

*CONCURRENT REINFORCEMENT SCHEDULES:
BEHAVIOR CHANGE AND MAINTENANCE
WITHOUT EXTINCTION*

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We evaluated the effects of concurrent schedules of reinforcement on negatively reinforced problem behavior and task completion with 3 children with autism. Results indicated that problem behavior occurred at high levels and relatively few tasks were completed when problem behavior produced a break (from tasks) and task completion produced either no consequence or a break. By contrast, problem behavior was eliminated and tasks were completed when problem behavior produced a break and task completion produced a break with access to preferred activities. Treatment gains were maintained without the use of extinction when the response requirement was increased and the schedule of reinforcement was thinned.

DESCRIPTORS: concurrent schedules, negative reinforcement, problem behavior, maintenance

Many of the serious behavior problems seen in individuals with disabilities may be a function of negative reinforcement applied to a particular behavioral repertoire. For example, when certain instructional sequences provide aversive stimulation, aggressive responses that result in the termination of that stimulation are negatively reinforced (Iwata, 1987). Experimental-epidemiological studies suggest that negative reinforcement accounts for a substantial proportion of cases of aberrant behavior (e.g., Derby et al., 1992; Iwata et al., 1994).

Interventions based on manipulations of the consequences provided for negatively re-

inforced problem behavior often include escape extinction (Goh & Iwata, 1994; Iwata, Pace, Kalsher, Cowdery, & Cataldo, 1990; Pace, Iwata, Cowdery, Andree, & McIntyre, 1993), defined as the termination of a negative reinforcement contingency. Although escape extinction has been demonstrated to reduce the occurrence of aberrant behavior (Heidorn & Jensen, 1984; Iwata et al., 1990), it is associated with a number of difficulties (Lerman & Iwata, 1996). First, an initial increase, or burst, in the frequency, duration, or magnitude of the problem behavior is characteristic of the extinction process (Iwata et al., 1990; Lerman & Iwata, 1995; Lerman, Iwata, & Wallace, 1999). Second, increases in behavioral variability (such as changes in the topography of the behavior, often involving more severe topographies of problem behavior) have been not-

We acknowledge the contributions to this study made by Daphna El-Roy and express our sincere and deep appreciation to her and the participants.

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ed (Goh & Iwata, 1994). A third complication involves procedural difficulties; that is, it may not be feasible to persist with the delivery of task demands due to the nature of the response requirement (e.g., verbal responding) or to an individual's size or strength (Piazza, Moes, & Fisher, 1996). Thus, extinction procedures may be difficult, if not impossible, to implement consistently in certain applied situations. Due to these limitations, it is important to develop alternative methods of decreasing aberrant behavior.

Negative reinforcement of an alternative response is another way to decrease negatively reinforced behavior (Kelleher & Cook, 1959; Logue & de Villiers, 1978). More recent research suggests that a concurrent-schedules approach, in which the parameters of reinforcement are manipulated, may be a desirable and effective option for treatment of aberrant behavior maintained by negative reinforcement (Fisher & Mazur, 1997; Harding *et al.*, 1999; Lalli & Casey, 1996; Mace & Roberts, 1993; Piazza *et al.*, 1997). When selecting alternative responses to reinforce in applied situations, compliance and task completion are responses of particular interest.

The distribution of behavior across concurrently available response alternatives can be viewed as a function of the relative frequency of reinforcement provided for each response (Herrnstein, 1970). Accordingly, enrichment of one or more parameters of reinforcement can increase the likelihood of responding to one alternative over the other. Whereas authors of applied matching studies (e.g., Dixon & Cummings, 2001; Mace, Neef, Shade, & Mauro, 1994, 1996; Neef & Lutz, 2001; Neef, Mace, & Shade, 1993; Neef, Mace, Shea, & Shade, 1992; Neef, Shade, & Miller, 1994) have focused on manipulations of positive reinforcement, there remains a paucity of applied research on the

effects of manipulations of negative reinforcement in concurrent schedules.

Golonka *et al.* (2000) examined the choice-making behavior of 2 participants who engaged in negatively reinforced problem behavior. When offered the choice of taking a break alone (i.e., negative reinforcement) or taking a break with access to preferred activities (i.e., combined positive plus negative reinforcement), both participants chose to take breaks with access to preferred activities and engaged in lower levels of problem behavior when this was the consequence for making an appropriate request. However, escape extinction was necessary to decrease the levels of problem behavior. In addition, the maintenance of behavior change over time was not measured, and thus the long-term effects of this treatment package could not be determined.

In 2001, DeLeon, Neidert, Anders, and Rodriguez-Catter compared the effects of providing edible items or a break contingent on completion of a task on the task completion and escape-maintained problem behavior of a single participant. When compliance produced an edible item (positive reinforcement) and problem behavior produced a break (negative reinforcement), compliance increased and problem behavior decreased. When a choice between the two reinforcers was offered, the participant initially selected the edible item (the positive reinforcer). However, when the response requirement was increased, choice for the reinforcer became inconsistent, and problem behavior increased. In addition, the maintenance of behavior change over time was not evaluated. Thus, the effectiveness of positive reinforcement in the treatment of negatively reinforced problem behavior remains unclear.

