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AUTHOR	Ferritor, D. E.; And Others
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ABSTRACT

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 cen 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 tha could be earned. The findings emphasize 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. (Author/JM)

EFFECTS OF CONTINGENT REINFORCEMENT FOR ATTENDING BEHAVIOR ON WORK ACCOMPLISHED

by

D. E. Ferritor, D. Buckholdt, R. L. Hamblin, and L. Smith

ABSTRACT

Past studies have shown that disruptive behavior can be eliminated and on-task behavior accelerated. The relationship between these behavior and actual performances 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.

EFFECTS OF CONTINGENT REINFORCEMENT FOR ATTENDING BEHAVIOR ON WORK ACCOMPLISHED[1]

by

Daniel Ferritor, David Buckholdt,

Robert Hamblin, and Lamar Smith

CEMREL and Carr Lane Elementary School

A number of recent studies (Hall, Lund, and Jackson, 1968; Thomas, Becker, and Armstrong, 1968; Hamblin, et al., 1971) have shown that teachers could be trained to increase so-called 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. While further extensions to different populations might be of some academic interest, other problems may be more important to an educational therapy.

Inattentive and disruptive behavior concern both classroom teachers and school administrators and, on the surface, appear to be incompatible with school work. The reduction of these behaviors, however, may not be a sufficient environmental change to produce accelerated work. While there is some correlational evidence (Marsh, 1956) for the relationship between increased attending behavior and achievement gains and further some behavioral 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, Ulrich, and Hawkins, 1969), the degree of relationship between attending behavior and achievement related behaviors is not clearly understood. The present experiments sought to investigate this 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 increased attending behavior and decreased disruptive behavior during a daily twenty-minute drill lesson. Contingencies were later placed on actual work accomplished and finally upon a combination of accomplished work and of attending behavior.

Methods

Subjects

Fourteen members of two third grade classes from an inner-city school serving an economically depressed, low income housing project served as subjects. At the beginning of the school year, these children had a mean age of ten years 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 hetereogeneity of social behaviors and of ability in arithmetic computation. Fourteen students were chosen for the experiment. Of these fourteen children five displayed a high degree of disruptive behavior, the remaining nine appeared average for the school; three of the fourteen children tested below the second grade in arithmetic computation and the remaining were average for the school.

Procedures

The experimental task was a set of 100 arithmetic computation problems which the children worked for twenty minutes each day. After consulting with the third grade teachers, over 5,000 arithmetic problems, testing arithmetic skills which 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 fourteen 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 ever made to give group lessons to the subjects. A twenty-minute timer was set and the children were told to begin work. The teacher was available to answer questions, and periodically moved through the room but otherwise busied herself with paper work. She was instructed to ignore any behavior other than relevant questions. The activity, then, was meant to simulate seat work assignments in the classroom in which the children work independently.

The following treatment conditions were used:

Baseline During the baseline the teacher was asked to circulate through the room at random times but not to attempt to generate any attending behaviors or suppress any disruptive behaviors. Her role was only to answer any questions the children might raise.

Tokens for Attending During the behavioral conditions (B_1 &

B_2), the teacher was given a series of definitions for attending behavior and asked to give small plastic chips to those children who appeared to be working. The tokens were exchanged intermittently by the children (approximately 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 & C_2)[2] the children received one token for every seven problems they worked correctly and bonus tokens for the accuracy of their work (i.e., one token for getting 21-30% of the problems attempted correct, two tokens for 31-40%, to eight tokens for 91-100% and an additional two tokens for a perfect paper).

Tokens for Correct Work and for Attending During the mix contingency (D_1 & D_2), the children 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. With the increased number of tokens during C conditions, store prices were adjusted upward to hold purchasing power constant.

Observations

All of the children in the group were observed on a ten-

second time-sampling basis. An observer with a stop watch and recording instrument watched all the children sequentially on a five-second observe, five-second record basis. Thus, the observer would observe and record Child 1 for ten seconds, Child 2 for ten seconds and so on through Child 14, and then return to Child 1. The observation categories were as follows:

(1) attending behaviors, which included activity working on his test paper or on scrap paper, looking at his paper, asking a question, listening to the teacher either counting on his fingers or softly counting aloud, and following the teacher's direction to sharpen a pencil, to pass out papers, or to get scrap paper.

