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STIMULUS CONTROL IN THE CLASSROOM AS A FUNCTION OF THE BEHAVIOR REINFORCED

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Eight fifth- and sixth-grade children with behavior problems performed in a classroom under three conditions: (1) unreinforced baseline, (2) reinforcement for being on task, and (3) reinforcement for the accuracy and rate of math problems solved. The teacher was absent for a portion of the class session under each of these conditions. In the teacher's absence, on-task behavior declined markedly and disruption markedly increased, regardless of the reinforcement condition in operation. In addition, the teacher's absence resulted in fewer problems attempted and decreased accuracy. However, the extent to which the children became disruptive was reduced and the number of problems attempted increased when reinforcement was contingent on academic accuracy and rate, instead of being contingent on being on task. The results suggest that by providing contingencies for the products of a child's classroom activities, rather than for being on task, the child will become more independent of the teacher's presence, and more under the control of the academic materials.

DESCRIPTORS: generalization, stimulus control, classroom management, social control, grade-school students

Dozens of studies have verified the utility of specifically arranging contingencies to facilitate the development of social and academic behavior in classroom settings (O'Leary & Drabman, 1971; Winett & Winkler, 1972). However, a number of authors have been concerned with the situational dependency of the behavior changes they have achieved (Levine and Fasnacht, 1974; Marholin, Siegel, and Phillips, 1976). A child may demonstrate appropriate social and/or academic behaviors in one class under one set of contingencies, yet, may not demonstrate those behaviors in another classroom under a less systematic set of contingencies (Meichenbaum, Bowers, and Ross, 1968; Walker and Buckley, 1972).

It may be that the failure to demonstrate previously trained behavior in a new environment is due to the absence of discriminative stimuli that were established in the training environment (Marholin *et al.*, 1976; Marholin, Steinman, McInnis, and Heads, 1975). In the classroom setting, for example, the teacher is often the sole or major discriminative stimulus for desired behavior. By continually assessing and reinforcing desired behavior in the classroom, the teacher becomes a discriminative stimulus for that behavior. Therefore, when the student leaves that teacher and the special management system being used in the classroom and is returned to the regular classroom, it is not surprising to find a marked deterioration in the child's behavior.

Several investigators have shown that the behavior trained in one setting is specifically tied to the people and conditions in that set-

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ting (Lovaas and Simmons, 1969; Meddock, Parsons, and Hill, 1971; Peterson, Merwin, Moyer, and Whitehurst, 1971; Peterson and Whitehurst, 1971; Redd, 1970, 1974, 1976; Redd and Birnbrauer, 1969; Redd and Wheeler, 1973; Risley, 1968; Tate and Baroff, 1967; Wahler, 1969). If an adult has been established as a discriminative stimulus for reinforced behavior, it should be expected that the presence of that adult will result in increases in that behavior and absence will result in decreases (Steinman, 1970*a, b,* 1976, Note 1). The typical classroom provides many opportunities for the teacher to develop such discriminative properties. Indeed, in most classroom situations the teacher is responsible for monitoring the child's behavior and is the primary agent for reinforcing and punishing contingencies. It is likely, therefore, that the teacher will develop discriminative properties for a variety of responses that function to increase the probability of continued reinforcement and decrease the probability of punishment. To the extent that the teacher's presence is necessary, both to monitor and to reinforce the child's classroom behavior, it should be expected that the child's appropriate classroom behavior will decrease in the teacher's absence (Marholin *et al.,* 1975). The child will simply learn a conditional discrimination in which responding appropriately to various classroom stimuli is functional only when the teacher is present.

Much of the research on classroom management has involved attempts to decrease disruptive behavior and increase task-oriented behavior (*e.g.,* Madsen, Becker, and Thomas, 1968; O'Leary, Becker, Evans, and Saudargas, 1969). Because of the nature of the behaviors being manipulated, *i.e.,* task orientation and disruption, the teacher's presence is necessary to observe the occurrence of these behaviors and to deliver appropriate consequences. Therefore, it is likely that the teacher's presence will develop discriminative stimulus properties for the children's appropriate classroom behavior. However, since the teacher's presence is necessary for observation and for delivery of consequences, the appropriate behaviors are not likely to be maintained when the teacher is absent.

One reason why so much research has focused on the development of on-task and nondisruptive behavior has been the assumption that these behaviors are precursors to improved academic performance. However, if one were interested in maintaining task-oriented behavior in a teacher's absence, the discriminative function exerted by the teacher's absence would have to be reduced and the stimuli maintaining the behavior would have to be limited to those remaining in the classroom setting. Instead of reinforcing on-task and nondisruptive behaviors directly, contingencies could be applied to another response class correlated with task orientation and appropriate social behavior but not requiring direct on-the-spot monitoring. Recently, several studies have shown that the amount of time that a child spends on a task can be increased and the amount of disruption decreased by reinforcing academic achievement directly, whether or not on-task and other related appropriate social behaviors are also reinforced (Ayllon, Layman, and Kandel, 1975; Ayllon and Roberts, 1974; Kirby and Shields, 1972; Sulzer, Ashby, Hunt, Konierski, and Krams, 1971; Winett and Roach, 1973). For present purposes, the importance of these findings is that they suggest a means by which appropriate social behavior and attending to assigned academic tasks might be maintained in the teacher's absence. Because changes in academic performance have been shown to be correlated with changes in on-task and other classroom social behaviors, reinforcing measures of academic performance (*e.g.,* rate and accuracy) should increase the extent to which a child remains on task. Furthermore, since academic performance need not require on-the-spot observation to be monitored and consequated by the teacher, on-task and disruptive behavior should become less dependent on the teacher's presence.

