1995

The effects of math-self-concept, perceived self-efficacy, and attributions for success and failure on test anxiety

Deborah L Bandalos, *James Madison University*
K. Yates
T. Thorndike-Christ

Journal of Educational Psychology
1995, Vol. 87, No. 4, 611-623

0022-0663/95/$3.00

Effects of Math Self-Concept, Perceived Self-Efficacy, and Attributions for Failure and Success on Test Anxiety

Deborah L. Bandalos and Kristin Yates
University of Nebraska—Lincoln

Tracy Thorndike-Christ
University of Western Washington

Structural equation modeling was used to test a model of test anxiety. Variables in the model included gender, number of years since one's last math course, attributions for failure and success, math self-concept, perceived self-efficacy, achievement, general test anxiety, and statistical test anxiety. Failure and success attributions were found to influence general test anxiety and statistical test anxiety for both male and female students. Women who attributed success to behavioral causes were found to have higher levels of math self-concept than women attributing success to external causes. For men, those attributing failure to external causes were found to have higher levels of the worry component of statistical test anxiety. Math self-concept was negatively related to both general test anxiety and statistics test anxiety, whereas perceived self-efficacy had a negative relationship with the worry component of statistics anxiety.

The possible influences of constructs such as attributions for success and failure (Geen, 1980; Hedl, 1987, 1990; Schwarzer, 1986; Wine, 1980), self-concept (Benson & Bandalos, 1989; Benson, Bandalos, & Hutchinson, 1994; Zeidner, 1992), and perceived self-efficacy (Betz & Hackett, 1983; Hembree, 1988; Hunsley, 1985; Stipek & Weisz, 1981; Zeidner, 1992) on both general test anxiety and subject-specific test anxiety have been the focus of many studies. With the exception of the studies by Zeidner and by Benson and her colleagues, however, these authors have investigated only one or two of these constructs using univariate techniques. The present study represents an attempt to examine the simultaneous impact of these constructs on test anxiety in a statistics class with structural equation modeling techniques. In the following sections, previous research relating test anxiety to attributions for success and failure, math self-concept, and perceived self-efficacy are presented.

Attributions for Failure and Success

Weiner, Frieze, Kukla, Reed, Rest, and Rosenbaum (1971) proposed an attributional theory of achievement motivation in which causal attributions for failure and success based on past performance were hypothesized to relate in systematic ways to feelings such as pride and shame and to both actual performance and expectations of future performance. In subsequent years, the relevance of attribution theory to test anxiety has been the subject of several studies (Arkin, Kolditz, & Kolditz, 1983; Geen, 1980; Hedl, 1987, 1990; Schwarzer, 1986; Wine, 1980). As noted by Arkin et al., current conceptualizations of test anxiety have focused on a *cognitive interference* model in which task-irrelevant thoughts such as inadequacy, helplessness, and concern over loss of status preoccupy the test-anxious student to the extent that performance is diminished. It is this worry or cognitive-interference component of test anxiety that has been found most often to relate to test performance (Hedl, 1987; Tryon, 1980; Williams, 1991). Because many of the task-irrelevant thoughts ascribed to test-anxious students focus on the reasons for their performance (i.e., "I'm not smart enough"), attribution theory may be relevant to an understanding of the nature of the test-anxious response.

Arkin et al. (1983) reported a pattern in which those students with high levels of test anxiety are more likely to attribute failure to a lack of ability and to attribute success to behavioral characteristics such as effort. Leppin, Schwarzer, Belz, Jerusalem, and Quast (1987) also noted a tendency for highly test-anxious students to cite a lack of ability as the cause of their unsuccessful performance. However, unlike Arkin et al., successes were attributed to external factors such as luck. Leppin et al. also found that low test-anxious students were more likely to externalize failure and to internalize success.

Covington and Omelich (1985) showed that ability attributions had a stronger positive relationship with both achievement level and feelings of self-worth than did effort attributions. However, they went on to note that "the substantial dependency of achievement level and self-regard on

Deborah L. Bandalos and Kristin Yates, Department of Educational Psychology, University of Nebraska—Lincoln; Tracy Thorndike-Christ, Department of Psychology, University of Western Washington.

This article is based on a presentation entitled *Gender Differences in Test Anxiety: Implications for Women*, given at the annual meeting of the American Educational Research Association, Atlanta, GA, April, 1993.

Correspondence concerning this article should be addressed to Deborah L. Bandalos, Department of Educational Psychology, 120 Bancroft Hall, University of Nebraska, Lincoln, Nebraska 68588-0345. Electronic mail may be sent via Internet to bandalos@unlinfo.unl.edu.

ability is readily subject to change" (p. 161). Such changes could depend on the magnitude of the perceived threat to one's sense of competence that is implied by failure under ability or effort attributions. For example, contrary to the findings of Arkin et al. (1983) and Leppin et al. (1987), Arkin, Detchon, and Maruyama (1981) found that highly test-anxious students tended to attribute failure on a classroom test to external factors. Because an actual classroom test was involved, Arkin et al. (1981) suggested that students may have felt the need to make more self-serving attributions because of the high level of threat implied by failure in that situation.

A number of researchers (Dweck & Licht, 1980; Frieze, Whitley, Hanusa, & McHugh, 1982; Hedl, 1990; Sweeney, Moreland, & Gruber, 1982) have suggested attribution theory as an explanation for the observed gender differences in test anxiety. However, a meta-analysis of 21 studies on gender differences in attributions conducted by Frieze et al. indicated that although women may have a slight tendency to attribute failure to lack of luck more often than do men, no significant gender differences in attributional style were supported.

The model tested in the current study was based on that suggested by Leppin et al. (1987). These researchers suggested that an unfavorable attributional style is reflected in a negative self-concept about one's own resources that may in turn lead to the development of anxiety. This hypothesis was implemented in the current study by positing direct paths from attributions to math self-concept and to perceived self-efficacy. Direct paths from attributions to test anxiety were also allowed to determine whether this relationship is completely indirect, as suggested by Leppin et al., or whether it has some direct component. Finally, attributions were hypothesized to influence achievement both directly and indirectly through math self-concept, perceived self-efficacy, and general test anxiety.

Math Self-Concept

Bandura's (1986) work in the area of self-efficacy expectations and self-concept also has implications for understanding test anxiety. Bandura stated that people engaging in new tasks make appraisals of their performance capabilities on the basis of their knowledge of how they have done in similar situations (pp. 398–399). In the current study, learning statistics was seen as a new task for most students, whereas learning math was considered to be a related task with which students would have had some previous experience. Thus math self-concept was included in the model with the expectation that students' perceptions of their math ability would influence their judgments regarding their ability to be successful in learning statistics. This hypothesis is consistent with recent findings by Benson et al. (1994) that revealed that math self-concept has a strong positive influence on perceived self-efficacy in statistics.

Bandura's (1986) conceptualization of self-concept as a global or composite view of self gives rise to the possibility *that self-concept* develops out of more specific feelings, such as self-efficacy. In the context of the current study such a conceptualization suggests that perceived self-efficacy influences math self-concept, rather than the reverse. However, it is also possible either that the relationship between the two variables is a reciprocal one or that the constructs are simply correlated with no causal connection. To explore these possibilities, we tested alternative models corresponding to these three competing hypotheses in the current study.

Relationships of math self-concept and test anxiety with achievement have also been found. Benson et al. (1994) and Zeidner (1992) found that students' self-evaluations of their math ability had a negative influence on test anxiety and a positive influence on achievement in statistics classes. Benson and her colleagues also reported that math self-concept had a significant negative effect on general test anxiety for women but not for men. This finding appears to be consistent with Kagan's (1987) suggestion that women are more apt to generalize their anxiety responses than are men.

On the basis of the research cited above, math self-concept was hypothesized to affect perceived self-efficacy in statistics, achievement scores in a statistics class, and both general test anxiety and statistics test anxiety.

