Sex Differences in Self-Efficacy and Attributions: Influence of Performance Feedback

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Abstract:
This study explored the hypothesis that explicit performance feedback would moderate sex differences in performance expectations (self-efficacy) and attributions. Within this context, this study investigated whether achievement cognitions differed as a function of grade level. Male and female students in grades six and eight judged their self-efficacy for learning a novel mathematical task (residues), after which they individually completed a written packet that provided instruction and practice opportunities. Students received performance feedback by checking answers to alternate problems. Following training, attributions and self-efficacy for solving residue problems were assessed. Although girls initially judged self-efficacy lower than boys, no sex differences were obtained on any measure following training. Sixth graders made higher effort attributions and demonstrated lower residue skill than eighth-grade students. Implications for teaching are discussed.

Article:
Bandura's theory of *self-efficacy* states that different treatments change behavior in part by creating and strengthening a sense of self-efficacy (Bandura, 1977, 1981, 1982). Self-efficacy refers to personal expectations of one's capability to perform actions in specific situations that may contain ambiguous, unpredictable, arid stressful features. Self-efficacy is hypothesized to influence choice of activities, amount of effort expended, perseverance when difficulties are encountered, and task accomplishments. People acquire information about their level of self-efficacy for a given task through self-performances, socially comparative vicarious means, persuasory influences, and physiological indexes.

In this view, attributional variables constitute a major influence on self-efficacy. Attributional theories of behavior hypothesize that people make causal ascriptions for the outcomes of their actions (Heider, 1958; Kelley, 1967), In achievement contexts, outcomes often are attributed to ability, effort, task difficulty, and luck (Frieze, 1980; Weiner, 1979; Weiner, Frieze, Kukla, Reed, Rest, & Rosenbaum, 1971). Future expectancies of success and failure heavily depend on ascriptions for prior outcomes (Weiner, 1979). For example, if one believes that the conditions surrounding a task will remain much the same, attributions of prior successes largely to relatively stable causes (i.e., high ability or low task difficulty) should result in higher expectancies of future success than attributions to the more unstable causes of great effort or good luck (McMahan, 1973; Weiner, 1979).

Recent research has explored sex differences in students' performance expectancies and attributions. Although there are some exceptions, the typical findings are that girls hold lower expectancies for success and are less likely to attribute success to ability than boys, particularly on masculine-type tasks (Crandall, 1969; Deaux, 1976; Maccoby & Jacklin, 1974; Parsons & Ruble, 1977). Similar results also have been obtained in studies of mathematical achievement (Fennema & Sherman, 1978; Heller & Parsons, 1981; Wolleat, Pedro, Becker, & Fennema, 1980).

One explanation for these findings is as follows. Research on sex role stereotypes shows that men generally are perceived as more competent than women on masculine-type tasks (Broverman, Vogel, Broverman, Clarkson,

& Rosenkrantz, 1972; Deaux, 1976). Because success is expected on a task at which one is thought to be competent, successful performance will tend to be attributed to the relatively stable cause of high ability (Deaux, 1976). In turn, ability attributions strongly influence expectancies for future success (Fontaine, 1974; McMahan, 1973; Weiner, Nierenberg, & Goldstein, 1976). To the extent that women view themselves as less competent than men on a masculine-type task (e.g., mathematics), women's successes should be expected with less certainty. Unexpected successes are not as apt to be attributed to high ability (Deaux, 1976), and less emphasis on ability as a cause of success will not promote expectations for future success, i.e., self-efficacy (Bandura, 1981, 1982).

Clear performance feedback may moderate sex differences in achievement cognitions (Lenney, 1977). Sex differences may be more likely on tasks that provide little information about one's level of competence compared with tasks that convey clearer feedback about what one can do (Lenney, 1977). In achievement contexts, for example, female students may hold lower performance expectancies than male students on an unfamiliar or ambiguous task that provides little information about personal capabilities (Lenney, 1977). Conversely, sex differences in achievement cognitions may be less likely when a task conveys clearer information about how well one has mastered its demands. Some support for these propositions has been obtained (Heller & Parsons, 1981; Lenney, 1977; Lenney & Gold, 1982; McHugh, 1982).

One purpose of the present study was to explore these ideas in an achievement context involving a novel mathematical task. Middle school students drawn from grades six and eight received instruction and practice opportunities on mathematical residues, which involved solving for the remainders of division problems without dividing. Although students were unfamiliar with this topic, they possessed the computational skills necessary to solve residue problems. During the training, students periodically received feedback on the accuracy of their solutions.

It was predicted that students would approach this novel mathematical task in a sex-differentiated fashion in that boys initially would hold a higher sense of self-efficacy for learning how to solve residue problems. It also was expected that providing clear performance feedback during the training would moderate this sex difference so that by the end of the instructional unit male and female students would not differ in their perceptions of self-efficacy for solving residue problems correctly. Performance feedback also was expected to mitigate potential sex differences in students' attributions—especially ability—of their progress on the residue unit; thus, it was predicted that no sex differences in attributional judgments would emerge.

