The Effects of Self-Recording on the Academic Performance of Elementary School Students

Saundra Eileen Epps Landry
Western Michigan University

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THE EFFECTS OF SELF-RECORDING ON THE ACADEMIC PERFORMANCE OF ELEMENTARY SCHOOL STUDENTS

by

Saundra Eileen Epps Landry

A Project
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Educational Specialist
Department of Psychology

Western Michigan University
Kalamazoo, Michigan
December 1980
Third-grade, regular education students participated in an experimental program that sought to examine the effects of self-recording on elementary student academic achievement. The experiment employed a multiple baseline design across 31 subjects, two settings, and curriculum (reading and mathematics). The subjects were introduced to the following conditions: Baseline, self-recording, baseline, self-recording, baseline. Results indicated that self-recording, alone, is an effective procedure for increasing academic achievement. Random responding, by some, indicated that further research is needed in this area.
ACKNOWLEDGEMENTS

I am grateful for the guidance, support, and confidence of my advisor, Dr. Howard Farris. I give thanks to Steve Ragotzy, Steve Hadden, Dave Lennox, and William Redmond for their assistance in this endeavor. A special thanks goes to my family for their patience, love, and encouragement.

Saundra Eileen Epps Landry
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INTRODUCTION

Academic achievement has been a primary concern of educators throughout history. All of us have some knowledge of the various methodology that has been employed by educators to achieve that goal, for all of us have experienced exposure to a public or a private school system. Methodology has ranged from segregation, humiliation, ostracism, and spankings; to praise, challenge, discovery, and rewards. Historically, low achievers have experienced the former, while high achievers have experienced the latter.

Behavioral methodology has empirically demonstrated that all students can experience academic achievement. "Herber found that enriched instruction in the first six years with children whose mothers were retarded produced a 30-point IQ advantage" (Becker, Engelmann, & Thomas, 1975, p. 209). Furthermore, academic achievement has been directly related to curriculum planning, teaching techniques, and classroom management (Engelmann, 1969; Becker, Engelmann, & Thomas, 1975; Becker and Engelmann, 1976).

A review of the literature within the area of behavioral analysis revealed that the various strategies researched to determine their effectiveness in facilitating student academic achievement can be categorized as: 1) contingent reinforcement of the appropriate behaviors and/or 2) restructuring of the learning environment.

Contingent reinforcement can be simply defined as the delivery of an object or event upon the occurrence of a defined behavior, a
behavior that occurs at a specific rate and/or level of accuracy. When objects or events, that are delivered upon the occurrence of a defined behavior, result in an increase or maintenance of the defined behavior, then those objects or events can be labeled "reinforcers."

The usefulness of tokens and points as reinforcing stimuli has been demonstrated in many studies that have chosen academic performance as the focus of their experimentation. The reinforcement of accurate responding, resulting in an increase in the number of math problems answered correctly was demonstrated by Hundert and Bucher (1976). Five boys, who were enrolled in a psychiatric hospital school acted as subjects. The boys had a past school history of discipline problems and of failing at least one grade in their regular school. During the study the boys earned points for the accurate completion of a predetermined number of problems. When a subject accumulated a minimum number of points, he could exchange them for a preselected toy (e.g. model airplane, toy gun). Contingent reinforcement of correct work resulted in an increase of the group mean performance. A mean increase of 6.4 problems answered correctly was seen.

Research conducted by Walker and Hops (1976), examined the effects of a contingent point system combined with descriptive praise on academic achievement test scores; specifically Metropolitan Achievement Test scores and Wide Range Achievement Test scores. The students earned points for correct academic responding (e.g. problems completed, papers finished), these points were exchanged
daily for a variety of back-up reinforcers, such as toys, games, model cars, etc. The results indicated an increase in achievement occurred.

Utilizing the strategy of contingent token reinforcement, Ayllon, Stephen, Barber, and Pisor (1976), researched the idea of increasing the rate of correct responses per minute of retardates. The study describes the strategy of restricting temporal limits to augment academic performance. Three educable retarded subjects received token reinforcement that was contingent upon correct math problems answered during the daily lessons. Tokens were exchangeable for a variety of privileges on a daily basis. The results demonstrated that graduated successive reductions in the number of minutes assigned for task completion, increased the rate of correct responses per minute for all three students.