It might also be predicted that a child will remain on task longer and engage in less disruptive behavior in the teacher's absence if the teacher were reinforcing academic performance, than if the teacher reinforced on-task and nondisruptive behavior whenever he or she was present. The former procedure should reduce the teacher's presence as a discriminative stimulus for on-task and nondisruptive behavior; the latter should tend to establish further the teacher's presence as a discriminative stimulus for these behaviors (Marholin *et al.,* 1975).

The present research sought to demonstrate a means by which the academic and social behavior of children can become less dependent on the teacher's direct supervision. In providing contingencies for the products of a student's classroom activities (*e.g.,* academic production), rather than for the teacher's judgements of the extent to which the student appears to be engaged appropriately in these activities, the student becomes more independent of the teacher's continuous observation and consequences, and should also remain on task more and exhibit fewer disruptive behaviors. As the child's classroom behaviors come more under the influence of the academic materials themselves, these behaviors should be less affected by the teacher's absence.

METHOD

The effect of the teacher's presence on the on-task and disruptive behavior and on the rate and accuracy of academic performance of eight conduct-problem children was assessed during three sets of contingencies: (A) a baseline condition, (B) when the teacher reinforced on-task and nondisruptive behavior, and (C) when the teacher reinforced the rate and accuracy of the children's academic performance, rather than on-task and nondisruptive behavior; these contingencies were studied using an ABCBC design.

Setting

The study was conducted in a typical public-school classroom containing 19 individual desks arranged in five groups of three or four desks each. Space was also available for small reading groups, individual tutoring, remedial instruction, and testing. An adjacent classroom was made available for children who failed to earn a free-time reinforcement period, employed in the procedures. Classroom staff included a certified elementary education teacher and two teacher's aides. The study was conducted in one of the regular classroom sessions attended each day by all children in the class.

Subjects

The four boys and four girls who participated were in a special classroom because of academic and behavioral problems experienced in their regular classrooms. The children ranged in age from 10 to 12 yr but were 1 to 4 yr below grade level in basic reading and math skills. They also exhibited a number of inappropriate social behaviors, such as talking out, throwing objects, defying the teacher, nonattending, walking aimlessly around the room, and slamming desks. The eight most disruptive and least task-oriented of the 19 children in the classroom were selected as subjects, based on 14 days of prebaseline data.

Materials

The materials consisted of mathematics textbooks currently being used in the classroom.[2] The mathematics problems consisted primarily of two-column addition, subtraction, multiplication, and division problems, interspersed with one- or two-sentence word problems demonstrating each new concept. Each unit of text material was preceded by a pretest designed to assess whether the material was beyond the student's level of competency. If a child failed to pass a particular unit's pretest at a specified criterion level, the child would be required to repeat previous units; children were seldom required to repeat material.

[2]The academic materials consisted of fourth-, fifth-, and sixth-grade mathematics textbooks (Denholm, Hankins, Herrick, and Vojtko, 1974).

Response Definitions and Data-Collection Procedures

Data were collected on disruptive, neutral, and task-oriented behaviors by two trained observers in the classroom. Occasionally, a third observer sat adjacent to one of the two regular observers and simultaneously gathered reliability data on the same children. Each observer was responsible for recording the behavior of four children in each 30-min session. The observer recorded the behavior of two children simultaneously for 5 min and then began recording the behavior of the other two children. Each observer recorded the behavior of the same four children throughout the study. In this manner, each child was observed for 15 min in each 30-min session. Observation periods were alternated systematically by observing a different pair of children first each day. The 5-min observation period was divided into 20, 10-sec intervals (*i.e.,* observe for 10 sec, record for 5 sec, repeat).

On-task behavior was defined as a child's actions or orientations indicating appropriate engagement in the assigned tasks. Specific examples include: getting out appropriate materials, looking at books or other materials, turning to appropriate page or assignment, shifting activities, writing answers to questions or working problems, following teacher's general instructions, appropriately looking at a person talking, talking with teacher, waiting with hand raised, and waiting in response to a teacher's prompt. To be rated on task, a child had to appear to be engaged in the assigned task for at least 9 sec of a 10-sec interval.

Behavior recorded as disruptive included three categories: (1) motor disruption, including touching, hitting, pinching, pulling others, and throwing objects; (2) verbal disruption, including talking aloud to self, talking to other children during individual work, yelling, singing and interrupting; and (3) noise, including nonword sounds, such as tapping, humming, dropping objects, slamming books, and whistling. If any one of these behaviors occurred in a 10-sec interval, the behavior was scored as disruptive for that interval. If the child was not scored as disruptive or on task in a particular 10-sec interval, he or she was scored neutral (*i.e.,* off task but not disruptive).

The interobserver reliability of these data was computed separately for the on-task, disruptive, and neutral behavior. Observation sheets from the two observers were compared interval by interval for each 10-sec period. Per cent agreement between the two independent observers was defined as the number of agreements that a particular behavior occurred within a given 10-sec interval, divided by the number of such agreements plus disagreements per 30-min session and multiplied by 100.

