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Prevalence, Distribution, and Correlates of Math Anxiety in College Students

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While counseling psychologists are becoming increasingly involved in the treatment of math anxiety, little is yet known about its prevalence, nature, or effects. The present study, an investigation of factors related to the prevalence and intensity of math anxiety in college students, utilized 652 subjects obtained from two math courses and one psychology course at a large midwestern university. 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. Higher levels of math anxiety were related to lower mathematics achievement test scores, higher levels of test anxiety, and higher levels of trait anxiety. Implications for the identification and treatment of math-anxious students and for the process of educational/vocational counseling are discussed.

In an increasingly technological society, knowledge of mathematics is critical to the pursuit of many existing and emerging occupational fields (Carnegie Commission on Higher Education, 1973; Sells, 1973). In addition to its necessity in scientific and technical fields, knowledge of mathematics is increasingly important in business, the social sciences, and the humanities (Stent, 1977). In spite of the importance of mathematics, however, many intellectually capable students avoid taking math courses in high school and in college and, consequently, restrict the range of careers from which they may choose to those that do not require quantitative skills. Many other students fail to perform as well in math as they are capable and, again, do not attain the mathematics knowledge that would expand the range of career options available to them.

One concept being used increasingly to explain both math avoidance and poor math performance is that of *math anxiety* (Stent, 1977; Tobias, 1976). Math anxiety, defined as "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972), is postulated to affect both the extent to which a student pursues any more than the minimally required amount of mathematics training and the extent to which he or she is able to learn and perform math skills and concepts. Thus, math anxiety may be a critical factor in a student's educational and vocational decisions and, in addition, may influence the student's achievement of his or her educational and career goals.

Because math anxiety is viewed as, in large part, a psychological problem, counseling psychologists are increasingly being called upon to assist in designing and implementing plans for its treatment. Treatment programs currently in operation occur in individual or group counseling settings and may include general anxiety management techniques, modification of irrational beliefs or negative attitudes toward math, and the development of more positive self-concepts

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and attitudes (Brooks, Faderman, Gregory, & Rice, Note 1; Hendel, Note 2).

While there is considerable interest in the treatment of math anxiety, very little is yet known about the actual prevalence and nature of the problem. Research on the prevalence of math anxiety in different populations is needed to establish the scope and severity of the problem, and data concerning demographic and background correlates of math anxiety would assist in the identification of types of students particularly in need of treatment. For example, several writers have suggested that due to the influence of sex role socialization, math anxiety is more common and more severe among women than among men (Stent, 1977; Tobias, 1976; Brooks et al., Note 1). While this assumption has implications for both the understanding and treatment of math anxiety, it has received scant attention from researchers.

The understanding of math anxiety also necessitates the investigation of its relationships with math ability and with other types of anxiety. For example, research on anxiety correlates of math anxiety would help to clarify both the relative specificity of math anxiety and the extent to which more general anxiety management procedures may be useful in its treatment.

The present research, part of a larger program of research on math anxiety, was designed to investigate factors related to the prevalence and intensity of math anxiety in college students. More specifically, its purposes were as follows: (a) to estimate the prevalence and intensity of math anxiety in college students in general; (b) to determine the extent to which levels of math anxiety differ as a function of sex, age, and prior preparation in math; (c) to investigate the relationships between math anxiety and ability, general anxiety, and test anxiety.

Method

Subjects

Three groups of subjects, a total of 652 people, were utilized in the present study; all subjects were students at Ohio State University. The first subject sample consisted of 122 students, 50 male and 72 female, enrolled in the most basic mathematics course offered at the university. This course (herein denoted Math 1) is a review of high school algebra and is designed for students whose math placement scores indicate least readiness for college-level math. Math 1 must be followed by a more advanced math course in order for the student to satisfy Ohio State's basic educational requirements. Students in this group either had less than 3 years of high school math or did poorly on math placement tests in spite of having 3 or 4 years of high school math.

The second subject sample consisted of 348 students, 188 male and 160 female, from a somewhat more advanced math course. This course (denoted as Math 2) is the precalculus course for students planning majors in engineering, the physical sciences, mathematics, and premedicine. Math 2 is followed by the most rigorous calculus sequence offered at the school. Thus, students in Math 2 tended to have had more high school math, had scored considerably higher than Math 1 students on placement tests, and were planning majors and careers requiring extensive preparation in math.

