*THE NONEFFECTS OF CONTINGENT REINFORCEMENT FOR
ATTENDING BEHAVIOR ON WORK ACCOMPLISHED¹*

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Past studies have shown that disruptive behavior can be eliminated and attending behavior accelerated in an academic setting. The relationship between these behaviors and academic performance is not well understood. The effects of behavioral and performance contingencies on classroom behavior and on academic performance were investigated. The subjects, third-grade students from an inner city elementary school, were exposed to a series of conditions including baseline, behavior contingencies, performance contingencies, and a mix of behavior and performance contingencies using a reversal design. The students worked 100 randomly selected mathematics problems for 20 minutes each day during each period. Behavioral contingencies improved attending and decreased disruptions but did not improve performance. Performance contingencies increased per cent correct problems but attending declined and disruptions increased. The combined contingencies increased both performance and attending. The experiment was replicated with another class of children varying the sequence of conditions and the amount of token reinforcement that could be earned. The findings emphasized the importance of designing specific contingencies for specific target behaviors. Behavioral contingencies did not have the positive effect on performance often implied, nor were performance contingencies alone able to maintain acceptable classroom behavior.

A number of recent studies (Hall, Lund, and Jackson, 1968; Thomas, Becker, and Armstrong, 1968; Hamblin, Buckholdt, Ferritor, Kozloff, and Blackwell, 1971) have shown that teachers could be trained to increase appropriate behavior and decrease disruptive behavior through modifying contingencies of reinforcement in the classroom. These techniques have been used with

beginning teachers (Hall, Panyan, Rabon, and Broden, 1968), with special education classes (Hall and Broden, 1967; Patterson, 1965), and recently with students in a secondary school classroom (McAllister, Stachowiak, Baer, and Conderman, 1969).

Student behaviors have been modified using teacher attention (Madsen, Becker, and Thomas, 1968), token economies (O'Leary, Becker, Evans, and Saudargas, 1969), other students as engineers (Surratt, Ulrich, and Hawkins, 1969), and group consequences (Barrish, Saunders, and Wolf, 1969). Studies have been conducted with single subjects (Wasik, Senn, Welch, and Cooper, 1969), special problem subjects (Broden, Bruce, Mitchell, Carter, and Hall, 1969), and with the entire class (McAllister, *et al.*, 1969). Thus, the modification of study behavior and of disruptive behavior has been extensively studied and replicated.

Inattentive and disruptive behavior concern both classroom teachers and school administrators and appear to be incompatible with school

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work. The reduction of these behaviors, however, may not be a sufficient environmental change to produce accelerated work. While some studies report apparent improvement in academic achievement as a result of the increased study time (O'Leary, *et al.*, 1969; Schmidt and Ulrich, 1969; Surratt, *et al.*, 1969), the relationship between attending behavior and achievement related behaviors is not clearly understood. The present experiments sought to investigate this particular relationship by directly measuring both work accomplished and attending behaviors.

EXPERIMENT 1

The first experiment investigated the effects on arithmetic performance of making reinforcement contingent upon attending behavior during a daily 20-min drill lesson. Contingencies were later placed on the actual work that was accomplished and then finally upon a combination of work accomplished and of attending behavior.

METHOD

Subjects

Fourteen members of two third-grade classes from an inner city school serving an economically depressed, low income housing project served. At the beginning of the school year, these children had a mean age of 10 yr one month, a mean IQ of 75 (Range 65 to 85) on the Otis-Lennon Mental Ability Test, and a mean grade level of 2.58 on the arithmetic computation section of the Stanford Achievement Test. The children were identified by their teachers on the basis of heterogeneity of social behaviors and of ability in arithmetic computation. Of these 14 children, five displayed a high degree of disruptive behavior, the remaining nine appeared average for the school; three tested below the second grade in arithmetic computation and the remainder were average for the school.

Procedures

The experimental task was a set of 100 arithmetic computation problems that the children worked for 20 min each day. After consulting with the third-grade teachers, over 5000 arithmetic problems, testing arithmetic skills that had already been taught, were generated. Each day a set of 100 problems, which contained the same proportion of randomly sampled addition, subtraction, multiplication, and division problems were drawn from the large pool of problems. The problems were then replaced in the pool for the next day's drawing. Thus, any given problem could have appeared more than once throughout the experiment.

