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ABSTRACT

This investigation, part of an on-going research program examining social learning theory applications to career development, tested several hypotheses derived from A. Bandura's self-efficacy theory in the career-related domain of mathematics. Specifically, the effects of failure on a mathematics task and on a task irrelevant to mathematics were explored. Findings indicate that, congruent with theoretical expectations, measures of mathematics self-efficacy (MSE) expectations of females were not influenced by verbal-task failure; however, contrary to predictions, MSE expectations of males rose significantly higher as a result of verbal-task failure. For the mathematics-task failure condition, again counter to expectations, females' MSE rose while males' MSE was not significantly affected. No task-failure effect was found on a global rating of subjects' mathematics ability. Findings for a global verbal ability rating were partly consistent with predictions; all subjects responded to verbal-task failure with a decrease in verbal ability ratings. Unexpectedly, subjects in the mathematics-failure condition significantly increased their ratings of their verbal ability on posttest, indicating that the effects of failure had a facilitating, rather than a debilitating influence on self-efficacy with respect to a task irrelevant domain. Implications of these results for future career-related self-efficacy research are discussed. (Author/JN)

Gender Differences in the Effects of Relevant and Irrelevant Task Failure on Mathematics Self-Efficacy Expectations

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Abstract

This investigation, part of an ongoing research program examining social learning theory applications to career development, tested several hypotheses derived from Bandura's (1977;1982) self-efficacy theory in the career-related domain of mathematics. Specifically, the effects of failure on a math task, and the effects of failure on a task irrelevant to mathematics, i.e., a verbal anagram task, on specific and general measures of math self-efficacy were explored. Conflicting results emerged. Findings indicated that, congruent with theoretical expectations, measures of math self-efficacy expectations of females were not influenced by verbal-task failure; however, contrary to predictions, math self-efficacy expectations of males rose significantly as a result of verbal-task failure. For the math-task failure condition, again counter to expectations, females' math self-efficacy rose while males' math self-efficacy was not significantly affected. No task-failure effect was found on a global rating of subjects' math ability. Findings for a global verbal ability rating were partly consistent with predictions; all subjects responded to verbal-task failure with a decrease in verbal ability ratings. Unexpectedly, subjects in the math-failure condition significantly increased their ratings of their verbal ability on posttest. Thus, generalization of the effects of task failure on self-efficacy expectations occurred, but the effects of failure had a facilitating, rather than a debilitating, influence on self-efficacy with respect to a task irrelevant domain. Implications of the results for future career-related self-efficacy research were discussed.

Gender Differences in the Effects of Relevant and Irrelevant Task Failure on Mathematics Self-Efficacy Expectations

Social learning theory applications to career decision-making, while holding great promise in furthering our understanding of the career development process, have not as yet generated much empirical research (Osipow, 1983). Mitchell, Jones, and Krumboltz (1979) for example, reviewed an impressive array of studies supportive of social learning theory propositions, but most of the research cited was retrospectively applied to the social learning approach. An exception to this trend is the research on applications of Bandura's (1977; 1982) self-efficacy theory to the understanding of vocational behavior, particularly the career behavior of women (e.g., Betz & Hackett, 1981, 1983).

Bandura (1977) postulates that self-efficacy expectations, i.e., a person's belief's concerning his/her ability to successfully perform a given task or behavior, are the major mediators of behavior and behavior change. In particular, Bandura suggests that counseling interventions designed to change behavior are effective because and to the extent that they increase the client's expectations of self-efficacy with respect to the problematic, e.g., previously avoided, behavior. Thus, interventions designed to facilitate approach behavior should, according to Bandura, be focused on increasing self-efficacy expectations with respect to that domain of behavior.

Hackett and Betz (1981), in extending Bandura's (1977) theory to the domain of career behavior, have pointed out the importance of the construct of self-efficacy in understanding the differences in the career behaviors of women and men. They argue that, largely as a result of socialization experiences, women exhibit lower expectations with regard to many career-related behaviors than men and, thus, fail to fully realize their capabilities and talents in career pursuits.