Observer reliability for on-task behavior had a mean of 95%, with a range of 87% to 100% for each day of observation; reliability for disruptive behavior had a mean of 86%, with a range of 68% to 100% for each day of observation, and reliability for neutral behavior had a mean of 82%, with a range of 57% to 100%.

The accuracy and rate data were obtained from the children's work sheets. Rate was determined by counting the total number of problems with complete or partial answers. Unanswered problems that preceded problems with answers were counted as attempted. Accuracy was defined as the percentage correct of all problems attempted.

Procedure

The effect of the teacher's presence on the children's social and academic behavior was assessed under three sets of contingencies: (A) nonreinforced baseline, (B) reinforcement for on task, and (C) reinforcement for academic accuracy and rate. Each baseline and experimental session lasted 30 min. During this time, the children were engaged in assigned seat work consisting of written mathematics problems.

In the final three sessions of each phase of the study, the teacher and both aides left the

classroom for the final 10 min of the class (*i.e.*, "teacher-absent probe"). Neither reinforcement nor punishment was delivered during this probe period. Each time before leaving, the teacher announced to the class: "We will be gone for about 10 minutes, and although you cannot earn marks during this time, we expect you to continue working."

Experimental Conditions

Phase A: baseline. On the first day of baseline, the academic materials (*i.e.*, math books) were introduced. The children's task-oriented, neutral, and disruptive behaviors and their academic production (*i.e.*, rate and accuracy) were recorded, but were not consequated. This condition lasted seven days. For an additional three baseline sessions, the teacher and both aides left the classroom for the final 10 min of the class period. Otherwise, the conditions in these last three sessions were identical to those of the preceding seven sessions.

Phase B1: on task reinforced. For the next 11 class sessions, the teacher and two aides rewarded each child (*i.e.*, including the 11 children not selected as subjects) with a "mark" and a positive comment when the child was observed to be appropriately engaged in academic work. An individualized variable-interval schedule of reinforcement was used. The schedule was determined by each child's baseline data. For children who seldom were on task, a richer schedule of reinforcement was used than for those who were on task more frequently. For example, Subjects 6 and 8 were on task 43% and 44% of the time during baseline, while Subjects 5 and 7 were on task only 27% and 18%, respectively. Therefore, Subjects 6 and 8 were rewarded on a VI 10-min schedule, and Subjects 5 and 7 on a VI 6-min schedule. For those children whose mean percentage of on-task behavior was in an intermediate range (*i.e.*, 29%, 31%, 36%, and 32% for Subjects 1, 2, 3, and 4, respectively) a VI 7.5-min schedule was employed. The teacher and two aides were each responsible for monitoring the schedules of reinforcement for a group of two or three subjects each day by carefully observing each child and a large clock located in the front of the classroom. The subjects for which each of the aides and teacher were responsible rotated on a daily basis. The marks earned were exchangeable for a 30-min free-time activity period following each experimental session. On Day 1 of the on-task reinforcement phase, the teacher explained to the class the contingencies in effect during the "special math period", including specific examples of behaviors that were to be reinforced (*e.g.*, sitting quietly, reading books, writing, getting out materials). If a child failed to earn the required number of marks to gain access to the free-time period, he or she went to an adjacent classroom to continue working on additional assignments. Each child had a 7.5- by 12.5-cm index card on his or her desk divided into segments for the receipt of marks. Marks were delivered by the teacher or aide by initialling the child's mark sheet. In the condition during which on-task behavior was reinforced, no marks or comments were dispensed for the academic work itself.

For the next three sessions, the same conditions were in operation during the first 20 min, but, in the last 10 min, the teacher and aides were absent and, as in all teacher-absent probe periods, no reinforcement was available.

Phase C1: academic rate and accuracy reinforced. For the next 13 days, on-task, disruptive, and neutral behavior continued to be recorded, but reinforcement was contingent on successful completion of the academic work assigned in each class session, rather than for the on-task behavior itself.

More specifically, reinforcement was contingent on a combined criterion of academic rate (*i.e.*, number of problems attempted) and accuracy (*i.e.*, percentage of problems completed correctly). Individual criteria for reinforcement were determined from the rate and accuracy data collected in the preceding two phases (*i.e.*, baseline, on task reinforced). From this infor-

mation, a mean rate and accuracy score was computed for each child. To receive reinforcement, each child had to equal or exceed his or her rate and accuracy criteria. For example, if Subject 1 had averaged 20 problems attempted with a 75% accuracy during the baseline and the on-task reinforcement phases, it would be necessary to complete at least 15 problems correctly to acquire maximum reinforcement in any one session.

To approximate the reinforcement density of the on-task reinforcement condition (Phase B1), the reinforcement schedule for each child's academic behavior was matched to the schedule used previously. For example, during Phase C1, Subject 6's criterion required that he correctly complete six math problems for each mark. Therefore, Subject 6 was rewarded on the average of three times during each 30-min session if he had correctly completed at least 18 problems. His previous work had indicated that the accurate solution of 18 problems was his mean. Similar schedules of reinforcement were employed during the 20 min preceding each probe. However, during the probes in Phase B1, no reinforcement could be obtained for work completed in the last 10 min of the probe sessions.