In another study, Lovitt and Curtiss (1969) were concerned with the effects of student imposed vs. teacher imposed contingencies. A 12 year-old student, enrolled in a class for children exhibiting behavioral disorders, served as the experimental subject. The subject received points for the accurate completion of academic assignments. Points earned were exchanged for an equal number of minutes-of-free-time. The results revealed that the subject demonstrated higher levels of increased response rates during the student imposed contingency program phases, than during the teacher imposed contingency phases. These results imply that students can develop self-management skills by arranging certain aspects of their environment.
Research concerned with the feasibility and effects of implementing a tangible reward system with upper elementary students, demonstrating the reinforcing properties of pennies was conducted by McMillan (1973). Thirty-three sixth grade students enrolled in a regular education classroom served as subjects. Each student was pre- and posttested with the arithmetic portion of the California Achievement Test, again test scores served as measures of achievement gain. An ABA design imposed two conditions upon the subjects. In the A condition, reinforcement was contingent upon performance, and in the B condition no reinforcement was provided. Posttest results showed an average gain of six months on grade-level scores.

Following the study, students were asked which they preferred, rewards or activities as reinforcers. The highest percentage of responses were for activities.

The Premack principle, which makes use of the reinforcing properties of activities, states that when the occurrence of a high probability behavior is contingent upon the occurrence of a low probability behavior, the occurrence of the low probability behavior, under similar environmental conditions, increases in frequency.

The Premack principle was utilized by Hopkins, Schutte, and Garton (1971); when they explored the effects of access to a playroom on the rate and quality of manuscript writing. The subjects were regular education, first and second grade elementary students. A student could enter the playroom as soon as his paper was completed and scored. The quicker the paper was completed, the more
time the student could spend in the playroom. As a result, an increase in the mean rate of responding was shown; however, no systematic increase in accuracy of performance across individuals was obtained.

Contracting is another area of contingency management that has received widespread acceptance among educators. Contingency contracting refers to an agreement between two or more people, specifying each party's responsibilities and benefits. According to Cole and Kitano (1978), behavior contracts are simple and effective procedures for managing social behavior and academic behavior.

Some of the research with contracting has been conducted by Arwood, Williams, and Long (1974). Their experiment attempted to compare the effects of teacher proclamations vs. the effects of contracting on student social and academic behaviors. Four students, described as "the most disruptive," served as target subjects. The subjects were exposed to three conditions, during one of which the students operated under a teacher-imposed point system and during one other, the students operated under a contract which they themselves had formulated. Free time and grades were made contingent upon earning a required number of points during both conditions. Higher rates of appropriate behavior, as well as, increases on weekly exam scores were reported to occur under the contracting conditions.

Kirkpatrick (1979) discussed the effects of contracting on the level of academic performance of students voluntarily attending a Guided Study Center. The Guided Study Center, cited in the study,
can be described as a specified area within the school, whose purpose is to provide students with the opportunity to work independently and/or to receive individualized assistance with student selected academic projects. The center is staffed, managed, and evaluated by high school and graduate students. Kirkpatrick utilized a multiple baseline design to demonstrate the favorable effects of contract intervention on the academic performance of six subjects.

Restructuring of the environment, previously discussed as a strategy in facilitating academic achievement, is defined as either providing additional components to the environment or rearranging the components already present within the environment.

Study-guides are academic aids which address the subject of additional components. Farnum and Brigham (1978) researched the effects of study-guides on the academic performance of regular elementary, fifth-grade students. Twenty-four students were the subjects of a multiple baseline semi-reversal design, which was implemented across groups and across textbooks. Academic achievement was measured by the mean difference in percent correct between group I and group II on weekly quizzes. Each study-guide was scored and the number of points earned was recorded at the top of the guide, the points served only as a feedback system to the students on how they had performed. The results showed that the groups using study-guides scored higher on weekly quizzes; always improving their academic performance.

Another "additional component" might be peer-tutoring, a procedure that is widely advocated within the academic sphere.
Research determining the effects of peer-tutoring on the academic performance of elementary school children in mathematics, was conducted by Harris and Sherman (1973). Twenty-four boys and girls in a regular education, fourth-grade classroom participated in a tutoring procedure that preceded the daily math period. A score of 90 percent or better on the daily math assignment meant "early recess." The recess contingencies were present during those sessions of no-student interaction, as well as, during those sessions of peer-tutoring. The results indicated that when students tutored each other, improved accuracy of performance occurred and so did student rate of performance.