In the first test of the self-efficacy approach to career development, Betz and Hackett (1981) found significant and consistent gender differences in self-efficacy expectations with regard to traditional and nontraditional occupations. Men's occupational self-efficacy was significantly higher than women's with regard to occupations traditionally dominated by men; women's occupational self-efficacy was significantly higher than men's with regard to occupations traditionally dominated by women. Furthermore, gender differences in career-related self-efficacy expectations were predictive of gender differences in the nature and extent of consideration of occupational alternatives on the part of college-aged women and men. The most interesting finding from this study was that the level of men's occupational self-efficacy was essentially the same with regard to traditional and nontraditional occupations; women's occupational self-efficacy fluctuated depending on occupational "traditionality."

On the basis of these results, further research on career-related self-efficacy focused upon one of the factors importantly influencing the nontraditional career choices of women: mathematics avoidance (Betz & Hackett, 1983). Women's continued underrepresentation in the relatively higher paying, higher status, scientific and technical fields has been partially explained by their lack of preparation, relative to men, in mathematics (Goldman & Hewitt, 1976; Sells, 1980). Females take significantly fewer math courses than do males in both high school and college, and far fewer women than men elect to major in mathematics (Ernest, 1976; Hewitt & Goldman, 1975). These gender differences in math avoidance have, in turn, been thought to be a result of negative attitudes and affective reactions to mathematics, e.g., math anxiety (Betz, 1978; Fennema & Sherman, 1977; 1978; Hendel, 1980; Sherman & Fennema, 1977). From the perspective of social learning theory however, self-efficacy expectations are proposed to be an even more important factor influencing attitudes towards mathematics and mathematics performance as well as math-related career choices (Bandura, 1982; Hackett & Betz, 1981).

The study by Betz and Hackett (1983) supported the major mediational role of self-efficacy expectations in the math-related career choice process. Results from this study indicated that mathematics-related self-efficacy was significantly correlated with both attitudes towards mathematics and the extent to which college students selected science-based (i.e., math-related) college majors. Furthermore, the math-related self-efficacy expectations of men were found to be significantly stronger than those of women. And finally, in a stepwise regression analysis, mathematics self-efficacy proved to contribute most significantly to the prediction of choice of science-based college major, followed by gender, years of high school mathematics, and math anxiety.

Hackett and Betz (1984), in a study of the relationship of math self-efficacy and actual mathematics performance to math-related career choice behavior, found further evidence of the importance of math self-efficacy expectations in the career choice process. Their results indicated a moderately positive correlation between math self-efficacy and indices of math performance, but a stepwise multiple regression analysis revealed that math self efficacy, gender, and years of high school math were the major predictors of choice of math-related college major; the math achievement and math performance variables did not enter significantly into the regression equation.

Thus, there is a growing body of empirical research supporting the validity of self-efficacy theory applications to the career decision-making process. The studies conducted so far have been correlational in nature, and have tested four major hypotheses derived from the Hackett & Betz (1981) extension of Bandura's (1977) theory: 1) that career-related self-efficacy expectations are predictive of career choice; 2) that gender differences in career-related self-efficacy are predictive of gender differences in the types of careers considered by college students; 3) that math self-efficacy expectations are significantly related to math performance; and 4) that math self-efficacy is superior to measures of math performance and attitudes towards mathematics in predicting math-related career choice behavior. However, several important hypotheses from the self-efficacy approach remain to be investigated. Particularly important at this point are experimental investigations designed to test the causal relationships proposed by Bandura (1977).