(2) not attending, which included looking out the window aimlessly, closing eyes and sleeping, and watching something that is going on in the room or in the hall without commenting on it or joining it.

(3) disrupting, which included talking out, hitting another student, making distracting noises, and throwing pencils, paper, or books.

(4) tokens, which included any token given by the teacher during the observation period.

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 89-95%), not attending behavior 91% (Range 85-99%). disruption 95% (Range 92-100%), and token 98% (Range 96-100%).

Results

Social Behavior

Figure 1 presents the attending and disruption data for each condition. During the baseline, the children attended approximately 80% of the sampled intervals and disruptions occurrred in about 8% of the intervals. The introduction of the token ecomony at the beginning of the B_1 condition effected an immediate decrease in disruptions and a steady increase in attending behavior until it reached over 90% on the final two days of the condition.

Figure 1 goes about here

During the C_1 condition in which tokens were given solely for correct work, the attending behavior dropped rapidly to

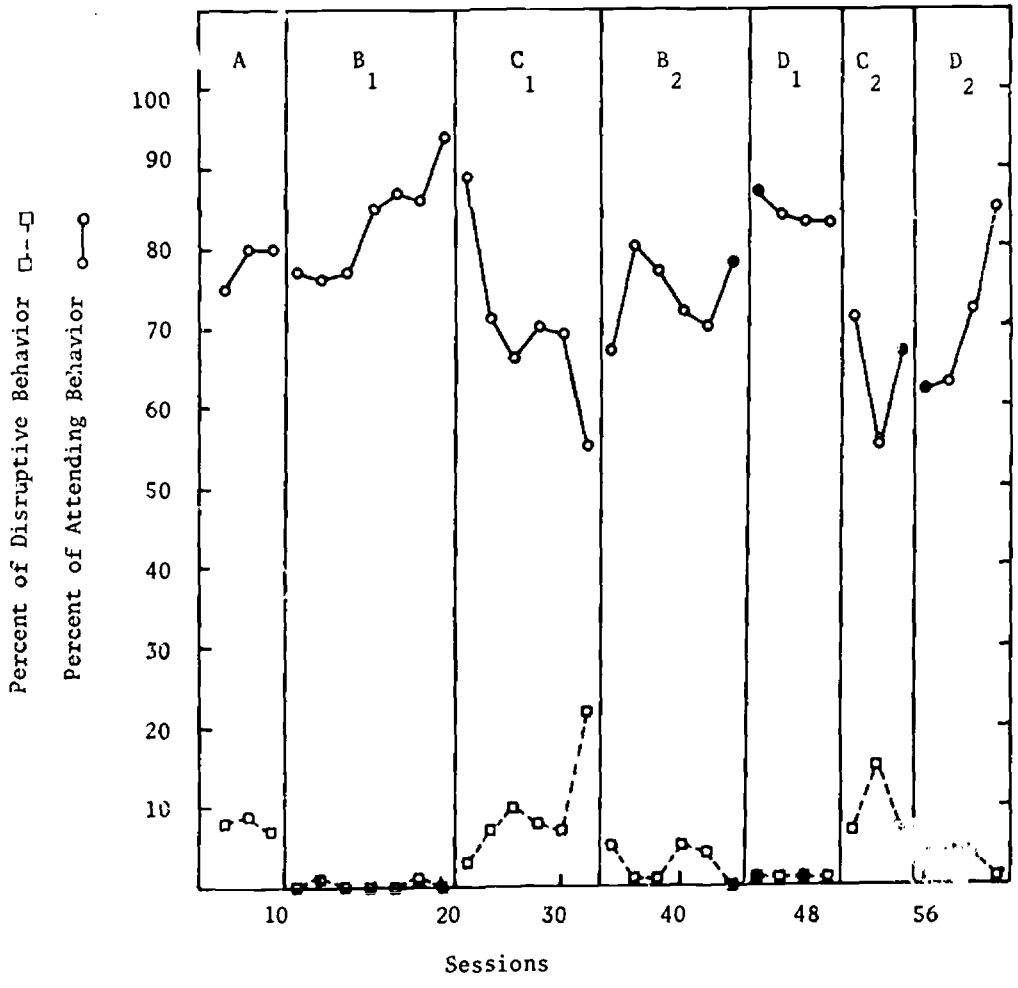

Figure 1. Percent of 10 second intervals in which attending and disruptive behavior occured for fourteen third grade children during a time when the children worked on 100 arithmetic computation problems. After the baseline condition (A), the children went through conditions in which reinforcement was made 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.