At 9:00 each morning, the 14 children were taken to a special classroom by a teacher trained by the two senior authors. When the children arrived they were seated and received the results of their previous day's work, and questions were answered. No attempt was made to give group lessons to the subjects. A 20-min timer was set and the children were told to begin work.

The following treatment conditions were used:

Baseline. In the baseline conditions, the teacher was asked to circulate through the three rows of children about once every minute and to answer questions related to the math problems. She was specifically told not to attempt to accelerate any attending behaviors or to suppress any disruptive behaviors.

Tokens for attending. During the behavioral conditions (B₁ and B₂), the teacher was instructed to give small plastic chips (tokens) to those children who were "attending". A list of behaviors that qualified as "attending behavior" was given to the teacher. This list was also used by the observers.

During a typical session, the teacher would circulate through the three rows of children about once each minute. As she circulated, she would unobtrusively place a token on the desk of children who were attending. Each child earned approximately 12 to 16 tokens per ses-

sion. The teacher was instructed to ignore children who were not attending. The tokens were exchanged intermittently by the children (about once a week) for a choice of candy, ice cream treats, inexpensive toys, high-interest activities, and occasional field trips.

Tokens for correct work. In the achievement conditions (C_1 and C_2)², the teacher continued to circulate among the three rows about once each minute. The children could now earn one token for every seven problems they worked correctly plus bonus tokens for the accuracy of their work (one token for 21 to 30% of the problems attempted worked correctly, two tokens for 31 to 40%, up to eight tokens for 91 to 100% and additional two tokens for a perfect paper). The tokens were awarded at the beginning of the next experimental period when the results of the previous day were reported. The children earned on the average of 10 to 18 tokens per session.

Tokens for correct work and for attending. During the mix contingency (D_1 and D_2), the children were contacted and received tokens for attending behavior as they had during the B conditions, but also received tokens for correct work as they had during the C conditions. The tokens for the previous day's work were distributed at the beginning of each session. With the increased number of tokens during D conditions, (approximately twice the number available in the other conditions), store prices were adjusted upward to hold purchasing power constant.

Observations

All children in the group were observed on a 10-sec time-sampling basis. An observer with a stopwatch and a sheet of paper for tallying behavior watched all the children sequentially

on a 5-sec observe, 5-sec record basis. Thus, the observer would observe and record Child 1 for 10 sec, Child 2 for 10 sec and so on through Child 14, and then return to Child 1. The observation categories were as follows:

- (1) attending behaviors, which included a child looking at or writing on his test paper or on scrap paper, asking a question, looking toward the teacher when she was talking, counting on his fingers or softly, counting aloud, sharpening a pencil, or passing out papers.
- (2) not attending, which included looking out the window, looking around the room, looking out in the hall, or sitting with closed eyes.
- (3) disrupting, which included talking out without raising his hand, hitting another student, making audible noises such as animal calls, scraping his desk on the floor or drumming his pencil on the desk or wall, or throwing pencils, paper, or books. If disrupting and attending or non-attending occurred during this 5 sec the observers were instructed to code the time segment as a disruption.
- (4) tokens, which included any token given by the teacher during the 5-sec period.

Token exchanges were held, on the average, every five school days. During the B and C conditions, prices were set so that a five-cent backup item could be purchased with approximately 20 tokens. During the D condition, a five-cent item cost approximately 40 tokens. Backup items varied in price from 5¢ to 50¢. The children were allowed to accumulate their tokens to purchase the higher priced items.

Figure 1 is an example of the recording instrument given to the observers. The empty squares in the top left corner were filled in each day by the observers with a number for each child present. The A, N, D, T letters refer to the behaviors to be observed. After each ob-

²During the first four days of the C_1 condition (i.e., first two data points), the children received one token for every seven problems worked correctly plus one token for every problem worked correctly in excess of the number worked correctly the previous day.