For example, in addition to postulating the mechanism by which behavior change is best effected, that is, that change programs should focus on self-efficacy expectations with regard to task performance, Bandura specified four sources of information through which efficacy expectations are learned and by which they can be modified. These sources of information are (1) performance accomplishments; (2) vicarious learning or modeling; (3) verbal persuasion e.g., encouragement and support from others; and (4) emotional arousal, e.g., anxiety. Bandura (1977; 1982) also detailed several hypotheses regarding the effects of these sources of information on the level, strength, and generalizability of self-efficacy expectations.

The purpose of the present study was to experimentally test several of the hypotheses derived from self-efficacy theory, and from Hackett and Betz's extension of that theory, in the career-related domain of mathematics. More specifically, its major purposes were: 1) to test the hypothesis that task-specific mathematics self-efficacy expectations (i.e., self-efficacy with regard to the specific math task employed in this study) will decrease as a result of a failure experience at a mathematical task; 2) to test the generalizability of the effects of math-task failure on math self-efficacy by examining the effects of math-task failure on a general (non task-specific) measure of math self-efficacy; 3) to test the effects of failure on a non math-related task (i.e., a verbal task) on both specific and general math self-efficacy expectations; 4) to further investigate the task-specific and non task-specific effects of failure by examining two comparably-scaled "global" ratings of math and verbal ability as a function of math and verbal-task failure; and 5) to explore gender differences in self-efficacy in response to task failure.

The major question being tested, then, is whether and in what way task performance will influence future task-related self-efficacy. In this study, math-task failure is expected to negatively affect self-efficacy with regard to that task, and this negative effect on task-specific efficacy expectations is expected to generalize to other measures of math self-efficacy and global math ability ratings. Failure at an unrelated, verbal task is expected to affect global verbal ability ratings, but is not expected to generalize to negatively influence math self-efficacy or global math ability ratings.

Method

Instruments

Background and Career Plans Questionnaire. A brief survey containing a series of questions eliciting demographic information, e.g., gender, as well as information regarding mathematics preparation and career plans was administered. In addition to the demographic information, two items assessing global ratings of subject's perceptions of their mathematical and verbal skills were included. For both math and verbal ability subjects were asked to rate themselves on a scale from "extremely low ability" (0), to "extremely high ability" (9), in comparison to other college students.

Mathematics Self-Efficacy Scale. The mathematics Self-Efficacy Scale (MSES), developed by Betz and Hackett (1983), contains 52 items identified as relevant to the study of math-related self-efficacy expectations. The scale is composed of three subscales: 1) the math tasks subscale, consisting of 18 items involving "everyday" math tasks, e.g., balancing a checkbook; 2) the math courses subscale, consisting of 16 math-related college courses; and 3) the math problems subscale, consisting of 18 arithmetic, algebra, and geometry problems.

For the course subscale, Ss were instructed to rate their confidence in their ability to complete each course with a grade of "B" or better. For the math tasks and math problems subscales, Ss simply rated their confidence in their ability to successfully perform the task or solve the problem. Confidence ratings for all scales were elicited on a 10-point continuum from "No confidence at all" (0) to "Complete confidence" (9). Mean scores were calculated for overall math self-efficacy (total scale score) across the three subscales. Betz and Hackett (1983) reported moderate item-total score correlations for the MSES subscales and high internal consistency reliabilities (coefficient alpha) for the three subscales (.90, .93, and .92 for the math tasks, math courses, and math problems subscales, respectively) and the total 52 item scale (.96).

Self-Efficacy for Number Series. A fourth scale, analyzed separately, was added to the MSES for the purposes of this study. Expectations of success with regard to solving a set of 12 incomplete number series were obtained via the same rating procedure employed on the MSES. The number series on this self-efficacy measure were similar, but not identical, to the number series performed by subjects in the experimental phase of the study. Mean scores were calculated for overall self-efficacy with regard to number series.