An experiment concerned with the effects of environmental manipulation was conducted by Saudargas, Madsen Jr., and Scott (1977). Their research demonstrated that home-reports, on the number of daily assignments completed, issued on a variable schedule, increased the number of daily assignments completed, issued on a variable schedule, increased the group production rates of regular education, third-grade students. No specific, predictable, individual pattern of responding could be determined. The teacher, who participated in the study, stated a preference for the variable schedule over a fixed schedule, reporting an increase in student completion of voluntary work assignments during those variable schedule phases.

Researchers Houten, Hill, and Parsons (1975) focused on the combined effects of environmental additions and environmental manipulations. The mean number of words written per minute, during the daily composition writing period, was used to measure the academic
performance of regular education, fourth-grade students in Halifax, Nova Scotia. The experimenters sought to determine the contribution of time limits, feedback, praise, and public posting on student performance. The results showed the highest rates of group performance followed the introduction of the public posting and praise condition.

Self-recording, the focus of the present study, can be identified as another environmental addition. The intent of the present experiment was not to rearrange any existing conditions, but to research the effects of the introduction of an additional component on the academic performance of regular elementary students.

Self-monitoring has been cited as an increasingly popular assessment tool and as a therapeutic strategy that can be used to teach self-help and coping skills (Cone and Hawkins, 1977). In his overview of self-monitoring, Richards (1977) describes the strategy as a simple, practical procedure that is easy to use; so easy, that most people can use it in most places with most problems. While making reference to many research investigations that have shown self-monitoring to frequently change behavior, sometimes dramatic and stable changes; he also points out that case histories and experimental studies with negative results abound. Richards lists nine variables that studies have identified as enhancing subject reactivity to the self-monitoring strategy. They are: 1) the subject is motivated to change, 2) the subject and therapist agree upon the targeted behavior, 3) the target behavior is discrete and nonverbal, 4) the subject sets the performance criteria, 5) reinforcement is contingent upon occurrence of targeted behavior,
6) subject receives feedback on performance, 7) behavior is monitored before it occurs, 8) only one behavior is monitored at a time, 9) self-monitoring occurs on a continuous schedule.

Self-monitoring can be defined then as the observation of some well-defined aspect of one's own behavior, the immediate recording of an occurrence of that observed behavior, the maintenance of a longitudinal chart or graph of those occurrences; and upon periodic evaluation of graphed results, maintain or redefine the previous goals.

The strategy could prove to be a useful self-management tool for public school students.

Broden, Hall, and Mitts (1971), were concerned with the problem of what to do with a student when the teacher does not want or cannot work with a specific student's individual need. An eighth-grade, junior high school, regular education student expressed concern to her counselor about her low academic achievement in her history class. After determining that individualized teacher attention was not possible to obtain for the student, self-recording was chosen as an alternative strategy. A within-subject design consisted of the following phases—baseline, self-recording, baseline, self-recording, self-recording plus praise, praise only, baseline. Each phase only lasted a few days. Behaviors recorded were identified as study behavior (on-task), and non-study behavior (off-task). After baseline data were collected by an observer, both the observer and the student recorded occurrences of the targeted behaviors. Self-recording produced a dramatic 50 percent increase in the student's study behavior during each of the self-recording phases. Agreement
between the student and the observer on the occurrence of student, study-behavior varied somewhat (from 1 percent to 29 percent) on a day to day basis. However, the means of the overall subject vs. observer records were similar. This experiment demonstrated that increased study behavior can result from the self-recording of the occurrences of the behavior, even when that recording is relatively inaccurate.

A between-subject investigation by Feigenbaum (1975) focused on the relationships that exist between the academic performance of elementary school age children and self-recording; when self-monitoring is used in isolation and when it is paired with teacher praise. Eleven students, 9 boys and 2 girls, enrolled in a special education classroom for emotionally impaired children served as subjects. The experimental conditions consisted of a baseline phase, a self-recording phase, and a self-recording-plus-praise phase. The behaviors that were selected for observation were as follows: 1) copying words from a worksheet onto a lined, writing sheet, 2) counting objects on a worksheet and then circling the correct numeral, and 3) worksheets containing matching-to-sample problems. An analysis of the results did not show any systematic change in responses across subjects. Random responding occurred across all phases among all of the subjects. Eight of the subjects demonstrated decreases in the mean number of problems completed during one of the self-recording phases. In addition, five of the subjects exhibited a continual decrease in mean responding across all of the phases. The results of this experiment confirm one of
Kazdin's (1974) tentative conclusions: That self-monitoring alone fails to control behavior. The results of this study, in contrast to those of Broden, Hall, and Mitts (1971), do seem to indicate that the self-recording was not a critical variable in the behavior changes that were seen to occur.

