Peer-Model Attributes and Children's Achievement Behaviors

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Abstract:

In two experiments, we investigated how attributed of peer models influenced achievement behaviors among children who had experienced difficulties learning mathematical skills in school. In Experiment 1, children (M = 10.6 years) observed either a same- or opposite-sex peer model demonstrating rapid (mastery model) or gradual (coping model) acquisition of fraction skills. Observing a coping model led to higher self-efficacy, skill, and training performance. In Experiment 2, children (M = 10.9 years) observed either one or three same-sex peer models demonstrating mastery or coping behaviors while solving fractions. Children in the single-coping model, multiple-coping-model, and multiple-mastery-model conditions demonstrated higher self-efficacy, skill, and training performance, compared with subjects who observed a single mastery model. In both studies, children who observed coping models judged themselves more similar in competence to the models than did subjects who observed mastery models.

Article:

Perceived self-efficacy, or personal beliefs about one's capabilities to organize and implement actions necessary for attaining designated levels of performance, is hypothesized to be an important mechanism mediating behavior change (Bandura, 1982, 1986). Self-efficacy can affect one's choice of activities, effort expenditure, persistence, and achievement. Individuals acquire information about their self-efficacy through their actual performances, vicarious (observational) experiences, forms of persuasion (e.g., “You can do this”), and physiological indexes (sweating and heart rate).

Modeled performances constitute an important source of information about one's self-efficacy (Bandura, 1986). Individuals who observe similar others performing a task are apt to believe that they also can perform the task because modeling implicitly conveys to observers that they possess the necessary capabilities for succeeding (Berger, 1977). This sense of efficacy is substantiated later when observers succeed at the task (Schunk, 1985). Observers' self-efficacy judgments depend in part on perceptions of similarity in competence to the model and on the outcome (e.g., success or failure) of the model's actions (Brown & Inouye, 1978 ; Zimmerman & Ringle, 1981).

The preceding considerations suggest that although adults can serve as powerful models for transmitting behaviors to children, behaviors that are constrained by ability may be more susceptible to peer influence (Davidson & Smith, 1982). Schoolchildren learn skills by observing their adult teachers, but observation of peer models may better enhance children's self-efficacy. In particular, an adult teacher's flawlessly modeling cognitive skills may not promote high self-efficacy in children who have encountered previous difficulties with the subject matter and who are likely to view the teacher as superior in competence. Models of the same age and sex as children and whom children view as similar in competence may teach children skills and promote their self-efficacy for learning those skills. Schunk and Hanson (1985) found that children who observed a same-sex peer (student) model solve subtraction problems developed higher self-efficacy for learning to subtract than did children who observed a teacher model solve the same problems.

The purpose of the present two studies was to investigate how various attributes of peer models affected children's achievement behaviors. The subjects were children who had encountered difficulties learning mathematical skills in their regular classes. One attribute investigated in both studies was the type of modeled behavior, mastery or coping. The terms mastery model and coping model are derived from therapeutic contexts in which modeling is used to reduce avoidance behaviors in fearful clients (Meichenbaum, 1971 ; Thelen, Fry, Fehrenbach, & Frautschi, 1979). Coping models initially demonstrate the typical fears and deficiencies of observers but gradually improve their performance and help them gain self-confidence, whereas mastery models demonstrate faultless performance from the outset (Kazdin, 1978 ; Kornhaber & Schroeder, 1975). Coping models, which illustrate how determined effort and positive thoughts can overcome difficulties, exert beneficial effects on behavior and attitudes (Thelen et al., 1979).

The Schunk and Hanson (1985) subjects observed either a peer mastery or coping model solving subtraction problems that involved regrouping; type of modeled behavior did not, however, differentially affect children's self-efficacy, skillful performance, or perceptions of similarity in competence to the model. Although these subjects' prior successes in subtraction were limited to problems without regrouping, children may have drawn on these experiences and concluded that if the peer model could learn, they could as well. In the present studies, we used a task (fractions) that children had few, if any, prior successes with in school. We expected that observing a coping model learn to solve fraction problems would lead to greater perceived similarity and higher self-efficacy and skillful performance, compared with observing a mastery model.

In Experiment 1, we also explored the effects of model sex; children observed either a same- or a cross-sex peer model. In many psychological theories, children are postulated to be more likely to attend to and to learn from same-sex models (Perry & Bussey, 1979); the literature, however, is not clear on this point. Researchers have found benefits due to same-sex models (Bussey & Bandura, 1984), benefits due to cross-sex models (Perry & Bussey, 1979), and no differences due to model sex (Rickard, Ellis, Barnhart, & Holt, 1970).