	A		A		A		A		A		A		A
N	D	N	D	N	D	N	D	N	D	N	D	N	D
T		T		T		T		T		T		T	

Fig. 1. Sample observation sheet for recording behavior.

ervation, the observer placed a slash through the A, N, or D for the child and a slash through the T if the teacher delivered a token.

Reliability checks were conducted throughout the study. Periodically, another trained observer made an independent, simultaneous record during the experimental period. The two observers would look at the same child during the same time sequence. These records were compared interval by interval and the per cent of agreement was calculated by dividing the number of agreements by the number of agreements plus the number of disagreements and multiplying by 100. Average reliabilities (based on 11 checks) for Experiment 1 and Experiment 2 were as follows: attending behavior 92% (Range 89 to 95%), not attending behavior 91% (Range 85 to 99%), disruption 95% (Range 92 to 100%), and token 98% (Range 96 to 100%). Ten reliability checks were also computed on test scoring 99% (Range 98 to 100%) and data recording 99% (Range 97 to 100%).

RESULTS

Social Behavior

Figure 2 shows the attending and disruption data for each condition. During the baseline, the children attended approximately 80% of the sampled intervals and disruptions occurred in about 8% of the intervals. With the introduction of the token economy in the B₁ condition, disruptions decreased and attending behavior

increased until it reached over 90% on the final two days of the condition.

During the C₁ condition, in which tokens were given solely for correct work, the attending behavior dropped to between 50 and 70% by the end of the condition. Simultaneously, disruptions rose to a high of over 20% of the sampled intervals. During this condition and all other conditions, there were no aversive consequences for disruptions and in the C conditions, the children were still able to earn tokens with the arithmetic assignment regardless of their social behavior. During the first reversal back to tokens for attending (B₂), the disruptions again decreased while the attending behavior rose slightly above its C₁ level.

In the D₁ condition, contingencies were placed both on attending behavior and on correct work. Disruptions decreased to a low level 1%, and attending increased to between 80 and 85%. In the reversal back to tokens for correct work (C₂), disruptions again increased, while attending decreased to the level it had been during the C₁ conditions.

In the final phase, (D₂) contingencies were again placed both on correct work and on attending behavior. As in the D₁ condition, disruptions decreased and attending behavior increased.

Correct Work

Placing contingencies on attending behavior or on correct work alone did not seem to have any strong effect upon the average number of

Fig. 2. Per cent of 10-sec intervals in which attending and disruptive behavior occurred for 14 third-grade children during a time when the children worked on 100 arithmetic computation problems. After the baseline condition (A), the children went through conditions in which reinforcement was contingent upon attending behavior (B), arithmetic performance (C) and a combination of arithmetic performance and attending behavior (D). Filled points are for single sessions; all others are combined data for two sessions.

problems that the children worked correctly. Figure 3 shows the data for the median number of problems worked correctly. There seemed to be little difference in the number of problems worked correctly between the B₁, C₁, B₂ conditions and the baseline period in which no special contingencies were in effect.

Figure 3 shows one effect of the change in contingencies from social behavior to work accomplished (B₁ to C₁). The median per cent

correct rose from an average of 54% during the B₁ condition to an average of 76% during the C₁ condition. The increased accuracy gained in the C₁ condition dropped slightly during the reversal to tokens for attending (B₂). However, time did not permit us to let the condition run to see if the accuracy would return to the level it had been in B₁. During the remaining conditions, some reinforcement was always contingent upon the work accomplished and the accuracy

remained as high or higher than it had been during the C₁ conditions or an average per cent corrected of 80%, 83%, and 82% for conditions D₁, C₂, and D₂ respectively.

Figure 3 shows that the only effect in the number of problems worked correctly came during the D conditions in which tokens were delivered both for attending and for correct work. These conditions were also the ones in which there were the lowest occurrences of dis-

ruptions and the highest attending behavior. (The teacher reported that the rate of questions asked increased greatly during the D conditions, but no direct observations were taken.)