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 (B_2), note that while the disruptions again dropped to a low level and the attending behavior rose above its C_1 level it did not increase as high as it had been during the B_1 condition.

In the D_1 condition, contingencies were placed both on attending behavior and on work accomplished. Notice that disruptions decreased to a low level 1%, and attending increased to between 80 and 85%.

In the reversal back to tokens solely for correct work (C_2), note that again the disruptions increased rapidly and attending decreased to the level it had been during the C_1 conditions.

In the final phase, we again placed contingencies both on work accomplished and on attending behavior. As had occurred in the D_1 condition, disruptions decreased and attending behavior increased.

Work Accomplished

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

number of problems which the children worked correctly. Figure 2 shows the data for the median number of problems worked correctly. Note that there seems to be little difference in the number of problems worked correctly between the B_1, C_1, B_2 conditions and the baseline period in which no special contingencies were in effect. (The slight differences which did obtain may be random variation due to differences in the difficulty of the sampled problems).

Figure 2 goes about here

The rather large changes in social behavior seen in Figure 1 had little direct effect on the number of problems these children worked correctly each day. That is, they worked approximately the same number correct on days when the room was so disruptive that the teacher complained she could not hear herself think as on days in which there were zero disruptions.

Figure 2 shows one effect of the change in contingencies from social behavior to work accomplished (B_1 to C_1). Notice that the median per cent correct rose from an average of 54% during the B_1 condition to an average of 76% during the C_1 condition. The children attempted fewer problems during the C_1 conditions (an average of 73 attempted) than during the B_1 condition (an average of 95 attempted), but did approximately the same number correct and thus per cent correct increased somewhat. More importantly, however, this

