Reward Contingencies and the Development of Children's Skills and Self-Efficacy

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Abstract:

This experiment tested the hypothesis that rewards offered for performance attainments during competency development promote children's arithmetic skills and percepts of self-efficacy. Children received didactic instruction in division operations and were offered rewards contingent on their actual performance, rewards for simply participating, or no rewards. Results showed that performance-contingent rewards led to the highest levels of division skill and self-efficacy, as well as the most rapid problem solving during the training program. In contrast, offering rewards for participation resulted in no benefits compared with offering no rewards. The findings suggest caution in how rewards are distributed in educational contexts.

Article:

According to Bandura (1977b), reinforcing consequences inform and motivate. As persons engage in activities, they notice the differential consequences of their actions. They thereby learn which behaviors lead to desirable outcomes and which result in un-desirable ones. Such information guides future behavior. Further, the anticipation of attaining desirable outcomes motivates behavior. The capacity to represent valued future outcomes in thought promotes initial task engagement and persistence.

The purpose of the present study was to determine the effects of tangible, extrinsic rewards offered in the context of arithmetic competency development on children's task mastery and percepts of self-efficacy. The conceptual focus was Bandura's theory of self-efficacy (Bandura, 1977a, 1981). According to this theory, different influences change behavior in part by strengthening percepts of self-efficacy. Self-efficacy is concerned with judgments about how well one can organize and implement courses of action in situations that may contain novel, unpredictable, or stressful elements. Percepts of efficacy can affect choice of activities, effort expended, and persistence in the face of difficulties. Efficacy information is conveyed through enactive attainments, socially comparative vicarious means, social persuasion, and indexes of physiological arousal.

In this conception, the anticipation of a rewarding consequence should promote children's skill development and percepts of self-efficacy. The motivational effects of reward anticipation should boost task accomplishments. As children observe their progress they develop a heightened sense of efficacy, which should help sustain task involvement and lead to greater skill development.

As compelling as these ideas sound, research has yielded mixed results on the effects of offering a reward for performance. Studies have shown that rewards facilitate performance, have a detrimental effect on performance, or have no effect. For example, offering a reward has been shown to boost performance on simple, unchanging tasks where performance is measured by rate or speed (McCullers, 1978), as well as on more complex tasks such as paired-associate learning (Goyen & Lyle, 1971), perceptual recognition (Glucksberg, 1962), and serial learning (Dornbush, 1965). Conversely, detrimental effects have been obtained with tasks requiring concept learning (McCullers & Martin, 1971), discrimination learning (Miller & Estes, 1961), and problem solving (Glucksberg, 1962).

In an attempt to reconcile these contradictory findings, McGraw (1978) proposed that experimental tasks be distinguished by whether they require an algorithmic or heuristic solution and by whether they are initially attractive or aversive. When a task is initially attractive and requires a heuristic solution, offering a reward should have a detrimental effect on performance. For the other combinations, rewards may facilitate or have no effect on performance, depending on whether subjects initially view the task as aversive or attractive, respectively.

In the present study, children who lacked division skills individually received instruction and opportunities to solve division problems, One group of children (performance-contingent reward) were told that they would receive points for each problem they completed and that they could exchange the points for prizes. A second group (task-contingent reward) were told that they would receive points for engaging in the task and that the points could be exchanged for prizes. A third group (unexpected reward) were not offered prizes but unexpectedly were allowed to choose prizes at the end of training.

McGraw's (1978) analysis suggests that the present use of rewards should promote skill development and perceived efficacy: Division requires an algorithmic solution, and the present sample of children who displayed low mathematical achievement was not expected to view the task in an attractive light. In studying the effects of reward anticipation, however, it is important to differentiate between rewards used to regulate behavior and those employed to foster skill development (Bandura, 1981). Telling children that they can earn rewards based on enactive accomplishments conveys a sense of efficaciousness that can be actualized through effort. This sense of efficacy is subsequently validated as children observe their actual progress. Heightened efficacy should sustain task involvement and pro-mote skills. Efficacy is further validated on receipt of the reward since it symbolizes in concrete fashion the progress that children have made.