Post Experimental Questionnaire. A brief, 9-item questionnaire eliciting subjects' reactions to the experimental task was administered at the posttest only. Four questions were concerned with self-evaluations related to performance attributions, i.e., ratings of potential ability, effort, task difficulty, and luck in solving the task. These are all factors found in the attribution literature to be important in performance self-assessment and future expectations of performance (e.g., Feather & Simon, 1971). Other questions on this instrument required Ss to rate their success at the experimental task, their satisfaction with their performance, and their expectations of future performance. Global ratings of math and verbal abilities were assessed as on the Background and Career Plans Questionnaire. All other ratings were obtained on a 0 to 9 scale from "not at all" to "extremely"; e.g., for the task difficulty item Ss responded to the question "How difficult did you think this task was?" on a scale of 0, "not at all difficult" to 9, "extremely difficult".

Subjects

All subjects (47 females; 40 males) were undergraduate students at a large midwestern university enrolled in introductory psychology courses. Participation in the study was voluntary and subjects received course credit for their participation. Seven female Ss were randomly identified and dropped from the analysis in order to obtain equal cell sizes. There were no significant differences on any of the dependent variables between scores of the screened-out subjects and the scores of subjects retained for the analyses.

Procedure

The Background and Career Plans Questionnaire, the Mathematics Self-Efficacy Scale, and the Self-Efficacy with regard to Number-Series instrument were administered to all subjects during the first experimental session. Subjects were then randomly assigned by gender to one of two experimental conditions: math or verbal problem-solving task. Two weeks after the initial session Ss returned for a second session. During the second experimental session, they were asked to attempt a problem-solving task and complete the Post-Experimental Questionnaire, the MSES, and the Number-Series self-efficacy instrument.

Math Task. The mathematical task consisted of twelve incomplete number series designed for this study for which Ss were asked to determine the formula and complete the sequence. For example, the formula for the series " 3 12 15 60 63" was "multiply by 4, then add 3;" the solution was 252.

Three of the sequences were relatively easy; the remainder were very difficult. Task difficulty was determined rationally and then tested by administering the problems to a group of counseling psychology graduate students.

Ss received instructions indicating that the number-series task was a measure of mathematical ability, and that the criterion for successful task performance was 6 problems correctly solved. Subjects had ten minutes to work on the problems. Therefore, the task was structured so that all Ss would experience failure at the task.

Verbal Task. This task consisted of a set of twelve disarranged words, or anagrams, that Ss were asked to unscramble. The list of anagrams was adapted from work by Feather and his associates (c.f., Feather, 1966; 1969; Feather & Sinon, 1971). Three relatively easy anagrams, and nine anagrams that were very difficult or impossible to solve were included. Anagram task difficulty was also tested by administering the problems to counseling psychology graduate students. The instructions and procedure for the Verbal-Task group were otherwise identical to those received by the Math-Task group. After all testing was completed Ss were thoroughly debriefed regarding the nature, purposes, and implications of the research.

Data Analysis

2 x 2 x 2 (Gender x Experimental Group x Repeated Measures) ANOVAs were conducted on the general, i.e., MSES, and specific, i.e., number series, math self-efficacy measures, and the global math and verbal ability ratings. A series of 2 x 2 (Gender x Experimental Group) ANOVAs were performed on the ability, effort,

difficulty, luck, satisfaction, perceptions of success, and future expectations ratings from the Post-Experimental Questionnaire.

Results

In order to check the experimental manipulation, the number of problems solved correctly by each subject in each experimental condition was computed. For the anagram task, the total number of correct responses ranged from one to three. The range of correct responses for the math task was zero to five, with only one female subject failing to solve any problems correctly.

Means and standard deviations for the math self-efficacy measures and the global math and verbal ability ratings for pretest and posttest were computed and are displayed in Table 1.