Knapczyk and Livingston (1973) used self-recording in combination with a token system to increase the accuracy of reading performance of 13 junior high school students enrolled in a special education program. Five conditions were imposed during the experimental design: Baseline, token and self-recording; token, self-recording, and student teacher; token and student teacher. Students earned a particular amount of money based upon percent of correct responses on daily reading assignments and kept a daily account of their earnings. The amount earned could be exchanged each Friday for various learning activities such as, teacher-constructed language games. The data shows an increase in the daily group averages of reading accuracy across all phases. No significant effects were seen between treatment phases, indicating that tokens rather than self-recording had a functional relationship with the dependent variable.

Most studies have combined self-recording with other behavioral strategies and have not researched the effects of self-recording as the sole independent variable in an experimental analysis. Also, as pointed out by McLaughlin (1976) the majority of research on behavioral self-control has taken place in special classroom settings and with a small number of students.
The present study was designed to integrate self-recording into elementary classrooms without disruption of the regular classroom procedures. The study sought to determine the effects of self-recording on the quality of academic performance of elementary students in a regular classroom setting. It is the purpose of this study to discern if self-recording is practical, is functionally related to academic quality, and can be recommended to the elementary classroom teacher as a viable self-management tool.
METHOD

Subjects

Thirty-one elementary students from two regular education, third-grade classrooms served as subjects. Reading and mathematics were the subject matter chosen for study. All students within each classroom participated in the study. Data were collected on 14 students, 7 students from each classroom. Originally 16 students were involved in data collection; however, 2 students, one from each classroom, transferred to other schools during the course of the program.

Setting

Schoolcraft, Michigan is a predominantly white, rural, lower-middle class area located approximately 15 minutes from Kalamazoo, Michigan. The Schoolcraft elementary, middle, and high schools have an approximate combined population of 900, including teachers. The Schoolcraft Elementary School was chosen as the program site because of its participation in the Precision Teaching Program which utilizes faculty and students of the Psychology Department at Western Michigan University as resource personnel.

Experimental Design

A multiple baseline design, incorporating a reversal design, was employed. Treatment was applied across subjects, settings, and
curriculum. This design allowed for both between and within subject comparisons.

Procedure

The students in each classroom were randomly divided into two groups. The students in each group had an equal and independent chance of being selected for either group and variability in student performance was evenly distributed between groups. Two conditions (baseline and self-recording) were sequentially alternated between the two groups.

All students in all groups participated in the initial baseline conditions. Data from the baseline condition served as a point of comparison for the effects of intervention. Data from this condition were collected until they appeared stable, this controlled data "trends." Upon stabilization of data in the initial baseline condition, treatment was introduced to group I. The initial treatment condition was followed by a return to baseline conditions. Baseline conditions were followed by a replication of the treatment condition, and this treatment was followed by a final baseline condition. The same procedure was sequentially replicated across group II, utilizing the multiple baseline methodology. The entire procedure was occurring concurrently within both classrooms.

The multiple baseline design facilitated experimenter control over extraneous variables such as teacher bias, peer interaction, and parental influence. Replication of the conditions enhanced the reliability and generalization of the functional relation.
Data Collection and Analysis

Accuracy of performance on assigned seatwork papers served as the dependent variable. Seatwork papers consisted of reading work­
book pages, dittoed worksheets, and student-copied papers. Only those papers deemed by the classroom teachers as being related to skills taught by themselves during classroom instruction were included in the data collection. Papers on skills taught before program initiation were also included. Students worked on review papers on one day and the next day worked on materials that introduced new concepts or activities. The inconsistent progression in difficulty occurred during baseline conditions as well as during treatment con­ditions. Unsystematic scheduling of materials remained constant across all phases, the number of problems per page and the number of pages assigned per day varied from day to day.

