# Progress Self-Monitoring: Effects on Children's Self-Efficacy and Achievement

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## Abstract:

This experiment investigated the effects of progress self-monitoring on children's achievement and percepts of self-efficacy in the context of mathematical competency development. Children lacking subtraction skills received didactic instruction in subtraction and practice opportunities. Some children (self-monitoring) monitored their own progress after each training session, whereas others (external monitoring) had their progress monitored by an adult. A third group received no monitoring. Results showed that self- and external monitoring led to significantly higher percepts of efficacy, skill, and persistence compared with no monitoring. The two progress monitoring conditions did not differ significantly on these measures. The utility of self-monitoring procedures in actual classrooms is discussed.

## Article:

There is growing interest in the role of self-regulation as a means of initiating and maintaining behavioral change (2, 12). The self-regulation process consists of three distinct components: self-monitoring, self-evaluation, and self-reinforcement (10, 11). Self-monitoring refers to deliberate attention to some aspect of one's behavior, and is often accompanied by recording its frequency or intensity. During self-evaluation, persons compare their level of attainment against some desired performance standard. Depending on the outcome of the evaluation, some form of self-reinforcement may then be administered. Feelings of self-satisfaction and perceptions of competence result when attainments match standards, whereas a perceived negative discrepancy between attainments and desired performance level should motivate individuals to strive toward improvement.

The purpose of the present study was to determine how self-monitoring of instructional progress in the context of children's arithmetic competency development affects achievement and percepts of self-efficacy. The conceptual focus was Bandura's theory of self-efficacy (1, 3). According to this theory, psychological procedures change behavior in part by strengthening perceived self-efficacy. Self-efficacy is concerned with judgments of how well one can organize and execute courses of action required in situations that may contain novel, unpredictable, and stressful elements. Percepts of efficacy can affect choice of activities, effort expended, and perserverance in the face of difficulties. Efficacy information is conveyed through enactive attainments, socially comparative vicarious measures, social persuasion, and inferences from physiological arousal.

Self-monitoring was originally employed in the larger context of therapeutic programs to determine the baseline rate of behaviors targeted for alteration. However, research using a variety of behaviors and different subject populations has demonstrated that self-monitoring in the absence of over self-imposed standards or reinforcement contingencies promotes behavioral change (5, 9, 13, 14, 17, 18). In one study (19), students periodically monitored their performances during mathematics sessions and recorded whether or not they were working on the appropriate instructional materials. Self-monitoring alone significantly increased students' time on task and mathematical achievement.

Where explicit performance standards and reinforcement contingencies do not exist, the effectiveness of self-monitoring may depend on the extent to which covert self-evaluation occurs (10, 19). In the self-efficacy analysis (1, 3), self-monitoring of instructional progress should promote and validate percepts of efficacy, as well as boost achievement. As children observe their progress while engaged in a cognitive learning task they experience a heightened sense of efficacy. Explicit monitoring to include recording of one's performance attainments provides a reliable guide to progress and helps validate percepts of efficacy. A strong sense of efficacy for being able to perform cognitive tasks should sustain subsequent task involvement and promote achievement.

In the present study, children who had failed to master subtraction operations in their regular classrooms received didactic instruction and opportunities to solve subtraction problems over several sessions. One group of children (self-monitoring) reviewed their work at the end of each training session and recorded the number of pages they completed. To investigate the effects of monitoring procedures more generally, a second group (external monitoring) had their work reviewed at the end of each session by an adult proctor who recorded the number of pages completed. To control for the effects of providing instruction, a third group (no monitoring) received the competency development program but no monitoring. Children were not provided with explicit performance standards, nor were overt reinforcement contingencies in effect.

If self-monitoring derives its effectiveness largely from covert self-evaluative processes (10, 19), then the monitoring agent may be less important than the monitoring itself since self-evaluation could conceivably occur as a result of monitoring by others. Self- and external monitoring were therefore expected to prove equally effective in promoting children's achievement and percepts of efficacy. In the absence of monitoring, however, children are on their own to gauge their progress. Since they might not do this, perceived efficacy may not be validated. These children were therefore expected to feel less efficacious and achieve less than those receiving either form of progress monitoring.

## Method

### *Subjects*

Subjects were 30 predominantly middle-class children ranging in age from 8 years, 6 months to 9 years, 5 months (mean age = 8.8 years). The 15 males and 15 females were drawn from two elementary schools. Since this study focused on processes whereby skills and percepts of efficacy could be cultivated when they were initially lacking, teachers were initially shown the subtraction skill test and nominated children who they felt could not solve correctly more than 25% of the problems. Children where individually administered the pretraining assessment by one of two female adult testers.

### *Procedure*

#### Pretraining Assessment

***Self-efficacy judgments.*** Children's percepts of self-efficacy for correctly solving subtraction problems were measured following procedures of previous research (4, 20, 21). 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 the perceived efficacy. Initially, children were given practice by judging their certainty of being able to jump progressively longer distances ranging from a few inches to several yards. This practice familiarized children with the scale's direction and general meaning of the values.