Insert Table 1 About Here

Table 2 presents the results of the three-way repeated measures ANOVAs on the specific and general mathematics self-efficacy measures. No significant main effects or two-way interactions for the ANOVA on the Number Series Self-Efficacy Scale emerged; there was a significant three-way (Gender x Experimental Group x Repeated Measures) interaction (F (1,76) = 8.19; $p < .006$). This three-way interaction was explored via Neuman-Keuls post-hoc comparisons (Games, 1971). The post hoc analysis revealed that a significant gender difference existed on the pretest for subjects in the math-task group ($p < .05$). This finding is congruent with findings from previous research that males have higher math self-efficacy expectations than females (Betz & Hackett, 1983). More problematic were the findings that significant differences on pretest number-series self-efficacy existed between females in the math-task and verbal-task groups, and males in the math-task and verbal-task groups (p's $< .05$). The differences between the two experimental groups for females appeared to be due to an unusually high mean score for females in the verbal-task group. Males in the math-task group scored higher on pretest than males in the verbal-task group ($p < .05$). On the posttest, significant differences were found between males and females in the verbal-task group, with males scoring significantly higher than females ($p < .05$).

Insert Table 2 About Here

The examination of pre-post differences for the math and verbal groups indicated that females in the math group, but not the verbal group, scored significantly higher on posttest number-series self-efficacy, while males in the verbal group, but not the math group, scored significantly higher on the same posttest measure (p's $< .05$). Males in the math group tended to score lower on posttest self-efficacy, but this difference was not significant. Females in the verbal group also scored lower on posttest number-series self-efficacy, but this difference was not significant either.

On the analysis of the general math self-efficacy measure (MSES), a significant main effect for the repeated measures factor emerged (F (1,76) = 4.64; $p < .04$). Contrary to expectation, the overall posttest math self-efficacy scores were <u>higher</u> than the pretest scores. The two and three-way interactions were not significant, precluding investigation of the exact causes of this finding according to the conventional logic of the three-factor ANOVA. However, because of the confusing results, and the fact that both the main effects for gender and the three-way (gender x experimental group x repeated measures) interactions approached significance ($p < .06$), a post-hoc exploratory analysis using the Tukey Wholly Significant Difference Test (Games, 1971), a more conservative test than the Neuman-Keuls, was conducted to better understand the trends in the data.

For three of the four groups, posttest scores on the MSES were higher than pretest scores. Only two of these trends were significant according to the WSD post-hoc comparisons. Females in the math-task group and males in the verbal-task group scored significantly higher on posttest MSES scores ($p < .05$). The finding for males in the math-task group then, were partially in keeping with the expectation that math-task failure would have a lesser influence on a general measure of mathematics self-efficacy than on a specific measure of math self-efficacy. The fact that males in the verbal group and females in the math group scored higher on posttest than pretest ran counter to predictions. However, even though females' posttest MSES scores were higher than their pretest scores, their scores were still lower than pretest or posttest scores for males in either experimental group. Males in the math group scored lower, though not significantly lower, on the posttest than on the pretest.

The results of the 2 x 2 x 2 (Gender x Experimental Task x Repeated Measures) ANOVAs on global math and verbal ability ratings are presented in Table 3. No significant differences emerged on the ANOVAS on global math ability ratings.

Insert Table 3 About Here

For the global verbal ability ratings, a significant difference for the Repeated Measures x Experimental Group factor emerged ($F = 8.96$; $p < .004$). Post hoc Neuman-Keuls comparisons indicated that posttest ratings of verbal ability for the verbal-task group were significantly lower than pretest ratings ($p < .05$); the opposite trend occurred for the math-task group. The posttest verbal ratings for the math-task group were also significantly higher than posttest verbal ratings for the verbal group ($p < .05$). Thus, the analyses on global verbal ratings yielded results congruent with predictions based on self-efficacy theory.

Finally, the results of the 2 x 2 (Gender x Experimental Group) ANOVAs on the posttest attribution, evaluation, and expectations ratings yielded no significant differences. The mean scores on the seven pertinent items from the post-experimental questionnaire were computed and examined in order to assess whether the experimental manipulation was successful, and to what degree subjects attributed their performance to the variables of ability, luck, effort, and task difficulty.