Researchers have suggested that children may be more likely to perform behaviors displayed by models whom they believe to be good examples of their sex role (Perry & Bussey, 1979 ; Spence, 1984); that is, sex of model may be less important than children's beliefs about how appropriate the modeled activity is for members of their sex (Bussey & Bandura, 1984). Accordingly, we did not expect differential effects on achievement behaviors due to sex of model. Although boys often expect to perform better in mathematics than girls, consistent differences do not emerge until junior high school (Meece, Parsons, Kaczala, Goff, & Futterman, 1982). We expected that our elementary-age male and female subjects would perceive learning to work fraction problems as appropriate.

In Experiment 2, we investigated the effects of number of models; children observed either one or three same-sex peer models. Multiple models increase the probability that observers will perceive themselves as similar to at least one of the models (Thelen et al., 1979). Observation of multiple models facilitates behavior change in therapeutic contexts (Bandura & Menlove, 1968 ; Marburg, Houston, & Holmes, 1976). We hypothesized that observing multiple models would enhance children's achievement behaviors more than would observing a single model. Given that our subjects had encountered difficulties learning mathematical skills in their regular classes, we felt that they might easily discount the successes of a single model. Conversely, we believed that children would be less likely to discount the diverse instances of successful learning displayed by multiple models.

Experiment 1

Method

Subjects. The final sample comprised 80 students in Grades 4 through 6 from four elementary schools. Ages ranged from 9 years 3 months to 12 years 7 months (M = 10.6 years). The 40 boys and 40 girls represented various socioeconomic backgrounds but were predominantly middle class. Ethnic composition of the sample was as follows: 64% white, 18% black, 10% Hispanic, and 8% Asian.

Subjects had previously been classified by the school district as working below grade level in mathematics. At the start of the academic year, children had been administered the Comprehensive Tests of Basic Skills (CTB/McGraw-Hill, 1982). Children whose mathematics total score was at or below the 35th percentile were assigned to below-grade-level classes. At the time of this study, the subjects did not qualify for special-education services.

Children's teachers were shown the fractions skill test and initially identified 87 students who they felt could not solve more than 10% of the problems. This selection procedure was followed because the experiment focused on processes whereby self-efficacy and skills could be developed when they were low and because we felt that the coping-model treatment would appear more credible to children who had few, if any, prior successes in solving fraction problems. From the initial sample, 7 children were excluded; 3 were absent and missed most of the training sessions, and 4 were randomly excluded from the appropriate cells for equalizing cell sizes.

Materials and procedure

The pretest on fractions self-efficacy and skill was administered to children individually by one of six female adult testers from outside the school. Testers followed a standardized set of instructions. On the self-efficacy test, children's perceived capabilities for correctly solving different types of fraction problems were assessed. For this assessment, 31 scales were portrayed on six sheets of paper. Each scale ranged in 10-unit intervals from not sure (10), through intermediate values (50–60), to really sure (100). The stimulus materials comprised 31 sample pairs of fraction problems; each pair appeared on an index card. The two problems constituting each pair were similar in form and operations required and corresponded to one problem on the skill test, although they involved different numbers. The reliability of the efficacy measure was assessed in a pilot study with 15 comparable children who did not participate in the actual study. The test-retest reliability coefficient was .79.

Children initially received practice with the self-efficacy scale by judging their certainty of successfully jumping progressively longer distances. In this concrete fashion, children learned the meaning of the scale's direction and the different numerical values. Following this practice, children were briefly shown the 31 sample pairs of fraction problems for about 2 s each. This brief duration allowed assessment of problem difficulty but not actual solutions; thus, children judged their capability to solve different types of problems rather than their certainty of solving any particular problem. The tester advised children to be honest and to mark the efficacy value that corresponded to their level of certainty for being able to solve correctly the type of problem depicted. After privately making each judgment, children covered it with a blank sheet of paper to preclude effects due to observing prior judgments. The 31 scores were summed and averaged.

The fractions skill test was administered immediately following the efficacy assessment. This test comprised 31 problems that tapped addition and subtraction as follows (examples in parentheses): addition, like denominators, no carrying (1/6 + 4/6); addition, like denominators, carrying (9/10 + 5/10) addition, unlike denominators, no carrying (5/16 + 2/4); addition, unlike denominators, carrying (11/15 + 37/45); subtraction, like denominators, no regrouping (7/9; − 3/9); subtraction, unlike denominators, no regrouping (21/36 − 8/18). Of these 31 problems, 21 were similar to those that children solved during the training sessions, whereas the other 10 were more complex. For example, during training, students solved problems with two terms, whereas some fractions skill test problems included three terms 1/3 + 2/12 + ¼). Different forms of the skill test were used on the pretest and posttest for eliminating potential effects due to problem familiarity. Reliability was assessed during the pilot study; children's scores on these parallel forms correlated highly ($r = .90$).