In contrast, when rewards are offered merely for participating in a task, children should not experience a heightened sense of efficacy. Further, such rewards actually may convey negative efficacy information: Children may infer that they are not expected to accomplish much and that they do not possess the requisite efficaciousness to perform well. Subsequent task accomplishments and skill development should be lower than that obtained under a reward system tied to enactive attainments.

In summary, it was hypothesized that offering rewards for performance attainments would be most effective in promoting children's skills and percepts of self-efficacy. In contrast, offering rewards for task participation was not expected to promote these outcomes over that expected as a function of merely providing training.

Method

Subjects

Subjects were 36 children drawn from two elementary schools. They ranged in age from 8 years 9 months to 1 years 5 months (*M* = 10.1 years). The 11 boys and 25 girls represented diverse socioeconomic backgrounds but were predominantly middle class. Because this study focused on processes whereby skills could be developed when they were initially lacking, teachers were shown the division skill test and identified children who they thought could not solve correctly more than about 30% of the problems. These children were individually administered the pretest by one of two adult female testers.

Pretest

Self-efficacy judgments. Children's percepts of self-efficacy for solving division problems were measured following procedures developed earlier (Bandura & Schunk, 1981; Schunk, 1981, 1982a). The efficacy scale ranged from 10 to 100 in 10-unit intervals from high uncertainty through intermediate values to complete certitude where the higher the scale value, the stronger was the perceived efficacy. Initially, children were given practice with the efficacy assessment by judging their certainty of being able to jump progressively longer distances ranging from a few inches to several yards. In this concrete fashion, children learned how to use the numerical scale values to convey the strength of their perceived efficacy.

Following this practice, children were shown 14 sample pairs of division problems for about 2 sec each. This procedure allowed children to assess problem difficulty, but the time was too brief to attempt solutions. The two problems constituting each pair were similar in form and operations required. For each sample, children privately judged their certainty of being able to solve the type of problem depicted by circling an efficacy value.

Each pair of problems corresponded in form and operations required to one problem on the subsequent skill test but they were not the same problems. Children were judging their capability to solve types of problems and not whether they could solve any particular problem. The measure of self-efficacy was the number of judgments recorded in the upper half (certainty side) of the efficacy scale.

Division skill test. Immediately following the efficacy assessment, children received the skill test, consisting of 14 division problems ranging from one to three digits in the divisor and two to five digits in the dividend. Of these 14 problems, one half were similar in form and operations required to some of the problems presented during the subsequent training phase, whereas the remaining problems were more complex. For example, during training children had to "bring down" numbers at most twice per problem, whereas some skill-test problems required that children bring down three numbers. The measure of skill was the number of problems that children solved correctly; small computational errors were discounted.[1]

The tester presented problems to children one at a time. Children were instructed to examine each problem and to place the page on a completed stack when they were through solving it or chose not to work it any longer. Children were given no performance feedback. The tester also recorded the time children spent with each problem. These persistence times were summed across problems and averaged.

Training Procedures

Children were randomly assigned within sex and school to one of three treatment groups (ns 12): performance-contingent reward, task-contingent reward, and unexpected reward. On two consecutive school days children received 40-minute training sessions during which they worked on two packets of instructional material. Each packet followed the same format except that the first packet covered one-digit divisors, whereas the second packet covered two-digit divisors. The first page of each packet contained a step-by-step worked example that involved bringing down one number. The second page contained a practice problem. The next several pages contained two to three problems per page to solve. Sufficient problems were included so that children could not complete all of them during the session; the two packets included 15 pages (38 problems) and 12 pages (24 problems), respectively.

Children were brought individually to a large room by one of two adult female proctors and were seated at desks that faced away from one another to preclude visual and auditory contact. For each child, the proctor had not administered the pretest and was blind to the child's experimental assignment. Initially, the proctor verbally reviewed the explanatory page by reading from a narrative while pointing to the example. If children asked for further assistance, the proctor simply reread the relevant narrative but did not supplement it in any way.

After children worked the practice problem, the proctor opened an envelope that contained the child's treatment assignment. The proctor then gave the appropriate experiment al instructions depending on the child's treatment condition. The proctor stressed the importance of children working the problems carefully and on their own and retired to an out-of-sight location. Children retained the explanatory page while solving problems alone.