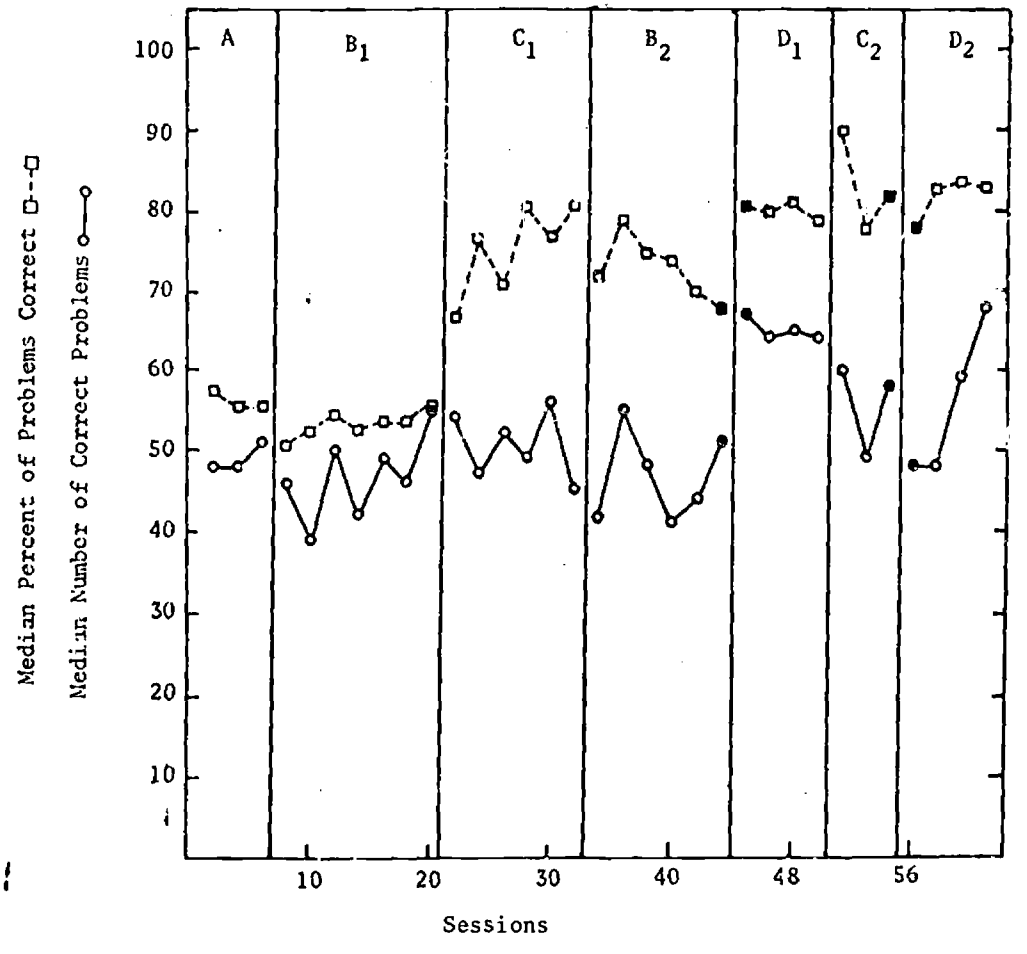

Figure 2. Median number of problems worked correctly and median percent of problems worked correctly by 14 third grade children during a time when the children worked on 100 arithmetic computation problems. Individual per cents were calculated by dividing the number correct by the number attempted. After the baseline condition (A) the children went through conditions in which reinforcement was made 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.

decrease in number worked seemed to reflect greater care in working the problems. That is the children no longer put down just any answer to problems they couldn't work. During the baseline and B_1 conditions, we would often collect assignments in which a child, for example, put the number 7 down whenever he did not know how to work a problem.

The increased accuracy gained in the C_1 condition dropped steadily during the reversal to tokens for attending (B_2). However, time did not permit us to let the condition run to see if the accuracy would deteriorate to the level it had been in B_1. 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 C_1 condition or an average per cent correct of 80%, 83%, and 82% for conditions D_1, C_2, and D_2 respectively.

Figure 2 shows that the only strong effect in the number of problems worked correctly came during the D conditions in which tokens were delivered both for attending and for the work accomplished. These conditions were also the ones in which there were low occurrences of disruptions and high 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 the measures of work accomplished. When contingencies were placed solely on work accomplished, the accuracy increased but the number of problems correctly worked stayed constant, while attending behavior dropped and disruptions increased. Only when contingencies were placed simultaneously on social behavior and work accomplished 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 intriguing data on the relationship between "attending behavior" and "work accomplished" 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 C_1 condition (reinforcement for achievement alone) had preceded the B_1 condition (reinforcement for behavior alone), would work accomplished 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 period. Since this increase could have produced the measured changes in work accomplished and attending, a second experiment was designed to address these two concerns.

EXPERIMENT 2

Methods

Subjects

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

Procedures

The procedures employed in this experiment were generally the same as those described earlier. There were 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 work accomplished.

Tokens for Correct Work During these conditions (C_1 & C_2), the children received one point for every problem they worked correctly plus points for accuracy in working the problems (the same contingency that was in effect during experiment 1).

Tokens for Attending Behavior In this condition (B) points were delivered to those children who appeared to work. 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. After the class ended the children received a tally of the number of tokens they received. Such a change was instituted to avoid some of the

problems encountered in the first experiment. That is, the children could no longer play with their tokens and the teacher could, if necessary, call a child's name from across the room and give him a check mark.

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 donditions and points for appearing to work as they had during the B condition.

Results

Social Behavior

Figure 3 shows the attending data for each condition. Notice that there was very little, if any, effect on attending behavior during the C_1 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 appearing to work, however, we find a definite increase in the attending behavior. During the reversal or C_2 condition, attending behavior again decreased to its C_1 level. In the final condition (D) in which points were delivered both for work accomplished and for attending behavior, note that the attending behavior occurred in slightly over 90% of the sampled time intervals.