Each of the 31 problems was portrayed on a separate sheet of paper. The tester presented problems one at a time and verbally instructed students to examine each problem and to place the page on a completed stack when they finished solving the problem or chose not to work on it any longer. Children were given no performance feedback on the accuracy of their solutions. The measure of skill was the number of problems solved correctly.

Following the pretest, children were randomly assigned within sex to four treatment conditions—male mastery model, male coping model, female mastery model, and female coping model. Videotapes that presented each of the six fraction skills in 7- to 8-min blocks were used rather than live modeling for ensuring standardized presentation across subjects. Videotape participants were two female adult teachers and four peer (child) models (two boys and two girls); the peer models ranged in age from 10 years 1 month to 10 years 10 months (M = 10.3 years). Female teachers were used because most elementary teachers in the school district were women. Teachers and models were drawn from a different school district and were unfamiliar to subjects.

Videotapes were distinguished by the sex of the peer model (male or female) and the type of modeled behavior (mastery or coping). Each videotape depicted one teacher and a male (peer) mastery model, a male coping model, a female mastery model, or a female coping model. Two versions were prepared for each of these four videotapes; each version portrayed one of the two teachers and one of the two male (or female) peer models. Thus, each of the two teachers was portrayed in all four videotapes, and each of the two male peer models and the two female peer models was portrayed in both the mastery and coping videotapes.

Each videotape initially portrayed the teacher explaining and demonstrating how to add fractions with like denominators (no carrying). For easier viewing, all work was conducted at a chalkboard. Following this 2- to 3-min demonstration, the teacher wrote a comparable problem on the board for the model to solve. On finishing the problem, the model was informed by the teacher that his or her solution was correct, and the teacher erased the work and wrote another problem on the board. The model solved problems for the remainder of the block (5–6 min). While solving each problem, the model verbalized the problem-solving operations and two different achievement beliefs. On completion of each 7- to 8-min block, the teacher explained and demonstrated the next fraction skill and gave the model problems to solve. Each videotape was about 45 min long.

In the male-mastery-model condition, the boy performed all operations correctly and worked at an average rate. Achievement beliefs verbalized by the model reflected high self-efficacy (e.g., “I can do that one”), high ability (“I'm good at these”), low task difficulty (“That was easy”), and positive attitudes (“I like working these”). The female-mastery-model condition was identical except that a girl served as the peer model.

The coping-model conditions differed from the mastery-model conditions in problem-solving behaviors and verbalizations. Initially, the model was hesitant and made errors (e.g., $1/4 + 2/4 = 3/8$). When errors occurred, the teacher supplied a prompt (e.g., “What do you do when the denominators are the same?”) or referred to the problems that she had worked. The peer model verbalized achievement beliefs that reflected low self-efficacy (e.g., “I'm not sure I can do that”), low ability (“I'm not very good at these”), high task difficulty (“These are tough”), and negative attitudes (“I don't like working these problems”). As the tape progressed, the boy (girl) made fewer errors and began to verbalize coping statements (e.g., “I need to pay attention to what I'm doing,” and “I'll try to do my best”). Gradually, the model improved his (her) performance so that problem-solving behaviors and verbalizations matched those of the mastery model.

Children assigned to the same experimental condition viewed the appropriate videotape in small groups. A female adult proctor introduced the tape by saying that it showed a teacher and a boy (girl) who was learning to work fraction problems. The proctor did not comment while children were watching the videotape.

The proctor administered three measures on completion of the tape—interest, perceived similarity in competence, and self-efficacy for learning. The 10-unit interest scale ranged from 10 to 100, with the following verbal descriptors: not interesting (10–20), ok (40), pretty interesting (70), and really interesting (90–100). For this measure, children judged how interesting they found the tape to watch. Interest was assessed because differential attention to the tapes could produce variations in self-efficacy unrelated to children's perceptions of similarity in competence to the model. The perceived similarity scale ranged from 10 to 100 in 10-unit intervals from I'm not as good (10–20), through we're the same (50–60), to I'm much better (90–100). The proctor asked children to think about the boy (girl) in the tape and to judge how they compared with him (her) in learning to work arithmetic problems. The measure of self-efficacy for learning, which was identical to the pretest efficacy assessment, required children to judge their certainty of learning how to solve different types of fraction problems rather than their certainty of being able to solve them.

All children received the fractions training program during 40-min sessions on 6 consecutive school days following the videotape session. Training sessions were conducted by one of six female adult proctors from outside the school. For any given child, the same proctor administered all six training sessions, had not administered his or her pretest, and was unaware of his or her experimental assignment.

