

*COMPETITION BETWEEN POSITIVE AND  
NEGATIVE REINFORCEMENT IN THE  
TREATMENT OF ESCAPE BEHAVIOR*

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We compared the effects of reinforcing compliance with either positive reinforcement (edible items) or negative reinforcement (a break) on 5 participants' escape-maintained problem behavior. Both procedures were assessed with or without extinction. Results showed that compliance was higher and problem behavior was lower for all participants when compliance produced an edible item rather than a break. Treatment gains were achieved without the use of extinction. Results are discussed regarding the use of positive reinforcement to treat escape behavior.

DESCRIPTORS: escape-maintained problem behavior, functional analysis, positive versus negative reinforcement

Treatments for escape-maintained problem behavior have typically consisted of providing escape either (a) on a noncontingent basis (noncontingent escape [NCE]; Vollmer, Marcus, & Ringdahl, 1995), or (b) via a differential reinforcement schedule (Carr & Durand, 1985; Lalli, Casey, & Kates, 1995; Steege, Wacker, Berg, Cigrand, & Cooper, 1989). In these studies, a functional analysis was used to identify the reinforcer responsible for behavioral maintenance so that it could be used to strengthen an alternative response (or be provided independent of responding) and to place the target problem behavior on extinction. However, there is evidence that increasing an alternative response can influence the rate of the target problem behavior even though its source of reinforcement may be unknown. For example, researchers have observed decreased rates

of problem behavior (without manipulating their contingencies) by increasing reinforcement for compliance (Parrish, Cataldo, Kolko, Neef, & Egel, 1986; Russo, Cataldo, & Cushing, 1981). Thus, it is possible that changing a consequence other than the one responsible for behavioral maintenance may have beneficial effects in the treatment of escape behavior.

A recent study by Piazza et al. (1997) examined the role of positive reinforcement in the treatment of escape behavior. The authors identified, via functional analyses, 3 participants whose problem behaviors were sensitive to positive (attention, tangible items, or both) and negative reinforcement (a break). Then, during tasks, compliance was reinforced with a break, tangible items, attention, or a combination of these, with or without extinction. Findings showed that compliance increased and problem behavior decreased for 2 participants when compliance was positively reinforced (playing with a therapist, watching television) even though problem behavior continued to produce a break. The 3rd participant required extinc-

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tion whether compliance was reinforced with items or a break. The results of the Piazza *et al.* study might be expected given that the alternative behavior produced positive and negative reinforcement whereas the problem behavior produced negative reinforcement only. It is unknown whether positive reinforcement in isolation would effectively compete with negative reinforcement in isolation.

A related issue in the treatment of escape behavior is the use of extinction. Although escape extinction has been used successfully either alone (Iwata, Pace, Kalsher, Cowdery, & Cataldo, 1990) or as part of a package (Vollmer *et al.*, 1995), escape extinction may be associated with undesirable side effects due to an individual's size or if it results in an extinction burst or emotional responding (see Lerman & Iwata, 1996, for a review). Thus, the findings from Piazza *et al.* (1997) and Lalli and Casey (1996) are promising regarding the use of positive reinforcement without extinction to treat escape-maintained problem behavior. The purpose of the present study was to assess the independent effects of positive reinforcement on escape behavior by reinforcing compliance with preferred edible items, which would eliminate the potential confounding effect of positive reinforcement and a break (negative reinforcement). Thus, the procedure in the current study arranges competing concurrent schedules of reinforcement with the consequences differing for the respective responses.

## METHOD

### *Participants and Setting*

Five individuals who had been admitted to a hospital inpatient unit for the treatment of severe problem behavior participated. Dante was 9 years old and had been diagnosed with severe mental retardation, autism, and pervasive developmental disorder.

He had been admitted for treatment of self-injurious behavior (hand biting). He could follow three-step instructions and communicated using a picture exchange communication system. Jay was a 3-year-old boy with a diagnosis of mild developmental delays who had been admitted for treatment of disruptive behavior. Jay was able to follow three-step instructions and communicated using vocalizations. Roy was 21 years old and had been diagnosed with severe mental retardation. He had been admitted for treatment of flopping (throwing himself to the ground). Roy could follow two-step instructions and communicated through gestures. Tommy was a 10-year-old boy with a diagnosis of severe mental retardation who had been admitted for treatment of flopping. Tommy could follow three-step instructions and communicated using gestures. Mia was 18 years old, had been diagnosed with severe mental retardation, and had been admitted for treatment of disruptive behavior. Mia could follow two-step instructions and communicated using gestures. All participants required some level of assistance with their self-care activities.