Ability ratings were moderately low ($M = 3.46$ on the 0 to 9 scale, $SD = 1.84$), while ratings of future expectations of similar task performance were moderately low to about average ($M = 3.85$; $SD = 1.52$). Success and satisfaction ratings were low ($M = 2.46$; $SD = 1.38$ and $M = 2.61$; $SD = 1.73$, respectively), indicating that subjects perceived their performance as a "failure". Effort and difficulty ratings were relatively high ($M = 5.96$; $SD = 1.94$, and $M = 6.66$; $SD = 1.54$, respectively), indicating that subjects may have attributed their poor performance to the difficulty of the task. "Luck" ratings were also low ($M = 2.87$; $SD = 1.89$).

Discussion

Although the results of the analyses on the four dependent variables were puzzling, several trends did emerge. The basic findings of the study will be summarized, and the most plausible explanations and implications of the results will be explored.

First, a three-way interaction emerged on the task-specific measure of math self-efficacy expectations. Females in the math-task group and males in the verbal-task group, contrary to expectation, scored higher on the posttest than the pretest. Males in the math-task group, in keeping with expectations derived from self-efficacy theory, scored lower, but not significantly lower, on posttest number-series self-efficacy as a result of failure at the number-series task. Females in the verbal group also scored lower on posttest task-specific self-efficacy. Thus, the hypothesis that math-task failure would produce a decrease in task-specific math self-efficacy, but failure at an unrelated task would have no effect on task-specific math self-efficacy, is not supported, although trends for the male math-task group and the female verbal-task group were in the expected direction. Interpretation of these results is confounded due to the existence of pretest differences between females in the math and verbal groups.

Second, scores of females in the math-task group and males in the verbal-task group also rose from pretest to posttest on the general math self-efficacy measure. Since pretest differences were not observed on this measure, these results indicate a valid trend in the data. Scores of males in the math group, and females in the verbal group, were not significantly different from pretest to posttest. Thus, for males, math-task failure did not affect general math self-efficacy expectations. Because of the differences in the mathematical domains between the math number-series task and the math self-efficacy scale, which sampled expectations regarding everyday math tasks, math problems, and math-related college courses, this lack of generalization is not surprising, even though some effect was predicted. The lack of a significant pre/post difference on the MSES for females in the verbal-task group was expected. However, once again, the rise in scores for the female-math and male-verbal groups is puzzling. Evidently, for males, but not for females, verbal-task failure produces a compensatory rise in math self-efficacy expectations. One possible explanation for this phenomenon is the fact that ability was not taken into account in this study. Stake (1983), for example, has noted that actual ability, even at novel tasks, is related to performance expectancies. It may be that males whose verbal-task performance was incongruent with their past experience compensated for their "failure" via a corresponding rise in self-efficacy expectations in another domain.

For females, the rise in general math self-efficacy as a result of math-task failure is even more puzzling. A possible, although admittedly speculative, hypothesis concerning the cause of these results can be derived from past research on sex differences in self-confidence in achievement settings. Lenney (1977) has noted that, in the presence of clear and unambiguous performance feedback, sex differences in performance expectations are not found. In the present study, although women's math self-efficacy expectations rose significantly from pretest to posttest as a result of math-task failure, there was a trend toward the convergence of women's and men's math self-efficacy expectations, at least for subjects in the math-task groups. Women's mean scores for the math-task condition were 6.32 on the pretest and 6.52 on the posttest; men in the same group scored 6.62 on the pretest and 6.59 on the posttest. The results of the analyses on the specific and general math self-efficacy measures point to the need for utilizing an index of actual ability in future research of this type in order to "tease out" these hypothesized relationships.