Accuracy was defined as: "Upon presentation of seatwork materials the student will correctly write or draw in the missing elements required for paper completion (e.g., letters, words, numbers, lines). Accuracy was measured by the ratio of number of correct answers/number of possible correct answers X 100. Data was collected on a daily basis, exceptions occurred when no teacher assignment was given. Three graduate students were utilized as data collectors. Reliability was assessed by comparing permanent product samples with observer recordings. Eighty-five percent reliability was obtained by computing $\frac{A}{A+D} \times 100$. Data were collected on the following information:
1. Total number of possible correct answers
2. Total number of student correct answers
3. Percent of student correct answers
4. No teacher assignment for the day
5. Student work not handed in for teacher correction
6. Student absence
7. Skills performed on assignments
8. Date of assignments

The classroom teacher was consulted if there were questions about the total number of possible correct answers. On several occasions, many of the problems assigned contained multiple answers (e.g., _____, _____, _____ are fruit), it was unclear whether the students received credit for three correct answers or were required to complete all three items correctly to receive credit for one correct answer. The number specified by the classroom teacher took precedence. The same procedure was utilized when concerns about total number of students correct answers arose. On several occasions students had corrected errors on their papers, but had not received credit (C) for the corrections by the classroom teacher.

Data collected during the experimental program is presented in graphic form and in tabloid form.

Permanent product samples were gathered on various days that were randomly chosen. Samples of students work were gathered for nine of the fifteen weeks of the program's duration. Permanent product samples were kept for purposes of reexamination, these samples were examined by the experimenter to assess reliability. The
accuracy of student performance (percent of accuracy) as computed by the experimenter was compared to the accuracy of student performance as computed by the data collectors.

Pupil self-recording of daily progress served as the independent variable. Self-recording was defined as: Upon return of teacher corrected seatwork materials, student will simultaneously receive a number of stickers or labels which will be affixed to student progress chart. Dispensation of stickers was as follows:

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The '0' to 49 percent range allowed reinforcement to follow student effort and handing-in seatwork behavior, even if no accuracy occurred.

Data collectors picked up student papers from the classroom teacher, recorded data information onto the data sheets, attached the appropriate amount of stickers to the student papers with paper clips, and returned the student papers to the classroom teacher.

Data collection experienced a holiday interruption. The program resumed operation at the point of interruption.

**Charting Procedures**

During intervention each student received an individual folder containing the progress chart. Folders were made from construction...
paper and remained at the student's desk. Upon receipt of the stickers, the students immediately affixed them to the chart. Stickers were dispensed concurrently with the return of the corrected seatwork papers. The classroom teachers were requested to only mark the correct answers (e.g., 'C') when checking papers, giving no attention to incorrect answers.

Upon initiation of the program, the experimenter addressed the classes as follows:

"Boys and girls, we're going to start a new program in which some of you will help me keep track of how many correct answers you're getting on your reading/math seatwork papers. Your teacher has so many things to do now, that she really needs our help. Those boys and girls that receive a folder will be my helpers for a while and then later on, I'll change helpers and the rest of you boys and girls will get a chance to help me also." The experimenter then passed out the folders to group I students and instructed the students to write their names on the folders. The experimenter then gave a demonstration of how the charting procedure worked, using sample materials. "After your papers are handed in, the teacher will check them. She's only going to mark those answers that are correct with a 'C'. Then I'll have your papers collected and I'll count up how many correct marks you have to see how many stickers you'll get. When you get your stickers put them on your chart like this
(experimenter demonstrates). This way you'll know and I'll know how well you're doing from day to day. Are there any questions?" Student questions about the program were answered by the experimenter.

New student charts were issued on a weekly basis. The reading class generally received a seatwork assignment on 4 of the 5 school days, and they received a new recording chart on every fourth assignment. The mathematics class generally received a seatwork assignment on 5 of the 5 school days, and they received a new recording chart on every fifth assignment. A variety of charts were available for teacher selection, with the exception of those charts that were holiday related. Holiday charts were dispensed during the week of the appropriate holiday.

Samples of student charts can be seen in Appendix A.
RESULTS

Reading Class

Four students, subjects A, B, C, and D (Figure 1), earned mean scores that ranged between 70 percent and 91 percent level of accuracy during the initial baseline condition. These subjects demonstrated increases of 15 percent, 12 percent, .07 percent, and .06 percent in accuracy of performance during the self-recording I phase, increases of 23 percent, 15 percent, .09 percent, and .09 percent during the self-recording II phase. Baseline II performance, however, did not return to the original baseline level of performance, but remained at or near the mean level of performance demonstrated during self-recording I. During baseline III, mean performance fell below the mean performance demonstrated during each of the self-recording conditions and baseline II conditions.