Perceived Self-Efficacy

Several researchers have discussed the relationship between the constructs of perceived self-efficacy and test anxiety (Betz & Hackett, 1983; Hembree, 1988; Hunsley, 1985; Stipek & Weisz, 1981). Bandura (1986) defines perceived self-efficacy as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (p. 391). Past performance, cues and messages from relevant others (such as parents, teachers, and peers), and levels of emotional arousal all contribute to judgments about one's efficacy. Those who form perceptions of themselves as inefficacious tend to give up easily; dwell on their perceived deficiencies, thus detracting their attention from the task at hand; suffer from anxiety and stress; and attribute their successes to external factors (Bandura, 1977, 1982, 1986).

In academic achievement or evaluative situations, lower levels of self-efficacy are related both to higher test anxiety (Betz & Hackett, 1983) and to greater decrements in task performance (Hembree, 1988; Hunsley, 1985; Stipek & Weisz, 1981). In the study by Benson et al. (1994), perceived self-efficacy, defined as confidence in one's ability to be successful in the statistics course in which the research was conducted, was found to have a negative relationship to general test anxiety but not to statistics test anxiety. This finding may be reflective of a tendency for students to overgeneralize math or math-related competence. Arch (1987) as well as Benson and Bandalos (1989) reported significantly lower levels of self-efficacy among women. Arch also noted that women tend to devalue their performance and to have more negative thoughts during exams than do men. In light of these research findings on self-efficacy, it was hypothesized that perceived self-efficacy in a statistics class would be positively related to achievement and negatively related to both general test anxiety and statistics test anxiety.

Background Variables

Finally, a number of background variables found to be related to test anxiety in previous research were included in the current study. These were gender, class standing (graduate vs. undergraduate), number of prior math courses, and years since one's last math course. Fox (1977) and Kagan (1987) suggested that gender differences in math achievement might actually be a reflection of differential course taking between men and women. In the current study an analogous hypothesis was that gender differences in levels of math self-concept and perceived self-efficacy were attributable to differential numbers of prior math courses. This hypothesis was tested by omitting direct paths between gender and both math self-concept and perceived self-efficacy but allowing direct paths from prior math courses to these two variables.

Class standing was included in studies by Benson et al. (1994) and Benson & Bandalos (1989), in which it was found that undergraduate students indicated higher levels of general test anxiety than did graduate students. No differences in levels of statistics test anxiety were found in the two studies. In the current study, class standing was expected to show a positive relationship to general test anxiety but not to statistics test anxiety.

The inclusion of the number of years since one's last math course was motivated by anecdotal observations that many students expressed apprehension at taking a statistics class because it had been so long since they had studied math. It was hypothesized that math self-concept would decrease with number of years since one's last math course and that the number of years since one's last math course would influence perceived self-efficacy and statistics test anxiety indirectly through its relationship with math self-concept. Gender differences in mean levels of perceived self-efficacy (Arch, 1987; Benson & Bandalos, 1989) and test anxiety (Bander & Betz, 1981; Benson et al., 1994; Betz & Hackett, 1983; Salamé, 1984; Sowa & Lafleur, 1986) have been reported in the literature. In the current study it was hypothesized that women would have higher levels of both general test anxiety and statistics test anxiety. However, on the basis of the work of Fox (1977) and Kagan (1987), gender was expected to influence math self-concept and perceived self-efficacy indirectly through the number of prior math courses.

Proposed Model

The purpose of the current study was to test a model of the relationships among the constructs of success and failure attributions, math self-concept, perceived self-efficacy in a statistics class, achievement, general test anxiety, and statistics test anxiety with structural equation modeling. The model tested was based on the hypotheses described in the previous sections and is shown in Figure 1. It should be noted that although the exogenous variables (class, gender, number of prior math courses, number of years since one's last math course, and attributions) were allowed to correlate freely, these paths were not included in Figure 1 in the interest of simplicity.

It was also of interest to investigate whether gender differences existed in the relationships of these variables with test anxiety. A second set of analyses was therefore conducted in which the invariance of path coefficients across the two gender groups was tested.

Method

Participants and Procedures

The 338 students who participated in the study were enrolled in graduate- and undergraduate-level statistics courses offered in departments of psychology and educational psychology at Western Washington University and the University of Nebraska—Lincoln. The sample was composed of 193 women (57%) and 145 men (43%). Although the undergraduate students represented a diversity of majors, including pre-med, social sciences, engineering, nutrition, and computer science, the graduate students were somewhat more homogeneous, with the majority coming from colleges of education and psychology.

Data were obtained from surveys administered during two different semesters. On both occasions we administered the initial survey during the first 2 weeks of class. Students were informed that the researchers were conducting a study of test anxiety. The students were told that their responses would remain anonymous and that participation was voluntary. The second survey was administered following a course examination that was expected to affect levels of statistics test anxiety. Students were included in the final sample of 338 only if complete data from both surveys were available and if they had given permission for their exam score to be used as a measure of achievement.

Measures

Four attitude scales, one achievement measure, and several background items were administered to all participants. The means and standard deviations for the continuous variables as well as the internal consistency estimates (coefficient alpha) for the four scales are shown in Table 1 for the total sample and for each gender group separately.

Math self-concept. The math self-concept scale was developed by Benson (1989) and consisted of seven items rated on a 5-point Likert scale ranging from *strongly disagree* (1) to *strongly agree* (5). Items related to such things as perceived math aptitude ("I feel that I am naturally good at math") and level of comfort with math ("I find it hard to think in terms of symbols").

Perceived self-efficacy. The perceived self-efficacy scale was developed for this study by Thorndike-Christ and Yates. It consisted of seven items thought to represent tasks involved in learning statistics. As recommended by Bandura (1986, pp. 396–397), the items on this scale refer to specific skills and abilities such as "constructing graphs" and "getting information from tables in research articles." These items were answered according to a 10-point scale ranging from *never* (1) to *always* (10) on which students indicated how often they felt they would be successful on each of the seven tasks. The self-efficacy and math self-concept items were subjected to an exploratory principal-axis factor analysis with an oblique rotation. Two factors were found that clearly separated the math self-concept and self-efficacy items. The two factors had a correlation of .49, indicating that the two scales measured factorially distinct but related components.