On Day 1 of the academic reinforcement condition, the teacher explained the new contingency system to the class: "Starting today you may earn your marks to pay for free time by completing your assignments correctly. Each of you will have a different number of problems to complete correctly to receive your marks." Following the teacher-delivered explanation to the class, teachers individually explained each child's criterion for reinforcement.

Phase B2: on task reinforced. Reinforcement for academic work ceased, and reinforcement for task-oriented behaviors was re-instated for the next seven days. As before, three probe sessions followed.

Phase C2: academic rate and accuracy reinforced. Reinforcement for task-oriented behavior was discontinued, and reinforcement for rate and accuracy was re-instated for the next 15 days. Individual subject rate and accuracy criteria were determined in a similar manner as in Phase C1, but they included all sessions through Phase B2. Again, three probe sessions followed.

RESULTS

Social Dependent Variables

The presence or absence of the teacher markedly affected the children's on-task and disruptive behavior. The overall effect of the

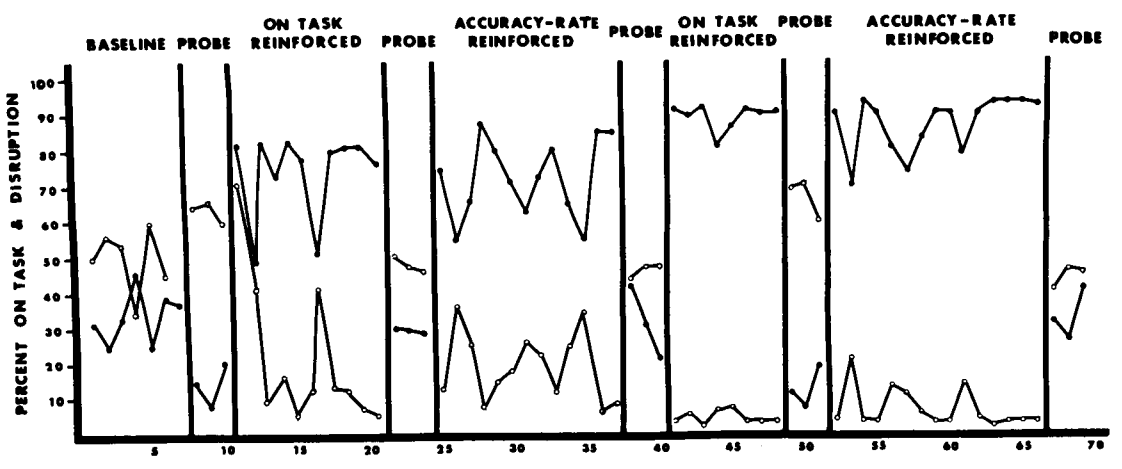

Fig. 1. The per cent of on-task and disruptive behavior in each phase of the investigation. Each point refers to the mean number of intervals in each session in which the children were scored as being on task or disruptive. The on-task (closed circles) and disruption (open circles) percentages are plotted separately.

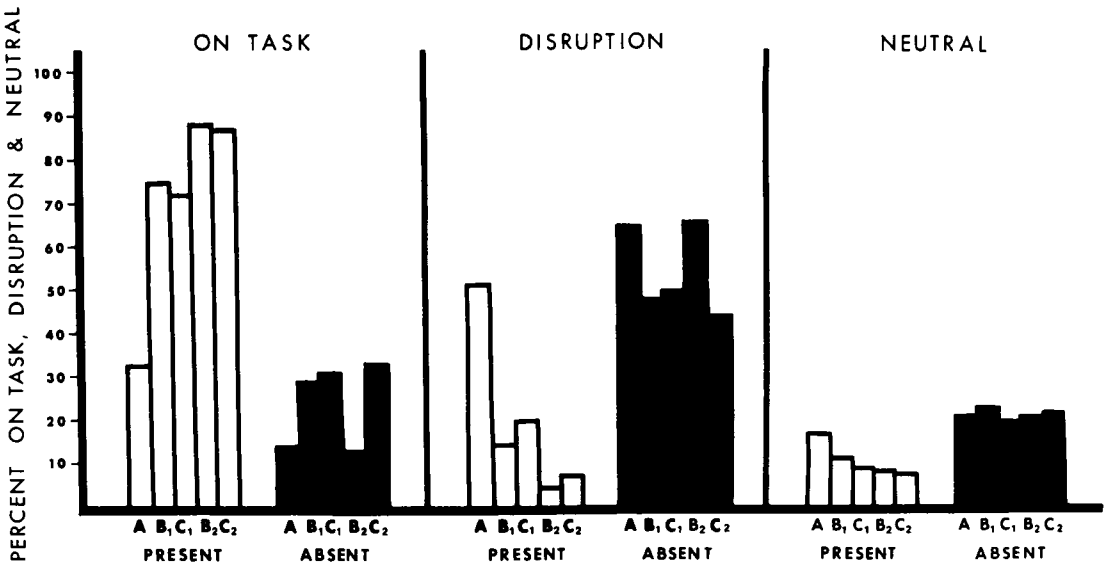

Fig. 2. The per cent of on-task, disruptive, and neutral behavior in each condition of the study. The on-task, disruption, and neutral data are plotted separately for sessions in which the teacher was present (open bars) or absent (darkened bars).

two contingency systems and the teacher's presence on the children's behavior is summarized in Figures 1 and 2. Children were much more disruptive ($F = 58.81$; 1,7; $p < 0.01$) and much less task oriented ($F = 208.68$; 1,7; $p < 0.01$) when the teacher was absent, regardless of which contingency system was in operation.