Subject E (Figure 1), who earned a mean score of 92 percent during the initial baseline, demonstrated an increase of .02 percent in mean performance during self-recording I, but failed to replicate that performance during self-recording II. Mean performance during treatment II fell below all previous levels of performance. Mean performance demonstrated during the initial baseline replicated across all baseline conditions.

Subjects F and G (Figure 1) earned mean scores of 95 percent and 97 percent accuracy during baseline I conditions. Subject F demonstrated no change in performance, subject G demonstrated a decrease in accuracy of performance during self-recording.
Figure 1
Within the reading class (Figure 2), an increase of .04 percent to 10 percent in mean accuracy of responding was seen occurring across both group I and group II. Within group I, the mean level of accuracy continuously increased across self-recording I, baseline II, and self-recording II conditions; increases of 10 percent, 11 percent, and 14 percent were seen. Within group II, the mean level of accuracy continuously declined following self-recording I; the 91 percent mean level of accuracy earned during the initial baseline was replicated during the final baseline performance.

Class mean performance of accuracy (Figure 2) increased during self-recording I, remained constant during baseline II and self-recording II conditions, returned to initial baseline performance during the final baseline condition. Class was defined as: All of the reading class subjects that were involved in the data collection.

The range of variability demonstrated by subject A during the initial baseline (Figure 3), decreased during the self-recording I condition and remained constant across all succeeding conditions.

Subjects B and C (Figure 3) also demonstrated a substantial range of variability during the initial baseline conditions. The range of variability demonstrated by these students also decreased during self-recording I, baseline II, and self-recording II conditions. During the final baseline conditions, the range of variability replicated the performance seen during the initial baseline.

The range of variability demonstrated by subject D (Figure 4) during the initial baseline condition, replicated across all succeeding baseline conditions. The decrease in variability
WITHIN READING GROUP MEAN LEVEL OF ACCURACY

GRP-1

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MEAN LEVEL OF ACCURACY FOR ENTIRE READING GROUP

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Figure 2

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demonstrated during self-recording I, also replicated across self-
recording II conditions.

Subjects E and F (Figures 4 and 5) demonstrated a uniform
range of variability across all conditions.

Subject G (Figure 5) demonstrated an increase in variability
of responding during self-recording II and baseline III conditions.

**Mathematics Class**

Subjects 1 and 2 (Figure 6) earned mean scores of 85 percent
and 86 percent during the initial baseline conditions. Increases
ranging from .05 percent to 10 percent in accuracy of performance
occurred during the self-recording conditions, while reversals in
performance occurred during baseline conditions.

Subject 3 (Figure 6) acquired a mean score of 88 percent
during the initial baseline. The student demonstrated an increase
of .06 percent in accuracy of performance during self-recording I,
which failed to replicate during self-recording II. During self-
recording II, mean level of accuracy dropped .02 percent below the
mean level of performance demonstrated during baseline I, yet
increased .03 percent above baseline II performance which fell
.05 percent below the initial baseline performance.

Subjects 4, 5, and 6 (Figure 6) earned mean scores of 71 percent,
78 percent, and 87 percent during the baseline I condition. A decrease
in accuracy of performance was seen during self-recording I, while an
increase in performance was seen during self-recording II. Subjects
4 and 6 earned mean scores during baseline II and baseline III that
MATHEMATICS CLASS MEAN LEVEL OF ACCURACY

Figure 6

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exceeded the mean scores earned during the initial baseline performance.

Subject 7 (Figure 6) demonstrated a continuous decline in mean accuracy of responding across all conditions. A mean score of 89 percent was earned during baseline I.

Within the mathematics class (Figure 7) an increase in mean accuracy of responding was seen for group II across all conditions succeeding initiation of self-recording. The only noticeable effects seen in group I performance was a decrease in accuracy during baseline II conditions.

Class mean performance (Figure 7) of accuracy remained relatively constant across baseline I, self-recording I, and baseline II conditions. A .09 percent increase in mean performance was seen during self-recording II.

Subjects 1 and 6 (Figure 8) demonstrated decreases in variability of performance during both self-recording conditions and an increase in variability of performance during baseline conditions.

Subject 3 (Figure 8) demonstrated consistency of performance, with the exception of the SR$_1$ phase, during which a decrease in variability of performance occurred.

Subject 4 (Figure 9) demonstrated a consistency of performance, with the exception of the SR$_2$ phase, during which the subject demonstrated a decrease in variability of performance.