Six sets of instructional material were used. Each set incorporated one of the six fraction operations previously described (skill test); the formats were identical. The first page contained a full explanation of the relevant operation and two examples of application of the solution strategy. Each following page contained several similar problems to be solved by using the designated strategy. Students worked on one set during each training session. Each set included sufficient problems so that children could not complete all of them during the session.

Table 1

Means and Standard Deviations for Experiment 1

Measure	Male model				Female model			
	Mastery		Coping		Mastery		Coping	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Self-efficacy[a]								
Pretest								
M	52.8	52.9	55.9	58.2	60.3	56.3	56.2	60.8
SD	18.2	24.0	20.4	25.1	21.9	20.0	25.6	20.0
Posttest								
M	72.8	68.5	85.5	84.4	72.3	69.8	85.7	86.7
SD	8.9	15.8	13.2	14.2	9.6	14.2	9.1	11.5
Skill[b]								
Pretest								
M	2.3	2.1	2.3	2.4	2.6	2.7	3.0	3.4
SD	2.9	3.0	3.4	3.2	3.8	3.3	3.0	3.7
Posttest								
M	8.5	8.2	13.7	13.6	9.4	8.2	13.7	14.1
SD	3.1	1.9	4.9	4.4	3.4	2.7	3.3	4.4
Perceived similarity[c]								
M	39.0	33.0	66.0	56.0	42.0	38.0	54.0	55.0
SD	24.7	24.1	11.7	27.2	28.6	27.8	22.2	25.9
Interest[d]								
M	45.0	42.0	41.0	40.0	52.0	51.0	52.0	43.0
SD	24.6	23.9	25.1	19.4	31.6	25.1	21.5	25.4
Self-efficacy for learning[e]								
M	65.8	69.9	90.4	84.1	69.2	70.9	86.9	84.5
SD	28.4	18.5	10.1	10.0	21.2	14.0	9.4	11.7
Training performance[f]								
M	162.2	157.4	187.2	186.1	161.8	153.4	184.5	185.9
SD	22.4	24.6	8.2	9.4	22.1	29.5	17.3	14.0

Note. $N = 80$; n per condition = 10.
[a] Average judgment per problem, 10 (low) to 100. [b] No. correct solutions on 31 problems. [c] 10 (*not as good*) to 100 (*much better*). [d] 10 (low) to 100. [e] Average judgment per problem, 10 (low) to 100. [f] No. problems completed.

At the start of each session, children met in groups of 4 to 5 with their proctor. The formats of the training sessions were identical. The proctor initially reviewed the explanatory page by verbalizing aloud the solution steps and their application to the sample problems. Following this instructional phase (about 5 min), children solved two practice problems in the proctor's presence. The proctor stressed the importance of performing the steps as shown on the explanatory page, seated subjects at desks separated from one another, and moved out of sight. Children solved problems alone during the remainder of the session (about 30 min). If they were baffled about how to solve a problem, they could consult the proctor, who reviewed the troublesome operation.[1]

Children received the posttest on the day following the last training session. For any given child, the tester was unaware of the child's experimental assignment and of how the child had performed during the training program. The self-efficacy and skill instruments and procedures were identical to those of the pretest except that the parallel form of the skill test was used. Tests and training materials were scored by an adult who had not participated in the data collection and who was unaware of the children's experimental assignments.

Results

Means and standard deviations of all measures are presented by experimental condition in Table 1 . Preliminary analyses of variance (ANOVA s) yielded no significant between-conditions differences on pretest measures (self-efficacy and skill). There also were no significant differences on any measure due to tester, school, or videotape version (within conditions).

Self-efficacy and skill

Intracondition changes (pretest to posttest on each measure were evaluated using the t test for correlated scores (Winer, 1971). Among boys, observing either a male coping model, $t(9) = 4.17$, $p < .01$; male mastery model, $t(9) = 2.94$, $p < .05$, or female coping model, $t(9) = 3.03$, $p < .05$, led to a significant improvement in self-efficacy. Observing a male, $t(9) = 3.85$, $p < .01$, or female, $t(9) = 4.37$, $p < .01$, coping model significantly enhanced self-efficacy among girls. In all eight experimental conditions, children showed significant gains in fractions skill from pretest to posttest, range of t (9) values = 4.12 to 21.59, all p s < .01.