Figure 3 goes about here

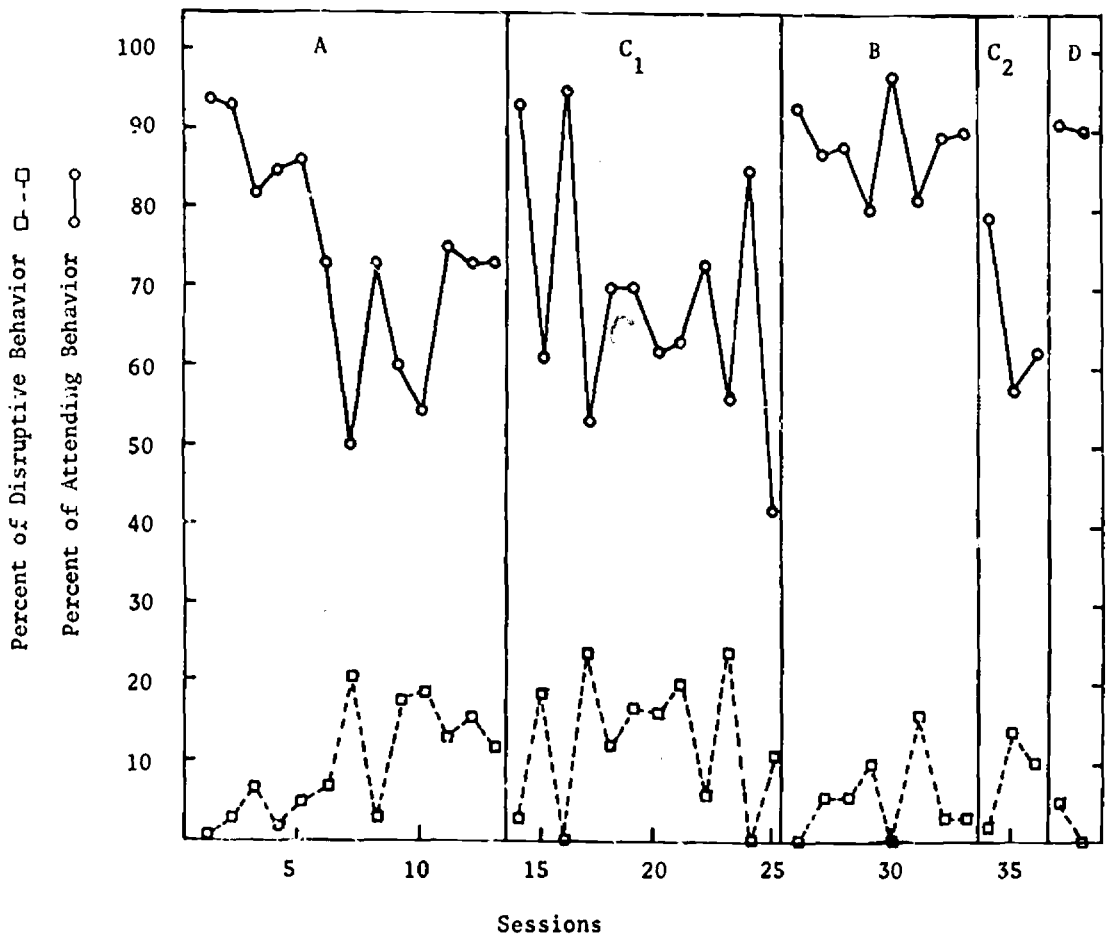

Figure 3. Percent of 10 second intervals in which attending and disruptive behavior occured for 9 third graders during a time when the children worked on 100 arithmetic computation problems. After the baseline condition (A), the children went through conditions in which reinforcement was made contingent upon arithmetic performance (C), attending behavior (B), and finally a combination of arithmetic performance and attending behavior (D).

In Figure 3 note that again disruptions are highest during the conditions in which reinforcement is contingent solely upon work accomplished. In condition B and condition D, when some reinforcement was for attending behavior, disruptions decreased sharply.

Work Accomplished

Figure 4 shows the median number of problems worked correctly. Notice that while there does seem to be some small increase in the number worked

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Figure 4 goes about here

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correctly during the B condition, the last three days of this condition are well within the range of number worked during the baseline and during the C_1 condition. In the C_2 reversal, the median number dropped lower than the baseline. Finally, we again find that the highest number of problems worked correctly occurred during the D condition, a condition which had to be terminated prematurely when the school year ended.