Both contingency systems clearly increased on-task behavior during the teacher's presence and decreased disruptive behavior. The percentage of time spent on task increased from a baseline of 33% to a mean of 80%; disruptive behavior decreased from a baseline of 51% to a mean of 8%.

The two contingency systems did not affect the on-task behavior differentially ($F < 1$). Furthermore, the contingency systems did not affect the disruptive behavior of the group differentially during the teacher's presence ($F < 1$). However, when the teacher was absent (*i.e.*, probe conditions), the disruptive behavior clearly was affected differentially by the two contingency systems. There was less disruptive behavior when academic rate and accuracy were reinforced than when reinforcement was contingent on on-task behavior ($F = 12.31$; 1,7; $p < 0.01$). This result was due mainly to an increase in disruptive behavior in the teacher's absence when on task was being reinforced for the second time (B2).

The on-task and disruptive behavior of each child in each experimental condition is summarized in Table 1. Six of the eight children became far less task oriented and much more disruptive when the teacher left the room, regardless of the contingency system in effect. The seventh child (Subject 2) deviated only during baseline, where on task was higher and disruption lower, when the teacher was absent compared to when she was present. Baseline measures of disruptive behavior for the eighth child (Subject 4) revealed a slightly higher frequency during the teacher's presence than during her absence. Moreover, for six of the eight children (Subjects 1, 3, 4, 5, 6, and 8), the increase in disruptive behavior was least when academic accuracy and rate were reinforced for the second time (C2). For Subjects 1, 3, 5, and 6, the amount of disruptive behavior in the teacher's absence was slightly less when on task was reinforced than when accuracy and rate were re-

Table 1

Individual-Subject Condition Mean Scores[1]

Phase	*A*	*Probe*	*B1*	*Probe*	*C1*	*Probe*	*B2*	*Probe*	*C2*	*Probe*	$\bar{C}$–$\bar{B}$ *Teacher Present*	$\bar{C}$–$\bar{B}$ *Teacher Absent*
S-1												
Rate	38	4	58	12	35	26	23	5	22	23	−12	16
Accuracy	70	84	90	69	90	75	69	59	78	64	5	6
On Task	29	17	73	28	67	32	76	7	82	47	0	22
Disruption	40	65	11	38	16	47	6	82	5	38	2	−18
S-2												
Rate	12	30	18	18	37	38	23	—	57	33	27	17
Accuracy	61	83	77	88	89	98	93	—	94	70	8	− 4
On Task	31	52	73	58	83	55	90	—	87	33	4	−14
Disruption	49	23	11	30	11	17	3	—	5	30	1	− 7
S-3												
Rate	10	4	17	17	30	17	38	3	45	107	15	52
Accuracy	69	0	48	84	83	53	51	100	86	84	35	−24
On Task	36	5	80	32	76	30	94	7	87	17	− 6	4
Disruption	53	92	13	55	21	63	4	83	8	70	6	15
S-4												
Rate	25	0	26	7	26	17	28	7	22	18	− 3	11
Accuracy	83	—	83	100	89	87	73	33	88	58	11	5
On Task	32	23	88	22	86	60	96	10	96	55	− 1	42
Disruption	41	32	1	32	6	8	0	52	1	15	2	−32
S-5												
Rate	28	2	38	33	28	4	31	7	30	14	− 6	−11
Accuracy	73	50	81	95	93	67	87	42	86	92	6	11
On Task	27	5	73	33	68	18	90	22	90	33	− 3	− 5
Disruption	61	63	18	43	24	55	4	55	8	35	5	− 4
S-6												
Rate	34	2	23	10	24	9	38	8	23	13	− 7	2
Accuracy	66	25	82	38	93	68	85	63	96	100	11	34
On Task	43	0	78	18	64	13	92	22	87	28	−10	1
Disruption	49	93	17	58	29	73	3	72	8	55	8	−23
S-7												
Rate	28	6	27	6	21	29	30	15	51	29	8	19
Accuracy	76	50	72	13	92	61	79	46	96	77	19	41
On Task	18	7	69	15	61	7	88	20	80	12	− 8	− 8
Disruption	74	88	23	73	35	90	9	77	13	77	8	9
S-8												
Rate	26	7	35	9	19	42	40	2	35	14	−11	23
Accuracy	52	0	27	0	81	57	38	0	80	5	48	31
On Task	44	5	68	27	70	35	80	5	84	37	3	20
Disruption	38	60	16	52	17	43	5	43	5	33	1	−10
$\bar{S}$ *1-8*												
Rate	25	7	26	14	28	23	31	7	36	31	1	16
Accuracy	69	42	70	61	89	71	72	49	88	69	18	13
On Task	33	14	75	29	72	31	88	10	87	33	− 3	8
Disruption	51	65	14	48	20	50	4	66	7	44	4	− 9

[1]Rate refers to the number of problems attempted. The rate scores reported during the 10-min probe sessions were each transformed to a score equivalent to those reported during the 30-min teacher-present sessions by multiplying by three. Accuracy represents the number of problems solved correctly divided by the number attempted. On task and disruption refer to the per cent of intervals in which the children's behavior was rated as on task or disruptive.

inforced. Subjects 2, 4, and 8, however, were less disruptive when academic rate and accuracy were reinforced for the first time (C1) than when on-task behavior was reinforced for the first time (B1). Subject 7's disruptive behavior increased equally under both presentations of

the two reinforcement conditions in the teacher's absence.