Third, while results of the analysis of global math ability ratings did not support the expected relationships between task failure and math ability estimates, the analysis of global verbal ability ratings were generally supportive of the major hypotheses derived from self-efficacy theory. Failure at the verbal task produced a decrease in verbal ability ratings for both males and females; however, the previously observed "compensatory" tendency emerged again. Subjects in the math-task group scored higher on posttest than on pretest verbal ability ratings.

It should be noted that the comparable math and verbal scores were ratings of "ability" and not ratings of self-efficacy per se. These measures were employed in order to assess the effects of math and verbal-task failure on similar math and verbal rating scales. Thus, the results of the global ability analyses, while theoretically related to self-efficacy, do not provide as strong a test of self-efficacy theory as the results from the math self-efficacy analyses.

Finally, the results from the analysis of the post-experimental questionnaire items indicated that subjects perceived themselves as failing on both verbal and math tasks, indicating that the experimental manipulation was successful. No differences in degree of success ratings were observed between experimental groups or between females and males. All other findings were congruent with expectations.

One of the potentially most important items on the post-experimental questionnaire was that of perceived task difficulty. The experimental tasks were constructed so that subjects would unambiguously perceive their performance as failing; consequently, task difficulty had.to be high. This strategy was employed in an attempt to avoid the problem of "bogus" performance feedback. Subjects perceived the experimental manipulation as intended; however, the degree to which the results were due to perceived task difficulty, an external attribution that would be expected to moderate the effects of failure on self-efficacy expectations, is unclear. No differences by gender or experimental group on this item were observed, but it still may be that perceived difficulty, though of similar magnitude for all groups, affected groups differentially.

Implications

The intriguing finding that math-task failure produced an increase in the specific and general math self-efficacy expectations of females warrants further research, as does the equally surprising tendency for males' math self-efficacy expectations and all subjects' ratings of verbal ability to increase as a result of a failure experience at an irrelevant task. These results, though contrary to self-efficacy theory, reflect the complexity of the ability/self-efficacy/performance/attributions inter-relationships, and may ultimately prove to be heuristic.

Several other aspects of the present study warrant comment when considering future research directions. One important implication of the present findings is that the effects of task difficulty on self-efficacy expectations need to be explored. External attributions of failure may mitigate the effects of task failure on self-efficacy. Second, the specific tasks employed in self-efficacy research will probably have an effect on gender differences in self-efficacy and must be taken into account in future research. Lenney (1977), for example, has noted that sex-linked tasks are more likely to produce gender differences in task self-confidence than non sex-linked tasks. Results from previous research on career-related self-efficacy support this contention (Betz & Hackett, 1981; 1983). Because the present study was a continuation of previous research on mathematics-related self-efficacy, the primary focus of the present study was the effects of failure, task relevant and irrelevant, on math self-efficacy, an obviously sex-linked task. The findings with regard to gender differences from this and similar studies thus may not be generalizable to other domains of behavior. The lack of gender differences on the ratings of verbal abilities is probably reflective of this phenomenon.

Another, related, area for further investigation is the specific tasks employed in self-efficacy research, regardless of sex-linkage. The anagram task has been used in much of the expectation and attribution research in the social psychology literature, and was therefore chosen as the math-irrelevant task for this study. The math number-series task was developed because it paralleled the anagram task in terms of the availability of a clear "correct" answer. However, failure at a number-series task of this nature may not produce the same results as failure at a math task that is more similar to common math items on achievement tests.

Finally, Betz and Hackett (1982), among others, have noted the problems inherent in applying the self-efficacy assessment methodology derived from studies of small animal phobias to the assessment of self-efficacy with regard to complex behaviors. Self-efficacy theory requires the construction of task-specific measures of self-efficacy, which in turn require the continuous development of new assessment procedures. Normative and reliability data exist for the MSES. However, the number-series self-efficacy scale, a task-specific measure of self-efficacy, was constructed solely for the present study. The difficulties in the analysis of the results from this scale may have been at least partly due to the utilization of an untested instrument. This suggests that future investigations be conducted within similar domains of behavior in order to make use of measures that have at least some reliability and validity data; that pilot studies providing supportive data be conducted before self-efficacy research on new domains of behavior begins, as was done in the Betz and Hackett (1983) study; or that alternatives to the standard self-efficacy assessment procedures be explored. A question with regard to the latter suggestion that has not been empirically investigated in the research on career-related self-efficacy, is whether task-specific self-efficacy measures are, in fact, superior to more general approaches in the assessment of self efficacy expectations.