This study also explored whether self-efficacy and attributions differed as a function of grade. Although there is some evidence for sex differences in very young children (Etaugh & Brown, 1975; Pollis & Doyle, 1972), most research shows that consistent sex differences do not emerge until sometime after children enter school, usually by about Age 8 (Crandall, 1969; Meece, Parsons, Kaczala, Goff, & Futterman, 1982; Parsons & Ruble, 1977; Parsons, Ruble, Hodges, & Small, 1976). In mathematics, it has been suggested that stable sex differences in achievement cognitions may not occur until late junior high school (Heller & Parsons, 1981; Parsons, 1983). By including students in grades six and eight, the present study investigated whether the expected initial sex difference in self-efficacy (i.e., girls lower than boys) was more pronounced among eighth graders. No differences in achievement measures (self-efficacy and attributions) due to grade were expected on completion of the residue training program.

METHOD

Subjects

Subjects were 60 students drawn from two middle schools (grades six through eight). Half of the subjects were sixth graders; half were in grade eight. Within each grade, equal numbers of boys and girls were included. Although a variety of socio-economic backgrounds were represented, students predominantly were middle class. All students were enrolled in regular (nonaccelerated) classes for daily mathematics instruction.

Procedures

All procedures were administered by an adult female experimenter, who met with students in small groups (*n* = 8-12). Students were seated at sufficient distances from one another to preclude viewing each other's work. The experimenter initially informed students that they were going to receive an instructional unit on mathematical residues, which involved solving for the remainders of division problems without actually dividing. She asked students if they knew how to do this, but no student reported familiarity. The experimenter explained that solving residue problems only required the basic computational skills of addition, subtraction, and multiplication.

Pretest Self-efficacy. Following this introduction, self-efficacy for learning how to solve residue problems was measured following procedures of previous research (Bandura & Schunk, 1981; Schunk, 1981). The efficacy scale ranged from 10 to 100 in 10-unit intervals from high uncertainty-10, through intermediate values-50/60, to complete certitude-100. Students were advised to be honest and to circle the efficacy value that corresponded to how certain they felt that they would be able to learn how to solve residue problems correctly.

Residue Training. Following the efficacy assessment, students received the residue materials, which consisted of a written packet subdivided into five sections. Each section began with a short set of instructions that explained a residue operation and demonstrated its application to a sample problem. Following these instructions were problems to solve. The entire packet included 25 problems. All problems had one-digit divisors; dividends ranged from four to eight digits.

The initial problems in the packet involved 9 residues. For example, to solve for the 9 residue of 37007 (i.e., the remainder of 37007 divided by 9), one first sums the digits in the dividend (3 + 7 + 0 + 0 + 7 = 17), then sums the digits in this sum (1 + 7 = 8), to arrive at the correct remainder (8). Problems became progressively more difficult by including 9-residue problems in different formats (e.g., 13___21 has a 9 residue of 7), as well as problems with other one-digit residues (e.g., solve for the 2 residue of 45379). Although the packet was graded in difficulty, it was designed to insure that students would experience success, because each set of instructions fully explained and exemplified the operation required to solve the ensuing problems.

Performance feedback was delivered in the following manner. Within each of the five sections, the answer to every other problem appeared in the right-hand margin opposite the next problem. Answers were given for alternate problems rather than for every problem to discourage copying answers. It was felt that providing answers to alternate problems would convey sufficient information to students concerning their level of competence.

After distributing the residue packet, the experimenter instructed students to work the pages in order and to read each set of instructions prior to solving the problems that followed. Students received a sheet of colored paper and were told to use this sheet to cover all problems below the one they were working on. They also were instructed not to change an answer if they discovered that they had solved a problem incorrectly. They were advised to try their best but that their work would not be graded. The experimenter gave no supplemental instructions on how to solve residue problems over those contained in the packet. If students had questions, they were advised to reread the appropriate instructions. All students individually completed the packet within a 45 minute period.[1]

Posttest Measures. Students' attributions for their problem-solving progress were assessed following completion of the packet, Three scales were shown on a sheet of paper; each 10 to 100 scale ranged in intervals of 10 from 10—not much, through intermediate values, to 100—a real lot. Scales were labeled "good at it" (i.e., ability), "worked hard" (effort), and "easy problems" (task). Label order was counterbalanced across subjects. A scale for luck was not included because pilot work showed that subjects rarely assigned any casual importance to luck. Such pilot testing has been recommended to determine the most salient perceived causes in a given situation (Weiner, 1983).

