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ABSTRACT

The study investigated the development of 48 gifted adolescents' competencies and achievement related cognitions in mathematical skill development and examined the effects of school achievement level and sex. Ss completed a self instructional packet on mathematical residues (remainders) and were periodically assessed on perceived ability, task difficulty, effort, general expectancy, and perceived efficacy. Compared with Ss who performed well in school, underachievers judged ability, general expectancy, and perceived efficacy lower, and rated task difficulty and effort higher. Contrary to prediction, there were no sex differences on any measure. Three possible reasons for the lack of sex differences were noted. (Author/CL)

Attributional and Expectancy Change in Gifted Adolescents

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Attributional and Expectancy Change in Gifted Adolescents

Attributional theories postulate that individuals utilize information to arrive at causal ascriptions for achievement outcomes in terms of ability, effort, task difficulty, and luck. Performances consistent with expectations tend to be attributed to stable causes, whereas outcomes contrary to expectations are more often attributed to unstable causes (Deaux, 1976; Heider, 1958; Weiner, 1979; Weiner et al., 1971). For example, students who expect to succeed are likely to attribute subsequent success to high ability, whereas if they fail they are apt to attribute it to an unstable cause, such as insufficient effort.

The purpose of the present study was to investigate the development of gifted adolescents' competencies and achievement-related cognitions in the context of mathematical skill development, and to determine whether these outcomes varied as a function of level of school achievement and sex. The conceptual focus was Bandura's theory of <u>self-efficacy</u> (Bandura, 1977, 1981). According to this theory, different influences change behavior in part by strengthening perceived self-efficacy. Self-efficacy is concerned with judgments about how well one can organize and execute courses of action required in situations that may contain novel and unpredictable elements. Percepts of efficacy can affect choice of activities, effort expended, and perseverance in the face of difficulties. Efficacy information can be conveyed through enactive attainments, socially comparative vicarious measures, social persuasion, and inferences from physiological arousal.

Efficacy appraisal is an inferential process that involves weighing the relative contribution of personal and situational factors that affect how one performs. In forming efficacy judgments, persons weigh the relative contribution of ability and nonability factors, such as the difficulty of the task, effort expended, amount of external aid received, situational circumstances under which the performance occurs, and temporal pattern of successes and failures. In the self-efficacy analysis, past performance outcomes and attributional judgments are viewed as conveyors of efficacy information. They influence future performance mainly through their intervening effects on perceived efficacy, such as when persons infer their efficacy from amount of effort expended and perceived task difficulty. For example, in cognitive appraisals of effort expended, success achieved with minimal effort fosters the perception of high ability whereas the same performance achieved with great effort connotes lower ability and will have less of an impact on raising perceived efficacy. When persons periodically fail but show improvement over time they are more likely to raise their perceived efficacy than people who succeed but see their performance level off compared with their previous improvement (Bandura, 1981).

In the present study, students previously identified as gifted according to school district criteria completed a self-instructional packet on mathematical residues (remainders). Half of the sample were classified as achievers on the basis of excellent mathematical performance in school, whereas the other half were classified as underachievers because level of school performance was lower than measured abilities would predict. Equal numbers of males and females were distributed across these two conditions. During the experimental session, students periodically judged their perceived ability, difficulty of the task, amount of effort expended, general expectancy of mastering the unit, and perceived efficacy for being able to solve different types of residue problems.

Although much has been written on the characteristics of gifted students (Stanley, Keating, & Fox, 1974), there has been little work on how they develop achievement-related cognitions. These outcomes may vary as a function of prior school achievement. There is evidence that gifted underachievers differ in important ways from gifted achievers (Gallagher, 1975). Compared with achievers, gifted underachievers hold lower self-concepts and display poorer overall adjustment patterns (Gallagher & Rogge, 1966). They also tend to lack self-confidence (Terman & Oden, 1947). Because such negative self-perceptions should manifest themselves in achievement contexts, it was predicted that gifted achievers would demonstrate greater skill development and judge general expectancies, perceived efficacy, and ability at the task higher. It was also expected that they would judge the task less difficult and report less effort expenditure.