All sessions were conducted individually in one of five therapy rooms (3 m by 3 m), and observers recorded data from behind a one-way mirror. A therapist and participant were present during sessions.

### *Dependent Variables and Data Collection*

Dante's self-injury consisted of *hand biting* (closure of the upper and lower teeth on the flesh of the wrist) and *body hitting* (forceful contact of an open or closed fist to the thigh). *Disruptive behavior* was defined as hitting or kicking the floor or walls (Mia) or throwing or breaking items (Jay, Mia). *Flopping* was defined as a participant dropping his body to the floor (Roy, Tommy). Each occurrence of Tommy's flopping was scored throughout a session. Roy's flopping was scored beginning with 3 consecutive seconds

of body contact with the ground and ended when he was standing for 3 consecutive seconds. Therefore, Roy's flopping was presented as the percentage of a session in which flopping was scored. Compliance with an instruction was defined as a participant independently initiating the task within 5 s of either the first (verbal) or the second (gestural) prompt of a three-step prompt hierarchy.

Observers used a computerized data-collection procedure to score the target behaviors during all functional analysis and treatment sessions. Interobserver agreement was collected on an average of 21% of the sessions, equally distributed across participants and conditions. To calculate agreement, sessions were divided into 10-s intervals and the smaller number of responses recorded by one observer was divided by the larger number of responses recorded by the second observer. For Roy's flopping (duration measure), the smaller number of seconds within a 10-s interval was divided by the larger number of seconds within the 10-s interval. These fractions were then averaged across a session. Mean occurrence agreement was 94% (range, 83% to 100%). Procedural fidelity data showed that therapists correctly implemented the procedures on an average of 89% of the opportunities across all participants.

#### *Experimental Designs and Sequence*

Participants' problem behaviors were initially assessed via functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). A series of analogue conditions was presented during 10-min sessions in a multielement design, with an additional sequential analysis (control, escape) for Mia. Four to five sessions were usually conducted daily, 5 days per week, with a minimum of 5 min between sessions.

The second phase of the study began with an evaluation of reinforcing compliance with

either an edible item (positive reinforcement) or a 30-s break from a task (negative reinforcement) with or without extinction for problem behavior. The effect of either positive or negative reinforcement (with or without extinction) on compliance and problem behavior was assessed using a series of reversal designs for all participants, except for Roy, whose treatment was evaluated in a multielement design. One to three 10-min sessions were conducted daily, 5 days per week. An NCE condition and an extinction-only condition were also conducted for Mia. Participants' access to edible items used during the functional analysis and treatment evaluation was uncontrolled other than during sessions throughout the study.

#### *Functional Analysis and Results*

The functional analysis consisted of attention, edible items, escape, control, and alone conditions similar to those in Iwata et al. (1982/1994). In the attention condition, the therapist provided the participant with age-appropriate toys and then diverted his or her attention to paperwork. The therapist provided a disapproving comment following each problem behavior. During the edible items condition, the participant was provided with access to a preferred edible item for 2 min prior to the session. At the start of a session, the therapist removed the item and placed it out of the participant's reach but within his or her view. Contingent on each occurrence of problem behavior, the therapist provided access to the edible item for 30 s. In the escape condition, the therapist provided an instruction every 30 s using a graduated prompt sequence (i.e., verbal, gestural, physical) with an interprompt interval of 10 s. The therapist provided descriptive praise for compliance with an instruction (except when physically guided). Each occurrence of problem behavior produced a 30-s break from the task (the therapist removed all task materials and did not interact

with the participant). We used self-care tasks for all participants. During control conditions, the therapist provided the participant with a requested toy and noncontingent attention (fixed-time [FT] 30-s schedule) and did not provide any instructions during the sessions. The therapist did not respond to problem behavior during this condition. In the alone condition, a participant was observed in the absence of preferred items and with no therapist present.

Results of the functional analyses are depicted in Figure 1. The multielement functional analysis for Mia shows variable rates of disruptive behavior during the escape condition and a slight increasing trend in the control condition. Responding in the edible items and attention conditions occurred at low or near-zero rates. The subsequent sequential and pairwise analyses (Iwata, Duncan, Zarcone, Lerman, & Shore, 1994) show a clear differentiation between the control and escape conditions. Dante's results show that SIB occurred most frequently during escape and infrequently during the edible items, control, and alone conditions. Jay's disruptive behavior occurred most frequently during the escape condition and infrequently in the edible items, attention, and control conditions. The functional analysis for Roy and Tommy shows that flopping occurred exclusively in the escape condition.