In conclusion, the present investigation was the first attempt to experimentally test self-efficacy applications to career development. As such, the study raises as many questions as it answers; the results were partly supportive of, and partly in contradiction of, expectations derived from self-efficacy theory with regard to the effects of task failure on relevant and irrelevant task self-efficacy and ability estimates. However, this research should provide direction to future research efforts, as well as stimulate discussions in the area of research on social learning theory applications to career development.

The basic, versus applied, nature of this investigation precludes statements about the implications for counseling beyond those already made elsewhere (see Hackett & Betz, 1981; Betz & Hackett, 1983). The overall goal of the research program of which this study was a part is to clarify the role of career-related efficacy expectations in the career development process, particularly with respect to women's career development. Better understanding of the factors influencing the development and modification of career-related self-efficacy expectations will ultimately have direct implications for career counseling.

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Table 1

Pretest and Posttest Means and Standard Deviations for Dependent Variables by Gender and Experimental Group

		Scales							
		MSES		Number Series		Global Math		Global Verbal	
	Testing	M	SD	M	SD	M	SD	M	SD
1. Females/math task	pre	6.32	1.55	3.87	1.74	4.4	1.43	6.0	1.59
	post	6.52	1.35	4.46	1.52	4.6	1.46	6.3	1.49
2. Females/verbal task	pre	6.18	1.23	4.90	1.71	4.65	1.56	5.75	1.16
	post	6.24	1.34	4.54	1.66	4.75	1.80	5.10	1.55
3. Males/math task	pre	6.62	1.15	5.03	1.61	4.8	1.96	5.6	1.43
	post	6.59	1.23	4.74	1.55	4.85	1.87	5.75	1.33
4. Males/verbal task	pre	6.91	1.14	4.47	1.75	5.35	2.08	5.85	1.31
	post	7.21	1.07	5.16	1.77	5.75	2.19	5.20	1.99

Note. N = 80; n = 20 in each group.

Table 2

Repeated Measures Analysis of Variance on Mathematics Self-Efficacy Measures by Gender and Experimental Group

	Number Series Scale		MSES	
Source	MS	F	MS	F
Between subjects				
Gender (G)	6.74	1.53	10.65	3.50
Experimental group (E)	2.37	.54	.59	.19
G x E	3.96	.90	4.43	1.45
Error	4.40		3.05	
Within subjects				
Repeated measures (RM)	1.01	.88	.69	4.64*
RM x G	.07	.06	.0001	.0002
RM x E	.003	.002	.09	.57
RM x G x E	9.34	8.19**	.53	3.58
Error	1.14		.15	

Note. N = 80; degrees of freedom for F-tests = 1,76.

*$p < .05$. **$p < .006$.

Table 3

Repeated Measures Analysis of Variance on Global Math and Verbal Ability Ratings by Gender and Experimental Group

Source	Global Math MS	Global Math F	Global Verbal MS	Global Verbal F
Between subjects				
Gender (G)	13.81	2.32	1.41	.39
Experimental group (E)	8.56	1.44	7.66	2.10
G x E	2.76	.46	3.31	.91
Error	5.94		3.65	
Within subjects				
Repeated measures (RM)	1.41	2.12	1.81	2.11
RM x G	.06	.08	.06	.07
RM x E	.16	.24	7.66	8.96*
RM x G x E	.51	.76	.06	.07
Error	.66		.85	

Note. $N = 80$; df = 1,76.

*$p < .004$.