Piazza *et al.* (1997) conducted an investigation of manipulations of negative reinforcement within concurrent schedules, in which they attempted to decrease problem

behavior and increase task completion. They compared the effects of negative reinforcement versus combined positive and negative reinforcement, with and without extinction, on task completion and negatively reinforced destructive behavior. The combined positive and negative reinforcement contingency involved a break from work during which the client had access to tangible items. This combination of work breaks plus tangible items for task completion was temporarily effective for 1 participant, but for another, escape extinction was necessary to reduce destructive behavior and increase task completion. In addition, escape extinction was necessary to maintain low levels of destructive behavior and high levels of task completion for all participants over time. These results suggest that, under some conditions, arranging extinction for destructive behavior and providing combined positive and negative reinforcement for an alternative behavior are effective means of treating negatively reinforced problem behavior.

Several researchers have attempted to thin the initial schedule of reinforcement for appropriate behavior while maintaining low levels of problem behavior without the use of extinction. For example, Zarcone, Iwata, Smith, Mazaleski, and Lerman (1994) used a stimulus (instructional) fading procedure to reduce levels of escape-maintained problem behavior and increase the rate of task completion. By reducing the frequency of instructions, problem behavior was rapidly eliminated. However, when the rate of instructions was increased, problem behavior increased, and escape extinction was then necessary to reduce and maintain low levels of problem behavior over time. Pace, Ivancic, and Jefferson (1994) used a stimulus (demand) fading procedure to decrease the escape-maintained obscene language of a person with traumatic brain injury. The demand fading procedure produced immediate and sustained decreases in obscenity that

were maintained as the rate of demands presented was increased without the use of escape extinction. The authors propose that the difference in their results from those of Zarcone et al. (1994) may be accounted for by their specific fading procedure. More specifically, whereas Zarcone et al. introduced demands into a situation that was previously associated with SIB, Pace et al. faded demands into a condition in which SIB had not occurred (i.e., an ongoing conversation condition).

The purpose of the current investigation was to examine the influence of concurrent reinforcement schedules on behavior change without the use of extinction. In addition, the maintenance of behavior change was evaluated under conditions of increased response requirements and leaner schedules of reinforcement.

METHOD

Participants and Setting

Three children participated in this study. Mickey was a 9-year-old boy who had been diagnosed with autism. He had been referred to the behavior assessment team in his school for an evaluation of aggression. Emily was an 11-year-old girl who had been diagnosed with autism. She had been referred to the behavior assessment team in her school for an evaluation of self-injurious behavior (SIB). Sean was a 10-year-old boy who had been diagnosed with health impairments related to vision, hearing impairments, mild to moderate mental impairments, and language impairment. He had been referred to his school psychologist for an evaluation of disruptive behavior. Mickey and Emily attended small private schools for children with autism. Sean attended the special education resource program at a public school. Mickey's spelling and computational mathematics skills were equivalent to those of a first-grade student. Sean's and Emily's academic skills

were equivalent to those of a second-grade student. The study was conducted in classrooms at the participants' schools.

The treatment procedure in Mickey's school at the time of his referral included a 60-s time-out contingent on every instance of aggression. The time-out area was an empty space in Mickey's classroom sectioned off by a movable divider. The procedure was also in place for Emily, in which the consequence for SIB was 3 min in a time-out area. A similar strategy was used for Sean, in which he was escorted to a time-out area for 5 min contingent on the occurrence of problem behavior.

Tasks and Materials

During the control and positive reinforcement conditions of the functional analysis, participants were presented with leisure materials (e.g., puzzles and trucks). To identify highly preferred activities, the student's teacher generated a list of 10 to 12 hypothesized highly preferred leisure materials. Four of these activities were available to the student during each session of the negative reinforcement/preferred activities (SR-/PA) condition, and the student chose one to play with after completing each task (similar to the procedure used by DeLeon, Fisher, et al., 2001). In the negative reinforcement condition of the functional analysis, academic tasks were used (e.g., math and spelling worksheets). During all conditions of the intervention for Mickey and Sean, the assigned tasks were academic worksheets comprised of review problems (e.g., addition problems) that could be completed independently with at least 80% accuracy. For Emily, the assigned tasks included academic worksheets and vocational activities, such as pen assembly and office supply packaging. All tasks were selected from each student's individualized education plan.

Response Definitions

Two responses were measured: problem behavior and task completion. Mickey's problem behavior was aggression, defined as hitting, kicking, scratching, or biting other people. Emily's problem behavior was self-injury, defined as hand biting. Sean's problem behavior was disruption, defined as tearing up and scribbling on paper and climbing and pounding on furniture. During the functional analysis, task engagement, defined as any appropriate actions required to complete a task, was measured. These data are not depicted graphically but are available upon request from the first author. Task completion, defined as the accurate completion of assigned tasks, was examined in the intervention analysis only.