Children then were shown briefly 18 sample pairs of subtraction problems, which allowed assessment of difficulty but not actual solutions. For each pair, children privately judged their certainty of being able to solve correctly the type of problem depicted by circling an efficacy value. Each problem pair corresponded in form and operations required to one problem on the skill test, but they were not identical. Children were judging their capability to solve types of problems and not whether they could solve any particular problem. Self-efficacy was scored as the number of judgments in the upper-half (certainty side) of the efficacy scale.

***Subtraction skill test.*** Immediately following the efficacy assessment, children received the subtraction skill test consisting of 18 problems ranging from two to six columns. Each problem tapped one of the following operations: no borrowing, borrowing once, borrowing from a one, borrowing twice, and borrowing caused by a zero. These problems were similar in form and operations required to some of the problems children would subsequently solve during training. 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 the problem or chose not to work on it any longer. They were given no performance feedback. The measure of skill was the number of problems that children solved correctly. The tester also recorded the time children spent with each problem. These persistence times were summed across problems and averaged.

## Training Procedures

Following pretesting, children were randomly assigned within sex and school to one of three conditions *(N* = 10): self-monitoring, external monitoring, no monitoring. On three consecutive school days, children received 30-minute training sessions, during which they worked individually on an instructional packet consisting of six sets of material. Each set covered a different subtraction operation and they were ordered in terms of least-to-most difficult (6) as follows: no borrowing, borrowing once in 2-column problems, borrowing once in 3-column problems, borrowing once caused by a zero, borrowing twice, and borrowing from a one. The format of each set was identical. The first page contained written explanation of the subtraction operation and two step-by-step worked examples. The next six pages each contained several problems to solve.

Children were brought individually by an adult proctor and were seated at desks spread over a large area to preclude visual and auditory contact with others. Initially, the proctor placed the entire packet in front of the child. The proctor then showed the children the first explanatory page and informed them that whenever they arrived at a similar page they were to bring it to the proctor. The proctor then read the narrative on this page while pointing to the exemplified operations. If children asked for further assistance, the proctor simply reread the relevant instructions but did not supplement them. The proctor stressed the importance of careful work and then retired to an out-of-sight location. Children solved problems alone. The proctor returned at the end of the session and gave the appropriate monitoring instructions but did not score the children's papers. Children marked their places in the packet by drawing a line and resumed there the following day.

## Monitoring Conditions

***Self-monitoring.*** The proctor instructed these children at the end of each session to count the number of pages they completed during the period and to record that number on the progress sheet which was a separate page filed at the end of the child's training packet. It contained the child's name and space to record the number of pages completed each session. The proctor departed immediately after giving these instructions; children recorded their progress privately. Children departed once they recorded their pages, after which the proctor returned and checked NA whether the children had done so. All children did for each session. In two instances, children erroneously counted one page short, but the proctor did not correct these errors.

***External monitoring.*** This condition was similar to self-monitoring except that the proctor counted and recorded the child's pages at the end of each session while the child observed: The proctor did this matter-of-factly and without any accompanying verbal reinforcement.

***No monitoring.*** Children in this condition received the same instructional material and practice opportunities as subjects in the preceding conditions but no monitoring. At the end of each session, the proctor simply informed children that the period was over.

## Posttraining Assessment

The posttest was administered individually by an adult tester the day after the third training session. It was similar to the pretest except that a parallel form of the skill test was employed to eliminate possible familiarity with the problems. In a separate assessment (4) using children similar to the present sample, these forms were

highly correlated, $r = .87$. For any given child, the same tester administered both pre- and post-assessments and was blind to the child's experimental condition.

## Results

Means and standard deviations by experimental condition are presented in Table 1. Preliminary analyses of variance revealed no significant differences due to tester, school, or sex of child on any pre- or posttest measure nor any significant interactions; the data were pooled across these variables. There were no significant between-condition differences on any pretest measure. Analysis of covariance procedures were applied to each posttest measure using the appropriate pretest measure as the covariate. Significant results were further analyzed using the Newman-Keuls multiple comparison test (16). Since the use of analysis of covariance necessitated demonstration of slope homogeneity across treatment groups (15), tests of slope differences for each measure were made by comparing a linear model that allowed separate slopes for the three treatment groups against one that had only one slope parameter for estimating the pre-posttest relationship pooled across treatments. These analyses found the assumption of slope homogeneity across treatments to be tenable.

For the measure of subtraction self-efficacy, analysis of covariance yielded a significant treatment effect, $F(2,26) = 7.60$, $p < .01$. Post-hoc comparisons revealed that the two monitoring conditions did not differ significantly from one another but each made significantly ($p < .01$) more efficacious judgments than the no monitoring condition.

