*DIFFERENTIAL EFFECTS OF FIXED- AND VARIABLE-TIME
FEEDBACK ON PRODUCTION RATES OF
ELEMENTARY SCHOOL CHILDREN*

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The performance of 26 third-grade students who worked on individual weekly academic tasks was compared under fixed- and variable-time "home reports". During fixed-time home reports, each student was given a report to take home on Friday that indicated the quantity of work the student had completed that week, contained comments concerning the quality of the work, and had a space for parental remarks and signature. The same report was given during the variable-time reports, except that seven to nine students were randomly selected each day to receive a home report. During variable-time reporting, students completed more assignments and completed assignments on a greater percentage of available workdays than during fixed-time reporting. The teachers' preference for the variable-time reporting was one additional advantage for the variable system.

DESCRIPTORS: elementary classwork, production rates, variable schedule, fixed schedule, feedback, children

Most of the experimental work involving schedules of reinforcement with humans has been conducted in laboratory or contrived settings (*e.g.*, Bijou, 1961; Bijou and Orlando, 1961; Weiner, 1969), although some recent work has provided evidence for the differential effects of schedules of reinforcement in applied situations. For example, Schroeder (1972) reported some of the parametric effects of reinforcement frequency, amount of reinforcement and required response force on the work output of retarded individuals in a sheltered workshop. In this study, when amount of reinforcement was held constant, it was found that work rates decreased as progressively longer fixed-interval schedules of reinforcement were employed, whereas, for two of the three subjects,

work rates increased when progressively larger fixed-ratio schedules of reinforcement were employed. In subsequent manipulations, it was found that the relationship between work rates and fixed-ratio schedules could be modified by the amount of force required for a particular response and that increasing the amount of force required for a particular response and increasing the amount of reinforcement delivered on a particular schedule decreased work rates.

Single and multiple ratio schedules of reinforcement have been varied using math work (Lovitt and Esveldt, 1970) when it was found that the students did more problems and received more points under multiple ratio schedules of reinforcement than when single ratio schedules were employed. No differences were found in response rate under the single ratio schedule when frequency of reinforcement was increased.

In a well-controlled study more directly related to school settings, the studying behavior of college students as a function of testing schedules was compared. It was found that more consistent daily study patterns and regular attendance in the study room were maintained

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with daily testing than when only weekly and three-week tests were scheduled (Mawhinney, Bostow, Laws, Blumenfield, and Hopkins, 1971).

Elementary schools as well as college classes continue to use report cards to reflect the classroom performance of students. However, since the grade received is often far removed in time from the work accomplished, the quality and quantity of production may have little immediate relation to the grades themselves. Anecdotal evidence from many teachers in behavior-modification workshops indicates that elementary school children generally show little concern with the report card until just before it is to be sent home (Madsen and Madsen, 1974). This response is very similar to students in college classes who appear to study at a greater rate just before a test (Mawhinney *et al.*, 1971).

The present study was a variation on the usual method of reporting elementary school children's progress. Two separate schedules of "home reports" were varied in an elementary school room and their differential effect on the students' academic production was evaluated.

PROCEDURES

Setting

Schoolroom. The study was conducted in a third-grade center of an elementary school in rural Leon County, Florida. A variety of academic and socioeconomic levels were represented in the student population (40% black and 60% white) as were rural, suburban, and metropolitan residences. A bimodal distribution of socioeconomic and ability levels was apparent with greater numbers of students at the lower and upper ranges.

One hundred students were instructed by four teachers in a large carpeted, acoustically tiled, learning center. The students were randomly assigned to teachers with no attempt at homogeneous academic grouping. The center (1080 square meters) consisted of four learning sections (two at each end) with individual por-

table tables for student desks. A common center area was bounded by two bathrooms and an outside door on one side and a teacher's preparation room on the other. Academic materials, special study and activity areas, and audiovisual equipment were in the large arena, which was used by all four teachers for individual and group study.

Teacher. The teacher, age 33, had 4 yr teaching experience in rural Northwest Florida. She participated in a 14-day workshop in behavior modification and individualized instruction before the beginning of the present school year. The workshop is described elsewhere (Madsen and Madsen, 1974). The teacher used behavioral principles of approval for appropriate classroom behavior and disapproval for inappropriate behavior. She was observed by trained personnel on 85 randomly scheduled half-hour observations distributed throughout the school year from October through May (average reliability 85%). Observers used 10-sec intervals, and the following percentages represent an average of the percentage of intervals observed during which the particular behavior occurred. Her approvals following appropriate student behavior averaged 42.2%, disapproval to inappropriate behavior 5.0%, and mistakes of approval and disapproval averaged 0.4%.

Academic routines. Twenty-six third-grade students from a learning section served as subjects. Each child was taught on the basis of a diagnostically prescribed individual program. Each student received on Monday a weekly assignment sheet that listed a minimum of 15 reading, five mathematic, and not more than a total of five additional assignments in other academic areas such as science, social studies, and geography. Published curriculum materials in reading and math were used to make the assignments. Because the students were on an individually prescribed instructional program, assignments varied in length and difficulty, but the length of each assignment for each student was the same throughout the study. Extra assignments could be done by each student if de-

sired. Extra assignments were purely voluntary and when complete, were noted on the assignment sheet by the teacher. Each child completed an extra work assignment at his or her own rate. The teacher specified that all regularly assigned material be completed by the end of the school day on Friday. As each assignment was completed, the teacher or teacher aide checked the work for accuracy and initialed the assignment sheet.

