Math as a Male Domain are almost identical. Three out of six items of the 'Perceived Anxiety' subscale belonged to Factor III. Almost all items of the Perceived Ability subscale and Attitude towards Math Lessons subscale belong to Factor I.

Discussion

The aim of the pilot study was to determine the reliability and validity of the new Math Anxiety Scale (MANX) and the Math Attitude Scale (MATT). For reliability, internal consistency of both scales were determined through alpha and item—total correlation coefficients. The obtained alpha coefficients were satisfactory for both MANX and MATT and its subscales providing evidence for the homogeneity of these measures.

Another test for internal consistency was the use of item total statistics. It showed that MANX items 10 and 13 had lower than required minimum ($r<.15$) item total correlation coefficients. This researcher believed that if those two

items are modified their item-total coefficients could increase. Hence, they were not discarded from the scale for further study.

In MATT, items 6, 7, 32 and 46 were deleted for two reasons: (1) because of their low item-total correlation coefficients, and (2) factor analysis revealed that they clustered in a different group than expected.

Factor analysis yielded six factors, four of which could be identified with or correspond to the four of the subscales. This finding was considered as an important evidence for the conceptual and content validity of MATT.

Limitations: The sample used for the pilot study consisted of 150 students of Istanbul Lisesi which is a special school, and therefore, far from being representative of the Turkish adolescents. The SES of the students and their abilities are above average.

Due to the shortage of time in which the study was completed the assessment of test-retest reliability of the scales could not be accomplished. It is suggested that the reliability and validity of MANX and MATT scales be replicated and cross-validated on a more representative sample. Also the stability of the scales should be determined.

Prevalence and Correlates of Math Anxiety

This part of the study aims to investigate the prevalance and correlates of math anxiety among Lise I students. It also seeks to determine sex differences in math anxiety and the relationship between math anxiety and vocational choice.

Prevalance of Math Anxiety

Math anxiety level as measured by MANX scores ranged from 46 to 149 for the sample of 380 students from five different high schools. The mean for the sample was 86.28 and the standard deviation 17.91. The minimum possible score for this four point Likert type and 45 item scale is 45 and the maximum possible score is 180.

Means and standard deviations of the MANX scores for different schools is presented in Table 9.

Table 9

Means and Standard Deviations of the MANX Scores for the Schools that Constitute the Sample

Name of School	N	Mean	S.D.
Istanbul Lisesi	56	84.40	19.84
Kabataş Erkek Lisesi	95	86.00	17.42
Boğaziçi Lisesi	51	91.27	13.82
Dost Lisesi	99	80.48	16.24
Beşiktaş Kız Lisesi	78	92.08	18.74

A one-way analysis of variance (Table 10) yielded differences in math anxiety among the sample schools, significant at the .0001 level.

Table 10

Analysis of Variance for Five Schools of MANX scores

Source of Variation	SS	D.F.	MS	F
Between groups	7452.86	4	1863.22	6.12*
Within groups	113201.33	372	304.30	
Total	120654.20	376		

* $p < .0001$

Scheffee's procedure ran after the oneway analysis of variance showed that MANX scores of two schools, Boğaziçi Lisesi (mean = 91.27) and Beşiktaş Kız Lisesi (mean = 92.08), were significantly higher than of Dost Lisesi (mean = 80.48).

Correlates of Math Anxiety

The Correlates of Math anxiety was determined through two sets of analyses (1) Pearson product moment correlations were computed between math anxiety and other variables namely, achievement (Grades), test anxiety (TAI), and attitudinal measures (subscales of MATT). (2) Multiple regression analyses were run for math anxiety and other variables which were hypothesized to correlate with math anxiety.

Pearson product moment correlations for math anxiety and correlates are presented in Table 10.

Table 11

Pearson Product Moment Correlation Coefficients between MANX and (1) Grades (2) TAI and (3) Subscales of MATT for the total sample

S c a l e	N	Pearson r	p
Math Grades	375	-.43	.0001
TAI	376	.62	.0001
Perceived Usefulness of Math	356	-.39	.0001
Perceived Attitudes of Parents towards Math	353	-.18	.001
Perception of Math as a Male Domain	355	.08	.06
Perceived Anxiety	367	.71	.0001
Perceived Ability	345	-.63	.0001
Attitude towards Math Lessons	350	-.62	.0001

Math Anxiety and Achievement

The Pearson Product Moment correlation coefficient between MANX and math grades ($r = -.43$, $p < .0001$) gave evidence for a moderately negative correlation between math anxiety and achievement.

For evidence of negative correlation between math anxiety and achievement, math grades and math anxiety scores of the students were tabulated according to schools in the sample (Table 12).

Table 12

Means and Standard Deviations of Math Grades and Anxiety Scores for Different Schools

Name of School	Grades		Math Anxiety Scores	
	Mean	S.D.	Mean	S.D.
Istanbul Lisesi	5.59	1.62	84.40	19.84
Kabataş Erkek Lisesi	4.90	1.63	86.00	17.42
Boğaziçi Lisesi	4.70	1.55	91.27	13.82
Dost Lisesi	6.04	1.79	80.48	16.24
Beşiktaş Kız Lisesi	4.91	2.01	92.08	18.74
Total	5.28	1.82	86.28	17.91

Analysis of variance for the math anxiety of the five schools (Table 10) had shown that Boğaziçi Lisesi and Beşiktaş Kız Lisesi differed significantly in their math anxiety levels from Dost Lisesi which has the lowest mean. With Table 12 that result can be explained in terms of the correlation between math anxiety and math achievement. As can be observed from this table when the math grades and math anxiety levels of these schools are listed in order, math anxiety levels and math grades correlate highly and positively. The mean math grade for Kabataş Erkek Lisesi was also low. The reason why the math anxiety level of this school did not differ significantly may be due to the relationship between sex and math anxiety, which will be tapped subsequently.