Similar individual-subject comparisons of the disruption and on-task data during the teacher's presence do not indicate systematic effects attributable to the particular contingency system in use. Thus, the individual data lead essentially to the same conclusions as the group analysis, *i.e.,* (1) the teacher's presence exerted strong control over on-task and disruptive behavior, and (2) the two contingency systems had a differential effect on disruptive and task-oriented behavior by producing significantly less disruption in the teacher's absence when she had been reinforcing academic accuracy and rate rather than on task.

Academic Dependent Variables

Throughout the study, data also were collected on the number of problems attempted in each 30-min class section (academic rate) and the number of problems solved correctly out of the number attempted (academic accuracy). During the probe sessions, the actual number of problems completed during the teacher's 10-min absence was multiplied by three to arrive at a measure that could be compared with the number of problems completed when the teacher was present. The effect of the two contingency manipulations and presence or absence of the teacher on accuracy and rate is illustrated in Figures 3 and 4.

The number of problems attempted in each session (academic rate) was differentially affected by the teacher's presence and absence ($F = 22.58$; 1,7; $p < 0.01$), with fewer problems being attempted in the teacher's absence than in her presence. Similarly, the number of problems attempted was differentially affected by the contingency system in operation, with the accuracy and rate reinforcement conditions producing a larger number of problems attempted than the on-task reinforcement conditions. This difference is due primarily to an increase in problems attempted during the teacher's absence, when accuracy and rate were reinforced ($F = 5.94$; 1,7; $p < 0.05$). The effect of the two reinforcement systems on rate during the teacher's presence did not differ reliably ($F < 1$). Indeed, during the teacher's presence the mean number of problems attempted remained quite constant throughout the study.

A striking reversal of effects on academic rate due to the two contingency manipulations during the teacher's absence is evidenced in Fig-

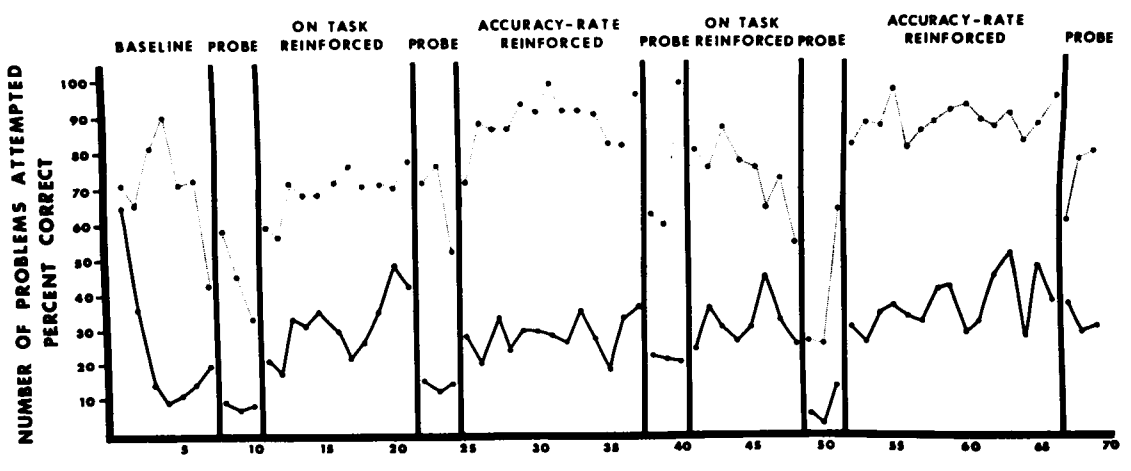

Fig. 3. The mean number of problems attempted (rate) and the per cent correct (accuracy) in each session. Solid lines represent rate and dotted lines represent accuracy. The y-axis represents percentage scores (accuracy, *i.e.* 0% to 100% accurate) *and* absolute numbers (rate, *i.e.,* 0 to 100 problems attempted).