Independent Variables and Experimental Design

Data were recorded on the occurrence of four independent variables: teacher prompts (defined as verbal instructions, gestures, and physical redirection given by the teacher to direct the student to complete tasks), termination of response requirements (defined as the removal of the task from the participant's desk), teacher attention (defined as social comments delivered by the teacher), and delivery of preferred activities (defined as providing the participant with access to preferred activities).

In the functional analysis, a multielement design was used to identify the contingency maintaining problem behavior. Following the functional analysis, a reversal design was used to evaluate the effects of concurrent schedules of reinforcement (specifically, negative reinforcement and preferred activities) on problem behavior and task completion.

Data Collection and Measurement

One to four experimental sessions were conducted per day; each was 10 min long. All sessions were videotaped and scored at a

later time by trained observers. The frequencies of aggression (Mickey), SIB (Emily), and teacher prompts were measured using a 10-s frequency, count-within-interval procedure. Disruption (Sean), termination of task demands, presentation of teacher attention, and presentation of leisure items were recorded using a 10-s partial-interval recording system. Data on aggression and SIB were expressed in terms of responses per minute, and were calculated by dividing the total number of responses by the total number of minutes elapsed during the session (10). Data on disruption were expressed in terms of percentage of 10-s intervals in which the response occurred, calculated by dividing the number of intervals with a response by the total number of intervals in each session (60) and multiplying by 100%. Data on task completion were expressed in terms of the percentage of tasks completed, calculated by dividing the total number of tasks completed by the total number of tasks required in each session and multiplying by 100%.

Interobserver agreement was scored using point-by-point comparisons, calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Data were computed for all dependent and independent variables for 33% of the sessions of each experimental condition. Mean agreement scores across the functional analysis conditions for dependent and independent variables were 99% and 97%, respectively, for Mickey, 98% and 95%, respectively, for Emily, and 96% and 95%, respectively, for Sean. Mean agreement scores for all dependent variables for each phase of intervention were 98% for Mickey (range, 87% to 100%), 95% for Emily (range, 92% to 100%), and 99% for Sean (range, 93% to 100%). Mean agreement scores for all independent variables for each phase of intervention were 95% for Mickey (range, 90% to 100%), 97% for Emily (range, 93% to

100%), and 92% for Sean (range, 82% to 100%).

Functional Analysis: Procedure

The functional analyses were conducted using procedures similar to those described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). Four analogue conditions were conducted to identify the maintaining contingencies for problem behavior: control, negative reinforcement, and positive reinforcement in the form of attention and materials. During the control condition, participants had unlimited access to preferred leisure activities and they were not required to complete any academic responses. The teacher was located within an arm's reach of the student and delivered attention (social comments or praise) at least once every 30 s. During the negative reinforcement condition, academic task demands were delivered, and contingent on each occurrence of problem behavior, the response requirements were terminated for 20 s. If the student did not begin the assigned task within 10 s of the initial delivery of the verbal instruction, verbal and gestural prompts were delivered every 10 s using a least-to-most intrusive prompt sequence. During both positive reinforcement conditions, no responses were required. Instead, during the attention condition, the participants had access to preferred activities, but access to teacher attention was restricted. Teacher attention was presented for 20 s contingent on the occurrence of problem behavior. During the materials condition, the participants had unlimited access to teacher attention (just as in the control condition) but limited access to leisure activities. Access to highly preferred activities was restricted, and was allowed for only 20 s contingent on each occurrence of problem behavior. Results of all 3 students' functional analyses suggested that their problem behavior was maintained, at least in part, by negative reinforcement.

Table 1
Names and Behavioral Contingencies for Each Condition of the Intervention

Name	Contingency for task completion	Contingency for problem behavior
No SR	No consequence	Negative reinforcement
SR-/PA	Positive plus negative reinforcement	Negative reinforcement
SR-	Negative reinforcement	Negative reinforcement

Intervention: Procedure

The name of each condition and the specific contingencies applied to problem behavior and task completion in each condition are displayed in Table 1. All sessions began with the teacher's instruction, "It's time for work." Participants were seated at their desks in their classrooms. The teacher put the task on each student's desk and instructed the students to complete the task. All tasks were those the teachers had reported to occasion high rates of problem behavior. The worksheets had four to eight problems on a page. For the purposes of measurement, each problem constituted a "task." A blank sheet of paper covered up all but one problem. Each time the participant completed a problem the next one was uncovered. When Emily's task was a vocational activity, one object to assemble or package was presented at a time. If the student did not begin the assigned task within 10 s of the initial delivery of the verbal instruction, verbal and gestural prompts were delivered every 10 s using a least-to-most intrusive prompt sequence.

In all conditions, contingent on every occurrence of problem behavior emitted during task demands, the teacher removed the task from the desk (on a fixed-ratio [FR] 1 schedule of negative reinforcement; 60 s for Mickey, 30 s for Emily and Sean). Contingent on every aggressive response Mickey emitted, his teacher removed the worksheet and escorted him to his time-out area, where he remained for 60 s. A timer was used to signal the end of the reinforcement period. When the timer rang, the tasks were re-

turned to the table and the teacher repeated the verbal instruction to complete the task. If the student had not completed the task when the 10-min session ended, the task was given to the classroom teacher with the instructions that the student was to complete the task. In all conditions, the teacher provided general praise, such as "nice job," at the end of sessions in which task completion occurred. The only variations across conditions were the contingencies arranged for task completion.