Math Anxiety and Test Anxiety

The Pearson Product Moment correlation coefficient of .62 ($p<.0001$) showed that math anxiety and test anxiety correlated highly and positively. The mean and the standard deviation for TAI for the total sample were 41.38 and 9.73 respectively.

Math Anxiety and Attitudes towards Mathematics

Attitude towards Mathematics was measured by the subscales of the Math Attitude Scale (MATT). The means, standard deviations and the maximum and minimum possible scores for the MATT subscales are presented in Table 13 for the total sample.

Table 13

Means, Standard Deviations, Minimum and Maximum Possible Scores for the Subscales of MATT for the total sample

Name of Subscale	Mean	S.D.	Minimum possible score	Maximum possible score
Perceived Usefulness of Mathematics	41.93	7.25	13	52
Perceived Attitudes of Parents towards Math	49.81	8.25	16	64
Perception of Mathematics as a Male Domain	11.58	3.45	6	24
Perceived Anxiety	18.38	3.36	6	24
Perceived Ability	28.42	5.56	10	40
Attitude towards Math Lessons	44.32	8.34	15	60

Math Anxiety and Perceived Usefulness of Mathematics correlated negatively and significantly ($r = -.39$, $p<.0001$). As the students perceived Math to be more useful, their anxiety levels decreased.

A significant but low negative correlation existed between parents Perceived Attiude towards math and math anxiety of the students ($r = -.18$, $p<.001$).

Perception of Mathematics as a male domain did not correlate with math anxiety for the total sample.

There was a high positive correlation ($r = .71$, $p<.0001$) between perceived anxiety and math anxiety.

The high significant negative correlation between Perceived Ability and Math Anxiety indicated that as the students perceived themselves to be more capable of doing mathematics they tended to be less anxious.

Math anxiety and Attitude towards Math Lessons correlated highly and negatively ($r = -.62$, $p<.0001$). As the students' attitudes towards Math became more positive, their math anxiety levels tended to decrease.

Multiple Regression Analysis

For further information on the correlates of Math Anxiety all data were subjected to multiple regression analysis. Two stepwise regression analyses were run. The dependent

variables were Math Anxiety for the first and Achievement for the second analysis.

The results of the multiple regression analysis for math anxiety are presented in Table 13. The independent variables in the regression analysis were: Achievement, test Anxiety, Perceived Usefulness of Mathematics, Perceived Attitude of Parents towards Mathematics, Perception of Math. as a Male Domain, Perceived Anxiety, Perceived Ability, Attitudes towards Math Lesson, Sex.

Table 14

Significant Multiple Regression Results with Adjusted R^2, Beta and p values on variables for Math Anxiety of the total sample

Variables	Adjusted $R^{2(a)}$	Beta(b)	p(c)
Perceived Anxiety	.498	.279	.00001
Attitude towards Math Lesson	.627	-.335	.00001
Test Anxiety	.717	.368	.0001
Perceived Ability	.724	-.121	.01

(a) Adjusted R^2 indicates the percentage the independent variable accounts for the variance in the dependent variable (Math Anxiety). Consecutive R^2 values are additive.

(b) Beta indicates the relationship between the independent and dependent variables.

(c) p value indicates the level of significance.

It can be observed from Table 14 that 50% of the variance in math anxiety can be accounted for by Perceived

Anxiety. 12% of the variance in math anxiety came from Attitude towards math lesson, 10% from Test Anxiety and 1% from Perceived Ability.

The results of the multiple regression analysis for achievement are presented in Table 14. The independent variables were: Math Anxiety, Sex, Test Anxiety and Attitude towards Math as measured by the six subscales of MATT.

Table 15

Significant Multiple Regression Results with Adjusted R^2, Beta and p values on Variables for Achievement of the whole sample

Variables	Adjusted $R^{2(a)}$	Beta(b)	p(c)
Perceived Ability	.264	.499	.00001
Sex	.288	.167	.001
Test Anxiety	.300	.126	.01

(a) Adjusted R^2 indicates the percentage the independent variable accounts for the variance in the dependent variable (Achievement). Consecutive R^2 values are additive.

(b) Beta indicates the relationship between the independent and dependent variables.

(c) p value indicates the level of significance.

As indicated in Table 15, 26% of the variance in Math Achievement was accounted for by the Perceived Ability in the whole sample. Sex and Test Anxiety each accounted for 2% of the variance in achievement.

Math Anxiety and Sex Differences

A t-test was done on the sample to observe the differences in Math Anxiety of males and females (Table 15). There was a significant difference between the two groups, in favor of male students.

Table 16

Means, Standard Deviations and t-value for the Math Anxiety Scores of Males and Females

Groups	N	Mean	S.D.	t
Males	226	83.97	17.53	-3.10*
Females	151	89.74	17.98	

* $p < .005$

Another t-test on the groups of males and females for the Perception of Mathematics as a Male Domain subscale presented significant results (Table 17), indicating that the male students perceived mathematics more as a male domain than the female students.

Table 17

Means, Standard Deviations and t-values for the Perception of Mathematics as a Male Domain Subscale of MATT for Males and Females

Groups	N	Mean	S.D.	t
Males	209	13.15	3.81	10.08*
Females	148	9.37	2.96	

* $p < .0001$

For further investigation of sex differences in Math Anxiety and its correlates, Pearson Product Moment correlations were computed for males and females, separately (Tables 18a and 18b).