Treatment Conditions[2]

Performance-contingent reward. The proctor in-formed these children that because they agreed to participate in the project they would earn five points for each problem completed during each session and that at the end of the second session they could exchange their points for prizes equal in monetary value to the points. The proctor then showed children the prizes, which included magic markers, erasable pens, stickers, and small notebooks. The importance of careful work was stressed to discourage children from proceeding through the packet carelessly; this instruction also was given in the other two conditions. At the end of the second session, the proctor totaled children's points and children chose their prizes.

Task-contingent reward. The proctor informed these children that because they agreed to participate in the project they would receive some prizes at the end of the second session. The proctor then showed children the prizes and explained that they would draw a number from a hat and that this would equal the monetary value of' their prizes. At the end of the second session, children drew the number $2.00 from a hat. This number was chosen since pilot work indicated that with diligent effort children could complete 40 problems. This group controlled for the effects of reward anticipation included in the performance-contingent condition.

Unexpected reward. These children were not in-formed of any reward contingency. At the end of the second session, they were told that because they agreed to participate in the project they could draw a number from a hat and choose prizes. All children drew the number $2.00. This group controlled for the effects of receiving training and a reward included in the other treatments.

Posttest

Efficacy judgments and division skill were reassessed the day after the second treatment session. The procedures were similar to those of the pretest except that a parallel form of the skill test was used and self-efficacy was assessed before and after the skill test. Children were informed prior to these assessments that the reward contingencies were not, in effect.

A parallel form of the skill test was used to eliminate possible familiarity with the problems. In a separate reliability assessment, these forms were highly correlated among a sample comparable to the present one, $r(13) = .86$, $p < .01$ (Schunk, 1982b). The self-efficacy scores collected prior to the skill test yield a measure of treatment effects and can be used to determine the relationship of self-efficacy to subsequent performance. Self-efficacy measured after the skill test shows whether perceived efficacy is affected by testing. For any given child, the same tester administered both the pre- and posttests. The tester was blind to the child's experimental assignment and had not served as the child's proctor. All tests were scored by an adult who was unaware of children's, experimental assignments.

Table 1
Pre- and Posttest Means and Standard Deviations

		Reward condition					
		Performance-contingent		Task-contingent		Unexpected	
Measure	Phase	*M*	*SD*	*M*	*SD*	*M*	*SD*
Skill[a]	Pretest	2.5	1.8	2.6	2.8	2.2	2.2
	Posttest	8.2	2.1	3.1	2.8	3.2	3.4
Persistence[b]	Pretest	53.9	46.5	47.9	32.1	43.0	40.8
	Posttest	74.3	54.9	56.5	26.9	58.9	35.0
Self-efficacy[c]	Pretest	5.2	2.9	3.9	4.1	5.0	3.6
	$Posttest_1$[d]	10.3	2.9	4.3	2.1	6.6	3.7
	$Posttest_2$[e]	10.7	2.7	5.3	1.8	6.1	3.3
Training progress[f]	Session 1	26.4	6.1	27.2	5.6	25.5	7.0
	Session 2	15.7	3.4	12.3	4.7	8.0	6.4

Note. $N = 36$; $ns = 12$.
[a] Number of accurate solutions on 14 problems.
[b] Average number of sec per problem.
[c] Number of efficacious judgments; maximum = 14.
[d] Measured before the skill test.
[e] Measured after the skill test.
[f] Number of problems completed.

Results

There were no significant differences due to tester, school, or sex of child on any pre- or posttest measure, nor were there any significant interactions. The data were therefore pooled for subsequent analyses. Treatment groups did not differ significantly on any pretest measure nor on amount of money earned (performance-contingent reward M = \$2.10). Pre- and posttest means and standard deviations are shown by experimental condition in Table 1. Analysis of covariance (ANCOVA) procedures were applied to each posttest measure using the appropriate pretest measure as the covariate. The three experimental conditions constituted the treatment factor. Two covariance analyses were performed on self-efficacy. To assess treatment effects, posttest judgments collected prior to the skill test were analyzed using the pretest measure as the covariate, whereas to gauge testing effects, judgments recorded after the skill test were analyzed with the efficacy measure prior to the skill test as the covariate. Significant F ratios were further analyzed using the Newman-Keuls multiple comparison test (Kirk, 1968).