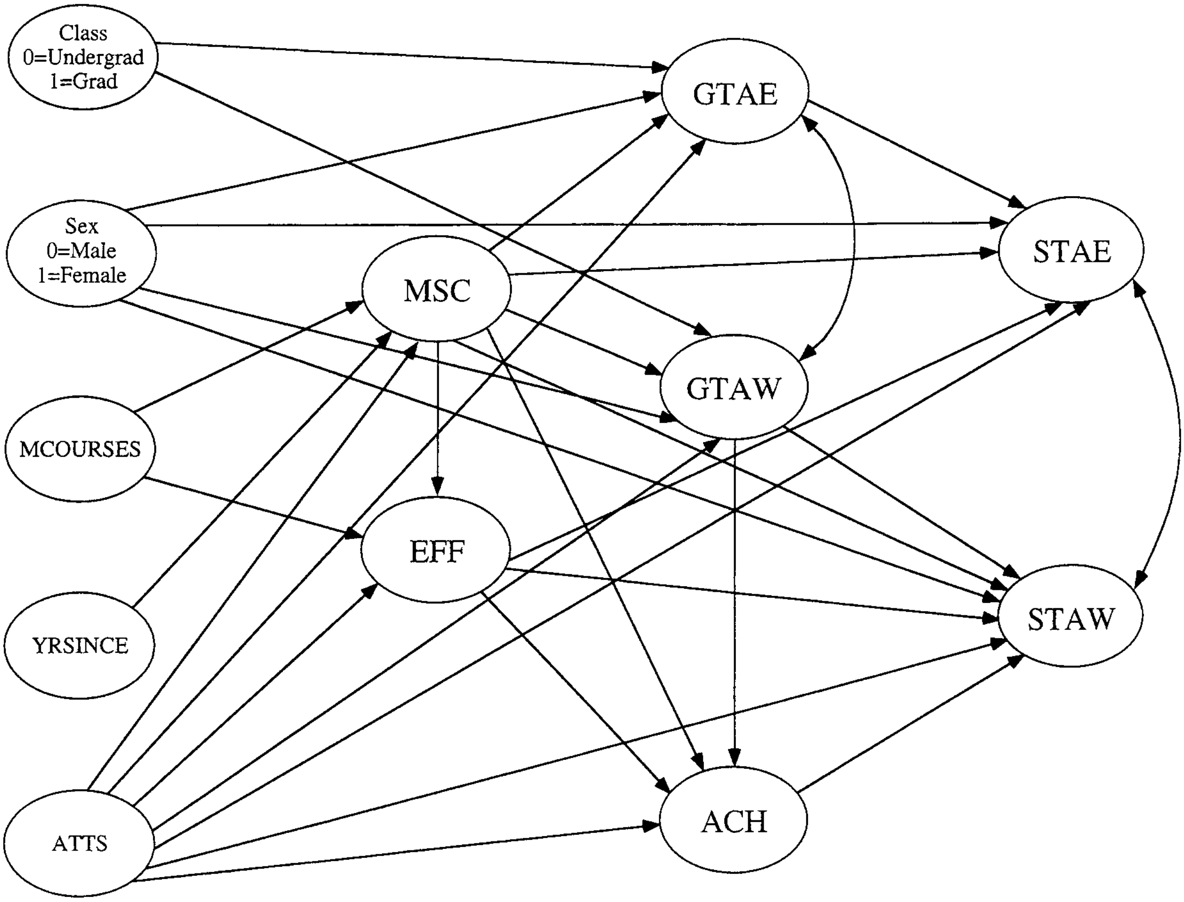

Figure 1. Originally hypothesized direct paths. ACH = achievement; ATTS = attributions; EFF = perceived self-efficacy; Grad = graduate; GTAE = general test anxiety–emotionality; GTAW = general test anxiety–worry; MCOURSES = number of prior math courses; MSC = math self-concept; STAE = statistics test anxiety–emotionality; STAW = statistics test anxiety–worry; Undergrad = undergraduate; YRSINCE = number of years since one's last math course.

Causal attributions. Attributions were measured by presenting students with two situations that we chose to represent success and failure conditions as unambiguously as possible. For the success situation, the statement was "You get an A on your statistics test." The failure situation presented was "You fail a statistics course that is required for your program." For each situation, students were required to state what the one major cause of the event would be for them, following the procedures recommended by Hedl (1990). The generated causes were classified into three categories as described by Hedl (1987, 1990) and by Peterson, Schwartz, and Seligman (1981). These factors were characterological, which was defined as something one has (ability, prior knowledge, interest in the material, or lack of these), behavioral (effort), and external (luck, instructor characteristics, or test characteristics). For simplicity, the three attribution patterns are referred to as ability (characterological), effort (behavioral), and external.

Test anxiety. Spielberger's (1980) Test Anxiety Inventory was used to measure general test anxiety and statistics test anxiety. The Test Anxiety Inventory consists of 20 items with a 4-point Likert response format ranging from *almost never* (1) to *almost always (4)*. It has been shown to measure two interrelated dimensions: worry and emotionality. Worry is conceptualized as the cognitive component of test anxiety and reflects concerns with performance on the test, whereas emotionality is a measure of physiological and affective reactions to testing, such as nervousness or feeling tense. Spielberger has reported correlations of .82 between the Test Anxiety Inventory and Sarason's (1978) Test Anxiety Scale and correlations ranging from .69 to .85 with Liebert and Morris's (1967) Worry and Emotionality Questionnaire. The two-factor structure of the Test Anxiety Inventory has been shown to be invariant over gender (Benson & Tippetts, 1990). This is of particular interest in the current study, as a non-invariant factor structure would mean that a scale does not measure a construct in the same way for both gender groups. If this were true, then any observed gender differences may be attributable to the instrument itself.

The general test anxiety scores were derived by administering the 8 worry and 8 emotionality items with directions to "Use the scale below to rate items . . . in terms of how you feel when taking tests in general." The statistics test anxiety score was obtained by readministering the Test Anxiety Inventory items following an examination in each statistics class and directing students to answer in terms of how they had felt while taking that exam. Worry and Emotionality subscales were created for both the general test

Table 1
Summary Statistics and Cronbach's Alpha for Each Scale × Gender and for Total Group

Scale	Men			Women			Total		
	M	*SD*	α	*M*	*SD*	α	*M*	*SD*	α
Prior math courses	1.66	1.24	.90[a]	1.37	1.46	.90	1.50	1.37	.90
Math self-concept	23.95	5.66	.88	22.38	6.89	.91	23.05	6.43	.91
Self-efficacy	51.08	11.28	.90	48.83	11.79	.91	49.78	11.61	.90
GTA–Worry	13.96	5.03	.91	13.41	4.65	.88	13.65	4.82	.89
GTA–Emotionality	17.29	5.99	.92	17.51	5.69	.90	17.42	5.81	.91
STA–Worry	13.96	5.45	.92	13.72	5.41	.92	13.82	5.42	.92
STA–Emotionality	16.41	6.07	.92	17.00	5.87	.90	16.75	5.96	.91
Midterm examination	52.24	9.58	.80[a]	51.55	8.83	.80	51.84	8.83	.80

Note. For men, $n = 145$. For women, $n = 193$. For total group, $N = 338$. GTA = general test anxiety; STA = statistics test anxiety.
[a] Values of Cronbach's alpha were set to the values shown for these two variables.

anxiety and statistics test anxiety scales by summing the appropriate items. Examples of Worry items are "Thoughts of doing poorly interfere with my concentration on tests" and "I freeze up on important exams." Emotionality was measured by items such as "While taking tests I have an uneasy, upset feeling" and "During tests I feel very tense."

Achievement. Although class examinations differed among the various courses, the content covered was typical of most first-level statistics courses. Because the exam scores were scaled differently in the separate classes, these scores were standardized within classes and converted to *T* scores ($M = 50$, $SD = 10$) for analysis.

Data Analysis

We used a covariance matrix as input to the LISREL-8 program (Jöreskog & Sörbom, 1993) to analyze the structural model. The covariance matrix is included as an Appendix. Separate covariance matrices for men and women can be obtained from Deborah L. Bandalos.

Math self-concept, self-efficacy, general test anxiety, and statistics test anxiety were represented by the total scores on the scales. Because the variable number of prior math courses had an extremely nonnormal distribution, with most students having had only one or two prior courses, it was transformed to its natural log. Gender, class, and failure and success attributions were dummy coded before being entered into the analysis. Four dummy variables, F1, F2, S1, and S2 were created to represent failure and success attributions, respectively. F1 and S1 compared ability with effort attributions, whereas F2 and S2 represented a contrast between external and effort attributions.

Because the reliabilities for the scales used were known, we accounted for this information by setting the measurement error variance for each of the latent variables (see Jöreskog and Sörbom, 1993, p. 168). Although reliabilities were not known for the exam score, this measure was not thought to be perfectly reliable. We therefore set the reliability for exam scores to .8. In general, incorporating reliability information in this manner allows the researcher to obtain estimates of the relationships among the variables that are corrected for measurement error.

The exogenous variables of gender, number of prior math courses, number of years since one's last math course, graduate versus undergraduate status, and attributions were specified to be fixed (with the fixed-x option in LISREL) because they were not jointly representative of a specific latent variable but were thought to influence the latent endogenous variables directly. When the fixed-x option is used, the variances and covariances among the exogenous variables do not affect the fit of the model to the data. Only those paths that were hypothesized on the basis of previous research (shown in Figure 1) were free to be estimated. All other paths between variables were set to zero. The residuals of the endogenous variables were also estimated. Although no causal relationships were posited between the Worry and Emotionality subscales of the general test anxiety and statistics test anxiety scales, the residuals of each pair of subscales were allowed to be correlated. Because the hypothesized relationships of failure and success attributions with the other variables in the model were the same, these have been combined under the heading "attributions" in Figure 1.