Table 18a

Pearson Product Moment Correlation Coefficients for Math Anxiety and its Correlates for Males

	2	3	4	5	6	7	8	9
1. Math Anxiety (MANX)	-.39**	.61**	.41**	-.20*	.09	-.72**	-.57**	.60**
2. Achievement (GRADES)		-.30**	.27**	.15	.05	.30**	.44**	.28**
3. Test Anxiety (TAI)			-.01	.08	.08	-.50**	-.20*	-.20*
4. Perceived Usefulness of Math				.58**	.02	.29**	.63**	.62**
5. Parents Perceived At. towards Math					.09	.06	.42**	.47**
6. Perception of Math as a Male Domain						-.12	.06	.01
7. Perceived Anxiety							.45**	.43**
8. Perceived Ability								.69**
9. Attitude towards Math Lesson								

* $p < .01$

** $p < .0001$

Table 18b

Pearson Product Moment Correlation Coefficients for Math Anxiety and its Correlates for Females

	2	3	4	5	6	7	8	9
1. MANX	-.52**	.63*	-.39**	-.20*	.34**	-.70**	-.70**	-.63**
2. GRADES		-.32**	.36**	.14	-.39**	.48**	.68**	.54**
3. TAI			-.22*	-.10	.12	.63**	-.37**	-.13
4. Perceived Usefulness of Math				.55**	-.30**	.24*	.47**	.61**
5. Parents Perceived Attitude towards MATH					.04	.16	.24*	.27*
6. Perception of Math as a Male Domain						-.33**	-.42**	-.41**
7. Perceived Anxiety							.62**	.39**
8. Perceived Ability								.72**
9. Attitude towards Math Lesson								

As Tables 18a and 18b indicate, the correlation between math anxiety and achievement were higher for females ($r = -.52$) than for males ($r = -.39$).

The correlation between math anxiety and Perception of Math as a Male domain was insignificant for males but significant ($r = .34$) for females. The higher the perception of math as a male domain the higher the math anxiety for females.

Although in the t-test (Table 16) it was observed that perception of males of mathematics as a male domain was stronger than that of females, their math anxiety levels did not seem to be related to this attitude.

Regression analysis for the whole sample had shown that Perceived Ability was the most important variable accounting for 26% of the variance in achievement. The correlation coefficient between achievement and Perceived Ability was higher ($r = .68$) for females than for males ($r = .44$). Similarly, the correlation coefficient between math anxiety and perceived ability was higher for females ($r = -.70$) than for males ($r = -.57$).

The correlation between attitude towards math lesson and achievement differed in the two groups. A significant but low correlation existed for males ($r = .28$). For females the correlation coefficient was moderately high ($r = .54$), indicating that the more positive the attitude towards math the higher the grades of females.

For females there existed a significant negative correlation between attitude towards math lesson and perception of math as a male domain ($r = -.41$) which was non-existent for males. As the female students perceived math more to be a male domain, their attitude towards mathematics lessons became more negative.

On the other hand, the correlation between Parents' perceived attitudes towards math and attitude of student towards math lesson was higher for males (r = .47) than for females (r = .27), indicating that as the male students perceived their parents' attitude towards math to be more positive, their attitude towards math lessons tended to become more positive also.

Math Anxiety and Vocational Choice

Choice of subject study concentration in Lise 2 determines the vocational choice of students to some extent. When a student decides to be in the 'Literature' Section in lise 2 it is unlikely that he or she will choose a subject at the university that requires mathematics. A t-test was done to observe the difference of math anxiety levels between the groups who choose 'Science' and 'literature', respectively. Table 19 presents the means, standard deviations and t-value for the math anxiety levels of the two groups.

Table 19

Means, Standard Deviations and t-values for the Math Anxiety of the Groups who Chose Science and Literature

Choice of Concentration	Mean	S.D.	t
Science	83.39	17.05	-6.14*
Literature	97.91	17.26	

* $p < .0001$

As can be seen from this table, math anxiety of the group that chose 'Literature' is significantly ($p<.0001$) higher than the other group.

Based on the information obtained from the brief questionnaire, students' vocational choices were grouped under eight professions, namely (1 engineering or science, 2 medicine, 3 law, 4 business etc.). Undecidedness was also taken as one of the groups.

An analysis of variance for math anxiety of students who made different vocational choice was carried out (Table 20). The Scheffe procedure showed that, the math anxiety of the group of students who failed to make a vocational decision was significantly higher than the group who wanted to study engineering or science.

Table 20

Analysis of Variance for Math Anxiety of groups of students who made Different Vocational Choices

Source of Variation	SS	DF	MS	F
Between groups	7038.41	6	1173.07	3.82*
Within groups	113615.79	370	307.07	
Total		376		

* $p < .001$

DISCUSSION

The results of the present study indicate that some degree of math anxiety exists among lise I students in general, but average scores differ among groups sampled by the researcher.

The absence of normative data on the Math Anxiety Scale (MANX) forces one to base the interpretations of the math anxiety level of the students on some criteria. One such criterion was the assumption that MANX scores would be distributed normally in the population. The mean of the population would be $45 \times 2.5 = 112.5$ and the standard deviation would roughly be one sixth of the range which is (180-45) / 6 = 22.5. Accordingly the scores could be classified: 89 - 112 'low' math anxious, 113-135 'moderately' math anxious, 136 - 158 'highly' math anxious, and 159 - 180 'very highly' math anxious.

The mean MANX score for the sample was 86.28 with a standard deviation of 17.91 and according to the above criterion only 10% of the students in the sample were 'moderately' or 'highly' math anxious. Hence the results of this study lead to a question whether there is very much math anxiety among high school students.

Math anxiety was found to be related to achievement. Thus higher achievement in mathematics was related to lower levels of math anxiety. These results are in agreement with previous research investigating the relationship between math anxiety and math achievement (Betz, 1978; Rounds and Hendel, 1980; Preston, 1986).

There was a positive correlation between math anxiety and test anxiety, consistent with previous findings (Betz, 1978; Rounds and Hendel, 1980; Dew and Galassi, 1983). The test anxiety level of students accounted for only 10% of the variance in math anxiety, suggesting once again, that math anxiety and test anxiety are related, but quite different from each other (Dew, Galassi, Galassi, 1984).

Math anxiety was found to be related to math attitude scales. Math anxiety correlated negatively with Perceived Usefulness of Mathematics, Perceived Ability and Attitude towards Math Lessons subscales, highly and significantly. A positive high correlation existed between Perceived Anxiety subscale and math anxiety.