No reinforcement (no SR). There were no contingencies for task completion during this condition. That is, neither positive nor negative reinforcement was provided contingent on completion of tasks.

Negative reinforcement/preferred activities (SR-/PA). During this condition, the contingency for completion of one academic task was escape from tasks and access to preferred activities (FR 1 schedule; 60 s for Mickey, 30 s for Emily and Sean). Activities chosen by the participant, or pictorial representations of them, were in view throughout the session. The teacher began the session by saying, "When you complete one task correctly, you can have a break and play with these toys." No additional pretraining was conducted to expose the student to the consequences for task completion. If the task was completed inaccurately, the teacher prompted the correct answer and directed the student to complete another task before he or she received the break with preferred activities. Independent accurate completion of one task produced a work break and access to preferred activities at the student's

desk. When the timer rang at the end of the reinforcement period, the teacher told the student that it was time for work, and if he or she did the work he or she could play with toys again.

Negative reinforcement (SR-). All procedures in this phase were identical to those used in the SR-/PA condition, with one exception: No preferred activities were available during work breaks. At the beginning of the session, the teacher told the student that if he or she completed one task accurately, he or she could take a break. Contingent on completion of one task, the worksheet was removed from the student's desk. When the timer rang at the end of the reinforcement period, the student was told that it was time for work, and if he or she did the work another break would be available. This condition was not conducted with Mickey.

Maintenance. Follow-up sessions were conducted immediately after the intervention was completed to evaluate the maintenance of behavioral gains over time under conditions of increased response requirements and leaner schedules of reinforcement. The maintenance phase was initiated when the data were determined to be stable upon visual inspection. All general procedures were the same as in the SR-/PA condition, with a few exceptions. First, during maintenance, the response requirement was increased. That is, a greater number of academic or vocational tasks were required to produce the break with preferred activities. The increases in response requirements were determined on an individual basis. They were based on the number of tasks the student had completed before engaging in problem behavior during the first one or two sessions of the second no-SR condition, during which task completion was on extinction (i.e., 102 tasks for Mickey and 34 tasks for Emily). Because Sean did not complete any tasks during the return to the no-SR phase,

the response requirement was increased to two tasks. Thus, the schedule of reinforcement for task compliance was increased to FR 102 for Mickey, FR 34 for Emily, and FR 2 for Sean. The second change made during maintenance was that the duration of reinforcement (the break with preferred activities) was increased to a length of time comparable to the duration of work breaks given to the student's peers (3 min for Mickey and 5 min for Emily). The duration of Sean's break remained at 30 s. A third change was that maintenance sessions were conducted with novel stimuli consisting of other types of tasks, and with novel people or teachers who were not involved in the intervention. Problem behavior continued to produce negative reinforcement on an FR 1 schedule throughout all maintenance sessions.

RESULTS

Figure 1 contains the results of the functional analyses of all 3 students. Overall results were similar: Problem behavior occurred at the highest rates during the negative reinforcement condition. During the negative reinforcement condition, Mickey's aggression averaged 1.3 per minute. Although there was a decreasing trend in the rate of aggression from the first to the last negative reinforcement session of Mickey's functional analysis, his teachers reported that high rates of aggression occurred when academic task demands were presented outside of the analogue sessions, and that therefore intervention was warranted. Emily's SIB occurred at relatively high rates during the negative reinforcement condition ($M = 0.36$ responses per minute) and occurred infrequently in the other conditions. Sean's disruptive behavior occurred most frequently during the negative reinforcement ($M = 49\%$ of intervals) and positive reinforcement (attention) ($M = 38\%$ of intervals) condi-