Much research has been conducted on sex differences in achievement contexts. A number of studies have identified sex differences in mathematical achievement in favor of males (Flanagan et al., 1964; Wilson, 1972). According to a prevalent stereotype, males are expected to be more competent than females in mathematics. Although there are some exceptions, the general findings are that females are more apt to hold lower expectancies for success and to attribute success to high effort and failure to low ability (Crandall, 1969; Wolleat, Pedro, Becker, & Fennema, 1980). In attributional terms, males expect to succeed in mathematics and therefore tend to attribute success to stable causes, such as high ability. Conversely, since females are more likely to expect failure or difficulty they are more apt to attribute success to unstable causes such as great effort. It was hypothesized that compared with females, males would demonstrate higher achievement, hold higher general expectancies for success and percepts of efficacy, judge their ability higher and the task less difficult, and believe they expended less effort. Since these sex differences were expected across levels of school achievement, no significant School Achievement X Sex interactions were predicted.

Method

Subjects

Subjects were 48 students in grades 6-8 drawn from four middle schools, and were predominantly middle-class. The 24 males and 24 females had previously been identified by the school district as gifted based on a scoring matrix that consisted of three components: teacher observation-nomination (district adapted from Renzulli-Hartman Behavioral Characteristics of Superior Students), intelligence quotient (Lorge-Thorndike), and standardized achievement (Iowa Test of Basic Skills - reading and mathematics). Within sex, half of the students were classified as achievers based on their school performance of being on the accelerated mathematics track and making As. The other half were classified as underachievers. They were either not on the accelerated track, or if on the track were making Bs or Cs.

Materials

The instructional material consisted of a written packet on mathematical residues. The objective of this unit was to solve for the remainder of a division problem without performing the division. For example, in one problem students had to solve for the 9-residue of 37007, or the remainder of 37007 divided by 9. One first sums the digits in the dividend (3 + 7 + 0 + 0 + 7 = 17), then sums again (1 + 7 = 8), to arrive at the correct remainder (8). Problems became progressively more difficult; for example, "If a number has a 9-residue of 8, what is its 3-residue?" However, successful solutions to all problems required only learning simple rules that incorporated addition and subtraction operations. No student reported previous familiarity with this topic.

The packet consisted of 12 pages, of which seven contained written instruction and a total of 23 problems to solve. The remaining five pages contained the self-perception measures. Each of these pages was identical in format. They were interspersed throughout the packet after every 1-2 pages of problems. Answers were provided to selected problems so that students would have a realistic basis to form self-perceptions. An answer was shown in the right-hand margin opposite the next problem. Students worked down each page and covered all problems after the one they were presently solving with a sheet of paper. The measure of residue skill was the number of problems that students solved correctly.

The self-perception pages contained five measures, each on a 10-unit scale, tapping perceptions of ability, task difficulty, effort, general expectancy, and perceived efficacy. The order of the measures was not counterbalanced across pages since pilot work revealed no consistent differences due to order. Students initially judged their ability to solve residue problems on a scale ranging from "not good" to "real good." The task difficulty question asked how difficult most of the problems had been; the scale ranged from "not difficult" to "real difficult." The effort measure asked how hard students had worked on more difficult problems, and the scale ranged from"not much" to "a real lot." The general expectancy question asked how certain students were that they would master the residue unit. For the measure of perceived efficacy, students read but did not work a sample problem of the type that appeared on the following page. Each sample problem was more difficult than the problems students had previously worked and was presented prior to students receiving appropriate instruction. Students were asked to judge their certainty of being able to solve correctly problems of the type shown. Students were not asked to judge whether they could solve the particular problem illustrated. The scales for the general expectancy and perceived efficacy ranged from "not sure" to "real sure." The five judgments on each measure were summed and averaged.