The use of an ANCOVA necessitated homogeneity of slopes across experimental conditions (Kerlinger & Pedhazur, 1973). Tests of slope differences for each measure were made by comparing a linear model that allowed separate slopes for each experimental condition against one that had only one slope parameter for estimating the pre—posttest relationship across the three treatments. These analyses found the assumption of slope homogeneity across treatments to be tenable.

Skill

An ANCOVA yielded a significant treatment effect, $F(2, 32) = 16.45$, $p < .001$. Newman-Keuls comparisons showed that performance-contingent reward subjects exhibited significantly ($p < .01$) higher division skill than each of the other conditions, which did not differ significantly from one another.

Persistence

An ANCOVA yielded a nonsignificant F ratio on this measure. It is apparent that persistence reflects in part factors not addressed in this study, such as work-rate preference. Some children may prefer to work slowly, whereas others work more rapidly.

Self-Efficacy

Analysis of self-efficacy judgments collected prior to the skill test revealed a significant treatment effect, $F(2, 32) = 13.34$, $p < .001$. Performance-contingent reward children made significantly ($p < .01$) more efficacious judgments than children in the other treatments, which did not differ from one another. Analysis of self-efficacy judgments collected after the skill test yielded a similar pattern, $F(2, 32) = 3.49$, $p < .05$.

Training Progress

To determine whether the offer of performance-contingent rewards led to more rapid problem solving during the training sessions, the number of problems that children completed during each of the two training sessions was analyzed using analysis of variance. No significant differences were found for the first session. A significant treatment effect was obtained on the more difficult two-digit divisor problems covered during the second session, $F(2, 33) = 7.07$, $p < .01$. Performance-contingent reward children completed significantly ($p < .01$) more problems than did children in the other groups, which did not differ from one another. The higher problem-solving rate of the performance-contingent subjects was not attained at the expense of accuracy. A similar pattern of results was found using the number of problems that children solved correctly; as before, small computational errors were discounted.

Correlational Analyses

Correlational analyses were conducted to gain information on the relationship of theoretically relevant variables. Pearson product-moment correlations were computed separately for each experimental condition. Since there were no significant between-group differences, correlations were averaged using an r to z transformation (Edwards, 1976).

Children's posttest percepts of self-efficacy measured before the skill test were related significantly to subsequent persistence, $r(34) = .43$, $p < .01$, and to skillful performance, $r(34) = .70$, $p < .001$. Persistence was correlated significantly with skill, $r(34) = .52$, $p < .01$.

Correlations also were computed between the posttest variables and training progress, defined as the number of problems completed. No significant correlations were found using first-session progress. However, rate of second-session problem solving was significantly related to posttest skill, $r(34) = .54$, $p < .001$. The same pattern of results was obtained using the number of problems solved correctly.

Discussion

The present study provides evidence that offering performance-contingent rewards promotes children's task accomplishments, percepts of efficacy, and skill development. In contrast, offering children rewards for simply participating at a cognitive-learning task does not promote these outcomes over what results from merely providing training. These findings are consistent with predictions from self-efficacy theory (Bandura, 1981). Children who are told that they can obtain rewards based on their performance attainments are apt to be motivated to work diligently. The offer of a reward for progress also conveys to children a sense of efficacy that can be actualized through effort. Percepts of efficacy are subsequently validated as children observe their actual progress. In contrast, offering children a reward simply for engaging in a task may convey that progress is not important and could even undermine percepts of efficacy if children infer that they must be low in ability because no performance expectations are provided.

The present results also can be interpreted along other lines of theorizing. Deci, for example, distinguishes between informational and controlling functions of rewards (Deci, 1975; Deci & Porac, 1978), Reward systems may be primarily structured to convey information about one's capabilities or to control behavior, and the relative salience of each influences subsequent behavior. A salient informational aspect indicating successful performance should promote feelings of competence, whereas a salient controlling aspect can lead to perceptions of the reward as the cause of the behavior. Although it is possible that some performance-contingent children viewed the rewards as controlling their behavior, the informational aspect of these rewards should have been highly salient, since they were clearly tied to progress. Conversely, the task-contingent rewards conveyed nothing about children's capabilities. To the extent that these children viewed the rewards as controlling, it was the more salient aspect.