In summary, reinforcement contingencies for attending behavior alone were consistently effective in decreasing disruptions and increasing attending behavior but seemed to have little effect on correct work. When contingencies were placed solely on correct work, the accuracy in-

Fig. 3. Median number of problems worked correctly and median per cent of problems worked correctly by 14 third-grade children during a time when the children worked on 100 arithmetic computation problems. Individual per cents were calculated by dividing the number correct by the number attempted. After the base-line condition (A), the children went through conditions in which reinforcement was contingent upon attending behavior (B), arithmetic performance (C) and a combination of arithmetic performance and attending behavior (D). Filled points are for single sessions; all others are combined data for two sessions.

creased but the number of problems correctly worked stayed constant, while attending behavior dropped and disruptions increased. Only when contingencies were placed simultaneously on attending behavior and on correct work did we find concurrent increases in attending behavior, number of problems worked correctly, and per cent of problems worked correctly.

This first experiment provided some data on the relationship between attending behavior and correct work but at least two methodological problems in the experiment raised some caution about the findings. The first concerned the sequencing of the conditions. Specifically, if the C₁ condition (reinforcement for correct work alone) had preceded the B₁ condition (reinforcement for attending alone), would correct work and attending behavior have increased simultaneously? The second concern centered around the increase in the number of tokens that could be earned in the D periods. Since this increase could have produced the observed changes in correct work and attending, a second experiment was designed to address these two concerns.

EXPERIMENT 2

METHOD

Subjects

The nine third-grade children who served in this experiment came from another third-grade class in the school described above. These children were similar along both behavioral and achievement dimensions to those reported earlier.

Procedures

The procedures were generally the same as those described earlier, with only minor differences introduced. The treatment conditions were as follows:

Baseline. During the baseline conditions, there were no special contingencies in effect, either for attending or for correct work.

Tokens for correct work. During these conditions (C₁ and C₂), the children received one

point for every problem they worked correctly, rather than one point for every seven problems as they had in the first experiment, plus points for accuracy in working the problems. The procedure for distributing points for accuracy was the same as described in Experiment 1. During this condition, the children received an increased number of tokens as they had in the D conditions of Experiment 1. They received on the average 35 to 45 tokens per day.

Tokens for attending behavior. In this condition (B), points were delivered to those children who were attending. The teacher was given a sheet of paper with each child's name and a series of boxes after his name. As she walked by a child, she would touch him on the shoulder and mark a check next to his name. Each child was contacted and earned on the average 12 to 14 tokens. After the class ended, the children received a tally of the number of tokens they received. This change in procedure for reinforcing attending behavior was instituted to avoid some of the problems encountered with tokens in the first experiment. The children could no longer play with their tokens and the teacher could, if necessary, call a child's name across the room and award a point, rather than personally delivering the reinforcement.

Tokens for correct work and for attending. During this condition (D), the children received points for problems worked correctly as they had during the C conditions and points for attending behavior as they had during the B condition.

RESULTS

Social Behavior

Figure 4 shows the attending data for each condition. There appeared to be little, if any, effect on attending behavior during the C₁ condition, in which points were delivered solely for correct work. As we moved into the B condition, in which the points were delivered contingent upon attending behavior, however, attending behavior definitely increased. During the reversal

Fig. 4. Per cent of 10-sec intervals in which attending and disruptive behavior occurred for nine third graders during a time when the children worked on 100 arithmetic computation problems. After the baseline condition (A), the children went through conditions in which reinforcement was made contingent upon arithmetic performance (C), attending behavior (B), and finally a combination of arithmetic performance and attending behavior (D).

or C₂ condition, attending behavior again decreased to its C₁ level. In the final condition (D), in which points were delivered both for correct work and for attending behavior, the attending behavior was observed in slightly over 90% of the sampled time intervals.

Disruptions were again highest during the conditions in which reinforcement was contingent solely upon work accomplished. In conditions B and D, when some reinforcement was for attending behavior, disruptions decreased.

Correct Work

Figure 5 shows the median number of problems worked correctly. While there did seem to

be a small increase in the number of problems worked correctly during the B condition, the last three days of this condition were well within the range of correctly worked problems during baseline and during the C₁ condition. In the C₂ reversal, the median dropped lower than the baseline. Finally, the highest number of problems worked correctly occurred during the D condition, a condition terminated prematurely when the school year ended.