A second set of analyses was done to determine whether the overall model obtained for the total sample would fit equally well for the male and female groups separately or whether some paths differed across the two groups. These analyses were done through the multiple-group procedures available in the LISREL 8 program. Multiple-groups analyses result in a statistical test of whether a single model can be fit to more than one group. If path coefficients differ significantly across groups, then the multiple-group analysis allows the researcher to determine which paths are not invariant.

Results

Overall Model

An initial test of the model resulted in several paths with nonsignificant *t* values. These paths were deleted one at a time, and the model was reestimated each time. We were careful to delete paths only when doing so did not result in the elimination of significant indirect effects.

Two paths were added on the basis of the LISREL modification indices, expected parameter change statistics, and standardized residuals. Only those paths that were theoretically defensible were added, and additions were made one at a time. All other path coefficients and fit statistics were examined after each addition to determine its effect on these values. The final model was obtained by adding these two paths and deleting paths with nonsignificant *t* values.

Alternative Models

In addition to the model shown in Figure 1, termed Model 1, four alternative models were tested that involved competing conceptualizations of two of the relationships. Model 2 included a reciprocal path between statistics test anxiety–worry and achievement. Although the measures of statistics test anxiety were obtained after a course exam with instructions to "answer according to how you felt while taking the exam in this class," it is possible that the levels of anxiety actually felt by students during the exam could have affected their test performance.

Models 3 through 5 represented the alternative treatments of the relationship between math self-concept and perceived self-efficacy discussed previously. In Model 3, reciprocal paths between the two variables were fit, whereas in Model 4 the two variables were hypothesized to be correlated, but with no causal or directional relationship. This was accomplished by allowing the residual paths for the two variables to be correlated while eliminating any direct paths between them. In Model 5, the order of the two variables was reversed, with perceived self-efficacy represented as influencing math self-concept.

Values of several goodness-of-fit indices for the five models are shown in Table 2. Bentler and Bonett's (1980) normed-fit index can be interpreted as the improvement in fit of the hypothesized model over a baseline model, relative to the fit of the baseline model. The baseline model used in this case was one of uncorrelated variables. Browne and Cudeck's (1989) single-sample cross-validation index was developed to assess the degree to which a set of parameter estimates obtained from one sample would fit if used in a similar sample. As with the chi-square statistic, smaller values are desirable. Because a better model–data fit can always be obtained by adding parameters to the model, James, Mulaik, and Brett (1982) proposed the parsimonious-normed-fit index to adjust the normed-fit index for improvements in fit gained at the expense of degrees of freedom. This adjustment is based on the rationale that each degree of freedom in a model represents a parameter that may have been incorrectly specified and that therefore represents a partial test of the model. Carlson and Mulaik (1993) described the parsimony ratio as a disconfirmability ratio because it represents the proportion of possible dimensions or parameters on which the hypothesized model can fail to fit.

Models 1 through 3 resulted in approximately equal degrees of model–data fit. Although the chi-square values for Models 2 and 3 were slightly lower than that for Model 1, the reciprocal paths added by these two models resulted in nonsignificant t values of -1.34 and -1.21, respectively. These were the paths from statistics test anxiety–worry to achievement in Model 2 and the path from perceived self-efficacy to math self-concept in Model 3. In Model 3 a negative value for the squared multiple correlation of math self-concept was also obtained. Model 4, which posited that math self-concept and self-efficacy were simply correlated with no causal link, resulted in a poorer fit than the first 3 models and had a modification index of 27.03 for the math self-concept to self-efficacy path. A similar result occurred for Model 5, which had a modification index of 16.76 for the math self-concept to self-efficacy path. Because Model 1 seemed to offer the best statistical fit to the data without adding superfluous model parameters, this model was retained.

Table 2
Goodness-of-Fit Indices for Models 1–5

Model	χ^2	*df*	Probability	NFI	ECVI	PNFI
1	65.54	52	.098	.96	.60	.48
2	63.86	51	.11	.96	.60	.47
3	63.62	51	.11	.96	.60	.47
4	89.42	52	<.01	.95	.67	.47
5	143.56	52	<.01	.91	.83	.45

Note. NFI = normed-fit index; ECVI = single-sample cross-validation index; PNFI = parsimonious-normed-fit index.

Final Model

The final model and standardized path coefficients are shown in Figure 2 in which dashed lines represent the two paths added post hoc. As can be seen from Figure 2, gender had significant effects only on general test anxiety–worry. Contrary to expectations, men reported higher mean levels of general test anxiety–worry. Undergraduate students reported higher levels of general test anxiety–emotionality and general test anxiety–worry, as expected. Number of prior math courses did not show the expected positive relationship with math self-concept. Instead, an unanticipated positive path was found between number of prior math courses and general test anxiety–emotionality. Math self-concept showed the expected negative relationships with statistics test anxiety–emotionality, general test anxiety–emotionality, and general test anxiety–worry but not with statistics test anxiety–worry, and it was positively related to perceived self-efficacy. Math self-concept and general test anxiety–worry both revealed the expected relationships with achievement levels. Contrary to what was anticipated, levels of self-efficacy were not related significantly to achievement, to either the Worry or Emotionality scales of general test anxiety, or to statistics test anxiety–emotionality. However, perceived self-efficacy did have a significant negative relationship with statistics test anxiety–worry. Students' failure attributions displayed several interesting patterns in this study. When students who attributed failure to a lack of ability were contrasted with those attributing failure to a lack of effort (represented by the F1 dummy variable), the hypothesized differences in levels of general test anxiety–emotionality, statistics test anxiety–worry, self-efficacy, and achievement were not found. However, students attributing failure to lack of ability were found to have significantly higher levels of both statistics test anxiety–emotionality and general test anxiety–worry and significantly lower levels of math self-concept.

The comparison of students who attributed failure to a lack of effort with those attributing failure to external causes