Posttest self-efficacy and skill were analyzed with a 2 × 2 × 2 (Sex of Model: Male or Female × Type of Modeled Behavior: Mastery or Coping × Sex of Child: Male or Female) multivariate analysis of covariance (MANCOVA) with the corresponding pretest measures as covariates. This analysis yielded a significant main effect for type of modeled behavior, Wilks's lambda = .561, $F(2, 69) = 27.04$, $p < .001$; all other main effects and all interactions were nonsignificant. Univariate analyses of covariance (ANCOVA s) revealed significant main effects for type of modeled behavior on each measure—self-efficacy, $F(1, 71) = 28.00$, $p < .001$, $MS_e = 152.50$, and skill, $F(1, 71) = 45.46$, $p < .001$, $MS_e = 11.15$. Observing a coping model significantly enhanced children's self-efficacy (M = 85.6) and skillful performance (M = 13.8), compared with observing a mastery model (respective M s = 70.9 and 8.6).

Videotape measures

The perceived similarity measure was analyzed with a 2 × 2 × 2 (Sex Of Model × Type of Modeled Behavior × Sex of Child) ANOVA . This analysis yielded a significant main effect for type of modeled behavior, $F(1, 72) = 12.95$, $p < .01$, $MS_e = 602.64$. Similarity judgments of children who observed a coping model (M = 57.8) were significantly higher than those of children who observed a mastery model (M = 38.0). Inspection of Table 1 shows that the mean similarity judgments of children assigned to coping-model conditions, with one exception, fell into the 50–60 range (we're the same), whereas the mean scores of children assigned to mastery-model conditions were lower than 50, or toward the 10–20 (I'm not as good) end point. Compared with subjects who observed a mastery model, therefore, subjects who observed a coping model judged themselves more similar in competence to the model. An ANOVA applied to the interest measure yielded nonsignificant results.

Self-efficacy for learning was analyzed with a 2 × 2 × 2 ANCOVA that used pretest efficacy as the covariate. This analysis yielded a significant main effect for type of modeled behavior, $F(1, 71) = 24.91$, $p < .001$, $MS_e = 226.70$; main effects for sex of model and sex of child and all interaction effects were nonsignificant. Observing a coping model (M = 86.5) led to significantly higher self-efficacy for learning to solve fraction problems, compared with observing a mastery model (M = 69.0).

Training performance

The number of problems that children completed during the training program was analyzed with a 2 × 2 × 2 ANOVA for determining whether experimental conditions exerted differential effects on children's motivation. This analysis yielded a significant main effect for type of modeled behavior, $F(1, 72) = 38.06$, $p < .001$, $MS_e = 389.47$. Children who observed a coping model (M = 185.9) completed significantly more problems during training than did subjects who observed a mastery model (M = 158.7). More rapid problem solving was not attained at the expense of accuracy; an identical pattern of results was obtained by using the proportion of problems that subjects solved correctly (total number correct divided by total number completed) as the measure of training performance.

Correlational analyses

Product-moment correlations among posttest self-efficacy, posttest skill, perceived similarity, self-efficacy for learning, and training performance (number of problems completed) are given in Table 2 . All correlations were significant beyond the $p < .01$ level. Posttest self-efficacy was positively related to all measures, as was posttest skill. The more similar in competence that children judged themselves to the model, the higher were their scores for self-efficacy for learning and their rates of problem solving during training. Self-efficacy for learning also was positively correlated with training performance.

Table 2

Correlations Between Measures (Experiment 1)

Measure	2	3	4	5
1. Self-efficacy for learning	.55	.48	.51	.38
2. Similarity	—	.35	.44	.38
3. Self-efficacy[a]		—	.61	.46
4. Skill[a]			—	.60
5. Training performance				—

Note. $N = 80$. All *p*s < .01.
[a] Posttest measure.

Experiment 2

Method

Subjects. The subjects were 40 boys and 40 girls (Grades 4 through 6) from four classes in one elementary school. Children ranged in age from 9 years 1 month to 13 years 3 months ($M = 10.9$ years). All subjects were enrolled in below-grade-level classes, and subject-selection procedures were identical to those of Experiment 1. Teachers initially nominated 88 children; 3 children missed some sessions because of illness, and 5 others were randomly excluded for equalizing cell sizes.

Materials and procedure

The testing, training, and videotape materials and procedures of Experiment 1 were used, with the following procedural modifications. Following pretesting, children were randomly assigned within sex to four treatment conditions—single mastery model, single coping model, multiple mastery models, and multiple coping models. All subjects observed peer models who were of the same sex as themselves (i.e., no cross-sex modeling).

Children assigned to single-model conditions observed a videotape that portrayed a teacher and one same-sex peer model. There were three versions of each of the four single-model tapes (male mastery, male coping, female mastery, and female coping). Two of the versions were those used in Experiment 1; the third version portrayed one of the teachers shown in the other two versions and a different boy and girl. At the time of videotaping, the latter two children were 10.0 and 11.1 years old, respectively. Within each treatment condition, the three videotape versions were shown in counterbalanced order across subjects.