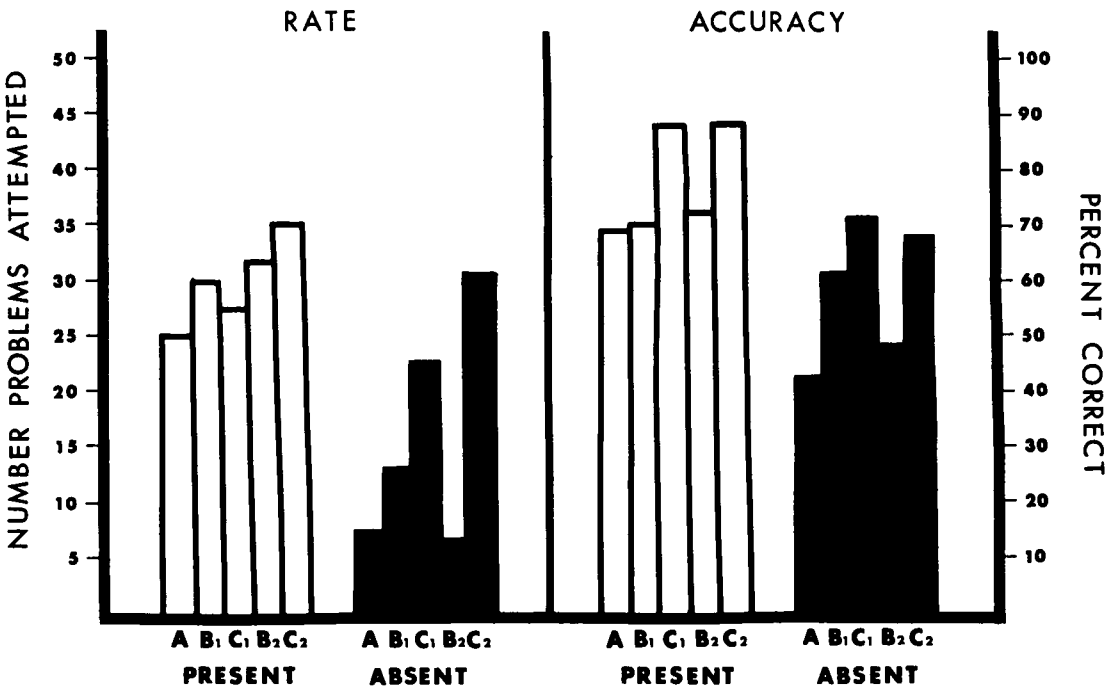

Fig. 4. The mean number of problems attempted (rate) and the mean number correct divided by the number attempted (per cent accuracy) in each condition of the study. The number of problems attempted and the per cent correct are plotted separately for sessions in which the teacher was present (open bars) or absent (darkened bars).

ures 3 and 4. During baseline, the group averaged seven problems attempted, which increased to a mean of 14 when on-task behavior was reinforced (B1). When reinforcement was contingent on the number of correct problems (C1), the group averaged 23 problems attempted. With the re-instatement of the on-task reinforcement contingency (B2), the eight children averaged only seven problems during the teacher-absent probes. Final re-instatement of the accuracy and rate reinforcement condition (C2) produced a dramatic increase in problems attempted, to a mean of 31, during teacher absence. The teacher's absence resulted in a mean decrease of 16 and 25 problems attempted per 30-min session during the first and second on-task reinforcement conditions. However, only slight mean decreases of five problems attempted were evidenced during both teacher-absence probe conditions following the first and second accuracy and rate reinforcement conditions. In other words, the two contingency systems had a clearly differential effect on the children's academic rate. There were decreases of 54% and 79% in the teacher's absence when on-task behavior had been reinforced, compared to minimal decreases of 17% and 12% when accuracy and rate were reinforced.

Consistent with the other three dependent measures, the mean number of problems solved correctly of the number attempted (academic accuracy) was differentially affected by the teacher's presence and absence ($F = 5.64$; 1,7; $p < 0.05$), with lower accuracy in the teacher's absence compared with her presence. Similarly, the percentage of problems solved correctly was differentially affected by the contingency system in operation ($F = 6.95$; 1,7; $p < 0.05$), with the two accuracy and rate reinforcement conditions producing a higher percentage of accurate problem solutions than the on-task reinforcement conditions. As can be seen in Fig-

ures 3 and 4, the children's accuracy increased from the initial on-task reinforcement condition (70% during teacher's presence, 61% during teacher's absence) to the initial accuracy and rate reinforcement condition (89% during teacher's presence, 71% during teacher's absence). Re-instatement of the on-task reinforcement contingency (B2) resulted in a decrease in accuracy (72% during teacher's presence, 49% during teacher's absence) with a recovery to prior levels when accuracy and rate again were reinforced (88% during teacher's presence, 69% during teacher's absence).

The number of problems attempted and the number solved correctly of the number attempted for each child in each experimental condition is summarized in Table 1. As can be seen, five of the eight children attempted fewer or an equal number of problems when the teacher was absent. The remaining three attempted more problems during the teacher's absence in at least one of the two accuracy and rate reinforcement conditions. Moreover, for six of the children, the difference between the number of problems attempted when the teacher was absent was least during both conditions in which academic accuracy and rate were reinforced.

Three of the children (Subjects 1, 7, and 8) were consistently less accurate when the teachers left the room, regardless of the contingency system in operation. Similar comparisons of the accuracy data, whether in the teacher's presence or absence, for the remaining five children do not reveal systematic effects.

In summary, the individual data lead essentially to the same conclusions as the group analysis, *i.e.,* (1) the teacher's presence exerted strong control over the number of problems attempted and accuracy of the solutions by the children, and (2) the two contingency systems had a differential effect only on the number of problems attempted by the children, by producing more problems attempted in the teacher's absence when she had been reinforcing academic accuracy and rate.