The third subject group consisted of 182 students, 81 male and 101 female, from an introductory psychology course. Because introductory psychology is required as part of basic educational requirements for most major fields, these students represented a variety of major fields and differed from each other in terms of prior math background and achievement. Students in the Psychology 1 group, as well as those in the Math 1 and Math 2 groups, were primarily freshmen and sophomores.

Instruments

Math anxiety was measured using a revised version of the Mathematics Anxiety scale, one of nine scales constituting the Fennema–Sherman Mathematics Attitudes Scales (Fennema & Sherman, 1976). The Mathematics Anxiety scale is intended to assess "feelings of anxiety, dread, nervousness, and associated bodily symptoms related to doing mathematics" (Fennema & Sherman, 1976, p. 4). Because the Fennema–Sherman Mathematics Anxiety Scale was designed for administration to high school students, several items were rewritten to be more appropriate for college students, and of the 12 items used on the Fennema–Sherman scale, 10 were selected to measure math anxiety in college students. Item responses were obtained on a 5-point Likert scale; responses ranged from 1 (strongly disagree) to 5 (strongly agree). Half the items were positively worded, while the other half were negatively worded. Scoring of negatively worded items was reversed so that higher scores would indicate more positive attitudes toward math, that is, less math anxiety. The items used in the Math Anxiety scale are shown, along with response category percentages, in Table 1. The first five items contained in Table 1 are positively worded, while items 6–10 are negatively worded.

Trait anxiety was measured using the A-Trait scale of the State–Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970). The STAI A-Trait scale, intended to assess "relatively stable individual differences in anxiety proneness" (Spielberger et al., 1970, p. 3), consists of 20 statements that ask people to

Table 1
Response Percentages for Items in the Math Anxiety Scale

Item	Response categories: SA or A	U	D or SD
1. It wouldn't bother me at all to take more math courses.	39	26	35
	37	19	44
	49	22	29
2. I have usually been at ease during math tests.	41	19	40
	33	12	55
	40	14	46
3. I have usually been at ease in math courses.	56	17	27
	48	14	38
	63	14	23
4. I usually don't worry about my ability to solve math problems.	48	17	35
	24	15	61
	45	15	40
5. I almost never get uptight while taking math tests.	35	19	46
	25	7	68
	29	12	59
6. I get really uptight during math tests.	46	13	41
	63	8	29
	53	14	33
7. I get a sinking feeling when I think of trying hard math problems.	35	23	42
	58	20	22
	35	21	44
8. My mind goes blank and I am unable to think clearly when working mathematics.	20	19	61
	31	15	54
	20	14	66
9. Mathematics makes me feel uncomfortable and nervous.	27	19	54
	51	12	37
	22	15	63
10. Mathematics makes me feel uneasy and confused.	28	16	56
	45	18	37
	23	16	61

Note. Under each response category, the top, middle and bottom percentages were obtained in the Psychology 1 (n = 182), Math 1 (n = 122), and Math 2 (n = 348) subject groups, respectively. Response categories are as follows: SA or A = strongly agree or agree; U = undecided; D or SD = disagree or strongly disagree.

describe how they generally feel. Subjects are asked to respond to each item using a 4-point scale; response categories are: 1 (almost never); 2 (sometimes); 3 (often); and 4 (almost always). For items on which ratings of 4 indicate high levels of anxiety (e.g., "I worry too much over something that really doesn't matter"), scoring weights are those of the item response chosen. For items on which ratings of 4 indicate low levels of anxiety (e.g., "I am calm, cool, and collected"), the scoring weights are reversed. Total scores range from a minimum of 20 to a maximum of 80, and the higher the score, the higher the level of trait anxiety.

Test anxiety was assessed using the Test Anxiety Inventory (TAI), an instrument developed recently by C. D. Spielberger of the University of South Florida. The TAI consists of 20 statements pertaining to feelings and reactions while taking tests; responses are obtained on a 4-point Likert scale with response categories identical to those used on the STAI. Scores may range from 20 to 80, and higher scores indicate higher levels of anxiety. Correlations between the TAI and Sarason's (1958) Test Anxiety Scale range from .85 to .95, and the TAI provides subscales for Worry and Emotionality components of test anxiety (Spielberger, Note 3).

Scores on the American College Test (ACT) were available through the admissions office for about two thirds of the subjects in each group. For purposes of the present study, the ACT Mathematics and ACT Verbal subtest scores were obtained. Demographic and background information were obtained using a questionnaire administered to each subject tested.