#### *Treatments*

Treatment for escape behavior progressed through a series of conditions in which (a) compliance with an instruction produced either edible reinforcement or a break and (b) problem behavior either produced a break or was placed on extinction. The specific series of conditions for each participant depended upon a participant's response to each treatment. During all conditions, a therapist (a) provided an instruction once every 30 s using sequential verbal, gestural, and physical prompts with a 10-s interprompt interval;

(b) provided descriptive praise for compliance; and (c) did not respond to problem behavior that occurred during the break. Each condition is labeled with two symbols (e.g.,  $S^{R+}/S^{R-}$ ) with the first symbol referring to the consequence for compliance and the second symbol referring to the consequence for problem behavior ( $S^{R+}$  refers to edible reinforcement and  $S^{R-}$  refers to a 30-s break).

*Baseline.* Baseline procedures were the same as those used in the escape condition of the functional analysis.

*Positive reinforcement of compliance without extinction ( $S^{R+}/S^{R-}$ ).* Prior to providing an instruction, the therapist described the contingency for compliance (e.g., "When you . . . then you get . . .") while displaying the edible item. Compliance with an instruction produced an edible item (e.g., dry cereal) that had been identified as preferred using methods described in Roane, Vollmer, Ringdahl, and Marcus (1998). After providing the edible item, the therapist continued with the task using the three-step prompt hierarchy. Problem behavior resulted in a 30-s break from the task (i.e., the therapist removed all task materials and did not interact with the participant). Preference assessments were conducted prior to sessions periodically (once per week) during this condition to ensure that preferred edible items were being provided contingent upon compliance.

*Negative reinforcement of compliance without extinction ( $S^{R-}/S^{R-}$ ).* In this condition, compliance with an instruction and problem behavior resulted in a 30-s break from the task. Prior to providing an instruction, the therapist described the contingency for compliance as described above.

*Positive reinforcement of compliance with extinction ( $S^{R+}/ext$ ).* Procedures in this condition were identical to those in the  $S^{R+}/S^{R-}$  condition, except that problem behavior did not produce a break. That is, the instructional activity continued even when problem behavior occurred.