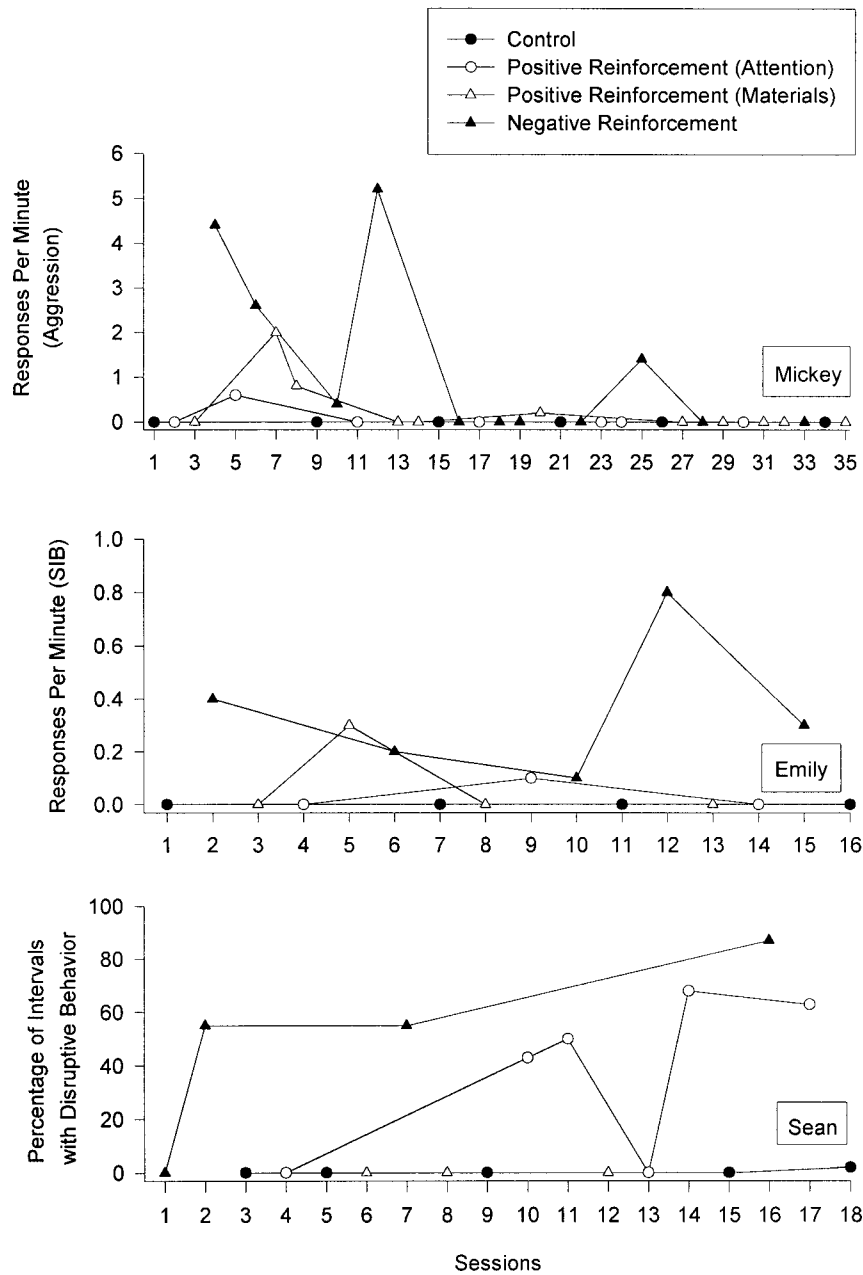


Figure 1. Rates (number of responses per minute) of aggression (Mickey, top panel) and SIB (Emily, middle panel) and the percentage of intervals with disruption (Sean, bottom panel) across sessions of the functional analysis.

tions. The attention function of Sean's disruptive behavior was addressed using an unrelated set of procedures at the conclusion of this analysis.

The top panel of Figure 2 shows the rate

of Mickey's aggression and percentage of tasks completed during the intervention. During the first no-SR phase, aggression occurred at high rates during all sessions ($M = 0.925$ per minute), and no tasks were com-