Procedure

Through the cooperation of the faculty in the department of mathematics, permission was obtained to enter sections of the Math 1 and Math 2 courses and administer the Math Anxiety scale and the questionnaire pertaining to demographic and background information. Students in the introductory psychology course were obtained through the psychology department subject pool. These students were administered the Math Anxiety scale, the State–Trait Anxiety Inventory, the Test Anxiety Inventory, and the background questionnaire. So that students would not be tested twice, introductory psychology students enrolled in one of the selected sections of Math 1 or Math 2 were eliminated from the study. Data were collected during the winter and spring quarters of 1977.

Data Analysis

In order to estimate the prevalence of math anxiety among college students, the percentages of students selecting each response alternative for each item were calculated. To permit investigation of group differences, response percentages were calculated separately for each of the three subject groups.

Prior to other analyses of Math Anxiety scale scores, the reliability of the scores was calculated. Using the split-half method, a reliability coefficient of .92 was obtained. Thus, the scale was considered sufficiently

reliable to be studied in relationship to other relevant variables.

Levels of math anxiety by sex and subject group were compared using a two-way analysis of variance design. The mean and standard deviation of scores within each cell were calculated, and post hoc comparisons of significant effects were made using Scheffé's (1959) method.

Pearson product-moment correlation coefficients were calculated to describe the degree of relationship between math anxiety and age, extent of high school math background, ACT scores, and trait and test anxiety scores. Correlations were calculated both within each subject group and separately for males and females within each group. When the correlations for males and females did not differ significantly from each other, the total-group value was used; when there were significant differences, both values were utilized. Scores on the STAI and TAI were available for only the 182 Psychology 1 subjects, and ACT scores were available for two thirds to three fourths of the subjects within the three groups.

Results

While it was not possible to interpret scores on the Math Anxiety scale in terms of the presence or absence of math anxiety, examination of item response percentages indicated the extent to which students responded to the items in ways suggesting its presence. Table 1 shows the item response percentages within each of the three subject groups; the categories of *strongly agree* and *agree* were collapsed, as were those of *strongly disagree* and *disagree,* to facilitate interpretation of the data. For the positively worded items (numbers 1–5), responses of disagree or strongly disagree indicate higher levels of math anxiety. For the negatively worded items (numbers 6–10), responses of agree or strongly agree indicate higher levels of math anxiety.

It may be noted, first, that moderately large percentages of students within all three groups responded in ways suggesting the presence of math anxiety. Disagreement with the positively worded items was most apparent for item 5; 46%, 68%, and 59% of Psychology 1, Math 1, and Math 2 students, respectively, disagreed with the statement "I almost never get uptight during math tests." The other positive item related to math tests (item 2) elicited disagreement percentages nearly as high as those for item 5. On the other positively stated items, the percentages of students disagreeing with the statements ranged from 23% to 61%.

Responses to the negatively worded items also suggested that a high proportion of college students may be math anxious. Approximately half of the Math 1 students and one fourth of the Psychology 1 and Math 2 students agreed with the statements "Mathematics makes me feel uncomfortable and nervous" (item 9) and "Mathematics makes me feel uneasy and confused" (item 10). As with the positively worded items, the expression of anxiety was most widespread in conjunction with math tests; 46%, 63%, and 53% of students in Psychology 1, Math 1, and Math 2 groups, respectively, agreed with the statement "I get really uptight during math tests" (item 6).

Means and standard deviations of scores on the Math Anxiety scale by subject group and sex are presented in Table 2. Results of the two-way analysis of variance indicated significant main effects for group, $F(2, 646) = 13.0$, $p < .001$, and sex, $F(1, 646) = 5.6$, $p < .05$, and a significant interaction effect, $F(2, 646) = 7.3$, $p < .01$. Post hoc contrasts indicated that students in Math 1 were significantly more math anxious ($M = 26.9$) than were students in Math 2 ($M = 31.6$) or Psychology 1 ($M = 31.1$) but that the dif-

Table 2
Means and Standard Deviations of Scores on Math Anxiety Scale for Males and Females in Three Subject Groups

Subject group	Males			Females			Total		
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
Psychology 1	81	33.5	8.2	101	29.1	9.1	182	31.1	9.0
Math 1	50	28.9	7.3	72	25.6	7.5	122	26.9	7.6
Math 2	188	31.1	8.0	160	32.3	9.5	348	31.6	8.7
Total	319	31.4	7.9	333	29.9	8.9	652	30.6	8.5

Note. Means were obtained from a 10-item Math Anxiety scale. Scores may range from 10 to 50; higher scores indicate more positive attitudes toward mathematics, i.e., lower levels of math anxiety.