According to the results of the multiple regression analysis, Perceived Anxiety, Attitude Towards Math Lessons and Perceived Ability were the most significant attitudinal variables accounting for a considerable amount of the variance in math anxiety scores.

Although with an average of 86.28 for a math anxiety scale, with the highest and lowest possible scores of 180 and 45 respectively, the prevalance of math anxiety can not be claimed, the means and standard deviations of some of the attitude scales were higher than expected. The mean for the Perceived Usefulness of Mathematics subscale (41.93 with S.D. = 7.25) was significantly higher than the 'expected' mean of the population. One can claim that math is perceived as very useful in the sample. Similarly, the students perceived their parents' attitudes as highly positive towards mathematics.

Perception of mathematics as a male domain was significantly lower than the 'expected' mean of the population. Students in general did not perceive mathematics as a male domain. It was found in the t-test that boys perceived mathematics more as a male domain than girls. But even males' scores were below the 'expected' average.

The Perceived Ability scores of the sample was above the 'expected' average. This may be one explanation why the math anxiety of the group was low in general, since Perceived Ability is an important variable in explaining the variance in math anxiety.

The attitudes of the students towards mathematics was generally positive.

The findings suggest that as far as the affective variables are concerned the math teachers of this sample are quite lucky. This is a group with low math anxiety, and whose attitude towards mathematics is mainly positive, and who perceives itself as capable of dealing with mathematics. As Ernest (1976) points out what is needed is "instructors who are competent in mathematics, who love the subject, who enjoy teaching it, and who will not project sexist expectations on the students."

Contrary to recent research findings, but in accordance with earlier studies (Betz, 1978; Tobias, 1976; Reavis, 1987; Holden, 1987), findings of the present study showed sex differences in math anxiety levels and attitudinal measures. The math anxiety levels of females were significantly higher than males. There exist gender differences in the correlations between anxiety and attitudinal measures. Hence, the regression analysis run for the total sample may be inadequate to determine all the correlates of math anxiety for male and female subjects. It is suggested for further research that regression analyses are run for male and female samples, separately.

One symptom of math anxiety is avoidance of mathematics. Literature shows that anxiety is an important variable for vocational choice (Fuqua, Newman, Seaworth, 1988; O'hare and Tamburri, 1986; Hawkins, Bradley and White, 1977). The results of the present study indicate that math anxiety is also

related to educational and vocational decidedness. Findings also suggest that math anxiety has a relationship to choosing university majors or professional careers.

There are various conclusions in this study that may have some implications for math teachers and guidance counselors.

Since achievement was found to be highly related to math anxiety, Math Anxiety Scale (MANX) could be used as a tool to assess the math anxiety levels of non-achievers.

Guidance counselors and math teachers could cooperate in preparing math anxiety reduction programs based on the findings of the present study. And those anxiety reduction programs could also be utilized in dealing with the problems of undecided students who may find it hard to choose a profession.

Limitations of the Study

The present research is limited with the selection of the sample. The subjects were selected from Istanbul and random sampling could not be achieved for practical reasons.

Another limitation was set by the shortage of time for research. Test-retest reliabilities of MANX and MATT could not be accomplished.

Math achievement could not be determined by the use of a standardized test. Instead math grades were used. This might have reduced the objectivity of the measurements, or rather, what was actually measured could have been math performance.

It is suggested to future researchers that the reliability and validity of MANX and MATT are replicated on a larger random sample, and normative data for the two scales are collected.

REFERENCES

Aiken,L.R. (1976). Update on attitudes and other affective variables in learning mathematics. Review of Educational Research, 46(2), 293-311.

Bayraktar,M.S. (1985). The effects of feedback treatment on math anxiety levels of sixth grade Yükseliş Lisesi students. Unpublished master's thesis, Middle East Technical University, Ankara.

Betz,N.E. (1978). Prevalence distribution and correlates of math anxiety, in college students. Journal of Counseling Psychology, 25(5), 441-448.

Dew,K.M.H., Galassi,J.P., Galassi,M.D. (1983). Mathematics anxiety: some basic issues. Journal of Counseling Psychology, 30(3), 443-446.

Dew,K.M.H., Galassi,J.P., Galassi,M.D. (1984). Math anxiety: Relation with situational test anxiety, performance, physiological arousal, and math avoidance behaviour. Journal of Counseling Psychology, 31(4), 580-583.

Dreger,R., Aiken,L. (1957). The identification of number anxiety in a college population. Journal of Educational Psychology, 48, 345-351.

Ernest,J. (1976). Mathematics and sex. The American Mathematical Montly, 83(8), 595-614.

Fennema,E., Sherman,J.A. (1976). Fennema-Sherman mathematics attitude scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. JSAS Catalog of Selected Documents in Psychology, 6(31).

Fulkerson,K.F., Galassi,J.P., Galassi,M.D. (1984). Relation between cognitions and performance in math anxious students: A failure of cognitive theory? Journal of Counseling Psychology, 31(3), 376-382.

Fuqua,D.R., Newman,J.L., Seaworth,T.B. (1988). Relation of state and trait anxiety to different components of career indecision. Journal of Counseling Psychology, 35(2), 154-158.

Gable,R.K. (1986). Instrument development in the affective domain. Boston, Kluwer-Nijhoff Publishing.

Hawkins,J.G., Bradley,R.W., White,G.W. (1977). Anxiety and the process of deciding about a major and vocation. Journal of Counseling Psychology, 24(5), 398-403.

Hendel,D.D., Davis,S.O. (1978). Effectiveness of an intervention strategy for reducing mathematics anxiety. Journal of Counseling Psychology, 25(5), 429-434.

Hinkle,K.S. (1987). An investigation of the relationships among learning style preferences, personality types, and mathematics anxiety of college students. (Doctoral dissertation, University of Maryland, 1986). Dissertation Abstracts International, 47, 2437-A.

Hopkins,J.C. (1988). The impact of perceived competence and perceived importance upon anxiety: Correlates of mathematics anxiety in college students. (Doctoral Dissertation, University of Denver, 1987). Dissertation Abstracts International, 48(10), 2580A.