DISCUSSION

The results indicate that classroom behavior can be influenced by a teacher's presence in the classroom. The children's task-oriented behavior, as well as their accuracy and rate of solving math problems, decreased markedly and their disruptive behavior increased substantially whenever the teacher left the room. However, it also was found that the extent to which the children became disruptive in the teacher's absence was decreased when reinforcement was made contingent on the accuracy and rate of the children's academic performance. Moreover, reinforcing correct problem solutions maintained the frequency of on-task behavior and the rate of attempted problems to a greater degree than either of the other experimental conditions in the teacher's absence.

The extent to which the children remained on task or exhibited disruptive behavior clearly was affected by both contingency systems in the teacher's presence, with systematic increases in task orientation and concurrent decreases in disruptive behavior relative to baseline measures. The increases in task orientation and decreases in disruptive behavior when academic achievement alone was being reinforced are similar to the findings by Ayllon and Roberts (1974), Kirby and Shields (1972), Marholin *et al.* (1975), and Winett and Roach (1972). However, of particular interest is the finding that the children were less disruptive and tended to remain on task more in the teacher's absence when academic behavior was being reinforced. This is consistent with an earlier study, in which it also was found that the extent to which the children became disruptive in a teacher's absence was reduced when reinforcement was contingent on the accuracy and rate of their behavior, rather than being delivered noncontingently or for simply being on task (Marholin *et al.,* 1975).

Although reinforcing accuracy and rate produced a large decrease in disruptive behavior in the teacher's absence the second time it was

imposed, the decrease was not as great when these contingencies were used the first time. One reason for this may have been the changes in the nature of the disruptive behavior observed. The class was clearly as disruptive in the teacher's absence during the first accuracy and rate reinforcement condition (Phase C1) as during the initial condition in which on-task behavior was reinforced (Phase B1). However, the types of disruptive behaviors were qualitatively different when accuracy and rate were reinforced (Phase C1). Following the baseline and initial on-task reinforcement condition, the children seemed to engage in more serious out-of-seat behaviors including hitting, running, throwing objects, and yelling during the teacher's absence. In contrast, following the first accuracy and rate reinforcement condition, the disruptive behaviors observed were limited mainly to in-seat talking. Unfortunately, the data system employed merely recorded either occurrences or nonoccurrences of disruptive behaviors, not their particular topographies. A finer-grain analysis might provide different results.

The data clearly demonstrate discriminative control by the teacher's presence over the rate of problems attempted in all experimental conditions. The strength of this discriminative control was consistently greater when accuracy and rate were reinforced, rather than on task. Therefore, in the teacher's absence, the children attempted more problems when their immediate reinforcement history included reinforcement for academic achievement, as opposed to task orientation.

Although the percentage of problems solved correctly in each session was clearly increased when the "marks" and positive comments by the teacher were made contingent on the number of problems solved correctly, the relative rate of the children's work was not similarly increased. Thus, reinforcing the number of problems solved correctly had the effect of sharpening the academic skills of the children. The number of problems attempted remained relatively constant, but the accuracy of problem solutions increased.

When "appropriate" social behaviors, *e.g.,* nondisruption and task orientation are the principal goals for modification, the teacher must observe and evaluate the appropriateness of the child's behavior, determine whether the stated criteria for a particular consequence are met, and deliver the consequence that the criteria dictate. The present data suggest that in such a situation, the presence of the teacher will develop discriminative control over the child's "appropriate" classroom behavior, because teacher presence is a prerequisite for behavioral observation, evaluation, and subsequent delivery of consequences. It may be suggested, therefore, that a contingency system that provides reinforcement for task-oriented and nondisruptive behavior alone (Phases B1, B2) will not be likely to maintain these behaviors when the teacher, who must be present to determine whether a criterion response has occurred, is absent.

To maintain behaviors, whether social or academic, in the teacher's absence, the discriminative control exerted by the teacher's presence would have to be at least partially abolished. In addition, the stimuli controlling the behavior would have to be those remaining in the classroom setting. If the number of problems solved correctly is used as the data, a record is provided that may be assessed and consequated later. Direct on-the-spot monitoring and consequating are not necessary.

The present findings, in conjunction with others (Johnston and Johnston, 1972; Rabin and Marholin, Note 2; Stokes and Baer, 1976), suggest a possible predictor of the occurrence or nonoccurrence of generalization from a training situation to a setting differing in at least one stimulus dimension (*e.g.,* a different teacher). A lack of generalization may be due to precise stimulus control developing during training by some stimulus that is not present in the generalization setting. On the contrary, the occurrence of generalization across settings

may be a function of stimuli present in the generalization setting that become discriminative for reinforcing consequences in the training setting. These conclusions suggest that increased emphasis be placed on the use of prearranged discriminative stimuli during training to initiate behavior of sufficient strength in the posttreatment environment, allowing for the reinforcement of the desirable behavior and thus further maintenance of that behavior.

In summary, the present results indicate that by providing contingencies for the products of a child's classroom activities (*i.e.,* academic achievement), rather than for some measure of task orientation or appropriate social behavior, the child will become more independent of the teacher's continual surveillance. Moreover, the child will come more under control of the academic materials themselves, rather than of the academic materials and teacher presence. Finally, the child will perform the academic tasks more accurately and/or at a faster rate than if task orientation alone were reinforced. Further implications might suggest that in any educational or clinical setting, special emphasis should be placed on the scheduling of specific discriminative stimuli likely to be present in multiple settings in the natural environment (Marholin and Siegel, *in press*).

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