Table 3
Relationships Between Math Anxiety and Verbal and Mathematics Achievement Test Scores in Three Groups of College Students

Item	Psychology 1		Math 1		Math 2	
	n	*r*	*n*	*r*	*n*	*r*
ACT verbal score						
Total group	120	.10	84	−.02	269	.04
Males	47	.10	32	−.18	153	.05
Females	73	.07	52	.00	116	−.01
ACT mathematics score						
Total group	120	.40**	84	.22*	269	.34**
Males	47	.17	32	.26	153	.38**
Females	73	.42**	52	.21	116	.34**

Note. ACT = American College Test.
* $p < .05$.
** $p < .001$.

ference between the means of the latter two groups was not statistically significant.

Overall, females reported significantly higher levels of math anxiety than did males. However, the significant Group × Sex interaction effect was due to the fact that the sex difference was found only in two of the three groups, and the difference was in the opposite direction in the third group. In the Psychology 1 group, the mean for females (29.1) differed significantly from that for males (33.5) at $p < .001$, while in the Math 1 group, the difference between the female (25.6) and male (28.9) means was significant at $p < .01$; thus, in these two groups, females reported higher levels of math anxiety. No significant sex differences in math anxiety in the Math 2 group were found, but the mean score was higher for females than for males, indicating slightly lower levels of math anxiety among the females.

Levels of math anxiety were found to be related to both the age of female students and to number of years of high school math background in both males and females. The correlations between age and level of math anxiety were −.29 ($p < .01$) for Math 1 females and −.17 ($p < .05$) for Math 2 females, indicating that in an age range of 17 to 34, the older women reported greater math anxiety than did the younger women. Correlations between age and math anxiety in males and in Psychology 1 females ranged from −.10 to .13 and were not significantly different from zero. Correlations between math anxiety and years of high school math were positive, of moderate magnitude (r = .19 to .43), and were statistically significant for males and females in all three subject groups; correlations calculated separately for males and females were not significantly different from each other. Thus, the more prior math preparation a student had, the less likely he or she was to report high levels of math anxiety.

Correlations between math anxiety and Verbal and Mathematics ACT scores are shown in Table 3. As shown in the table, level of math anxiety was not related to ACT Verbal scores but was moderately related to ACT Mathematics scores; correlations between math anxiety and ACT Mathematics scores ranged from .17 (Psychology 1 males) to .42 (Psychology 1 females). The relationship between math anxiety and achievement was strongest in the Math 2 group, where correlations were of moderate magnitude and statistically significant for both males and females. In the Psychology 1 group, the relationship was significant for females but not for males, and in the Math 1 group correlations were marginally significant for both females and males. Thus, there was a general tendency for higher levels of math anxiety to be associated with lower math achievement test scores.

Table 4 presents the Pearson product-moment correlations among scores of the Psychology 1 subjects on the Mathematics Anxiety scale, the A-Trait scale of the State–Trait Anxiety Inventory, and the total score, Emotionality score, and Worry score

Table 4
Correlations Among Math Anxiety, Trait Anxiety, and Test Anxiety in College Students

Scale	2	3	4	5
1. Math anxiety	−.28	−.42	−.38	−.43
2. Trait anxiety[a]		.42	.38	.46
Test anxiety[b]				
3. Total score			.95	.93
4. Emotionality				.79
5. Worry				—

Note. All correlations are based on $n = 182$ and are statistically significant at $p < .001$.
[a] A-Trait scale of State–Trait Anxiety Inventory.
[b] Test Anxiety Inventory.

of the Test Anxiety Inventory. As shown in the table, higher levels of math anxiety (as indicated by lower scores on the Math Anxiety scale) were related to higher levels of trait anxiety, overall test anxiety, and both emotionality and worry components of test anxiety. All of these correlations were statistically significant ($p < .001$) and indicate a moderate degree of association between math anxiety and other types of anxiety. Correlations computed separately for male and female students did not differ significantly from each other or from the total group correlations.

Discussion

The results of the present study indicate that math anxiety occurs relatively frequently among college students in general but that average levels of math anxiety do differ within subgroups of individuals.