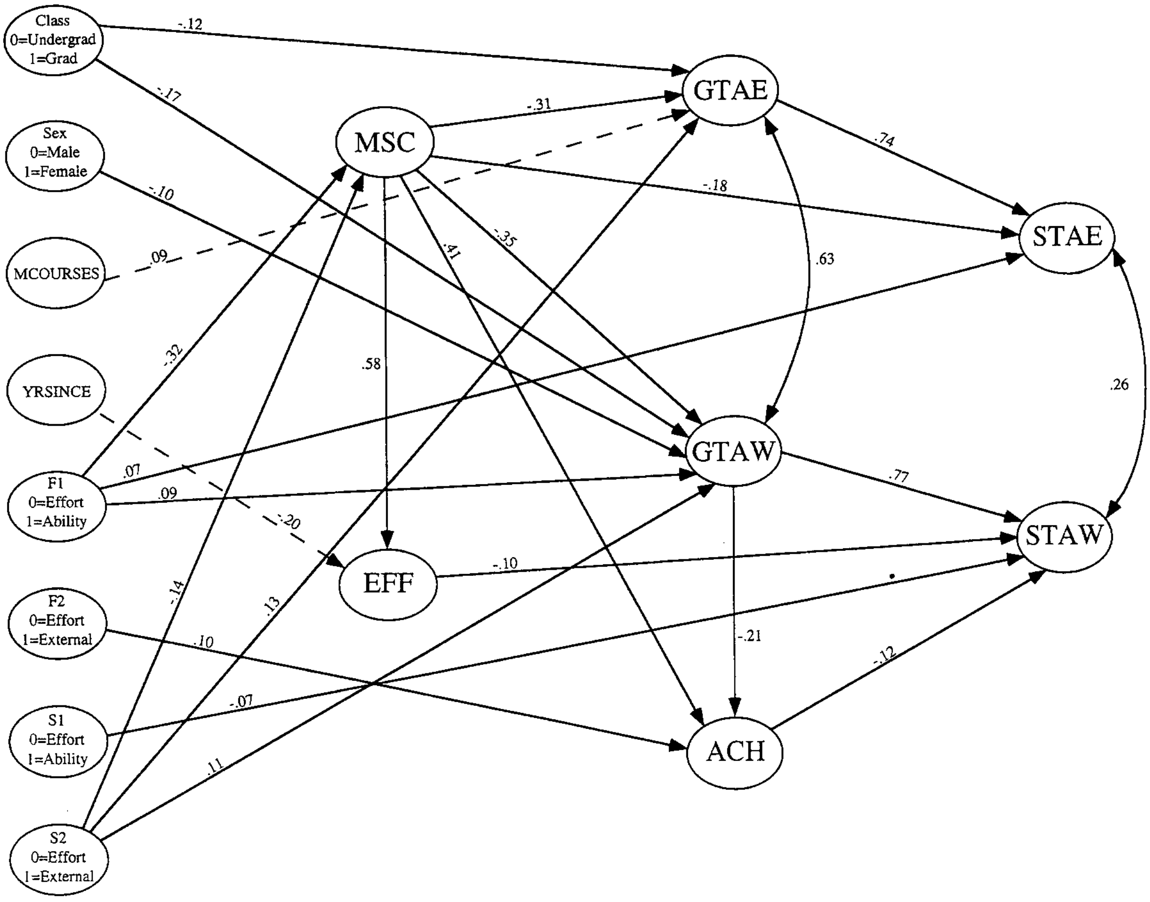

Figure 2. Final model showing standardized path coefficients. Dashed lines represent the two paths added post hoc. ACH = achievement; EFF = perceived self-efficacy; F1 = dummy variable for failure attributions coded 1 = ability and 0 = effort; F2 = dummy variable for failure attributions coded 1 = external and 0 = effort; Grad = graduate; GTAE = general test anxiety–emotionality; GTAW = general test anxiety–worry; MCOURSES = number of prior math courses; MSC = math self-concept; S1 = dummy variable for success attributions coded 1 = ability and 0 = effort; S2 = dummy variable for success attributions coded 1 = external and 0 = effort; STAE = statistics test anxiety–emotionality; STAW = statistics test anxiety–worry; Undergrad = undergraduate; YRSINCE = number of years since one's last math course.

(represented by the dummy variable F2) did not result in the expected differences in levels of all types of test anxiety, math self-concept, or perceived self-efficacy. Although a significant relationship with achievement scores was found, it was in a direction opposite to what was anticipated, favoring those attributing failure to external causes.

Students attributing success to effort rather than to ability displayed unexpectedly higher levels of statistics test anxiety–worry, but the two groups did not differ in terms of math self-concept, general test anxiety–emotionality, general test anxiety–worry, statistics test anxiety–emotionality, perceived self-efficacy, or in achievement scores. Finally, students making external rather than effort attributions for success reported significantly higher levels of general test anxiety–emotionality and general test anxiety–worry as well as significantly lower levels of math self-concept.

The final model shown in Figure 2 had an acceptable fit to the data, $\chi^2(52, N = 337) = 65.54, p = .098$. All but four standardized residuals had values less than 2.0. Values of the normed-fit index and parsimonious-normed-fit index were .96 and .48, respectively. Although the normed-fit-index value indicates a good model–data fit, the parsimonious-normed-fit-index value suggests that this fit was achieved at the expense of parsimony (or what Carlson and Mulaik, 1993, have termed disconfirmability) and that relatively few model parameters were actually free to be tested.

Separate Models for Men and Women

A second set of analyses involved the use of multiple-group procedures to determine whether identical models would hold for men and women or whether some of the paths differed across the two gender groups. Although mean differences were found only for general test anxiety–worry and for number of prior math courses taken, this does not preclude the possibility that the relationships among the variables in the model may differ by gender.

To test for the possibility of different models for men and women, we used the final model obtained for the combined sample as the base model in a series of multiple-group-invariance analyses. The first of these analyses involved the estimation of separate path coefficients for men and women. In this model, the values of the path coefficients were allowed to differ by gender, but the same pattern of paths was required to hold for both gender groups. This specification resulted in the standardized parameter values shown in Table 3.

As can be seen from Table 3, there were some substantial differences in parameter estimates for the two groups. In some cases, path coefficients were significant for one group and not the other. In looking at these values, it should be kept in mind that the power associated with a path depends on where the path is located in the model (Kaplan & Wenger, 1993), or, more specifically, on the values of the covariances among the estimated parameters. Because of this, large observed differences between path coefficients may not be statistically significant, but small differences may.

The estimation of separate path coefficients for women and men indicated that the same paths could be used in models for men and women, although not necessarily with the same values, $\chi^2(92, N = 337) = 113.04$, $p = .067$. Subsequent invariance analyses involved a series of steps in which increasing numbers of parameters were set to be invariant across the two gender groups. First, all gamma paths (exogenous to endogenous) and then all gamma and beta (endogenous to endogenous) paths were set to be invariant across men and women. The chi-square values, degrees of freedom, and *p* values from these analyses are reported in Table 4. Chi-square difference tests between pairs of analyses are shown in the lower half of the table. These analyses test whether inclusion of the additional constraints (invariant paths) resulted in a significant decrement in the overall fit of the model.

As can be seen in Table 4, the inclusion of invariance constraints on the gamma matrix resulted in an increase in the chi-square value that was marginally significant ($.05 < p < .10$), indicating that some of the paths may not be equal across men and women. Although the chi-square difference test was not significant, the model with gamma paths invariant did not fit the data, $\chi^2(104, N = 337) = 132.76$, $p > .05$. The addition of invariance constraints on the beta paths did not significantly worsen the fit over that of Model 2, signifying that these values were essentially the same for both gender groups.

Table 3
Standardized Path Coefficients for Men and Women

Parameter	Men	Women
MSC to EFF	.45*	.65*
MSC to GTAE	−.44*	−.19*
MSC to GTAW	−.50*	−.24*
MSC to ACH	.44*	.41*
MSC to STAE	−.14*	−.23*
EFF to STAW	−.08	−.13*
GTAE to STAE	.74*	.71*
GTAW to STAW	.73*	.78*
GTAW to ACH	−.14	−.22*
ACH to STAW	−.11	−.13*
MCOURSES to GTAE	−.01	.18*
YRSINCE to EFF	−.20*	−.20*
F1 to MSC	−.39*	−.25*
F1 to GTAW	.19*	.10
F1 to STAE	−.01	.11*
F2 to ACH	.10	.09
S1 to STAW	−.09	−.04
S2 to MSC	−.02	−.24*
S2 to GTAE	.10	.18*
S2 to GTAW	.07	.18*
CLASS to GTAE	−.12	−.08
CLASS to GTAW	−.17*	−.15*

Note. MSC = math self-concept; EFF = perceived self-efficacy; GTAE = general test anxiety–emotionality; GTAW = general test anxiety–worry; ACH = achievement; STAE = statistics test anxiety–emotionality; STAW = statistics test anxiety–worry; MCOURSES = number of prior math courses; YRSINCE = number of years since one's last math course; F1 = dummy variable for failure attribution coded 1 = ability and 0 = effort; F2 = dummy variable for failure attribution coded 1 = external and 0 = effort; S1 = dummy variable for success attribution coded 1 = ability and 0 = effort; S2 = dummy variable for success attribution coded 1 = external and 0 = effort; CLASS = dummy variable coded 1 = graduate student and 0 = undergraduate student.
$*p < .05$.