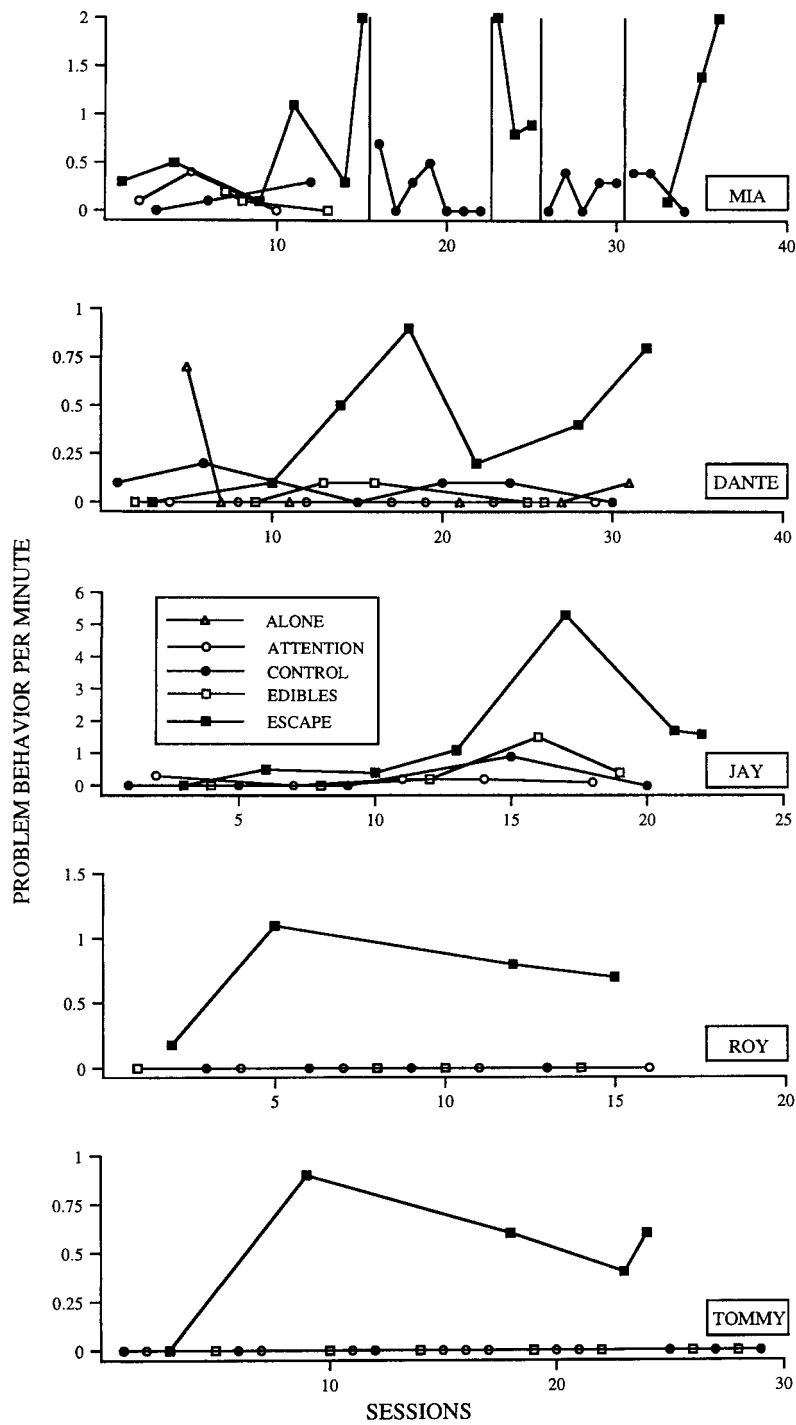


Figure 1. Number of responses per minute of problem behavior during the functional analyses for all participants.

*Negative reinforcement of compliance with extinction ( $S^R$ -ext).* Procedures in this condition were identical to those in the  $S^R$ -/ $S^R$ - condition, except that problem behavior did not produce a break.

*Noncontingent escape (NCE).* In this condition (for Mia only), a therapist provided a 30-s break on an FT 10-s schedule and did not provide any differential consequences for problem behavior or compliance.

*Extinction only.* In this condition (for Mia only), compliance produced descriptive praise, and problem behavior did not produce a break.

*Positive reinforcement schedules.* Schedules of positive reinforcement were increased in one phase for 3 participants. We initially increased Dante's, Jay's, and Tommy's schedules by a substantial amount to test the efficacy of positively reinforcing compliance without a gradual change. A fixed-ratio (FR) schedule was either increased or decreased based on a visual analysis of the data for rates of problem behavior.

## RESULTS

### *Treatment*

The results for Mia are presented in the top panel of Figure 2. During baseline, disruptive behavior averaged 1.1 per minute, and compliance averaged 52% (compliance data were not available for the last two sessions in this phase). During  $S^R$ -/ext, compliance increased ( $M = 61\%$ ) but rates of disruptive behavior remained high ( $M = 2.3$ ). However,  $S^R$ -/ext was in effect for only five sessions, which may not have been an adequate test for extinction. In NCE, rates of disruptive behavior were high and variable ( $M = 1.9$ ), and compliance was unchanged ( $M = 62\%$ ). During extinction-only sessions, disruptive behavior remained high ( $M = 2.4$ ), and compliance showed a decreasing trend ( $M = 65\%$ ). By contrast, during  $S^R$ +/ $S^R$ -, rates of disruptive behavior quickly decreased ( $M = 0.2$ ), and

compliance increased ( $M = 77\%$ ). A return to baseline showed increased rates of disruptive behavior ( $M = 3.4$ ) and lower rates of compliance ( $M = 59\%$ ). Rates of disruptive behavior decreased ( $M = 0.3$ ), and compliance increased ( $M = 67\%$ ), when compliance again produced an edible item during the  $S^R$ +/ $S^R$ - condition. Thus, for Mia, treatment gains were obtained only when compliance was reinforced with edible items (even though disruptive behavior still produced a break).