Hunsley,J. (1987). Cognitive processes in mathematics anxiety and test anxiety: The role of appraisals internal dialogue, and attributions. Journal of Educational Psychology, 79(4), 388-392.

Kaymak,D.A. (1985). The development of the Turkish form of the Spielberger test anxiety inventory: A study of transliteral equivalance and reliability. Unpublished master's thesis, Boğaziçi University, Istanbul.

Levitt-E.E. (1967). The psychology of anxiety. Indianapolis, The Bobbs-Merrill Company Inc.

Llabre,M.M., Suarez,E. (1985). Predicting math anxiety and course performance in college women and men. Journal of Counseling Psychology, 32(2), 283-287.

Mitzel,H.E. (1982). Mathematics Education. In H.E.Mitzel, J.H.Best, W.Rabinowitz (Eds.), Encyclopedia of Educational Research: Vol. I. New York: The Free Press.

Morris,L.W., Kellaway,D.S., Smith,D.H. (1978). Mathematics anxiety rating scale: Predicting experiences and academic performance in two groups of students. Journal of Educational Psychology, 70(4), 589-594.

Muinos,J.M. (1988). A comparison of the levels of mathematics anxiety among black, Hispanic and white college students. (Doctoral dissertation, United States International University, 1987). Dissertation Abstracts International, 48(9), 2290A.

Nunnally,J.C. (1967). Psychometric theory. New York: McGraw-Hill.

O'Hare,M.M., Tamburri,E. (1986). Coping as a moderator of the relation between anxiety and career decision making. Journal of Counseling Psychology, 33(3), 255-264.

Öner,N. (1986, April). Development of the Turkish form of the Test Anxiety Inventory. Paper presented of the AREA meeting, San Francisco. (Eric Document Reproduction Service No. ED 275 765).

Preston,P.A. (1987). Math anxiety: Relationships with sex college major, mathematics background, mathematics achievement, mathematics performance, mathematics avoidance, self rating of mathematics ability, and self rating of mathematics anxiety as measured by the revised mathematics anxiety rating scale (RMARS). (Doctoral dissertation, University of Tennessee, 1986). Dissertation Abstracts International, 47(7), 2434A.

Reavis,P.S. (1989). Mathematics anxiety and the relationship between attitude, sex, ethnicity and achievement in mathematics in three high school curriculum tracks. (Doctoral dissertation, the University of Arizona, 1987). Dissertation Abstracts International, 49(7), 1742A.

Resnick,H., Viehe,J., Segal,S. (1982). Is math anxiety a local phenomenon? A study of prevalance and dimensionality. Journal of Counseling Psychology, 29(1), 39-47.

Richardson,F.C. Suinn,R.M. (1972). The mathematics anxiety rating scale: Psychometric data. Journal of Counseling Psychology, 19(6), 551-554.

Richardson,F.C., Woolfolk,R.L. (1980). Mathematics anxiety. In I.G.Sarason (Ed.), Test anxiety: Theory research and applications (pp.271-288).

Rounds,J.B.Jr., Hendel,D.D. (1980). Measurement and dimensionality of mathematics anxiety. Journal of Counseling Psychology, 27(2), 138-149.

Rounds,J.B.Jr., Hendel,D.D. (1980). Mathematics anxiety and attitudes toward mathematics. Measurement and Evaluation in Guidance, 13(2), 83-89.

Spielberger,C.D. (1966). Anxiety and behavior. New York: Academic Press.

Suinn,R.M., Edie,C.A., Nicoletti,J., Spinelli,P.R. (1972). The MARS, a measure of mathematics anxiety: Psychometric data. Journal of Clinical Psychology, 28, 373-375.

Tobias,S. (1976). Math anxiety what it is and what can be done about it? MS, September, 56-59.

Tobias,S. (1978). Overcoming Math Anxiety. Newyork: Norton and Co.

Tobias,S., Weisbrod,C. (1980). Anxiety and mathematics: An update. Harvard Educational Review, 50(1), 63-71.

REFERENCES NOT CITED

Ashenfelter,M.D. (1987). Reduction of math anxiety levels of students enrolled in elementary accounting. (Doctoral dissertation, Oklahoma State University, 1986). Dissertation Abstracts International, 47(8), 2859A.

Covington,M.V., Omelich,C.L. (1987). "I knew it cold before the exam": A test of the anxiety-blockage hypothesis. Journal of Educational Psychology, 79(4), 393-400.

Foley,T.C.D. (1987). A description of a pilot program to reduce math anxiety and increase academic achievement in a subsequent required pre-college level basic mathematics course. (Doctoral dissertation, Temple University, 1986). Dissertation Abstracts International, 47(8), 2933A.

Gentry,W.M. (1987). A comparison of two palliative methods of intervention for the treatment of mathematics anxiety among female college students. (Doctoral dissertation, Virginia Polytechnic Institute and State University, 1986). Dissertation Abstracts International, 48(4), 859A.

Holden,C. (1987). Female math anxiety on the wane. Science, 236(4802), 660-661.

Kutash,I.L., Schlesinger,L.B. (1980). Handbook on stress and anxiety. San Francisco, Jossey-Bass Publishers.

Mathison,M.A., Robertson,D.F. (1980, August). Interventions in math anxiety for adults. Paper presented at the Fourth International Congress on Mathematical Education.

Mosteller,F., Tukey,J.W. (1977). Data analysis and regression. Massachusets, Addison-Wesley Publishing Company.

Peterson,P.L., Fennema,E. (1985). Effective teaching, student engagement in classroom activities, and sex-related differences in learning mathematics. American Educational Research Journal, 22(3), 309-335.

Sanford,L.S. (1987). Is female math anxiety real? Science, 237(4813), 350.

Saygı,M., Aksu,M. (1988). The effects of feedback treatment on math anxiety levels of sixth grade Turkish students. School Science and Mathematics, 88(5), 390-396.