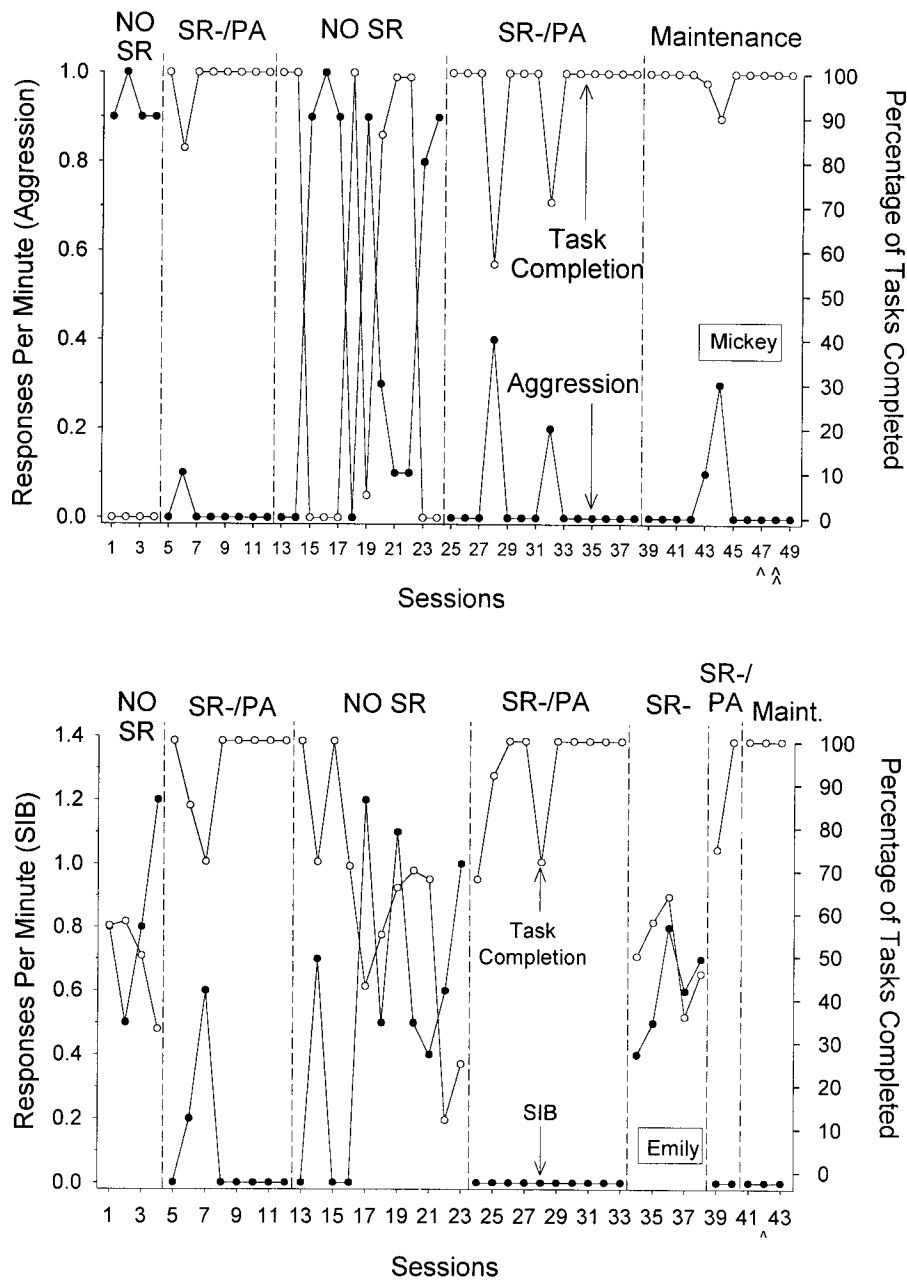


Figure 2. Rate of aggression (left y axis) and percentage of tasks completed (right y axis) across conditions of the intervention for Mickey (top panel). The single carat indicates probe with novel tasks. The double carat indicates probe with novel instructor. Rate of SIB (left y axis) and percentage of tasks completed (right y axis) across conditions of the intervention for Emily (bottom panel). The carat indicates probe with novel instructor and novel tasks.

pleted. In the first session of the SR-/PA phase, aggression decreased to zero, and all tasks were completed. During the return to the no-SR phase, aggression and task com-

pletion occurred at variable rates. In the return to the SR-/PA phase, aggression again immediately dropped to zero, with a concomitant increase in task completion to

100%. Maintenance began in Session 39, at which point the response requirement was increased to 102 problems and the duration of the break with preferred activities was increased to 3 min. Aggression occurred at low rates in 2 of the 10 sessions. It did not occur at all in sessions conducted with novel tasks (beginning in Session 47) or novel people (beginning in Session 48).

The SR- condition of the intervention was not implemented with Mickey. After a close analysis of the results of the no-SR (A) and SR-/PA (B) conditions, we questioned the effects of providing only negative reinforcement for both problem behavior and task completion. Therefore, the SR- condition was added to the analyses conducted with Sean and Emily.

The results of Emily's analysis are presented in Figure 2. During the first no-SR phase, SIB occurred at an average rate of 0.8 responses per minute, and fewer than 60% of the tasks were completed. In the first session of the SR-/PA phase, SIB decreased to zero and 100% of tasks were completed. Responding remained at those levels for all but two sessions of that phase. When the no-SR phase was repeated, SIB occurred at variable rates. Task completion steadily decreased across sessions of that phase. When the SR-/PA phase was repeated, SIB immediately decreased to zero, and 100% of tasks were completed in 7 of the 10 sessions. During the SR- phase, SIB and task completion occurred at moderate levels. In the subsequent and final SR-/PA phase, SIB never occurred and task completion increased to 100%. Beginning in Session 41, maintenance began, and the response requirement was increased. From that point forward, Emily was required to complete 34 worksheet problems or the entire vocational activity (e.g., assemble 30 pens) before receiving combined positive and negative reinforcement. Beginning in Session 42, novel teachers conducted the sessions. During mainte-

nance sessions, Emily completed all of the tasks and SIB never occurred.

Figure 3 shows the percentage of intervals with disruptive behavior and percentage of tasks completed during Sean's intervention. In the first no-SR phase, disruption and the number of tasks completed were highly variable. In the first session of the SR-/PA condition, disruptive behavior decreased to zero, and task completion was variable for the first four sessions and then increased to 100%. In the subsequent return to no SR, disruptive behavior returned to levels observed in the first no-SR condition, and Sean did not complete any tasks. When the SR-/PA phase was repeated, disruption again immediately decreased to zero and task completion immediately increased to 100%. Beginning with Session 28, seven sessions of the SR- condition were randomly alternated with five sessions of the SR-/PA condition. During SR- sessions, the occurrence of disruption was elevated and relatively few tasks were completed compared to the SR-/PA phase. In Session 40, maintenance began, and the response requirement was increased to two tasks. Novel tasks were also introduced. Disruption never occurred, and 100% of all tasks were completed during maintenance sessions.