Dante's rates of SIB averaged 0.6 per minute and his compliance averaged 79% during baseline (Figure 2). During  $S^R$ +/ $S^R$ -, SIB immediately decreased to zero, and compliance gradually reached 100% ( $M = 99\%$ ). A return to baseline resulted in variable rates of SIB ( $M = 0.4$ ) and compliance ( $M = 40\%$ ). During the second  $S^R$ +/ $S^R$ - phase, SIB quickly returned to zero, and compliance increased to 100%. By contrast, during  $S^R$ -/ $S^R$ -, SIB increased to an average of 0.4 per minute, and compliance decreased to 60%. During the third  $S^R$ +/ $S^R$ - phase, this pattern of responding was quickly reversed, with SIB at zero and compliance at 99%. To complete the comparison between the treatments (i.e., reinforcing compliance with either edible items or a break) we returned to an  $S^R$ -/ $S^R$ - phase. As in the initial  $S^R$ -/ $S^R$ - phase, rates of SIB increased ( $M = 1.3$ ), and compliance decreased ( $M = 54\%$ ) during this phase. The final phase for Dante consisted of increasing the schedule of reinforcement for compliance during the  $S^R$ +/ $S^R$ - condition. We initially reintroduced treatment with an FR 1 schedule and observed an immediate reduction in rates of SIB to zero and an increase in compliance. With an FR 10 schedule, rates of SIB remained low and compliance high. When the schedule was changed to FR 20, high rates of compliance were maintained, but we observed an increase in rates of SIB. We then returned to an FR 1 schedule, which decreased rates

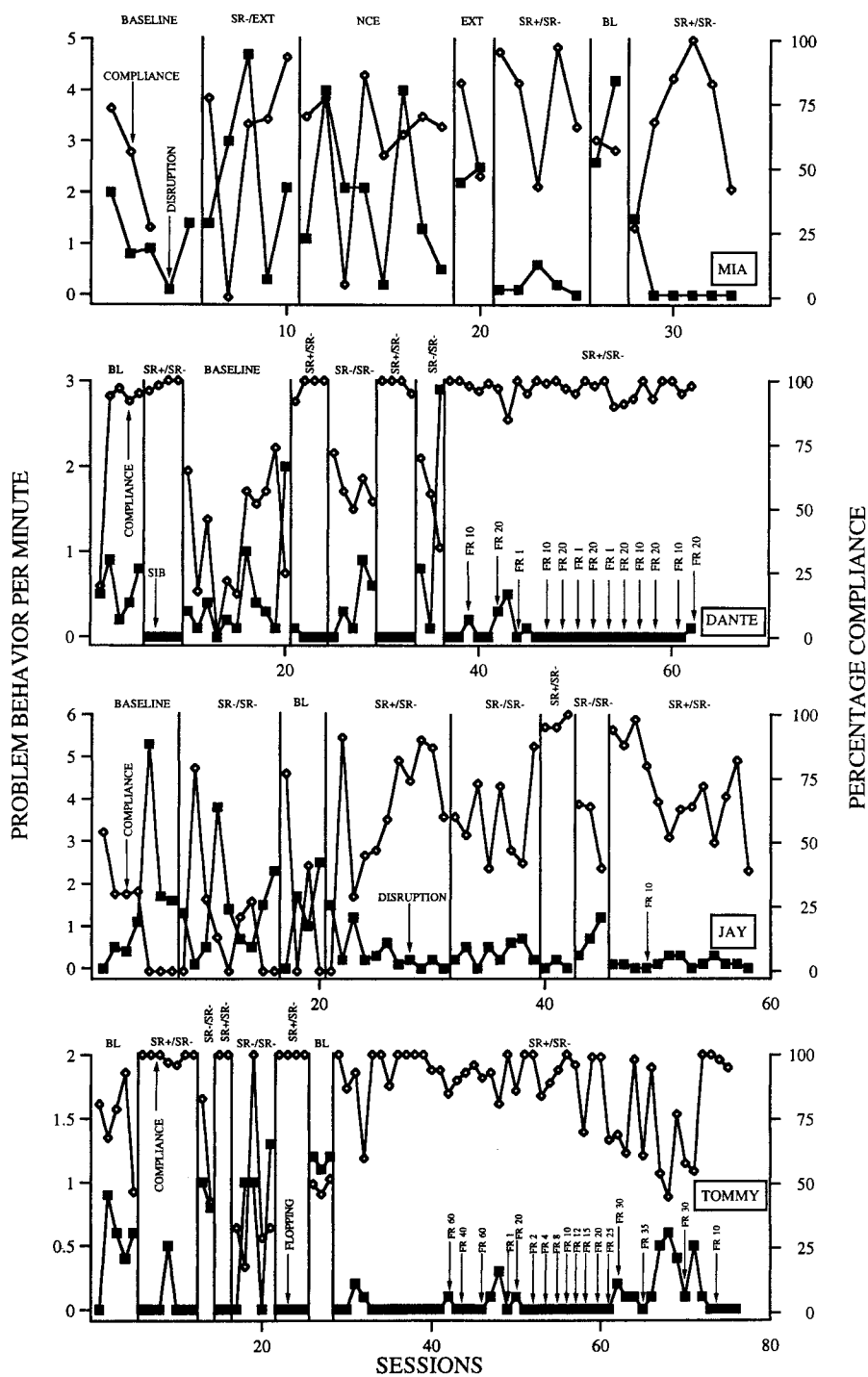


Figure 2. Number of responses per minute of problem behavior (left y axis) and the percentage of compliance (right y axis) during baseline and treatment conditions for Mia, Dante, Jay, and Tommy.

of SIB. Low rates of SIB and high rates of compliance were maintained throughout the remainder of the study with the schedule requirement increased to FR 20.