Subject 7 (Figure 9) demonstrated an increase in variability of performance during baseline II conditions which remained constant across succeeding conditions.
WITHIN MATHEMATICS GROUP MEAN LEVEL OF ACCURACY

**Figure 7**

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Subjects 2 and 5 (Figure 10) demonstrated a consistent range of variability across all conditions.
DISCUSSION

The results of this study reflect the inconsistency of subject reactivity to the strategy of self-recording that was found in the current literature. The results do show, however, that self-recording increased student academic achievement. Academic achievement is defined here as the percentage of correct responses earned on daily seatwork assignments. The advantage of percentages can be viewed as the use of a measurement tool that provided a consistent measurement of performance when the number of problems assigned varied significantly from day to day. A disadvantage can be viewed as the limit of achievement that can be seen by the use of such a measure.

Distinct increases in the level of academic achievement during both of the self-recording phases was shown for 6 of the 14 subjects. Four of the subjects were from the reading class and two were from the math class. These students exhibited optimal reactivity to the strategy of self-recording. That reactivity is confounded somewhat by the failure to replicate baseline performance during the reversal conditions for all, except one of the subjects. For subject number 1 (see Figure 6), an implicit functional relationship between academic achievement and self-recording was observed, suggesting that self-recording alone can control academic behavior.

Random responding, which included increases and decreases, above and below baseline measures of academic performance for eight
of the subjects, precluded any demonstration of a systematic change in behavior across all subjects. Some plausible explanations for these results might lie in the reading teacher's report of how she observed the exchanging, trading, and giving away of stickers among those students who were self-recording; therefore, reinforcement for some was not contingent upon performance and the control for accuracy of recording was lost.

Another variable to consider might be the private charting procedure that was used in this study. Richards (1977) pointed out the need for an obtrusive recording device to enhance reactivity to self-monitoring. The subjects in this study kept their recording charts folded and inside of their desks, only viewing them upon receipt of the stickers. Public display of each chart might have prompted more uniformity of responding among the subjects.

Still yet another variable to explore is that of experimenter imposed targeted behavior vs. subject chosen targeted behavior (Arwood, Williams, and Long, 1974). The targeted behavior in this study was experimenter imposed and possibly not a goal especially embraced by the subjects. This perspective may apply to the subjects in this study, even more so than it would to others, because of the high level of accurate responding (70 percent to 96 percent) that was demonstrated during the initial baseline condition. A program designed to generate student interest in exhibiting 100 percent accuracy and implemented before the self-recording procedure, might have enhanced uniformity of reactivity. This concept is evidenced by the increase or maintenance of baseline levels of achievement.

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seen for 10 (83 percent) of the 12 students during the second introduction of the self-recording (SR₂) procedure; subject D (Figure 1) did demonstrate 100 percent accuracy during that phase.

A systematic pattern of responding can be seen for those five subjects that exhibited increases in academic achievement upon the introduction of the self-recording strategy. Once those students had produced a daily increase in the number of correct answers that they placed on their seatwork papers, they maintained that level of performance even when self-recording was not available to them during the reversal phase (B₂). The subjects had been informed, however, that they would have another opportunity to record; possibly the anticipation of once again engaging in the self-recording activity may have been enough to maintain their increased level of achievement. It can be hypothesized then, that it may be possible to maintain increased accuracy of responding, over time, with intermittent self-recording, a strategy successfully utilized by Saudargas, Madsen Jr., and Scott (1977).

These explanations can account in general for the random responding that occurred across subjects, but they do not account for the .05 percent decreases in achievement demonstrated during initial introduction of self-recording (SR₁) by subjects 4 and 5.

Subject 4 (Figure 6) began self-recording approximately one week before the Christmas holiday. The holiday season with its extra classroom, holiday-related activities, may have precluded academic achievement (as defined in this study) for this particular student.
Subject 5 (Figure 10) had experienced a gradual decline in performance during the initial baseline phase ($B_1$). This decline, which can be seen on the graphed presentation of the students daily performance, carried over into the self-recording phase ($SR_1$). The data suggests that for this subject, treatment in the form of individualized instruction was needed in combination with the self-recording procedure to enhance his academic achievement. It goes without need for further empirical demonstration, that no additional aid can replace academic instruction. The same explanation can apply to the sharp consistent decline of the academic achievement exhibited by subject 7 (Figure 6), a decline which was consistent across all phases.