As Figure 4 shows, we again find that the median per cent correct is highest during conditions in which some reinforcement is contingent upon the work accomplished. Note how per cent correct increases during the C_1 condition, drops quickly during the B conditions, and finally recovers its C_1 level during C_2, and further increases to slightly over 90% during the final D condition.

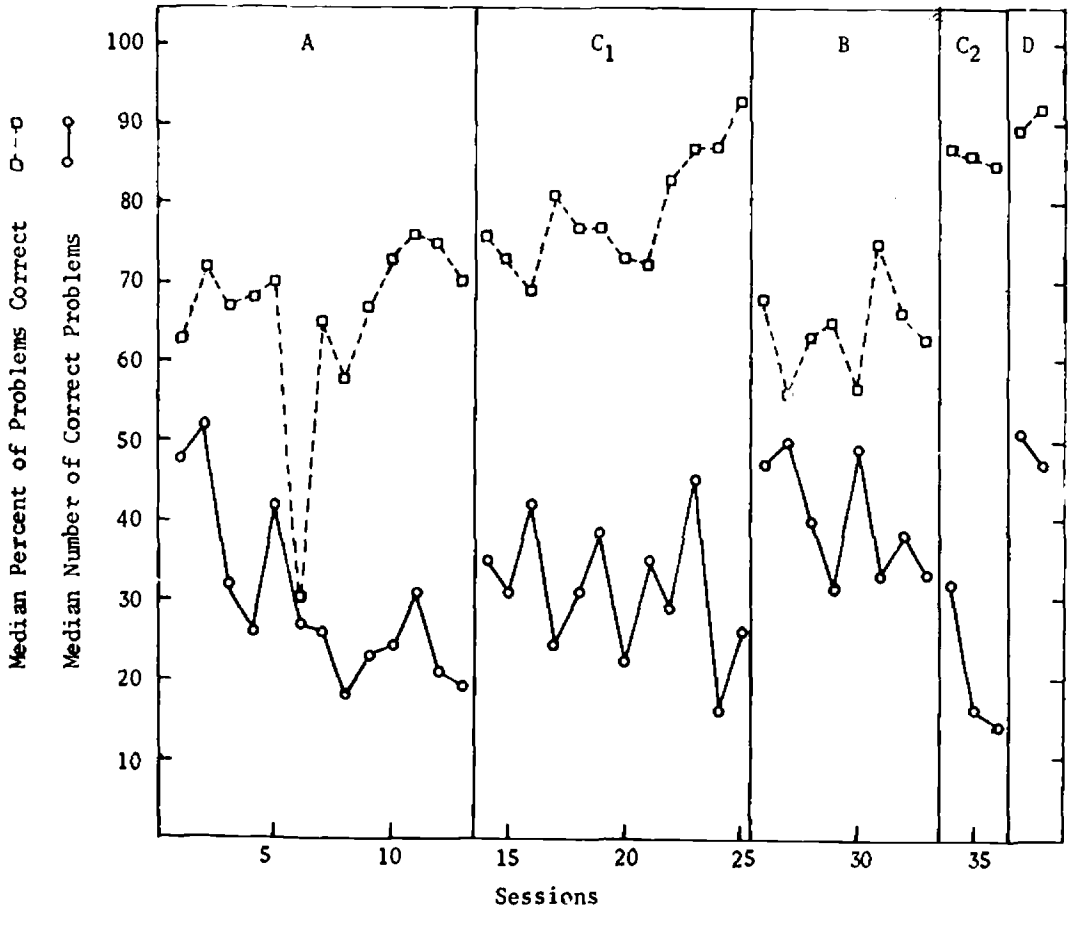

Figure 4. Median number of arithmetic problems worked correctly and median percent worked correctly for a group of nine third graders working 100 computational problems. Individual percentages were calculated by dividing the number correct by the number attempted. After the baseline condition (A), the children went through conditions in which reinforcement was made contingent upon arithmetic performance (C), attending behavior (B), and finally a combination of arithmetic performance and attending behavior (D).