A related explanation derives from self-perception theory (Bem, 1967, 1972). Individuals form perceptions of the causes of their behavior and believe that given behaviors are primarily extrinsically or intrinsically motivated. Persons are more likely to believe that they are extrinsically motivated when rewards are salient, clear, and sufficient to account for the behavior. One factor that may influence young children's self-perceptions is how much they are distracted from thinking about the rewards; the more they are distracted, the less likely they should be to perceive the rewards as salient causes of behavior. Because performance-contingent children knew that rewards were dependent on progress, they may have attended more to solving problems and thereby may have been more distracted from thinking about the rewards than were task-contingent subjects. The fact that the former group solved problems more rapidly during the second training session supports this idea. Further, Ross (1975) found that children who were distracted from thinking about a reward demonstrated greater sub-sequent task engagement than children who were instructed to think about the reward and those who were promised a reward but were given no ideation instructions.

The present study replicates previous findings that, even in enactive contexts, judgments of self-efficacy are not mere images of past accomplishments (Bandura & Schunk, 1981; Schunk, 1981, 1982a, 1982b). The number of problems that children completed during training was not significantly correlated with subsequent judgments of self-efficacy. This is not surprising. Efficacy appraisal is an inferential process that involves weighting the relative contribution of personal and situational factors. In addition to information derived from past performances, efficacy appraisal is influenced by the perceived difficulty of the task, amount of effort expended, type of external aid received, situational circumstances under which the performance occurred, and the temporal patterns of success and failure. Future research should explore children's perceptions of these factors to determine how children weight and combine sources of efficacy information to form efficacy judgments.

These ideas are consistent with predictions from self-worth theory (Beery, 1975; Covington & Beery, 1976). Individuals in our society strive to maintain a self-image of high ability because their self-worth depends on the ability to achieve. Failure is to be avoided, and students who perceive that they are low in ability may demonstrate self-serving biases in judging their capabilities. For example, they may judge their capabilities unrealistically low to insure success, or they may overestimate grossly what they can do such that failure does not reflect a lack of ability. Such self-serving tendencies were probably less pronounced among performance-contingent children who developed greater skill and likely were more certain of their capabilities.

A number of theoretical perspectives stress the idea that self-expectations constitute an important variable in under-standing subsequent behavior (Bandura, 1981; Covington & Beery, 1976; Kukla, 1972; Weiner, 1977). The present study provides some support for this idea, because children's perceptions of their capabilities bore a significant relationship to subsequent skillful performance. Previous research also has shown that expectations for success are one of the best predictors of later performance (Covington & Omelich, 1979; Schunk, 1981). This study also has practical significance. Parents and teachers often offer children rewards for working at a task. The present results suggest that this practice has limited benefits. Although it is true, as Lepper and Greene (1978) point out, that engaging in a task over time should result in increased skill proficiency, mere task engagement may not convey much valid information to children concerning their capabilities. When re-wards are clearly tied to progress, children receive additional information on what they are capable of doing. The prevalence of re-wards in our educational systems suggests a closer look to determine how well their use is enhancing skills and promoting a sense of personal efficacy.

Notes:

[1] This scoring method reflects children's division skills more accurately than one requiring perfect accuracy, by which children who correctly apply division operations but make a small error in subtraction are penalized as much as children who fail to work the problem. Skill data using the perfect-accuracy scoring method were analyzed and yielded similar results to those reported.

[2] Although experimental treatments were counter-balanced across schools, the order of administration within each school was unexpected reward, task-contingent reward, and performance-contingent reward. This order was followed because I felt that the reward variable could be a dynamic one and that children might discuss the contingencies with one another. Had the three conditions been run simultaneously, children in the task-contingent and unexpected reward groups might have been discouraged because they could not earn points. Children were randomly assigned to conditions, and the short duration of' the study mitigated any systematic between-condition differences due to intervening classroom experiences.

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