The behavior of handing-in seatwork papers was not included in the definition of academic achievement utilized in this study, but was observed in the collected data. This additional information further demonstrated the efficacy of self-recording to change behavior and to enhance levels of academic achievement. Handing-in seatwork papers, at a rate of 100 percent, was observed to occur only during the intervention conditions. These results suggest that a functional relationship may exist between self-recording and handing-in seatwork behavior. This possibility further suggests that self-recording might be an effective tool in ameliorating the academic performance of those students whom teachers identify as having the skills but not doing the work.

The subjects in this study were randomly divided into four groups. Upon investigation, an interesting phenomena can be seen
between the two groups formed within the reading class (see Figure 2). Both group one and group two demonstrated increases in academic achievement, however, while group one exhibited a consistent increase in levels of accuracy, group two demonstrated an initial increase that was immediately followed by a consistent decrease in achievement. Group one demonstrated and maintained a .05 percent increase in performance, while group two initially demonstrated a .05 percent increase above the initial baseline ($B_1$), but failed to maintain it. Even so, both groups maintained 90 percent levels of accuracy following the self-recording program. A review of the percentage distribution chart on page 17, may offer an explanation of these data. The maximum number of stickers (6) could be earned within the 90 percent to 100 percent range of accuracy. Since group two had performed at a 90 percent level of accuracy before self-recording was introduced, their group members had nothing tangible to show for their increased output, subsequently the group mean returned to and maintained its 90 percent level of achievement, the level of achievement that was demonstrated during the initial baseline.

An examination of the group performance demonstrated within the mathematics class (see Figure 7) is also of interest. Group one demonstrated no reactivity to the self-recording strategy, while group two exhibited a gradual increase in achievement, which readily became apparent during the second introduction of self-recording ($SR_2$). Group one may have needed individualized, remedial instruction on the mathematical operations that they were asked to perform, or may have needed back-up reinforcers in conjunction with
the self-recording to facilitate group reactivity.

An analysis of student performance between the reading class and the mathematics class revealed that four of the seven targeted subjects in the reading class demonstrated increases in levels of achievement, while increases were only shown for two of the seven targeted subjects in the mathematics class. The greater number of students exhibiting increases in achievement within the reading class may have been enhanced by the opportunity of the students to have their papers checked, the time to remediate errors and to receive credit (C) for those remediations, before their papers were picked up for data collection. This opportunity to remediate errors was established as part of the classroom routine before intervention.

The combining and averaging of student performances into group scores (Figures 2 and 7) did not reflect the differing levels of achievement that was seen within and between the reading group and the mathematics group. In viewing classroom group levels of achievement, similar increases in levels of accuracy were seen to occur across both groups. These results were observed by the classroom teachers, who expressed positive attitudes toward the self-recording strategy. They both stated that they were extremely pleased with the increase in student motivation during the experimental program.

It is important to note that increases in academic achievement were observed to occur in response to the self-recording strategy despite the inaccuracy of the recording by some of the subjects. These results are comparable with the results of Broden, Hall, and
Mitts (1971). On the other hand, the random responding observed by some of the subjects is comparable with the results of Feinbaum (1975). The results of this study and of previous studies suggest the need for further research. There are four variables related to self-recording that may contribute to the effects of self-recording on elementary students academic achievement. One is the public display of the recording charts. Another is the shaping of students to select 100 percent accuracy as a targeted behavior on seatwork assignments. A third is maintaining control over student recording. A fourth is recording on an intermittent schedule.

It is often difficult, within the public school setting, to conduct research without interruption of the regular classroom routine, or without the complete rearrangement of the classroom components. This need for disruption, the need to insure experimental control over selected variables, deters public school personnel from welcoming experimental applications of behavioral strategies that have been empirically proven to work in the laboratory setting. The simplicity of self-recording, its near zero monetary cost, its low level of response cost, and its high level of reactivity for some, suggest that further identification of the variables that enhance reactivity across all subjects, would be a tremendous contribution to the body of information being compiled by behavioral research in the area of academic achievement.

The results of this study show that self-recording alone can increase academic achievement for some. Future research in this area will provide behavioral analysts with the knowledge of how to
prompt maximum reactivity from all students. The strategy of self-recording, as a self-management tool, may be recommended to the classroom teacher upon the acquisition of that information.
APPENDIX A

Samples of the Self-Recording Charts Used by Students
Great Going!

Name:
Start
BIBLIOGRAPHY