This second experiment, in which the sequencing of conditions was changed and the additional tokens in the D condition were eliminated, essentially replicated the findings of the first. Contingencies on "attending behavior" alone increased attending and decreased disruptive behavior, but had little effect on the measures used here for correct work accomplished. Reinforcement contingencies for correct work alone increased accuracy of work but had little positive effect on attending behavior and appear to increase disruptive behavior. Only when reinforcement was contingent both for attending behavior and for work accomplished did we find increased attending, decreased disruptions, along with increased average problems worked correctly and increased accuracy.

SUMMARY

In the introduction we noted that a number of experiments have been designed with contingencies to reduce the frequency of disruptive behavior and increase attending behaviors. An ancillary question which is usually implied if not raised directly in these experiments is how these contingencies effect academic achievement. The series of experiments reported here were designed specifically to answer this question, to compare the rate of academic achievement under various contingencies of reinforcement.

Contingencies on "attending behavior" alone increased

attending 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 positive effect on attending behavior and appeared to increase 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 two experiments were further designed to test the effects of different sequences of the contingency conditions and also different ways of controlling for the amount of 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 essential difference.

IMPLICATIONS

A variety of beneficial, although often unexpected, behavioral changes is frequently noted in studies such as those reported in the introduction to this paper. For example, a relationship between attending behavior and academic achievement is suggested in statements such as , "The 'working' behaviors modified in the present experiment are assumed to be correlated with the actual accomplishment of assigned work and ultimately

with academic achievement." (Surrat, et al., 1969), "Improvement in academic achievement during the year may have been related to the Token Program. . . ." (O'Leary, et al., 1969), and "Yet student attention, however defined, seems to be an important parameter of successful academic performance." (Packard, 1970). Other relationships, such as between attending behavior and affective or even self-improving behavior are also posited. In recent issues of this journal we find: "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." (Madsen, et al., 1968) and ". . . the availability to teachers of a set of techniques for controlling the disruptive behavior of students is of obvious advantage in terms of smoother classroom functioning. In addition, being taught to manifest task-relevant classroom behavior is worthwhile to the child himself." (Ward and Balsar, 1968.) Finally, we find references to side effects which "logically" might occur such as ". . . the teachers had more time for constructive teaching or all pupils because of the decrease in disruptive behaviors in the classroom." (Hall, et al., 1968) and "Further, such tactics used effectively in eliminating and controlling behavior problems may have the added advantage of freeing the teacher so that he might have more time to do a better job of teaching." (Schmidt and Ulrich, 1969).

These authors imply that a variety of positive side effects

can result from behavioral reinforcement in addition to the increased cooperative and on-task behaviors of the target children. Teachers and children will be happier, more of the teacher's time will be spent on instruction, and children will make significant academic improvements. Yet none of the authors present convincing data to demonstrate that such positive side-effects actually accompany behavioral improvements in children.

This study has shown, in fact, that contingencies which increase attending behavior and reduce disruptions do not necessarily increase student performance, at least in arithmetic drill exercises. Additional contingencies had to be structured before performance improved. The same may also be true for other "hoped-for" by-products of behavioral or other contingencies. If we want improved student performance, better teacher preparation and presentation, or more positive attitudes, contingencies should be structured specifically for each of these target behaviors. Cavalier promises of desirable side-effects should be avoided. A teacher can count on an increase in the specific behaviors which are being reinforced but it is dangerous to promise or hope for additional benefits. There may be cases when positive ancillary effects will occur but these should not be promised without much more extensive research.

Figure Captions

Figure 1. Percent of 10 second intervals in which attending and disruptive behavior occured for fourteen 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 made 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.

Figure 2. Median number of problems worked correctly and median percent 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 baseline condition (A) the children went through conditions in which reinforcement was made 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.

Figure 3. Percent of 10 second intervals in which attending and disruptive behavior occurred for 9 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).

Figure 4. Median number of arithmetic problems worked correctly and median percent 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 made contingent upon arithmetic performance (C), attending behavior (B), and finally a combination of arithmetic performance and attending behavior (D).

Footnotes

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[2] During 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.

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