Table 4
Chi-Square Statistics for Multiple-Group Invariance Analyses

Model	χ^2	*df*	Probability
1. Gamma and beta paths same pattern	113.04	92	.067
2. Gamma paths invariant	132.67	104	.030
3. Gamma and beta paths invariant	148.52	114	.016
4. Free MCOURSES → GTAE women only	141.79	114	.040
5. Free S2 → MSC women only	135.33	114	.084
6. Free F2 → STAW men only	130.86	113	.120
Comparisons			
Model 2 to Model 1	19.63	12	
Model 3 to Model 2	15.85	10	
Model 4 to Model 3	6.73	—	
Model 5 to Model 4	6.46	—	
Model 6 to Model 5	4.47	1*	

Note. MCOURSES = number of prior math courses; GTAE = general test anxiety–emotionality; S2 = dummy variable for success attribution coded 1 = external and 0 = effort; MSC = math self-concept; F2 = dummy variable for failure attribution coded 1 = external and 0 = effort; STAW = statistics test anxiety–worry.
$*p < .05$

To explore group differences in the gamma paths, we examined standardized residuals, *t* values, and modification indices for all parameters in each group. In a multiple-groups analysis, modification indices are obtained for each group separately. These modification indices are estimates of the improvement in the overall chi-square value that would result if the parameter were not constrained to be equal across groups. Examination of the modification indices revealed three paths that were not invariant.

The largest modification index was obtained for the path from number of prior math courses to generalized test anxiety–emotionality. This path coefficient had a negative but nonsignificant value for men and a significant positive value for women. This path was therefore allowed only for women. This new model was estimated, and the modification indices were examined. A second large modification index was found for the path from S2 to math self-concept. This path was also significant only for women, indicating that lower levels of math self-concept were displayed by women who attributed success to external causes but not by men making the same attribution. A model was estimated to take this change into account, and one additional large modification index was found. This modification index corresponded to the path from F2 to statistics test anxiety–worry and indicated that for men, only those attributing failure to external causes reported higher levels of statistics test anxiety–worry. The addition of these three model changes resulted in the model shown in Figure 3 in which dashed lines indicate paths that were not invariant across gender. Path values shown are the common metric standardized coefficients provided by the LISREL-8 program. These values are standardized by pooling the covariance matrices

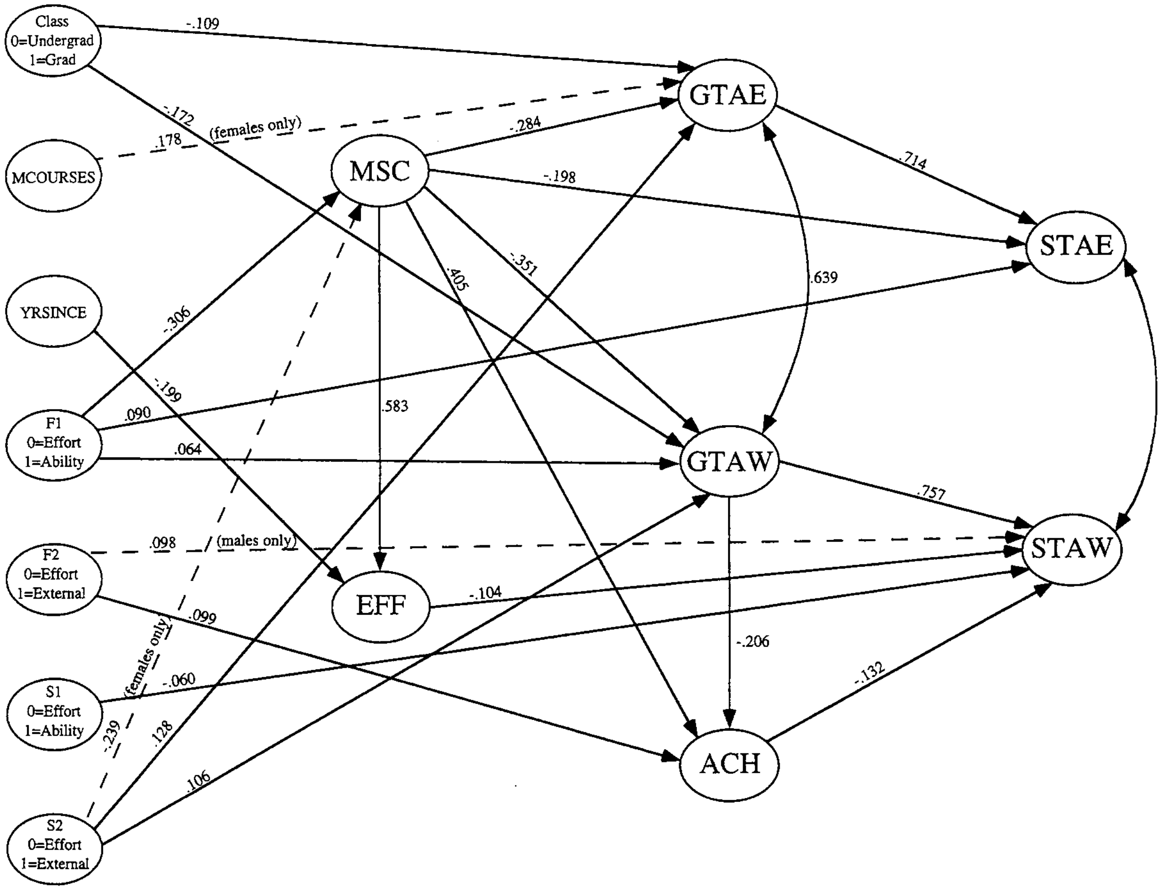

Figure 3. Test anxiety model for men and women showing invariant paths and common metric standardized path coefficients. Dashed lines indicate paths that were not invariant across gender. ACH = achievement; EFF = perceived self-efficacy; F1 = dummy variable for failure attributions coded 1 = ability and 0 = effort; F2 = dummy variable for failure attributions coded 1 = external and 0 = effort; Grad = graduate; GTAE = general test anxiety–emotionality; GTAW = general test anxiety–worry; MCOURSES = number of prior math courses; MSC = math self-concept; S1 = dummy variable for success attributions coded 1 = ability and 0 = effort; S2 = dummy variable for success attributions coded 1 = external and 0 = effort; STAE = statistics test anxiety–emotionality; STAW = statistics test anxiety–worry; Undergrad = undergraduate; YRSINCE = number of years since one's last math course.

for each group, resulting in a solution in which the latent variables are standardized across rather than within groups.

Discussion

Although the results of the current study have replicated many of the findings of the previous studies by Benson and her colleagues (Benson & Bandalos, 1989; Benson et al., 1994), several differences were also found. For example, Benson et al. found that math self-concept was related to general test anxiety rather than to statistics test anxiety. The current study replicated the results with regard to general test anxiety, but a significant negative relationship with the emotionality component of statistics test anxiety was found as well. The findings with regard to the relationship between math self-concept and general test anxiety are consistent with Richardson and Woolfolk's (1980) suggestion that students may tend to overgeneralize the importance of math competence. However, because the general test anxiety data were collected in a statistics class, students may not have been able to disassociate their general test anxiety from their anxiety about the class, even though they were instructed to reply in terms of their levels of test anxiety in all their classes.

The results with regard to self-efficacy were somewhat supportive of those reported by Benson et al. (1994) in that self-efficacy was shown to have a slightly stronger relationship with statistics test anxiety–worry for women than for men. However, this difference was not significant. That self-efficacy was significantly related only to the worry component of statistics test anxiety is supportive of Wine's (1980) contention that it is the worry component of test anxiety that is related to other cognitive variables. The overall lack of direct relationships shown by self-efficacy may be due to the collinearity of that variable with math self-concept. This possibility is supported by the results from the alternative model in which the roles of math self-concept and self-efficacy were reversed. Although this model resulted in a poorer model–data fit than the originally hypothesized model, in the alternate model perceived self-efficacy was found to have both a significant negative relationship with general test anxiety–worry, general test anxiety–emotionality, and statistics test anxiety–emotionality and a significant positive relationship with achievement. Future research should include measures that more clearly separate these two constructs.