DISCUSSION

In the current investigation, immediate and sustained decreases in problem behavior and increases in task completion occurred when task completion produced both negative reinforcement and access to preferred activities and problem behavior continued to result in negative reinforcement. Escape extinction was not necessary in any case. These findings extend the work of Piazza *et al.* (1997) by demonstrating that concurrent schedules of reinforcement can be arranged to decrease negatively reinforced problem behavior and increase an adaptive alternative

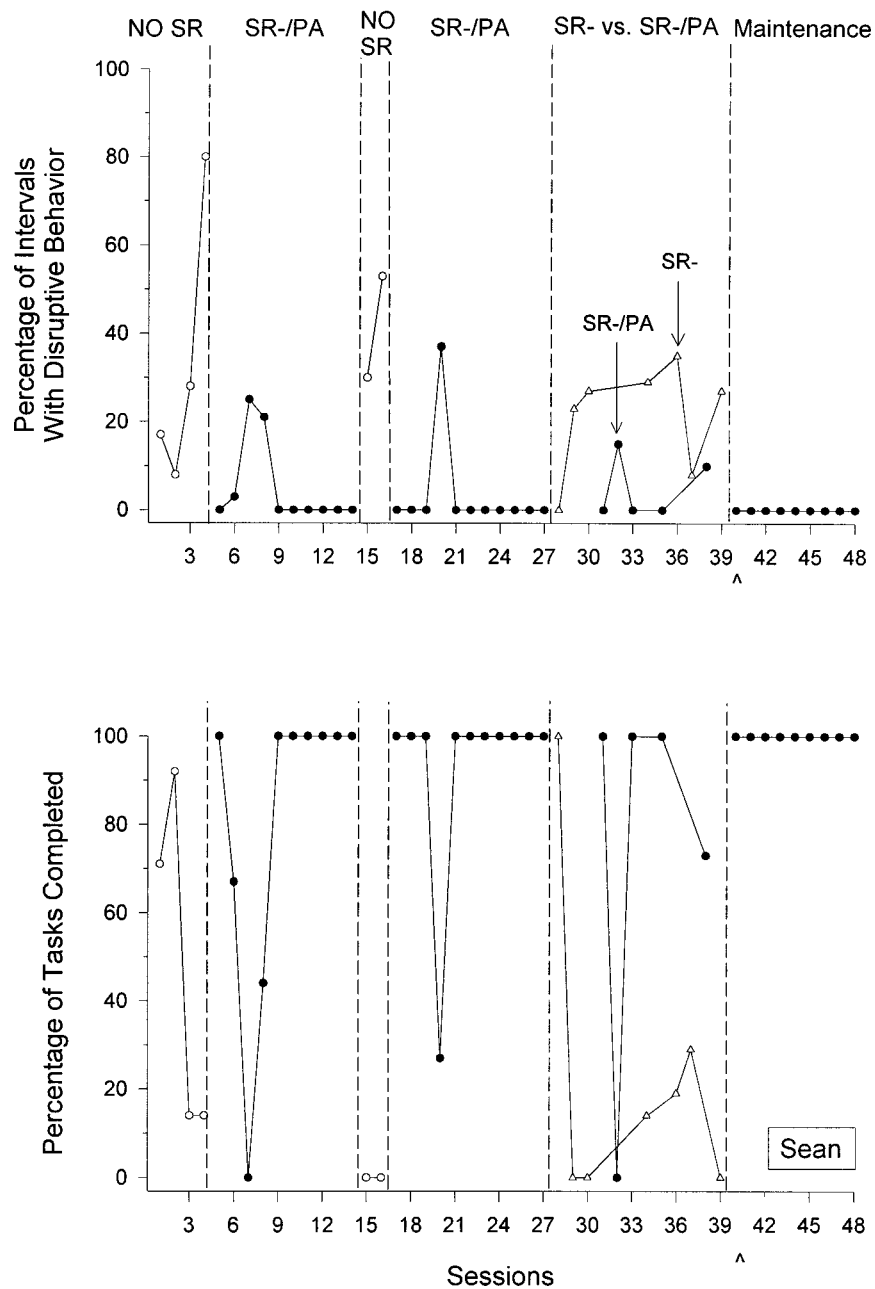


Figure 3. The percentage of intervals with disruptive behavior (top panel) and percentage of tasks completed (bottom panel) across sessions of the intervention for Sean. Aggression produced negative reinforcement on an FR 1 schedule in all conditions. The caret indicates the session in which novel tasks were introduced.

response without the use of escape extinction. Furthermore, these effects were maintained under conditions of leaner schedules of reinforcement without the need for escape extinction. This is of particular importance

to caregivers in applied settings, where extinction techniques are hard to implement consistently and effectively.