Procedures

A female experimenter administered the packet to small groups ($\underline{n}$ = 8-10) of students. The experimenter initially explained that students would be working on a topic called residues, which concerned itself with how to solve for remainders to division problems without performing the division. The experimenter then asked whether students had previous familiarity with the topic. No student reported prior knowledge of residue procedures.

Students were advised to work one page at a time and to not skip around. Students were given the packet and a piece of construction paper; the experimenter explained that students should use the construction paper to cover all problems on the page following the one they were solving. On finishing a problem, students were to move the paper down to the next black line where an answer would appear to selected problems. Students were also advised to read the appropriate instructions prior to solving problems.

The experimenter explained that questionnaire pages were interspersed throughout the packet, and that when students came to one of these pages they should answer all questions prior to proceeding to the next page. They were advised to mark how they really felt on each of these questionnaire items since there were no right or wrong answers. The experimenter also explained that students would not receive a grade for their work.

The experimenter gave no supplemental instructions over that contained in the packet. If students had questions, they were advised to reread the relevant sections of the packet. Students completed the packet individually. Average session length was approximately 1 hour.

Results

Table 1 shows the means and standard deviations for each measure by experimental condition across trials. Preliminary analyses revealed no significant differences on any measure due to grade, so data were pooled across this variable. Data were analyzed using a 2 (School Achievement) x 2 (Sex) analysis of variance with repeated measures (Trials).

Analyses of variance yielded significant main effects for School Achievement across all measures: skill, $F(1, 44) = 6.25$, $p < .05$ ability, $F(1, 44) = 7.40$, $p < .01$; task difficulty, $F(1, 44) = 5.77$, $p < .05$; effort, $F(1, 44) = 4.69$, $p < .05$; general expectancy, $F(1, 44) = 6.85$, $p < .05$; and perceived efficacy, $F(1, 44) = 4.54$, $p < .05$. Compared with underachievers, achievers solved correctly significantly more problems, judged ability, general expectancy, and perceived efficacy significantly higher, and judged task difficulty and effort significantly lower.

There were no significant differences on any measure due to Sex, nor were there any significant School Achievement x Sex interactions. A significant main effect for Trials was found for all measures except effort: skill, $F(4, 176) = 229.12$, $p < .001$; ability, $F(4, 176) = 6.18$, $p < .001$; task difficulty, $F(4, 176) = 13.94$, $p < .001$; general expectancy, $F(4, 176) = 4.14$, $p < .01$; and perceived efficacy, $F(4, 176) = 9.83$, $p < .001$. The Trials effect for skill is not meaningful because the number of problems to be solved varied from trial to trial. Regardless of treatment condition, students judged ability, general expectancy, and perceived efficacy lower and task difficulty higher as the problems became more difficult to solve.

The finding that students' self-perceptions differed significantly due to level of school achievement suggests generalization of self-perceptions formed by school experiences. An alternative explanation is that because groups differed significantly in task skill, their self-perceptions evolved from differential performance feedback during the experiment.

To test this possibility, data from Trial 1 were analyzed according to a 2 (School Achievement) x 2 (Sex) ANOVA. For the skill measure, the main effect for School Achievement was nonsignificant. However, a significant main effect was found on the ability, $F(1, 44) = 4.81$, $p < .05$, task difficulty, $F(1, 44) = 9.12$, $p < .01$, and general expectancy measures, $F(1, 44) = 8.24$, $p < .01$. Nonsignificant results were found for the perceived efficacy and effort measures. There were no significant main effects on any measure for Sex, nor were there any significant School Achievement x Sex interactions. Therefore, although achievers and underachievers did not differ in skill or perceived efficacy, achievers judged ability and general expectancy higher and task difficulty lower.

Discussion

The present study demonstrates important differences among gifted students in competency development and achievement-related cognitions. Compared with students who perform well in school, those who underachieve relative to their talents showed less skill development, made lower judgments of ability, general expectancy of mastering the unit, and self-efficacy for being able to solve specific types of problems, and judged effort and task difficulty greater. These differences occurred even though the novel experimental task only required application of simple rules and computational skills.