The experimenter explained that this paper showed three things that help students work problems. She explained the scale and each of the attributions, and provided examples of how hypothetical students might mark the scales. Students were advised to think about their work and to mark how much they thought each factor helped them solve problems. They were told that their judgments did not have to add to a certain number (e.g., 100). Students privately recorded their ratings.

Self-efficacy was measured immediately following the attributional assessment. The scale and procedures were identical to those of the pretest except that students judged their certainty for being able to solve residue problems correctly. All assessments and instructional materials were scored by an adult who was unfamiliar with the purpose of the study.

RESULTS

Means and standard deviation of all measures are presented by experimental condition in Table 1. Preliminary analyses revealed no significant between-school differences on any measure.

Pretest Self-Efficacy

Self-efficacy judgments were analyzed according to a 2 (Sex: boy/girl) × 2 (Grade: sixth/eighth) analysis of variance. ANOVA yielded a significant main effect due to sex, ($F(1, 56) = 15.49$, $p <$,001) however, the main effect of grade and the Sex × Grade interaction were nonsignificant. Consistent with prediction, female students entered the experiment with a lower sense of self-efficacy for learning how to solve residue problems compared with male students.

TABLE 1

Means (and Standard Deviations)

	Experimental Condition			
	Grade 6		Grade 8	
	Boys	Girls	Boys	Girls
Self-efficacy[a]				
Pretest	70.0 (16.5)	45.3 (22.3)	68.7 (27.5)	49.3 (18.7)
Posttest	73.3 (16.3)	67.3 (25.9)	74.7 (24.5)	71.3 (24.7)
Skill[b]	15.7 (3.4)	15.2 (5.4)	18.2 (3.8)	17.3 (3.1)
Attributions[c]				
Ability	67.3 (19.1)	66.7 (28.2)	62.7 (27.4)	62.7 (28.9)
Effort	62.7 (24.6)	59.3 (27.6)	43.3 (17.6)	46.0 (26.9)
Task	62.7 (19.8)	65.3 (29.0)	63.3 (25.5)	68.0 (20.1)

Note. $N = 60$, $n = 15$ in each condition.
[a]Range of scale: 10 (not sure)–100.
[b]Number of correct solutions on 25 problems.
[c]Range of scale: 10 (not much)–100.

Residue Skill

The number of residue problems that students solved correctly was analyzed with ANOVA. A significant main effect due to grade was obtained ($F(1, 56) = 5{,}50$, $p < .05$). Eighth-grade students solved more problems correctly than sixth graders. The same finding was obtained on separate analyses of the problems for which answers were provided and those for which answers were not given.

Attributions

Students' attributions for their problem-solving progress were analyzed with a 2 × 2 multiple analysis of variance. MANOVA yielded a significant effect due to grade ($\Lambda = .848$, $F(3, 54) = 3.23$, $p < .05$). Univariate F tests conducted on each attribution revealed a significant effect only on effort attributions ($F(1, 56) = 6.65$, $p < .05$). Compared with eighth graders, sixth-grade students placed significantly greater emphasis on effort as a cause of problem-solving progress.

Posttest Self-Efficacy

This measure was analyzed with analysis of covariance using pretest self-efficacy as the covariate. ANCOVA yielded nonsignificant results.

Correlational Analyses

Correlational analyses were conducted to explore the interrelationships between theoretically-relevant variables. Product-moment correlations were computed among pretest self-efficacy, residue skill, the three attributions, and posttest self-efficacy. Initially, correlations were computed separately within each of the our experimental conditions. Because there were no significant between-condition differences in correlations of any measures, correlations were averaged using an r to z transformation (Edwards, 1976).

Pretest self-efficacy was positively related to subsequent residue skill, $r(58) = .27$, $p < .05$. The more problems that children solved correctly, the greater emphasis they placed on ability as a cause of problem-solving progress, $r(58) = .37$, $p < .01$, and the higher were their subsequent self-efficacy judgments, $r(58) = .41$, $p =$,41, $p < .01$. Higher ability attributions were associated with lower effort judgments, $r(58) = — .26$, $p < .05$, and greater emphasis on task ease also was associated with lower effort attributions, $r(58) = — .48$, $p < .01$. Both ability, $r(58) = .77$, $p < .01$, and task attributions, r(58) = .27, $p < .05$, were positively related to posttest self-efficacy.

DISCUSSION

The present study supports prior evidence of sex differences in students' achievement expectancies and helps to clarify this evidence. When confronted with a novel mathematical task, sixth- and eighth-grade girls judged their self-efficacy for learning how to solve problems lower than boys; however, this sex difference was eliminated as a result of receiving performance feedback in the context of an instructional unit. No sex differences were obtained in students' demonstrated skills or in their attributions for their problem-solving progress.