The lack of a direct path between the number of prior math courses and the math self-concept scale used in this study is puzzling. This phenomenon may be due to the use of the log transformation of number of prior math courses in the current study. This transformation had the desired effect of reducing the amount of nonnormality for that variable, but it also resulted in less variance. Another possible explanation for this finding could be that one's math self-concept is more a function of the group with which one compares oneself than of the amount of preparation one has. Although *social comparison theory* indicates that individuals most often compare themselves with others in their immediate surroundings, more experience in math courses could create a tendency toward unrealistic upward expectations with a referent group whose actual ability exceeds that of the individual. Goethals, Messick, and Allison (1991) suggested that this may be especially true for women, because they have found that women are less likely than men to make favorable social comparisons about intellectual ability.

Following this line of reasoning may also shed light on the unexpected positive relationship between number of prior math courses and general test anxiety–emotionality for women. Social comparison theory posits links with test anxiety such that if students' previous perceptions of experiences in math-related courses have not been positive, if students' comparisons of their ability have not been favorable, or both, then higher anxiety may result. This may have been the case with the women in the current study who, although they have taken more math courses than their peers, apparently did not choose to pursue math as a career field. This may have been due to less than positive experiences in those courses. Although this line of reasoning is at this point only conjecture, it does not seem unreasonable given current theory and findings in these areas.

The results with regard to the relationships between attributions for failure and success and test anxiety were consistent with those obtained in previous research (Arkin et al., 1983; Geen, 1980; Leppin et al., 1987). For both gender groups, those attributing failure to a lack of effort consistently reported lower levels of test anxiety than did those citing either ability or external causes, whereas those attributing success to external causes reported higher levels of test anxiety.

Although Benson et al. (1994) found no significant gender differences in their structural model of test anxiety, three such differences were found in the current study. One of these was the unexpected positive path between number of prior math courses and general test anxiety–emotionality discussed earlier. The other two had to do with attributions for failure and success, which were not included in the Benson et al. model. In the current study it was found that men attributing failure to external causes rather than to a lack of effort reported higher levels of statistics test anxiety–worry. A similar result was found by Arkin et al. (1981) in a situation involving an actual classroom test. Arkin et al. hypothesized that students may have felt more of a need to make self-serving attributions in light of the threatening nature of the situation.

For women only, those attributing success to external factors were found to have significantly lower levels of math self-concept than those making effort attributions. This finding is consistent with the speculation of Leppin et al. (1987) that ". . . a generalized unfavourable attributional style will be reflected in a negative self-concept about one's own resources . . ." (p. 69).

Future research should seek to clarify the differential functioning of success and failure attributions in explaining test anxiety. In addition, the small amounts of explained variance in the models, particularly for women, suggest that other variables are needed to more fully understand differences in levels of test anxiety. One such variable may be one's learning style or goal orientation. Dweck and Leggett (1988) proposed that an individual's goal orientation in achievement situations affects the behavior of that individual when he or she is faced with challenges. Learning goals are thought to lead to adaptive behavioral responses such as increased effort or strategy shifting, whereas performance goals give rise to maladaptive responses such as anxiety. Goal orientation has also been found to interact with ones' attributions for success and failure. Those students with learning goals are more likely to attribute success to internal, controllable causes such as effort (Ames & Archer, 1988; Elliot & Dweck, 1988). Those students whose goals are performance oriented have a tendency to attribute failure to external, uncontrollable causes such as luck or teacher characteristics or to internal, uncontrollable causes such as a lack of ability (Meece, Blumenfeld, & Hoyle, 1988).

A final caveat is in order regarding the development of the model. Model modifications in this study were made in a post hoc fashion on the same sample on which the original model was tested. Such procedures were necessary in this study because of the relatively small sample size. The results of this study appear to be consistent with current theory and have, in many cases, replicated those of previous studies. However, many of the expected relationships of attributions for failure and success with achievement and perceived self-efficacy were not found to be significant. It is important that replication studies be conducted to determine the extent to which the findings of this study can be generalized.

References

Ames, C., & Archer, J. (1988). Achievement in the classroom: Student learning strategies and motivational responses. *Journal of Educational Psychology, 80,* 260–267.

Arch, E. C. (1987). Differential responses of females and males to evaluative stress: Anxiety, self-esteem, efficacy, and willingness to participate. In R. Schwarzer, H. van der Ploeg, & C. Spielberger (Eds.), *Advances in test anxiety research* (Vol. 5, pp. 97–106). Hillsdale, NJ: Erlbaum.

Arkin, R. M., Detchon, C. S., & Maruyama, G. M. (1981). Roles of attribution, affect, and cognitive interference in test anxiety. *Journal of Personality and Social Psychology, 43,* 1111–1124.

Arkin, R. M., Kolditz, T. A., & Kolditz, K. K. (1983). Attributions of the test-anxious student: Self-assessments in the classroom. *Personality and Social Psychology Bulletin, 9,* 271–280.

Bander, R. S., & Betz, N. E. (1981). The relationship of sex and sex role to trait and situationally specific anxiety types. *Journal of Research in Personality, 15,* 312–322.

Bandura, A. (1977). Self-efficacy: Towards a unifying theory of human behavior. *Psychological Review, 84,* 191–215.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37,* 122–147.

Bandura, A. (1986). *Social foundations of thought and action.* Englewood Cliffs, NJ: Prentice Hall.

Benson, J. (1989). Structural components of statistical test anxiety in adults: An exploratory model. *Journal of Experimental Education, 57,* 247–261.

Benson, J., & Bandalos, D. L. (1989). Structural model of statistical test anxiety in adults. In H. van der Ploeg & R. Schwarzer (Eds.), *Advances in test anxiety research* (Vol. 6, pp. 137–154). Hillsdale, NJ: Erlbaum.

Benson, J., Bandalos, D. L., & Hutchinson, S. (1994). Modeling test anxiety among males and females. *Anxiety, Stress, and Coping, 7,* 131–148.

Benson, J., & Tippetts, E. (1990). A confirmatory factor analysis of the Test Anxiety Inventory. In C. Spielberger & R. Diaz-Guerrero (Eds.), *Cross cultural anxiety* (Vol. 4, pp. 149–156). New York: Hemisphere/Taylor-Francis Publishing.

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin, 88,* 588–606.

Betz, N. E., & Hackett, G. (1983). The relationship of self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Behavior, 23,* 329–345.

Browne, M. W., & Cudeck, R. (1989). Single sample cross-validation indices for covariance structures. *Multivariate Behavioral Research, 24,* 445–455.

Carlson, M., & Mulaik, S. A. (1993). Trait ratings from descriptions of behavior as mediated by components of meaning. *Multivariate Behavioral Research, 28,* 111–159.

Covington, M. V., & Omelich, C. L. (1985). Ability and effort valuation among failure-avoiding and failure-accepting students. *Journal of Educational Psychology, 77,* 446–459.

Dweck, C. S., & Leggett, E. S. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95,* 256–273.

Dweck, C. S., & Licht, B. G. (1980). Learned helplessness and intellectual achievement. In J. Garber & M. E. P. Seligman (Eds.), *Human helplessness* (pp. 197–221). New York: Academic Press.

Elliot, E. S., & Dweck, C. S. (1988). An approach to motivation and achievement. *Journal of Personality and Social Psychology, 54,* 5–12.

Fox, L. (1977). The effects of sex role socialization on mathematics participation and achievement. In L. Fox, E. Fennema, & J. Sherman (Eds.), *Women and mathematics: Research perspectives for change. NIE Papers in Education and Work* (Vol. 8, pp. 1–77). Washington, DC: U.S. Department of Health, Education, and Welfare.