Unique to this study is the way in which the schedule of reinforcement for task com-

pletion was thinned and the response requirement was increased. Instead of slowly increasing the number of responses required to produce reinforcement, the students were immediately required to complete a relatively large number of tasks (i.e., 102 tasks for Mickey and 34 tasks for Emily). By capitalizing on the large number of tasks completed during the return to the no-SR condition, we were able to avoid the slow process of increasing the response requirement one task at a time, and thus we were able to move to a more natural schedule of reinforcement more rapidly. In this way, the treatment procedures could be transferred to and maintained in the students' classroom routines relatively quickly and easily.

It is noteworthy that task completion increased to 100% and problem behavior decreased to zero immediately following the first introduction of SR-/PA (Session 5) for all 3 participants. The lack of an apparent reinforcement process (i.e., learning via differential consequences) suggests that either the instructions presented by the teachers at the start of the treatment session or the presence of preferred materials used as positive reinforcement functioned as discriminative stimuli.

It is also noteworthy that for Mickey and Emily task completion remained high for the first one to two sessions of the second no-SR phase, even though both positive and negative reinforcement for this response were discontinued. By contrast, task completion immediately decreased to zero for Sean when positive and negative reinforcement were terminated in the second no-SR phase. One possible explanation of these differences is that task completion may have been more sensitive to the effects of positive reinforcement for Mickey and Emily, whereas Sean's behavior may have been influenced primarily by negative reinforcement in this context. That is, negative reinforcement (escape) remained available during the no-SR

phase, but was contingent only on problem behavior. Thus, one might expect a rapid shift from task completion to problem behavior (as occurred with Sean) if both responses were influenced primarily by negative reinforcement, because switching would effectively mitigate the establishing operation for negatively reinforced responses. By contrast, one might expect a more gradual decline in task completion (as occurred with Mickey and Emily) if this response was heavily influenced by positive reinforcement, because switching to problem behavior would not have much effect on the establishing operation for positively reinforced responses.

One limitation to this interpretation of our results relates to the order of the experimental conditions: The SR- condition never preceded the SR-/PA condition. Therefore, it remains unknown whether the escape-alone contingency would have been sufficient to decrease problem behavior and increase task completion had the participants not already had a history of escape with access to preferred activities for task completion. Other researchers have shown that providing a break alone for task completion was not sufficient to decrease problem behavior and increase task completion (Piazza *et al.*, 1997). However, a more thorough analysis of this effect might arrange the sequence of conditions in a counterbalanced format.

A second limitation of this investigation is the lack of a direct analysis of the effects of positive reinforcement alone. For practical reasons, edible reinforcers were not available for our participants. Future investigators may want to examine the effects of conditioned reinforcers by providing positive reinforcement in the form of tokens exchangeable for positive reinforcers. Such studies may prove to be interesting for both conceptual and practical reasons.

Another limitation of this study concerns the decreasing trend in rates of aggression

seen in Mickey's functional analysis. Specifically, the target behavior almost never occurred during the second half of the analysis. Mickey's teachers reported that each day, they began by delivering an academic task demand. Mickey immediately responded by displaying intense aggression, and spent much of the day in time-out (negative reinforcement). Thus, his teachers had virtually stopped delivering academic task demands, due to the intense aggression that always followed their requests. Therefore, it is possible that during the second half of the functional analysis, academic tasks presented by the experimenter did not establish escape as a reinforcer for aggression. We interpreted the analysis to suggest that aggression was maintained by negative reinforcement because all the sessions in which there were 2.0 responses per minute or more were negative reinforcement sessions. The first phase of the intervention analysis, no SR, was procedurally quite similar to the negative reinforcement sessions of the functional analysis. The increases in rates of aggression seen in this condition indicated that aggression was sensitive to negative reinforcement. One possible explanation for the immediate increase in rates of aggression seen during the first phase of the intervention is that during the functional analysis, sessions were not initiated until Mickey had independently left the time-out area for more than 5 min. During the intervention, however, sessions were begun regardless of whether Mickey had independently left his time-out area, which may have established escape as a reinforcer.

The findings of this study indicate that concurrent schedules of reinforcement can be arranged to produce immediate and sustained changes in negatively reinforced problem behavior and task completion without the use of extinction. Future research is warranted to investigate the necessary and sufficient manipulations to each response alternative (i.e., problem behavior and an appro-

priate alternative) to achieve sustained decreases in problem behavior and increases in an appropriate alternative response without extinction.

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Received August 1, 2001

Final acceptance February 20, 2002

Action Editor, Robert Stromer

STUDY QUESTIONS

1. What are some of the problems associated with using extinction as treatment for problem behavior maintained by negative reinforcement?

2. What are some alternative treatments for escape behavior, and what general approach did the authors take?
3. Speculate why the participants' previous treatment (time-out) for problem behavior may have been ineffective.
4. Describe the contingencies arranged for problem behaviors and task completion in the three conditions.
5. What modifications were made to the SR-/PA condition during the maintenance phase?
6. How were response requirements increased during the maintenance phase, and to what extent were these requirements an adequate test of the absence of extinction?
7. Summarize the results obtained during the intervention phase of the study.
8. How did the authors account for the large and abrupt changes in behavior that were observed during the beginning of the SR-/PA condition?

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