Segeler,E.E. (1987). Effectiveness of transactional analysis training in improving mathematics achievement, reducing math anxiety, and changing associated negative attitudes and attributions for failure. (Doctoral dissertation, University of Pittsburgh, 1986). Dissertation Abstracts International, 47(10), 3691A.

Triandis,H.C. (1971). Attitude and attitude change. New York, John Wiley and Sons, Inc.

APPENDIX A

MATH ANXIETY SCALE (MANX)

Her maddede genel olarak nasıl hissettiğinizi anlatan şıkkı cevap kağıdına işaretleyin.

1- Matematik dersinde bir arkadaşım tahtaya kalktığında, iyi ki onun yerinde değilim diye düşünürüm.

2- Bir genel sınavın matematik kısmına gelince paniğe kapılırım.

3- Cevabı bilmediğim bir soru için tahtaya kalktığımda paniğe kapılırım.

4- Matematik ödevi yapmaktan hoşlanırım.

5- Fen derslerindeki formüller bana sevimsiz gelir.

6- Gelecek derse kadar hazırlamam için çok sayıda zor matematik problemi verildiğinde paniğe kapılırım.

7- Matematik sınavına bir saat kala hiçbir şey düşünemez olurum.

8- Zor bir matematik konusunu çalışmak üzere matematik kitabımı elime aldığımda karnıma ağrılar girer.

9- Dolmuşta alacağım paranın üstünü hesaplarken bile heyecandan kafam karışır.

10- Üyesi olduğum eğitsel kolun hesaplarını tutmaktan çok hoşlanırım.

11- Karnemi aldığımda matematik notuma bakmaya korkarım.

12- Çözdüğüm problemlerin bile açıklamasını yapmaktan rahatsızlık duyarım.

13- Bir konunun sözlü olarak anlatılması yerine, sayı ve grafiklerle açıklanması çok hoşuma gider.

14- Matematik sınavından bir gün önce kendimi çok kötü hissederim.

15- Garsona getirdiği hesabın yanlış olduğunu söylediğim zaman, onun tekrar hesaplamasını izlerken heyecanlanırım.

16- Matematik kitabını elime almak beni huzursuz eder.

17- Birisi beni izlerken toplama gibi basit bir işlemi bile yapamam.

18- Yıl sonundaki matematik sınavlarında öyle heyecanlı olurum ki, bütün bildiklerimi unuturum.

19- Habersiz matematik sınavı verilmesinden çok korkarım.

20- Sene başında ilk matematik dersine başlarken kendimi güvenli ve rahat hissederim.

21- Matematik sınavına çalışırken, alacağım notu düşünmekten kendimi alamam.

22- Matematik kitabının sayfalarını karıştırırken başaramıyacağım duygusuna kapılırım.

23- Matematik dersinde anlamadığım bir yeri sormak için parmak kaldırmaya cesaret edemem.

24- Karnemdeki notların ortalamasını hesaplarken bile rahatsızlık duyarım.

25- Matematik sınavına bir hafta kala bende huzursuzluk başlar.

26- Zamanla ilgili bir hesap yapmak bile bana rahatsızlık verir.

27- Dersten sonra anlamadığım bir yeri matematik öğrenmenime rahatça sorarım.

28- Başarısız olduğumu düşündüğüm matematik sınavının sonucunu beklerken çok heyecanlı ve karamsar olurum.

29- Bir ilkokul öğrencisinin matematik ödevine yardım etmem istenirse, çözemiyeceğim soruların çıkmasından korkup, yardımı reddedebilirim.

30- Liseden mezun oluncaya kadar öğrenmem gereken matematik konularını düşündüğümde, bir gün okulu bitirebileceğimden kuşku duyarım.

31- Sayılarla uğraşmak keyfimi kaçırır.

32- Geometri sorularını zevkli bulmacalara benzetirim.

33- Arkadaşım bana bir problemin çözümünü anlatırken, onu anlamadığımı fark ettiğimde bütün sinirlerim gerilir.

34- Matematik dersinde kafam karışır.

35- Sosyal derslerin en sevdiğim kısımları az da olsa, matematiğe yer veren konularıdır.

36- Matematik dersinde öğretmeni dinlemekte güçlük çekiyorum.

37- Bir sonraki dersin matematik olduğunu bilmek canımı sıkar.

38- Günlük yaşamdaki 'bir arabanın 5 litre benzin ile kaç kilometre yol gideceğini hesaplamak' gibi problemler beni kaygılandırır.

39- Matematik kitabı içimi karartıyor.

40- Herhangi bir matematik kitabını açıp problemlerle dolu bir sayfa görmek beni mutlu eder.

41- Bir problem verildiğinde, çözüm için gereken formülü hemen hatırlayamazsam paniğe kapılırım.

42- Matematik sınavında beş dakika önce kalbim küt küt atmaya başlar.

43- Başarılı olduğumu düşündüğüm matematik sınavının sonucunu beklerken rahat ve huzurlu olabilirim.

44- Üzerinde bir süre çalıştığım bir matematik sorusunu öğretmen çözmemi isterse, heyecandan yaptıklarımı unuturum.

45- Bir arkadaşım dergide çıkan matematik sorusunu çözmemi istese, basit soruları çözemeyip mahçup olmaktan korkarım.

APPENDIX B

MATH ATTITUDE SCALE (MATT)

Her bir maddeyi iyice okuyun ve sizin için ne kadar geçerli olduğunu cevap kağıdınıza işaretleyin.

1- Matematik bilmek herkes için çok yararlıdır.

2- Matematik erkek işidir.

3- Matematik derslerimiz çok zevkli geçiyor.

4- Matematiğim iyidir.

5- Matematikten korkarım.

6- Matematik dersinin zorunlu olması gereksizdir.

7- Bazı mesleklerde matematik bilgisine gerek yoktur.

8- Matematik dersinde canım sıkılıyor.

9- Matematik derslerimiz yeteri kadar ilginç değil.

10- Matematik sınavını düşünmekten ders çalışamadığım olur.