Four multiple-model videotapes (male mastery, male coping, female mastery, and female coping) were made by splicing together segments of the appropriate single-model tapes. Each multiple-model videotape portrayed three peer models of the same sex; thus, the three boys (girls) who appeared in the different single-male- (female-) model videotapes were portrayed in each male (female) multiple-model videotape (mastery and coping). We felt that three peer models would offer a diverse basis for perceiving similarity in competence and also allow each model to solve several problems. The verbalizations and problem-solving behaviors shown on the multiple-model tapes were identical to those on the single-model tapes. Each of the two teachers appeared in the four multiple-model videotapes; each of the three boys (girls) was portrayed in two of the six blocks on both the mastery and coping tapes. Each boy (girl) solved the same number of problems on each of the four tapes.

Perceived similarity in competence was assessed after children finished viewing the appropriate videotape. The proctor asked children assigned to multiple-model conditions to think about the three boys (girls) shown on the tape and to decide which boy (girl) seemed most like themselves in learning to work mathematical problems. Children then judged perceived similarity in competence relative to this model. This measure was more refined than one asking children to judge how much they were like all the boys (girls) in mathematics because the latter would have required children to average mentally their perceptions of similarity to each of the models.

Results

Means and standard deviations are shown in Table 3 . Preliminary ANOVAS yielded no significant between-conditions differences on pretest self-efficacy or skill. There also were no significant differences on any measure due to tester or to videotape version.

Table 3
Means and Standard Deviations for Experiment 2

	Single model				Multiple model			
	Mastery		Coping		Mastery		Coping	
Measure	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Self-efficacy[a]								
Pretest								
M	48.0	47.4	45.5	44.5	46.7	41.4	46.6	48.1
SD	16.9	12.9	16.5	21.2	25.3	15.4	14.4	18.8
Posttest								
M	62.5	64.1	80.9	86.9	82.4	78.1	83.7	81.3
SD	10.7	12.1	15.0	10.5	8.5	14.3	13.7	15.5
Skill[b]								
Pretest								
M	2.3	1.1	1.6	1.7	1.2	1.4	1.1	1.1
SD	2.5	2.4	1.4	2.4	2.6	2.3	2.6	2.1
Posttest								
M	6.6	7.9	12.1	13.2	12.5	12.1	13.4	13.3
SD	1.6	2.4	4.0	3.5	4.1	3.8	2.9	4.9
Perceived similarity[c]								
M	25.0	37.0	58.0	56.0	33.0	34.0	56.0	51.0
SD	20.7	25.0	12.3	15.8	15.7	12.6	14.3	23.8
Interest[d]								
M	56.0	59.0	59.0	69.0	65.0	64.0	70.0	70.0
SD	31.0	19.1	31.1	30.0	22.2	20.7	19.4	24.0
Self-efficacy for learning[e]								
M	61.8	62.7	81.5	82.1	77.8	80.6	82.6	84.0
SD	12.2	11.6	8.5	15.3	14.5	7.3	5.1	12.4
Training performance[f]								
M	152.2	158.4	175.0	179.5	177.2	178.7	175.3	180.5
SD	17.8	17.5	11.3	10.9	16.3	14.7	19.6	13.5

Note. $N = 80$; n per condition = 10.
[a] Average judgment per problem, 10 (low) to 100. [b] No. correct solutions on 31 problems. [c] 10 (*I'm not as good*) to 100 (*I'm much better*). [d] 10 (low) to 100. [e] Average judgment per problem, 10 (low) to 100. [f] No. problems completed.

Self-efficacy and skill

Pretest-to-posttest changes on each measure were evaluated within treatment conditions by using the t test for correlated scores (Winer, 1971). These analyses revealed that all eight experimental conditions experienced a significant gain in fractions self-efficacy and skill, range of t (9) values = 3.52 to 14.34, all p s < .01.

Posttest self-efficacy and skill were analyzed with a 2 × 2 × 2 (Number of Models: Single or Multiple × Type of Modeled Behavior: Mastery or Coping × Sex of Child: Male or Female) MANCOVA with the corresponding pretest measures as covariates. This analysis yielded significant main effects for number of models, Wilks's lambda = .827, F (2, 69) = 7.19, $p < .01$, and for type of modeled behavior, Wilks's lambda = .768, F (2, 69) = 10.44, $p < .001$, as well as a significant Number × Type interaction, Wilks's lambda = .858, F (2, 69) = 5.70, $p < .01$.