As Figure 5 shows, the median per cent correct was highest during conditions in which some reinforcement was contingent upon the work accomplished. Per cent correct increased during the C₁ condition, dropped quickly dur-

ing the B conditions, and finally recovered its C_1 level during C_2 , and increased to slightly over 90% during the final D condition.

This second experiment, in which the sequencing of conditions was changed and the large number of tokens (circa 40) in the D condition was controlled by also having a large number present in the C condition essentially replicated the findings of the first. Contingencies on attending alone increased attending behavior, but had little effect on the measures used here for correct work. Reinforcement contingencies for correct work alone increased the accuracy of work but had little effect on attending behavior. Only when reinforcement was contingent both

for attending behavior and for correct work did we find increased attending behavior, decreased disruptions, along with increased average problems worked correctly and increased accuracy. While the changes observed in disruptive behavior did replicate the changes observed in the first experiment, they were not dramatic changes. This was not surprising because no specific contingencies were directly applied to disrupted behavior in either experiment.

DISCUSSION

A variety of beneficial side effects are frequently noted in behavior modification studies.

Fig. 5. Median number of arithmetic problems worked correctly and median per cent worked correctly for a group of nine third graders working 100 computational problems. Individual percentages were calculated by dividing the number correct by the number attempted. After the baseline condition (A), the children went through conditions in which reinforcement was contingent upon arithmetic performance (C), attending behavior (B), and finally a combination of arithmetic performance and attending behavior (D).

For example, Surrat, *et al.*, (1969) suggested a relationship between attending behavior and academic achievement: "The 'working' behaviors modified in the present experiments are assumed to be correlated with the actual accomplishment of assigned work and ultimately with academic achievement (page 91)." Other relationships, such as between attending behavior and affective or even self-improving behavior are also posited, Madsen, *et al.*, (1968) stated: "This report is part of a series of studies aimed at demonstrating what the teacher can do to achieve a 'happier', more effective classroom through the systematic use of learning principles (p. 139)."

Such statements suggest that a variety of positive side effects can result from behavioral reinforcement in addition to the increased attending behaviors of the target children.

This study, however, suggests that contingencies that increase attending behavior and reduce disruptions do not necessarily increase student performance, at least in arithmetic drill exercises. Contingencies on attending alone increased attending behavior and decreased disruptive behavior, but had little effect on the measures for correct work accomplished. Reinforcement contingencies for "correct work" alone increased the accuracy of work but had little effect on attending behavior and appeared to correlate with increased disruptive behavior. Only when reinforcement was contingent both for attending behavior and for correct work accomplished did we find increased attending, decreased disruptions, along with increased number of problems worked correctly. The same may also be true for other "hoped-for" by-products of behavioral or other contingencies. Speculations of change in other than targeted behaviors may be misleading. If one desires improved student performance, better teacher preparation and presentation, or more positive attitudes, contingencies should be structured specifically for each of these target behaviors.

The two experiments were also designed to test the effects of different sequences of the contingency conditions and also different ways of

controlling for the amount of token reinforcement in the combined or D conditions. The two experiments essentially replicated one another's findings, suggesting neither sequencing nor the amount of token reinforcement made any substantial difference.

At least one biasing factor, however, could have influenced these results. Although the absolute number of tokens earned in condition D of the first experiment and condition C of the second experiment were approximately equal, the relative number of tokens earned increased within each of the two experiments. That is, in Experiment 2 just as in Experiment 1, the highest number of tokens could be earned in condition D because once more the opportunities of B and C were combined.

Even though the changes observed in academic performance were not as strong as behavior change in studies focusing solely on attending and disruptive behavior, the changes do appear to be replicable. In these two experiments, reinforcement contingencies were placed both on number correct and on per cent correct. The results suggest that one aspect of academic performance, per cent correct, is more easily influenced by reinforcing contingencies than is number worked correctly.

While the present experiments did not provide any final answers, they do point out the need for more intensive research effort in the area of academic performance. They further show simultaneous observations of social and academic classroom behavior to be a fruitful approach.

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