11- Babam matematik dersinin çok önemli olduğunu düşünür.

12- Matematikte başarılı olmam anneme göre diğer derslerden daha önemlidir.

13- Matematiğim kuvvetlidir.

14- Matematiği kolayca anlayabilirim.

15- Matematikte erkekler daha başarılı olurlar.

16- Her meslekte bir miktar matematik bilgisine gerek duyulur.

17- Matematik bilgisi iyi olan bir kişi diğer bilimleri rahatça anlar.

18- Matematiksel kuralları bilmek, mantıklı düşünmeye yardımcı olur.

19- Matematik dersinde başka şeylerle ilgilenirim.

20- Matematik dersi beni kaygılandırır.

21- Matematik dersinde konuları anlayamıyorum.

22- Matematik dersinde bana soru sorulacak diye çok korkarım.

23- Matematik kafam yoktur.

24- Matematikte başarılı olmam babama göre diğer derslerden daha önemlidir.

25- Matematik dersinde heyecandan yapabileceğim soruları bile çözemiyorum.

26- Matematik sınavlarında heyecanlanmasam daha başarılı olabilirim.

27- Matematikte başarılı olmam annemi çok gururlandırır.

28- Matematikte başarılı olmam babamı çok gururlandırır.

29- Matematik bilgisi gerektiren konularda çok başarılıyımdır.

30- Matematik dersi benim için keyifli bir oyun saati gibidir.

31- Matematik dersi yerine ilgilendiğim başka bir derse girmeyi tercih ederim.

32- Matematik dersinde öğretmeni daha iyi dinlemek için önde otururum.

33- Genellikle matematiği iyi olan kızlar, yalnızca dersleriyle ilgilenen, fazla arkadaşı olmayan, sıkıcı kişilerdir.

34- Matematik dersini erkek öğretmenler daha iyi anlatır.

35- Çalışırsam matematikten iyi notlar alabilirim.

36- Annem için matematikten iyi notlar almam birşey ifade etmez.

37- Babam için matematikten iyi notlar almam birşey ifade etmez.

38- Matematik bilmek ileride işime yarayacak.

39- Matematik zihinsel gelişim için yaarlıdır.

40- Belli temel bilgilerin dışında matematik bilmek gereksizdir.

41- Teknolojinin gelişmesinde matematiğin yeri büyüktür.

42- Matematik sınavlarında erkek öğrenciler daha yüksek notlar alırlar.

43- Her alanda başarı için matematik bilgisi faydalıdır.

44- Matematik olmasaydı teknoloji bu denli gelişemezdi.

45- Matematik birçok bilimin temelini oluşturur.

46- Müzik, resim, edebiyat gibi sanat alanlarında matematik gerekli değildir.

47- Büyük matematikçiler hep erkektir.

48- En sevdiğim ders matematiktir.

49- Matematik dersinin zorunlu olmasına annem karşıdır.

50- Matematik dersinin zorunlu olmasına babam karşıdır.

51- Matematik dersinde, derse katılmaktan çok hoşlanırım.

52- Matematik dersinde başarılı olmak benim için çok önemlidir.

53- Matematik en önemli derslerimizden biridir.

54- Matematik ödevlerinden nefret ederim.

55- Matematik başarılı olduğum bir derstir.

56- Annem matematikte başarılı olan kişilere hayranlık duyar.

57- Babam matematikte başarılı olan kişilere hayranlık duyar.

58- İleride matematikle ilgili bir konuda çalışırsam başarılı olabilirim.

59- Matematiği neden okumak zorunda olduğumu anlayamıyorum.

60- Matematik insanı daha iyi düşünmeye zorlar.

61- Annem matematiğin insanın zekasını geliştirdiğini düşünür.

62- Babam matematiğin insanın zekasını geliştirdiğini düşünür.

63- Ne kadar çalışırsam çalışayım, matematikte başarılı olamıyorum.

64- Matematik dersi beni bunaltıyor.

65- Matematik olağanüstü zevkli bir konudur.

66- Matematikten iyi not almak beni çok mutlu eder.

67- Matematik dersine çalışmaktan hoşlanmam.

68- Annem matematiğin her meslek için gerekli olduğunu düşünür.

69- Babam matematiğin her meslek için gerekli olduğunu düşünür.

70- Annem matematik dersinin çok önemli olduğunu düşünür.

APPENDIX C

TEST ANXIETY INVENTORY

İSİM: ..... YAŞ: ..... TARİH: .....

CİNSİYET: .....

YÖNERGE: Aşağıda, insanların kendilerini tanımlamak için kullandıkları bir dizi ifade sıralanmıştır. Bunların herbirini okuyun ve genel olarak nasıl hissettiğinizi anlatan ifadenin sağındaki boşluklardan uygun olanın içini karalayın. Burada doğru ya da yanlış yanıt yoktur. İfadelerin hiçbiri üzerinde fazla zaman harcamayın, ancak yazılı ve sözlü sınavlarda genel olarak nasıl hissettiğinizi gösteren yanıtı işaretleyin.