An ANCOVA applied to posttest self-efficacy revealed significant main effects for number of models, F (1, 71) = 7.43, $p < .01$, and for type of modeled behavior, F (1, 71) = 15.94, $p < .001$; the Number × Type interaction also was significant, F (1, 71) = 10.49, $p < .01$ (MSe = 163.50). Posttest means were evaluated by using Dunn's multiple-comparison procedure (Kirk, 1982). These analyses showed that the single-coping-model (M = 83.9), multiple-coping-model (M = 82.5), and multiple-mastery-model (M = 80.3) conditions did not differ but that subjects in each condition judged self-efficacy significantly higher than did subjects assigned to the single-mastery-model (M = 63.3) condition (all p s < .01).

The measure of posttest skill also was analyzed with an ANCOVA and yielded significant main effects for number of models, $F(1, 71) = 14.40$, $p < .001$, and for type of modeled behavior, $F(1, 71) = 18.45$, $p < .001$, as well as a significant Number × Type interaction, $F(1, 71) = 8.30$, $p < .01$ ($MS_e = 12.01$). Dunn's procedure revealed no significant differences among the single-coping-model (M = 12.7), multiple-coping-model (M = 13.4), and multiple-mastery-model (M = 12.3) conditions; each of these conditions, however, demonstrated significantly higher fractions skill than did children assigned to the single-mastery-model (M = 7.3) condition (p s < .01).

Videotape measures

An ANOVA applied to the perceived similarity measure yielded a significant main effect for type of modeled behavior, $F(1, 72) = 32.22$, $p < .001$, $MS_e = 328.33$. Observing a coping model (M = 55.3) led to significantly higher similarity judgments than did observing a mastery model (M = 32.3). Table 3 shows that the mean similarity judgments of coping-model subjects were in the 50–60 range (we're the same); the mean scores of mastery model children fell between 50 and the 10–20 (I'm not as good) end point. As in Experiment 1, therefore, observing a coping model led to perceptions of greater similarity in competence, compared with observing a mastery model. The interest measure yielded nonsignificant results.

On the measure of self-efficacy for learning, an ANCOVA revealed significant main effects for number of models, $F(1, 71) = 13.70$, $p < .001$, and for type of modeled behavior, $F(1, 71) = 21.91$, $p < .001$; the Number × Type interaction also was significant, $F(1, 71) = 10.10$, $p < .01$ ($MS_e = 126.77$). Dunn's procedure showed that subjects in the single-coping-model (M = 81.8), multiple-coping-model (M = 83.3), and multiple-mastery-model (M = 79.2) conditions judged self-efficacy for learning significantly higher than did those in the single-mastery-model (M = 62.3) condition (all p s < .01); the former three conditions did not differ from one another.
Training performance

An ANOVA yielded significant main effects for number of models, $F(1, 72) = 11.31$, $p < .01$, and for type of modeled behavior, $F(1, 72) = 9.99$, $p < .01$, and the Number × Type interaction was significant, $F(1, 72) = 10.08$, $p < .01$ ($MS_e = 240.01$). Multiple comparisons showed that children in the single-mastery-model (M = 155.3) condition completed significantly fewer problems during training than did subjects assigned to the single-coping-model (M = 177.3), multiple-coping-model (M = 177.9), and multiple-mastery-model (M = 178.0) conditions (all p s < .01), which did not differ from one another. Identical results were obtained when the proportion of problems that subjects solved correctly was used.

Correlational analyses

Intercorrelations among posttest self-efficacy, posttest skill, perceived similarity, self-efficacy for learning, and training performance (number of problems completed) revealed a pattern identical to that obtained in Experiment 1.

General Discussion

The results of these studies support the idea that the type of modeled behavior can have important effects in achievement settings. Children who observed a single peer model coping with initial difficulties but gradually learning to work fraction problems demonstrated higher self-efficacy for learning, training performance, posttest self-efficacy and skill, and judged themselves more similar in competence to the model, compared with children who observed a single peer mastery model. These benefits could not be due to instructional factors because the mastery- and coping-model treatments included the same type of teacher instruction. We also do not believe that attentional factors were responsible; children's judgments of their interest in viewing the videotapes did not differ as a function of treatment condition. The present results support the idea that perceived similarity in competence to models is an important means of conveying information about one's self-efficacy for learning (Bandura, 1986 ; Brown & Inouye, 1978 ; Schunk, 1985).

As Meichenbaum (1971) noted, however, the benefits of coping models can arise because of increased perceived similarity between observers and models or because of explicit modeling of coping techniques for overcoming difficulties. In the present studies, coping techniques were conveyed through the actions and verbalizations of the model, which stressed such factors as concentrating and working hard. Although the videotape teachers did not explicitly instruct the peer models to use these techniques, it is possible that subjects learned that increased concentration and hard work could produce better results. Such beliefs can raise self-efficacy (Bandura, 1986 ; Schunk, 1985). Future researchers might disentangle the effects of increased perceived similarity from those due to modeling of coping techniques by including a treatment in which a peer model uses coping techniques but demonstrates the rapid learning characteristic of a mastery model.