During Jay's baseline, disruptive behavior averaged 1.5 per minute, and compliance averaged 21% (Figure 2). In the initial  $S^{R-}/S^{R-}$  phase, disruptive behavior remained high ( $M = 1.3$ ), and compliance was variable ( $M = 19\%$ ). A return to baseline produced high rates of disruptive behavior ( $M = 1.3$ ) and variable compliance ( $M = 30\%$ ). In the initial  $S^{R+}/S^{R-}$  phase, disruptive behavior decreased to 0.4 per minute, and compliance increased to 60%. We returned to an  $S^{R-}/S^{R-}$  condition and observed similar patterns of responding, with SIB at 0.4 and compliance at 59%. During the next  $S^{R+}/S^{R-}$  phase, rates of disruptive behavior were lower ( $M = 0.1$ ) and less variable, and compliance was higher ( $M = 97\%$ ). The final  $S^{R-}/S^{R-}$  phase produced an increasing trend for disruptive behavior ( $M = 0.7$ ) and a decreasing trend for compliance ( $M = 56\%$ ). We ended Jay's program with an  $S^{R+}/S^{R-}$  phase and obtained low rates of disruptive behavior ( $M = 0.1$ ) with variable rates of compliance ( $M = 71\%$ ) when we increased the schedule of reinforcement to FR 10.

Tommy's flopping averaged 0.5 per minute, and his compliance averaged 72% during baseline (Figure 2). During  $S^{R+}/S^{R-}$ , flopping decreased to zero, and compliance increased to 100%. In the  $S^{R-}/S^{R-}$  phase, flopping increased to 0.9 per minute, and compliance decreased to 63%. During a return to  $S^{R+}/S^{R-}$ , flopping rates were zero, and compliance was 100%. By contrast, during the second  $S^{R-}/S^{R-}$  phase flopping increased to 0.7 per minute, and compliance decreased to 43%. A return to the  $S^{R+}/S^{R-}$  condition again produced zero rates of flopping and 100% compliance. During a return to baseline, flopping averaged 1.2 per minute, and compliance averaged 49%. Rates of flopping decreased and compliance increased

when we reinstated the  $S^{R+}/S^{R-}$  condition. When we abruptly increased the schedule to FR 60, we observed an increase in flopping and a slight decrease in compliance. Responding decreased under an FR 40 schedule but again increased when we returned to an FR 60 schedule. Subsequently, we adjusted the schedule of reinforcement for compliance and ended the study for Tommy on an FR 10 schedule that produced zero rates of flopping and high rates of compliance.

We used a multielement treatment design for Roy to compare the effects of reinforcing compliance with either an edible item or a break. During baseline, flopping averaged 47% of the session with Therapist 1 and 69% of the session with Therapist 2 (Figure 3). Baseline rates of compliance were similar for both therapists (Figure 3). Rates of flopping decreased substantially ( $M = 11\%$ ) in  $S^{R+}/S^{R-}$  but remained high in  $S^{R-}/S^{R-}$  ( $M = 70\%$ ). Compliance was higher in the  $S^{R+}/S^{R-}$  condition ( $M = 32\%$ ) than in the  $S^{R-}/S^{R-}$  condition ( $M = 18\%$ ). These findings remained constant when the therapists switched conditions in the final phase.

## DISCUSSION

We first identified 5 participants (via functional analysis) with problem behavior that was sensitive to escape from tasks (Iwata *et al.*, 1982/1994). In the subsequent treatment analysis, we examined the effects of reinforcing compliance with either an edible item ( $S^{R+}$ ) or a break ( $S^{R-}$ ), with or without extinction. Rates of problem behavior were lower and compliance was higher when compliance resulted in edible reinforcement ( $S^{R+}/S^{R-}$  condition) than when compliance resulted in a break ( $S^{R-}/S^{R-}$  condition) for all participants. Treatment gains were obtained without the use of extinction.