An explanation for these findings is as follows. Students may approach unfamiliar or ambiguous tasks in a sex-differentiated fashion because they have little or no information about their task-specific capabilities. In contrast, when tasks are more familiar or when students receive clear performance feedback while working on the task their achievement cognitions are likely to reflect their actual task performances (Lenney, 1977; Lenney & Gold, 1982). Self-performances provide the most reliable information about one's self-efficacy for performing a given task (Bandura, 1977, 1982; Schunk, in press, b). Students are apt to feel more competent as they work at a task and receive performance feedback indicating some degree of success (Schunk, in press, b), Among middle school students, the perception of progress ought to result in emphasis on ability as a cause of success because ability attributions become increasingly important in explaining successes with development (Harari & Covington, 1981; Nicholls, 1978, 1979). In turn, ability attributions exert a strong influence on expectancies for future success (Fontaine, 1974; McMahan, 1973; Weiner et al., 1976).

The present study not only extends previous research by showing that clear performance feedback moderates sex differences in achievement expectancies but also highlights a complexity of such feedback. All of the present subjects completed the residue packet. Had objective performance feedback not been provided, it seems possible that students could have formulated a subjective impression of how well they were doing merely as a result of completing the task, because students would have become more familiar with residue operations and known how they responded to items. Lenney and Gold 0982), for example, found that task completion without explicit performance feedback reduced sex differences in expectancies for success; however, women still made lower self-evaluations than men. Task completion may have its greatest impact on sex differences in achievement cognitions when as a result of working at the task students can derive objective information about their performances. In the present study, students could not derive objective performance information from merely working at the task, because they were instructed not to perform the division, they were not allowed to use calculators, and the problems were sufficiently complex to preclude mental division. Thus, even though they completed the residue packet, students should have been highly uncertain of whether their answers were correct in the absence of performance feedback.

Compared with eighth-grade students, sixth graders solved fewer problems correctly and placed greater emphasis on effort as a cause of problem-solving progress. The difference in residue skill may be a function of eighth graders being more competent in mathematical problem-solving and computational skills due to their additional coursework. This factor also may explain the sixth graders ' greater stress on effort to the extent that they had to expend greater effort to solve problems. The difference in effort attributions also could reflect developmental considerations. Young children view effort as the prime cause of outcomes and ability-related terms as roughly synonymous; however, around Age 9 children begin to differentiate ability from effort (Nicholls, 1978, 1979). With development, effort as a causal factor declines in importance (Harari & Covington, 1981; Nicholls, 1978, 1979). It is possible that effort as a cause of success was valued more by the sixth-grade students than by the eighth graders.

Given the residue skill and effort attribution differences, it seems somewhat surprising that sixth graders also did not judge posttest self-efficacy lower than eighth-grade students. Self-performances provide valid efficacy information, and success achieved with less perceived effort should raise self-efficacy more than when greater effort is required (Bandura, 1981). At the same time, efficacy appraisal is an inferential process that involves weighting the relative contributions of many factors, such as self-perceptions of ability, effort expended, task difficulty, amount of external aid received, situational circumstances under which the performances occurred, and temporal pattern of successes and failures (Bandura, 1981, 1982; Schunk, in press, b), Sixth graders placed as much emphasis as eighth graders on ability and task ease as causes of problem-solving progress. As noted earlier, ability and task attributions are relatively stable causes and strongly affect achievement expectancies (Fontaine, 1974; Harari & Covington, 1981; McMahan, 1973; Weiner, 1979).

This study has practical implications. Although teachers generally structure tasks such that students will experience some success, merely succeeding at a task will not guarantee a strong sense of self-efficacy (Schunk, in press, b). Students who approach a task with low expectancies for learning ought to benefit from explicit performance feedback that highlights their progress. How to structure this feedback is an important topic for instructional research. Microcomputers would seem to offer an especially effective means of delivering performance feedback.

Along these lines, the evaluative feedback given by classroom teachers may have important effects on students' achievement cognitions (Dweck, Davidson, Nelson, & Enna, 1978). Dweck et al. (1978) found that elementary-school teachers praised boys more than girls' 'for intellectual aspects of their. work but that girls received more criticism of intellectual performance than boys. Such criticism resulted in attributions of failure to low ability, whereas negative evaluation of other aspects of school performance (e.g., neatness) increased attributions to low effort. These results suggest that teachers unwittingly may be promoting negative achievement expectancies among girls. Other research demonstrates that students' sense of self-efficacy is aided by delivering verbal attributional feedback (e.g., "You're good at this") that links their problem-solving progress with ability (Schunk, in press, a). Attributional feedback easily can be delivered along with performance feedback and may enhance students' skills and sense of efficacy for applying them.

Notes:

[1] For the performance feedback to inform students about their capabilities it was necessary that students could not derive objective performance information simply from working at the task. To this end, students were told to not perform the division and were not allowed to use calculators. Further, the problems were sufficiently complex to preclude mental division.

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