We wish to qualify the obtained benefits of observing a coping model because the subjects were children who had experienced difficulties learning mathematical skills and who had few, if any, prior successes with fractions. Therapeutic advantages of coping models typically involve fearful subjects in threatening situations fraught with failures (Kornhaber & Schroeder, 1975 ; Meichenbaum, 1971). In achievement settings, benefits of coping models might be obtained with students who find tasks anxiety provoking or who typically experience difficulties in learning new material. Among normal learners, observing a mastery model might promote self-efficacy better. Observation of a peer who is having difficulty learning could convey high task difficulty, which would not raise children's self-efficacy for learning (Schunk, 1985).

These considerations relate to attribution-retraining research in which students are taught to place greater emphasis on effort as a cause of successes and failures (Foersterling, 1985). Linking past failures with insufficient effort promotes effort attributions and persistence (Andrews & Debus, 1978 ; Dweck, 1975), and effort feedback for prior successes enhances children's motivation, self-efficacy, and skills (Schunk, 1982). The coping models in our studies were, in effect, making effort attributions for improved performance by stressing increased attention and hard work, whereas the mastery models emphasized high ability and low task difficulty. Given the remedial status of our subjects, it is likely that the coping models' statements seemed more credible. Research shows, however, that once children develop skills, ability attributions exert stronger effects on achievement behaviors (Schunk, 1985).

Experiment 2 demonstrated that observing several peers rapidly or gradually learning a cognitive skill promoted self-efficacy for learning, training performance, and posttest self-efficacy and skill as well as did observing a single coping model and better than did observing a single mastery model. These results support the idea that behavior change can be facilitated by exposing observers to multiple models (Bandura & Menlove, 1968 ; Kazdin, 1978 ; Marburg et al., 1976). Although benefits of diversified modeling can derive from subjects' perceiving themselves as similar in competence to at least one of the models (Thelen et al., 1979), children's similarity judgments did not differ as a function of number of models. Perceived similarity in competence is not the only means of conveying information about one's self-efficacy for learning (Bandura, 1986). Perceived similarity in competence may be a more important source of efficacy information when children are exposed to a single model and have a less diverse set of modeled cues to use in judging self-efficacy.

Exposing students to multiple models may not always promote self-efficacy. Remedial students who observe many normal learners solving problems may not feel very efficacious. In our study, children were unfamiliar with the models' mathematical learning capabilities and their typical performances. In contrast, children in school have more information about other students and can appraise their classmates' abilities quite realistically (Stipek & Tannatt, 1984). Children may give greater weight to perceived similarity in competence in judging their own self-efficacy when they have reliable information about their peers' learning abilities.

Experiment 1 yielded no significant effects due to sex of model or to sex of subjects. Although some researchers have shown that same-sex models exert more powerful effects on behavior than do cross-sex models, the appropriateness of modeled behavior seems more important than does the sex of the model (Bussey & Bandura, 1984 ; Perry & Bussey, 1979). Children perform the actions of cross-sex models when they view these actions as appropriate for their own sex. Learning to work arithmetic problems in elementary school is not a sex-typed activity. Sex differences in perceived capabilities and in mathematical performance do not reliably emerge until junior high school (Meece et al., 1982).

Consistent with previous similar research (Schunk & Hanson, 1985), the present studies support the idea that self-efficacy is not merely a reflection of prior performance. Although children's pretest efficacy judgments did not differ as a function of experimental treatment, between-conditions differences emerged following children's observations of the videotapes. It is likely that higher self-efficacy brought about by observing peer models was substantiated during the training program and led to higher performance on the posttest (Schunk, 1985). This study also shows that capability self-perceptions bear an important relation to subsequent achievement. Personal expectations for success are viewed as important influences on behavior in a variety of theoretical approaches to achievement (Corno & Mandinach, 1983 ; Covington & Beery, 1976 ; Schunk, 1985 ; Weiner, 1979).

In future research, peer modeling needs to be examined in greater detail for determining how children's self-efficacy and achievement are influenced by different model attributes. For example, researchers should determine whether multiple models and coping behaviors are beneficial with various types of tasks. When children believe that a task is easy, a single mastery model may promote children's self-efficacy, even among the present type of subjects. We also recommend conducting research in actual classrooms for addressing such questions as whether teacher modeling of coping techniques benefits children's achievement behaviors and how perceived similarity in competence affects children's learning efficacy when diverse cues concerning others' performances are available.

Footnotes

1 Of the 80 students in the final sample, 8 consulted the proctor at various times during the training program; they were proportionately distributed throughout the treatment conditions. In Experiment 2, 12 students consulted the proctor.

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