These findings replicate and extend previous work on the relationship between

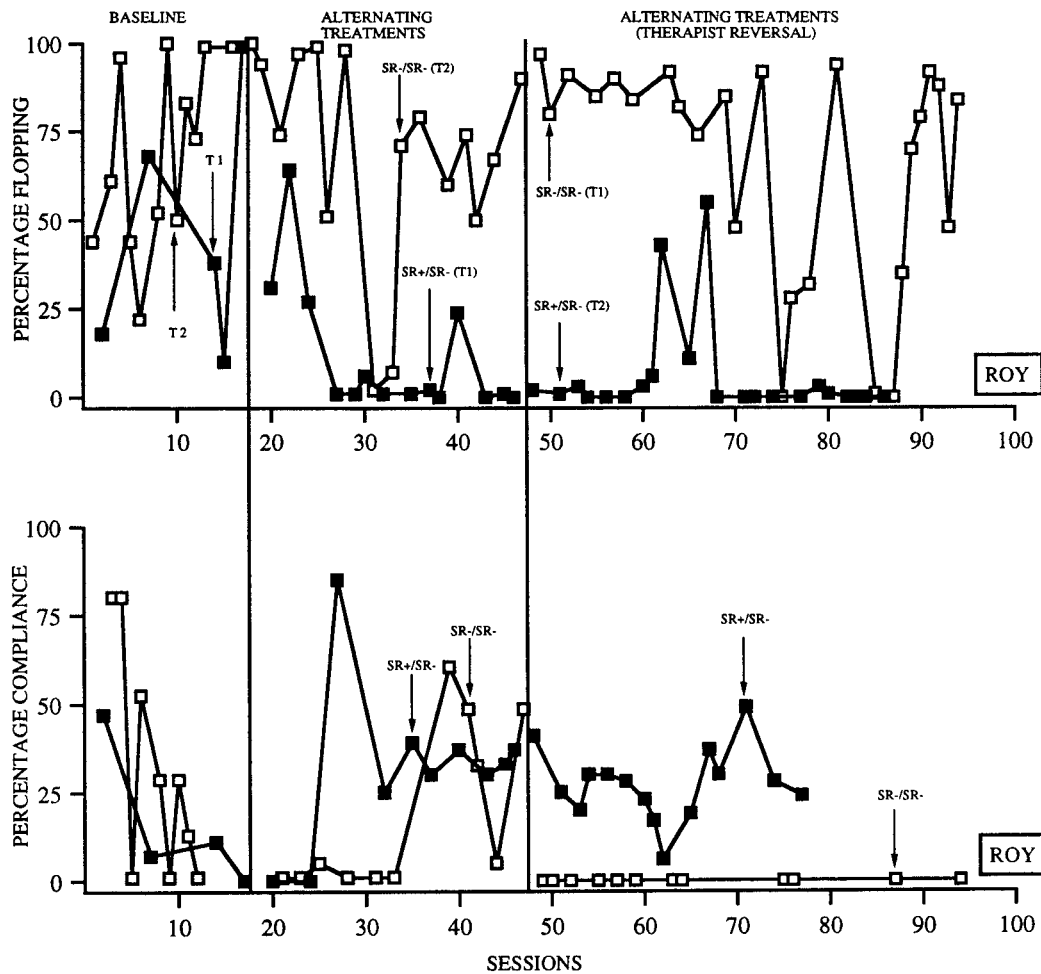


Figure 3. The percentage of session time flopping (top panel) and the percentage of compliance (bottom panel) during baseline and the alternating treatment conditions for Roy.

problem behavior and compliance in the following ways. First, the results support previous work showing that positive reinforcement (i.e., preferred items, praise, edible items, tokens, brief physical contact) contingent on compliance can produce concomitant decreases in problem behavior (Lalli & Casey, 1996; Parrish et al., 1986; Piazza et al., 1997; Russo et al., 1981) without the use of extinction. That is, when compliance resulted in edible reinforcement, problem behavior decreased even though it still produced a break. In addition, the effects of positive reinforcement were sufficient to allow us to thin the schedule of reinforcement

for compliance to practical levels for the 3 participants for whom it was attempted. We were able to thin the schedule of reinforcement for compliance from FR 1 to FR 10 for Jay and Tommy and to FR 20 for Dante (schedule increases were not attempted for Mia and Roy). Second, our findings extend those of Piazza et al., who reinforced compliance with the combination of a break plus access to items (i.e., negative and positive reinforcement). In the present study, we reinforced compliance with edible items only, thus demonstrating the independent effects of positive reinforcement on compliance and problem behavior.