The present results also show that most of these differences mainifested themselves early in the course of skill development. After solving only a few simple problems, underachievers judged ability and general expectancy significantly lower, and task-difficulty significantly greater. These differences could not have been a function of initial task performance since groups did not differ significantly in skill. Either the underachievers entered the experiment with different self-perceptions or processed the initial performance information differently. The present study cannot disentangle these possibilities since students made no judgments prior to solving residue problems. Collecting pre-performance self-perception measures would have provided students no objective basis for making self-judgments.

It is interesting that although level of school achievement influenced students' initial general expectancy for success, it had no effect on residue self-efficacy. Combined with the finding that underachievers judged ability lower on the first trial, this supports the idea that percepts of efficacy are influenced by both ability and nonability factors (Bandura, 1977, 1981). A general expectancy for mastering a unit may be more heavily influenced by previous experiences in the same subject area.

Surprisingly, no significant sex differences were found on any measure. This contradicts previous research demonstrating higher expectancies for success among boys as well as differences in attributional judgments (Dweck, Davidson, Nelson, & Enna, 1978; Dweck, Goetz, & Strauss, 1980; Parsons & Ruble, 1977). Even studies that have reported no significant sex differences in expectancies for familiar tasks have found significant differences in favor of males for unfamiliar tasks (Heller & Parsons, 1981).

One possible explanation for the present results may be in the type of teacher feedback these students typically receive. Using elementary children as subjects, Dweck et al. (1978) found that males received significantly more positive feedback on intellectual aspects of performance whereas females received significantly more negative feedback. It is likely that feedback by elementary and junior-high teachers differs (Heller & Parsons, 1981); junior-high teachers may show less differentiation in disseminating positive and negative feedback for academic performance. This may be especially true with gifted students whose intellectual talents are not in question.

A second possibility is that sex differences had not yet emerged. Sex differences in mathematical expectancies do not consistently appear until late junior high school (Heller & Parsons, 1981; Parsons, in press). It is known that males elect more advanced courses in mathematics than females (Pedro, Wolleat, Fennema, & Becker, 1981). The present sample had not been exposed to options in course selection. It is possible that over the next few years a differential selection in mathematics courses in favor of males would occur even among mathematically gifted students, which could promote self-perception differences. More research is needed in this area.

A third possiblity is that since the present sample received answers to selected problems they had an objective basis for forming self-perceptions. This contrasts with much previous research in which students judged expectancies for success at ambiguous or unfamiliar tasks (Heller & Parsons, 1981; Parsons &

Ruble, 1977). In such cases, students are apt to form self-perceptions based more on the experimenter's performance feedback than on their perceptions of the component skills and the extent to which they possess them.

Future research should explore how students process performance feedback given in the context of competency development. A useful strategy has been suggested by Diener and Dweck (1978). In this study, children verbalized as they solved problems. These verbalizations were recorded and subsequently categorized, such as representing useful strategies, attributions, self-instructions, and affective statements. This type of experimental paradigm could expand our knowledge of how students process information and form achievement-related cognitions as they are developing skills.

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Table 1

Means (and Standard Deviations) By Experimental Condition

Measure	Achievers		Underachievers	
	Females	Males	Females	Males
Skill[a]	20.8 (3.5)	20.8 (3.5)	18.6 (5.3)	18.6 (5.0)
Ability[b]	82.2 (15.2)	88.7 (13.7)	71.3 (25.2)	76.2 (20.8)
Task Difficulty[b]	26.3 (16.1)	25.5 (18.7)	40.2 (26.4)	36.8 (24.9)
Effort[b]	34.8 (20.5)	41.3 (28.6)	50.9 (26.1)	51.7 (26.5)
General Expectancy[b]	79.7 (20.1)	88.8 (15.0)	68.4 (26.2)	73.2 (24.2)
Perceived Efficacy[b]	69.1 (25.0)	76.9 (28.3)	58.2 (27.7)	62.6 (25.1)

Note: N = 48; n = 12.

[a]Number of correct solutions; maximum = 23.

[b]Range 10 (low) - 100 (high).