A significant treatment effect was also obtained on the skill measure, $F(2,26) = 7.14$, $p < .01$. Children who received monitoring procedures exhibited significantly ($p < .01$) higher subtraction skill than did no monitoring subjects. The two monitoring conditions did not differ significantly.

**Table 1—Means and Standard Deviations**

| Measure | Phase | Experimental Condition: Self-monitoring $\bar{X}$ | Self-monitoring *SD* | External monitoring $\bar{X}$ | External monitoring *SD* | No monitoring $\bar{X}$ | No monitoring *SD* |
|---|---|---|---|---|---|---|---|
| Self-efficacy[1] | Pretest | 5.1 | 1.8 | 4.8 | 2.0 | 5.0 | 2.1 |
| | Posttest | 15.6 | 2.3 | 14.9 | 2.6 | 7.2 | 4.7 |
| Skill[2] | Pretest | 2.5 | 1.7 | 2.7 | 1.4 | 2.4 | 1.5 |
| | Posttest | 13.3 | 2.9 | 12.1 | 3.3 | 5.8 | 3.4 |
| Persistence[3] | Pretest | 15.7 | 8.3 | 17.2 | 10.1 | 14.8 | 6.9 |
| | Posttest | 30.6 | 10.7 | 33.7 | 12.1 | 18.6 | 10.0 |
| Progress[4] | — — — | 29.3 | 4.6 | 27.5 | 4.7 | 26.1 | 3.2 |

NOTE: $N = 30$; $n = 10$.
[1]Number of efficacious judgments on 18 problems.
[2]Number of accurate solutions on 18 problems.
[3]Average number of seconds per problem.
[4]Number of pages completed out of 36 during training.

Analysis of covariance yielded a similar treatment effect on the persistence measure, $F(2,26) = 6.85$, $p < .01$. Children who received monitoring subsequently persisted on test problems significantly longer ($p < .01$) than did children whose training progress was not monitored, e.g., the monitoring groups did not differ.

No hypothesis was advanced concerning the effects of monitoring on instructional progress. To investigate this possibility, an analysis of variance was applied to the number of pages of problems the children completed during the training sessions. This result was nonsignificant. The same finding was obtained using the number of training problems that children solved correctly.

## Discussion

The present study demonstrates that progress monitoring in the context of competency development is highly effective in promoting percepts of efficacy and achievement. Further, it was the monitoring process itself, and not the monitoring agent, that was important. These beneficial outcomes were obtained even though experimental conditions did not differ on measures of instructional progress.

These results may be explained as follows. As children observe their progress during training, they develop a heightened sense of efficacy (3). Subsequent monitoring directs children's attention to the work they completed and provides an objective indicant of progress, which helps to validate perceived efficacy. In a subsequent test situation in which children decide how long to spend on problems, a heightened sense of efficacy sustains task involvement and results in greater achievement. Conversely, when children's performances are not monitored they are on their own to assess their progress. Even though skills develop, children may be unsure of their capabilities. During testing, lower percepts of efficacy lead to less persistence and lower achievement.

Data analyses revealed no differences in any measure due to monitoring agent. In many classroom situations, self-monitoring would seem preferable to external monitoring. Once teachers had instructed students on how to monitor their progress, self-monitoring would allow teachers to devote more time to other matters. Self-monitoring also allows students to gain capability information on their own. This should help foster a more general sense of responsibility for mastering cognitive learning, which is an important developmental task accomplished chiefly in school (3).

The present self-monitoring procedure included elements of reviewing and recording. Future research might examine whether recording promotes achievement outcomes beyond the effects due to reviewing. From a developmental perspective, recording of progress may be highly important for young children who tend to have short time frames of reference and who may not always be cognizant of what they have accomplished. As children develop, they become better able to keep prior progress information in mind.

This study supports the theoretical idea that judgments of self-efficacy are not mere reflections of past performance (3). This idea has been supported by previous research in the area of achievement behavior (4, 20, 21). Although experimental conditions did not differ in instructional progress, subjects who received monitoring later judged efficacy significantly higher.

This is not surprising since judgments of personal capabilities derived from one's performance vary depending on the weight placed on personal and situational factors that affect how one performs (3). In forming efficacy judgments, persons weigh the relative contribution of ability and nonability factors, such as perceived task difficulty, effort expended, amount of external aid received, situational circumstances under which the performance occurs, temporal pattern of successes and failures, and evaluative standards against which performances are appraised.

The self-monitoring process bears a striking resemblance to the procedures involved in goal setting. Goal setting represents a form of self-motivation in which persons compare present performances to internal standards (2, 22). The anticipated satisfaction of attaining a goal leads to sustained involvement until performances match standards. Goal-setting procedures can be easily integrated with regular classroom instruction (7, 8). A system in which students pursue attainable goals and periodically monitor their progress toward those goals should prove highly effective in cultivating skills and validating a sense of efficacy for applying them.

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