A potential explanation for the findings of the present study and those of Piazza *et al.* (1997) may be the relative value of the reinforcers produced by the different responses. In the experimental arrangements in both studies, compliance and problem behavior were correlated with different reinforcers (available concurrently). Previous research has suggested that the quality of reinforcement may influence response allocation when concurrent response alternatives are available (Fisher, Thompson, Piazza, Crossland, & Gotjen, 1997; Neef, Mace, Shea, & Shade, 1992). In the present study, choice for the higher quality reinforcer was observed even when the reinforcement schedule was more favorable for problem behavior. For example, we thinned the reinforcement schedules for compliance to an FR 10 with Jay and Tommy and to an FR 20 with Dante (while problem behavior remained at an FR 1); however, participants allocated their responding to the alternative that produced the higher quality reinforcer. Similar to those of Piazza *et al.*, participants responded almost exclusively (problem behavior was at near zero rates) to the option that produced edible reinforcement (compliance). Quality of reinforcement may have also accounted for the differences in rates of compliance between baseline and treatment. During baseline, therapists reinforced compliance with praise; during treatment they reinforced compliance with edible items. Thus, participants chose escape over praise during baseline but chose edible items over escape during treatment.

Another potential explanation may be that problem behavior and compliance formed a response class (Catania, 1998) during an instructional situation. That is, because compliance and problem behavior both produced the same consequence (i.e., a break) they were established as members of a response class. Therefore, reinforcing compliance via escape from a task during a sit-

uation in which problem behavior occurred ( $S^{R-}/S^{R-}$  condition) may have inadvertently strengthened problem behavior. However, this explanation is speculative because it was not tested directly.

The results of our study may have important clinical implications. First, our findings showed that an arbitrary reinforcer (i.e., one not responsible for behavioral maintenance) was effective in reducing rates of problem behavior when delivered contingent on compliance. These findings are consistent with previous work that showed that noncontingent delivery of arbitrary reinforcers was effective in decreasing rates of problem behavior (Fischer, Iwata, & Mazaleski, 1997). Although arbitrary reinforcers (i.e., edible items) effectively reduced rates of problem behavior, our findings are not meant to suggest that treatment should proceed without first conducting a functional analysis. Identifying behavioral function allows us to understand the dimension of reinforcement being controlled in the treatment (in this study, the quality of reinforcement). Thus, we suggest that our findings be viewed simply as support for positively reinforcing compliance as an additional treatment option for escape behavior.

Second, treatment gains were obtained without the use of extinction (i.e., problem behavior still produced a break). These gains were initially obtained when reinforcement schedules were equal for compliance and problem behavior (FR 1) and then were maintained when the reinforcement schedule for compliance was gradually thinned for 3 participants.

An area for future study may be to investigate whether treatment gains in the  $S^{R+}/S^{R-}$  condition are a result of the response-reinforcer relationship (compliance  $\rightarrow$  edible reinforcement) or an increase in the amount of reinforcement available in a given instructional context. That is, were treatment gains due to differences in the quality of reinforce-

ment available in the competing schedules or were they a result of altering the establishing operation for escape behavior (i.e., the presence of positive reinforcers for compliance lessened the aversiveness of the demand situation)? Future investigations may want to assess the effects of providing edible reinforcement on a noncontingent basis while problem behavior continues to produce a break.

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*STUDY QUESTIONS*

1. Describe some ways to reduce the frequency of escape behavior through the manipulation of reinforcement contingencies.
2. The authors alluded to some limitations associated with the use of extinction. What specific problem might be encountered when using escape extinction?
3. What were the results of the functional analysis for all participants? Why were procedures altered for Mia?
4. What were the independent variables evaluated in this study, and how were they combined into the various interventions?
5. Summarize the results obtained with the various interventions for each of the participants.
6. The authors suggested that positive reinforcement of compliance (without extinction) may have been effective because compliance resulted in a higher quality of reinforcement (i.e., edible items) than did problem behavior (i.e., escape). How might one test this hypothesis?
7. The authors described the stimuli used in positive reinforcement conditions as “arbitrary.” What is meant by “arbitrary,” what type of manipulation is required to demonstrate such a characteristic, and how was it accomplished in this study?
8. What behavioral mechanisms may have been responsible for decreases in problem behavior observed when edible reinforcement was provided for compliance?

Questions prepared by Eileen Roscoe and Rachel Thompson, The University of Florida