Frieze, I. H., Whitley, B. E., Hanusa, B. H., & McHugh, M. C. (1982). Assessing the theoretical models for sex differences in causal attributions for success and failure. *Sex Roles, 8,* 333–343.

Geen, R. G. (1980). Test anxiety and cue utilization. In I. G. Sarason (Ed.), *Test anxiety* (pp. 43–61). Hillsdale, NJ: Erlbaum.

Goethals, G. R., Messick, D. M., & Allison, S. T. (1991). The uniqueness bias: Studies of constructive social comparison. In J. Suls & T. A. Wills (Eds.), *Social comparison: Contemporary theory and research* (pp. 149–176). Hillsdale, NJ: Erlbaum.

Hedl, J. J. (1987). Explorations in test anxiety and attribution theory. In R. Schwarzer, H. van der Ploeg, and C. Spielberger (Eds.), *Advances in test anxiety research* (Vol. 5, pp. 55–65), Hillsdale, NJ: Erlbaum.

Hedl, J. J. (1990). Test anxiety and causal attributions: Some evidence toward replication. *Anxiety Research, 3,* 73–84.

Hembree, R. (1988). Correlates, causes, and effects of test anxiety. *Review of Educational Research, 58,* 47–77.

Hunsley, J. (1985). Test anxiety, academic performance, and cognitive appraisals. *Journal of Educational Psychology, 77,* 678–682.

James, L. R., Mulaik, S. A., & Brett, J. M. (1982). *Causal analysis: Assumptions, models, and data.* Beverly Hills, CA: Sage.

Jöreskog, K., & Sörbom, D. (1993). *LISREL 8 user's reference guide*. Chicago, IL: Scientific Software International.

Kagan, D. M. (1987). A search for the mathematical component of math anxiety. *Journal of Psychoeducational Assessment, 4,* 301–312.

Kaplan, D., & Wenger, R. N. (1993). Asymptotic independence and separability in covariance structure models: Implications for specification error, power, and model modification. *Multivariate Behavioral Research, 28,* 467–482.

Leppin, A., Schwarzer, R., Belz, D., Jerusalem, M., & Quast, H. H. (1987). Causal attribution patterns of high and low test-anxious students. In R. Schwarzer, H. van der Ploeg, & C. Spielberger (Eds.), *Advances in test anxiety research* (Vol. 5, pp. 97–106). Hillsdale, NJ: Erlbaum.

Liebert, R. M., & Morris, L. W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. *Psychological Reports, 20,* 975–978.

Meece, J. L., Blumenfeld, P. C., & Hoyle, R. H. (1988). Students' goal orientations and cognitive engagement in classroom activities. *Journal of Educational Psychology, 80,* 514–523.

Peterson, C., Schwartz, S. M., & Seligman, M. E. P. (1981). Self-blame and depressive symptoms. *Journal of Personality and Social Psychology, 41,* 253–259.

Richardson, F. C., & Woolfolk, R. L. (1980). Mathematics anxiety. In I. G. Sarason (Ed.), *Test anxiety* (pp. 271–288). Hillsdale, NJ: Erlbaum.

Salamé, R. F. (1984). Test anxiety: Its determinants, manifestations and consequences. In H. van der Ploeg, R. Schwarzer, & C. Spielberger (Eds.), *Advances in test anxiety research* (Vol. 3, pp. 83–119). Hillsdale, NJ: Erlbaum.

Sarason, I. G. (1978). The Test Anxiety Scale: Concept and research. In C. D. Spielberger & I. G. Sarason (Eds.), *Stress and anxiety* (Vol. 5, pp. 193–216). Washington, DC: Hemisphere.

Schwarzer, R. (1986). Self-related cognitions in anxiety and motivation: An introduction. In R. Schwarzer (Ed.), *Self-related cognitions in anxiety and motivation* (pp. 1–17). Hillsdale, NJ: Erlbaum.

Sowa, C. J., & Lafleur, N. K. (1986). Gender differences within test anxiety. *Journal of Instructional Psychology, 13,* 75–80.

Spielberger, C. D. (1980). *Preliminary professional manual for the Test Anxiety Inventory.* Palo Alto, CA: Consulting Psychologists Press.

Stipek, D. J., & Weisz, J. R. (1981). Perceived personal control and academic achievement. *Review of Educational Research, 51,* 101–137.

Sweeney, P. D., Moreland, R. L., & Gruber, K. L. (1982). Gender differences in performance attributions: Students' explanations for personal success or failure. *Sex Roles, 8,* 359–373.

Tryon, G. S. (1980). The measurement and treatment of test anxiety. *Review of Educational Research, 50,* 343–372.

Weiner, B., Frieze, I. H., Kukla, A., Reed, L., Rest, S., & Rosenbaum, R. M. (1971). *Perceiving the causes of success and failure.* Morristown, NJ: General Learning Press.

Williams, J. E. (1991). Modeling test anxiety, self-concept and high school students' academic achievement. *Journal of Research and Development in Education, 25,* 51–57.

Wine, J. D. (1980). Cognitive-attentional theory of test anxiety. In I. G. Sarason (Ed.), *Test anxiety: Theory, research, and applications* (pp. 349–385). Hillsdale, NJ: Erlbaum.

Zeidner, M. (1992). Statistics and mathematics anxiety in social science students: Some interesting parallels. *British Journal of Educational Psychology, 61,* 319–328.

Appendix

Covariance Matrix for Men and Women Combined

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. MSC	41.36														
2. EFF	39.56	134.87													
3. GTAE	−10.67	−12.53	33.79												
4. GTAW	−10.24	−14.73	20.34	23.18											
5. ACH	24.60	29.55	−8.57	−14.09	83.64										
6. STAE	−15.19	−19.46	25.27	17.84	−14.06	35.46									
7. STAW	−12.88	−21.25	18.05	19.84	−19.06	24.49	29.38								
8. SEX	−0.38	−0.55	0.05	−0.14	−0.17	0.15	−0.06	0.24							
9. MCOURSES	0.16	0.46	0.42	0.17	0.08	0.17	0.15	−0.04	0.26						
10. YRSINCE	−1.36	−7.76	−1.38	−0.88	−1.46	0.15	0.08	0.19	−0.19	8.14					
11. F1	−0.89	−1.51	0.43	0.48	−0.63	0.60	0.46	0.04	−0.01	0.18					
12. F2	0.10	−0.04	0.13	0.08	0.35	0.20	0.20	0.00	0.01	−0.12	−0.06	0.15			
13. S1	0.16	0.22	−0.03	0.06	−0.17	−0.07	−0.11	−0.02	−0.01	−0.01	0.01	−0.01	0.14		
14. S2	−0.16	−0.29	0.16	0.14	−0.28	0.19	0.17	0.00	0.00	0.04	0.00	0.00	−0.01	0.03	
15. CLASS	−0.10	−0.36	−0.28	−0.32	0.20	−0.10	−0.28	0.03	0.00	0.72	0.02	−0.01	0.01	0.00	0.20

Note. MSC = math self-concept; EFF = perceived self-efficacy; GTAE = general test anxiety–emotionality; GTAW = general test anxiety–worry; ACH = achievement; STAE = statistics test anxiety–emotionality; STAW = statistics test anxiety–worry; SEX = 193 women and 145 men; MCOURSES = number of prior math courses; YRSINCE = number of years since one's last math course; F1 = dummy variable for failure attribution coded 1 = ability and 0 = effort; F2 = dummy variable for failure attribution coded 1 = external and 0 = effort; S1 = dummy variable for success attribution coded 1 = ability and 0 = effort; S2 = dummy variable for success attribution coded 1 = external and 0 = effort; CLASS = dummy variable coded 1 = graduate student and 0 = undergraduate student.

Received December 15, 1993
Revision received May 23, 1995
Accepted June 14, 1995 ■