Examination of response percentages for each of the 10 items on the Math Anxiety scale suggested that math anxiety is a problem for a large proportion of college students and that it may be problematic even for those students who plan majors and/or careers requiring extensive math background. Approximately half of the Math 1 students and one fourth of the Psychology 1 and Math 2 students indicated that math made them feel "uncomfortable, nervous, uneasy, and confused." Expressions of anxiety were most common when the items concerned math tests; about half the students in all three groups reported getting "really uptight" during math tests.

Sex differences on the Math Anxiety scale varied according to subject sample. In the Psychology 1 and Math 1 groups, women reported significantly higher levels of math anxiety than did men. In the Math 2 group, however, women and men reported equivalent levels of math anxiety. Findings of greater math anxiety among women than men in two of the three groups correspond to findings of Fennema and Sherman (1977), who found that high school boys generally reported significantly more positive attitudes toward mathematics, including greater confidence in their ability to learn math, than did high school girls.

In two subject groups (Math 1 and Math 2), older women reported higher levels of math anxiety than did younger women. The younger students in these samples were the typical college undergraduates who enter college immediately following high school graduation. For the older, nontraditional women students, more time had passed since they had taken high school mathematics; thus, it would not be surprising if they felt more anxious about math than did the younger women.

Results also indicated a moderately strong relationship between math anxiety and number of years high school math. This relationship, consistent across sexes and subject groups, suggests that high school math preparation strongly influences how a college student will feel about math. Statistically significant correlations ranging from .19 to .43 between math anxiety and number of years of high school math are similar in magnitude to that found by Hendel (Note 2) in a sample of adult women enrolled in a math anxiety treatment program; Hendel found a correlation of −.31 between scores on the Math Anxiety Rating Scale (MARS) and number of semesters of high school math.

Math anxiety was found to be moderately related to mathematics achievement test scores (ACT Mathematics subtest). Thus, higher achievement in math is related to lower reported levels of math anxiety. These results are in agreement with previous research investigating the relationships between math anxiety and math achievement; for example, Sherman and Fennema (1977)

found that high school students in the upper half of the achivement distribution reported more positive attitudes toward math than did students in the lower half.

Finally, math anxiety was moderately related to both trait anxiety and test anxiety. In Hendel's study (Note 2), a correlation of .65 between math anxiety and test anxiety was found. Hendel's conclusion that anxiety about evaluation is one component of math anxiety is supported by the present data, and in addition, the present data suggest that people who tend to be anxious in a variety of situations (i.e., trait anxiety) are also more likely to report math anxiety.

The relatively high prevalence of math anxiety in the college students studied strongly suggests the need both for increased awareness of math anxiety as a potential problem area and for the development of appropriate treatment methods. In particular, the results have important implications for the process of educational/vocational counseling. Many students seeking counseling for academic problems may, if questioned specifically, report particular problems with math courses and/or anxiety about their ability to learn math. Counselors may wish to be especially attuned to the possibility of math anxiety in students who have had inadequate math backgrounds and in women students, especially those returning to school in adulthood. Since most undergraduate degree programs require students to take at least one mathematics course, highly math-anxious students may need support and assistance in order to achieve their educational goals.

Further, the moderate degree of relationship between math anxiety and test anxiety suggests that some students reporting test anxiety may be primarily math anxious and experiencing greatest difficulties with anxiety during math tests. Counselors may wish to explore this possibility and, when appropriate, focus treatment of test anxiety on math content and problems.

Finally, counselors assisting students in the process of decision making should explore the extent to which anxiety about math is causing a student to limit his or her educational and/or vocational options. While this study did not address the relationships between math anxiety and educational and vocational decisions, Sells's (1973) study strongly suggested that failure to pursue coursework in mathematics can severely limit the educational and vocational options available to students. Thus, attention to these possible effects of math anxiety would seem to be warranted.

Given the prevalence and possible effects of math anxiety, further development of methods for its treatment is needed.[1] The results of this study, indicating moderately strong relationships between math anxiety and trait and test anxiety, do suggest that basic anxiety management techniques, treatment of test anxiety, and training in test-taking skills may be useful, although probably not sufficient, components of math anxiety treatment programs.

It should be noted that this study provides only a first attempt to elucidate the prevalence, nature, and effects of math anxiety. Further study is needed concerning the genesis of math anxiety, its effects on achievement and participation in math curricula and on career decision making, and on effective methods for its treatment.

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[1] Information regarding math anxiety treatment programs currently in operation may be obtained from the author.

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