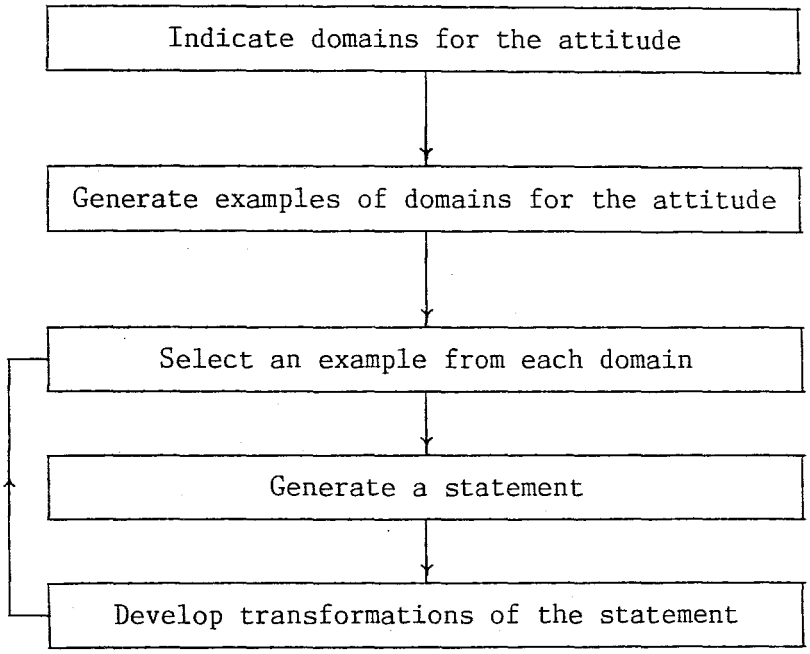
	hiçbir zaman	bazen	sık sık	her zaman
1. Sınav sırasında kendimi güvenli ve rahat hissederim.	(1)	(2)	(3)	(4)
2. O dersten alacağım notu düşünmek, sınav sırasındaki başarımı olumsuz yönde etkiler.	(1)	(2)	(3)	(4)
3. Önemli sınavlarda donup kalırım.	(1)	(2)	(3)	(4)
4. Sınavlar sırasında, birgün okulu bitirip bitiremiyeceğimi düşünmekten kendimi alamam.	(1)	(2)	(3)	(4)
5. Bir sınav sırasında ne kadar çok uğraşırsam kafam o kadar çok karışır.	(1)	(2)	(3)	(4)
6. Sınavlarda kendimi huzursuz ve rahatsız hissederim.	(1)	(2)	(3)	(4)
7. Önemli bir sınav sırasında kendimi çok sinirli hissederim.	(1)	(2)	(3)	(4)
8. Başarısız olma düşünceleri, dikkatimi sınav üzerinde toplamama engel olur.	(1)	(2)	(3)	(4)
9. Bir sınava çok iyi hazırlandığım zamanlar bile kendimi oldukça sinirli hissederim.	(1)	(2)	(3)	(4)
10. Önemli sınavlarda sinirlerim öylesine gerilir ki midem bulanır.	(1)	(2)	(3)	(4)
11. Bir sınav kağıdını geri almadan hemen önce çok huzursuz olurum.	(1)	(2)	(3)	(4)

	hiçbir zaman	bazen	sık sık	her zaman
12. Önemli sınavlarda kendimi adeta yenilgiye iterim.	(1)	(2)	(3)	(4)
13. Sınavlar sırasında kendimi çok gergin hissederim.	(1)	(2)	(3)	(4)
14. Önemli bir sınav sırasında paniğe kapılırım.	(1)	(2)	(3)	(4)
15. Sınavların beni bu kadar rahatsız etmemesini isterdim.	(1)	(2)	(3)	(4)
16. Önemli bir sınava girmeden önce çok endişelenirim (kurarım).	(1)	(2)	(3)	(4)
17. Sınavlar sırasında, başarısız olmanın sonuçlarını düşünmekten kendimi alamam.	(1)	(2)	(3)	(4)
18. Önemli sınavlarda kalbimin çok hızlı attığını hissederim.	(1)	(2)	(3)	(4)
19. Sınav sona erdikten sonra endişelenmemeye (kurmamaya) çalışırım, fakat yapamam.	(1)	(2)	(3)	(4)
20. Sınavlar sırasında öylesine sinirli olurum ki, aslında bildiğim şeyleri bile unuturum.	(1)	(2)	(3)	(4)

APPENDIX D

Development of the items of MATT using the Domain Preferenced Approach

Each item, an operational definition for an attitude, was constructed based on the given flow chart as mentioned before,



Example:

- Indicate domains for the attitude: Usefulness → Perceived usefulness of mathematics.

- Generate examples of domains for the attitude:

  "gerekli"

  "yararlı"

  "önemli"

  "geliştirici"

  "düşünmeye zorlayıcı"

  etc.

- Select an example from each domain:

  "yararlı"

- Generate a statement:

  "Matematik çok işe yarar"

- Develop transformations of the statement:

  "Matematik her işe yarar"

  "Matematik herkese yarar"

  "Matematik herkesin işine yarar"

  "Matematik bilmek herkes için çok yararlıdır"

- Item no. 1: "Matematik bilmek herkes için çok yararlıdır".

- Select another example from the domain: gerekli

- Generate a statement:

"Matematik herkese gerekir"

- Develop transformations of the statement:

"Matematik herkese gerekmez"

"Matematik her meslekten kişiye gerekmez"

"Bazı mesleklere matematik gerekmez"

"Bazı mesleklerde matematik bilgisine gerek yoktur"

- Item no. 2: "Bazı mesleklerde matematik bilgisine gerek yoktur"

When a sufficient number of items are generated for a given domain, the next domain is selected. The procedure goes on until all the items are constructed.

In order to determine which items are to be used in the scale, a judgemental rating form is given to 10 or 15 experts.

Example:

Aşağıdaki cümleler "Matematiğe Karşı Tutum" ölçeğinde kullanılacaktır. Lütfen her cümlenin hangi bölüme ait olabileceğini ve bu bölüme uygunluk derecesini işaretleyiniz.

Bölümler: I. Matematiğin yararlılığı (Perceived Usefulness)

II. Matematiğin erkeklere daha uygun bir alan olduğuna dair görüş (Math being perceived as a mate domain)

.

.

.

Madde	Bölüm						Uygunluk Derecesi		
	I	II	III	IV	V	VI			
1. Matematik bilmek herkes için çok yararlıdır.	( )	( )	( )	( )	( )	( )	(1)	(2)	(3)
2. Matematik erkek işidir.	( )	( )	( )	( )	( )	( )	(1)	(2)	(3)
.				.					
.				.					
.				.					

Based on the evaluations of the judges, items with an average of 2.5 and above for each domain are selected and they constitute the items of the attitude scale.