Student home reports. Each student was given a report to be taken home every Friday afternoon that listed the quantity of work completed by the student in each academic area and provided for teacher comments concerning the quality of the week's work. No requirements were made to ensure that the parents signed the reports or that the students returned them. Each home report informed the parent that a minimum of three reading assignments and one math assignment should be completed per day. In addition, the report indicated that assignments in other academic areas were to be completed as assigned. The teacher filled in the number of assignments completed for that week in each academic area. The home reports covered assignments completed since the last reporting period.

Data recording. The teacher recorded on each individual assignment sheet the day of the week each assignment was completed. Assignments were recorded as complete if at least 85% accuracy in each academic area was obtained. If a student completed an assignment without the required accuracy, the student redid the assignment until the accuracy requirement was met. An assignment was recorded as complete only if the accuracy requirements were met. The basic data consisted of percentages of assignments completed each day. To arrive at the percentages, the number of assignments a child completed correctly was divided by the total number of assignments required for the week. Reliability with the teacher was achieved by one author who daily checked student assignment sheets and the assignments for accuracy and

completeness. The teacher and experimenter were usually in 100% agreement; any discrepancies were corrected.

Because changes in the total number of weekly assignments from one week to the next might have affected the results, the mean number of weekly assignments was calculated for each condition. A test for sampling errors (Dixon and Masser, 1957) showed that all the weekly assignment means among conditions (mean range 19.70 to 21.14) were well within the expected range ($r_{10} = 0.32$).

Experimental Conditions

Fixed-time I (one week). The regular academic routine of giving each student a production report to be taken home on Friday was continued.

Variable-time I (two weeks). The students were informed on Monday that the home-report procedure would change, and that instead of a weekly report some reports would be sent home each day. They were instructed that no one would know which reports were going home until it was announced by the teacher 30 min before the end each day of school. The teacher received a list of seven to nine students who should receive the home report that day. The assignment was random except for one stipulation that each student received at least one report once per week.

Fixed-time II (one week). The class was informed on Monday morning that home reports were again to be sent home on Fridays.

Variable-time II (one week). The class was returned to the variable schedule and informed of the change on Monday.

RESULTS

The production rates of the students were directly related to the home-report schedule employed (Figure 1).

Correctly completed assignments averaged 83.1% of the weekly total during fixed-time I, 92.8% during the first week and 110.9% dur-

Fig. 1. Assigned work completed (weekly percentage) and percentage of total student work days when assignments were completed during fixed-time and variable-time conditions.

ing the second week of variable-time I. Percentages greater than 100% represent completion of extra voluntary assignments. The completed assignments dropped to 73.9% during fixed-time II and again increased to 154.2% during variable-time II. Percentages of assignments completed correctly was higher during variable-time conditions than during fixed-time conditions (comparisons between pooled results of fixed-time conditions and pooled results of variable-time conditions were statistically significant ($p < 0.001$, t test for correlated means, $t = 4.89$).

An additional indication of student reaction to the changed home-report schedules is the percentage of "work days" during which any work was completed and checked by the teacher (Figure 1). These percentages were determined as follows. Students who completed an assignment correctly that was checked by the teacher were counted each day. The total number of these over a condition was then divided by the total number of work days in that condition (students present times number of days). The results closely parallel the data on percentage of assignments completed. During fixed-time I, some work was completed and checked 67.8% of the total work days available. There was an increase during each week of variable-time I (week one = 75.4% and week two = 92.3%). A decrease occurred during fixed-time II (77.7%). During the final return to variable-time, 100% of the work days showed completed assignments. These data indicated that the students were completing assignments at a steadier rate during the variable-time schedules than during the fixed-time schedule of home reports.

The change in home-report schedule from fixed- to variable-time resulted in increased production for all students except one (25 of 26) whose production rates were opposite to those produced by the rest of the class.

DISCUSSION

The major implication of these results is that most teachers (even those trained in behavioral

methodology who are individualizing instruction) are probably able to increase group production rates by changing home-report schedules. Throughout the school year, the students in the present study were being observed working on academic materials (on-task) over 70% of the time (85 observations) and were completing approximately 85% of their assigned weekly work. However, a higher production rate was achieved when home reports were placed on a variable-time period. Additionally, assignments were completed at a steadier rate during each week when the variable-time schedule of home reports was in effect. The individual results, while indicating an increase in production during variable-time conditions, fail to demonstrate any consistent patterns analogous for animal literature (*e.g.*, Ferster and Skinner, 1958). It appears that while the overall effect is an increase in production, elementary school children do not respond with specific predictable individual patterns of responding.

One potential problem with these results is that an increase in the frequency of home reports during the variable-time conditions might have accounted for the results, rather than the change in the home-report schedule. Since the reports were randomly assigned during the variable-time period, this possibility was evaluated after the study was completed. The production of completed assignments of students receiving two home reports ($N = 16$) during the variable-time schedules was compared with those students who received only one ($N = 10$). The attendant results were not significant (t test less than one).

The fixed- and variable-time schedules of home reports used in this study were not completely analogous to conventional fixed and variable schedules of reinforcement. In conventional fixed- and variable-time schedules, reinforcement is contingent on both the passage of a certain time period and the occurrence of a response. In contrast, home reports were given to students on a particular day, whether or not the student had completed any work on that

day. However, since the reports did indicate the quantity and quality of work completed since the last report, the home reports were, in a sense, response contingent.

The teacher who participated in the study reported many of her students stated a preference for the variable-time schedule, as did she. It was far easier for her to handle seven reports a day rather than 26 in one day. She stated further that she was primarily concerned with the happiness of her students and was not concerned whether or not the students evidenced any "scallopings of work effects". In addition, during the second week of variable-time I, 25% of the students completed extra voluntary assignments and during variable-time II, all but one of the students did some voluntary extra work. During the fixed-time conditions, no voluntary extra work was done by any student. The variable schedule produced a consistent responding rate even after the assignments for the week were completed.

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