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NONCONTINGENT REINFORCEMENT AS TREATMENT FOR SEVERE PROBLEM BEHAVIOR: SOME PROCEDURAL VARIATIONS

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Noncontingent reinforcement (NCR) as a treatment for problem behavior has typically included (a) continuous access to reinforcers at the onset of treatment and (b) extinction. We extended research on NCR by conducting a three-phase preliminary investigation of these components. In Phase 1, a functional analysis showed that the problem behavior of 3 participants with developmental disabilities was maintained by tangible positive reinforcement. In Phase 2, treatment started with the initial NCR interval based on the latency to the first problem behavior during baseline. In Phase 3, treatment consisted of NCR without extinction to determine whether extinction was an essential treatment component. Results showed that the initial NCR schedule based on latency (Phase 2) and NCR without extinction (Phase 3) were effective for reducing rates of problem behavior compared with baseline. Findings are discussed regarding the initial schedule of reinforcement and extinction as components of NCR.

DESCRIPTORS: aggression, extinction, noncontingent reinforcement, self-injurious behavior, tangible reinforcement

Recent research has shown the effectiveness of noncontingent reinforcement (NCR) as a treatment for problem behavior. Noncontingent reinforcement weakens the response–reinforcer relation by providing the reinforcer independent of the individual's behavior and may reduce the individual's motivation to emit problem behavior to obtain the reinforcer because those reinforcers are freely available. As a treatment, NCR has certain benefits. First, NCR guarantees consistent rates of reinforcement because reinforcer delivery is independent of behavior. Second, previous studies have shown that NCR may help to avoid extinction bursts (Hagopian, Fisher, & Legacy, 1994; Mace & Lalli, 1991; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993; Vollmer, Marcus, & Ringdahl, 1995). Third, NCR is easy to use because reinforcement delivery is time based rather than performance based. Finally, researchers have shown the applicability of NCR for treating problem behavior that is maintained by either social (Hagopian et al., 1994; Mace & Lalli, 1991; Marcus & Vollmer, 1996; Vollmer et al., 1993; Vollmer, Marcus, & Ringdahl, 1995) or automatic (nonsocial) reinforcement (Goh et al., 1995; Vollmer, Marcus, & LeBlanc, 1994).

Although NCR has received much recent attention, questions exist regarding the parameters under which the treatment is most effective. Two questions relate to (a) deciding the initial schedule of reinforcement required for behavior reduction and (b) the necessity of an extinction component. Typically, reinforcers are initially made available

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continuously or on a dense schedule and are then gradually faded to a lean schedule. For example, Vollmer and colleagues (Marcus & Vollmer, 1996; Vollmer et al., 1993; Vollmer, Marcus, & Ringdahl, 1995) initially provided access to the reinforcer continuously (i.e., objects, attention, or escape); similarly, Mace and Lalli (1991) used a dense schedule (variable-time 10 s). However, continuous (or near-continuous) reinforcement schedules may be impractical in some cases. Therefore, Hagopian et al. (1994) compared dense and lean schedules of reinforcement to evaluate whether starting treatment with a dense schedule was necessary for behavior reduction. Findings showed the initially dense schedule of reinforcement produced immediate reductions in problem behavior. In contrast, the lean schedule of reinforcement was effective only after the schedule was systematically faded. Although the above studies showed the benefits of starting treatment with a dense schedule, no studies have evaluated NCR parameters derived from baseline response levels (e.g., latency to the first response, mean interresponse time).

A second question regarding NCR relates to the use of extinction as part of treatment. Mace and Lalli (1991), Hagopian et al. (1994), and Vollmer et al. (1993) used NCR with extinction to treat attention-maintained problem behavior. Similarly, Marcus and Vollmer (1996) combined extinction, NCR, and differential-reinforcement-of-alternative-behavior schedules to reduce problem behavior that was maintained by tangible reinforcement. Finally, Vollmer, Marcus, and Ringdahl (1995) used noncontingent escape plus extinction to reduce escape-maintained self-injury (SIB). Because extinction was used in all of these studies, it is unknown whether extinction is an essential component of the treatment.

Given the two questions presented above, we conducted a three-phase preliminary investigation of NCR's essential components. In Phase 1, we conducted a functional analysis. In Phase 2, we tested the effects of an initial schedule of reinforcement based on the mean latency to the first problem behavior during baseline. Noncontingent reinforcement was combined with extinction during this phase. In Phase 3, we extended the analysis to 1 participant to observe if similar patterns of responding could be obtained without implementing extinction.

METHOD

Participants and Setting

Participants were 3 children who had been admitted to a hospital inpatient unit specializing in the treatment of severe problem behavior. Donny was 3 years old with mild developmental delays and was admitted for treatment of aggression. He was ambulatory, required assistance in all self-care activities, and communicated using spoken words. Donny's parents managed his aggression with reprimands and physical restraint. Tony was 9 years old with severe mental retardation and was admitted for treatment of SIB. He was ambulatory, required hand-over-hand assistance in all self-care activities, and communicated using gestures. Tony took 0.5 mg of haloperidol twice per day throughout the study as prescribed by his community-based pediatrician. Tony's grandparents managed his SIB by holding his hands until he was calm. Harry was 7 years old with severe mental retardation and was admitted for treatment of SIB. He was ambulatory, required hand-over-hand assistance in all self-care activities, and communicated by pointing to picture cards for a drink, food, or toy musical instruments. Harry's parents managed his SIB with reprimands, mild slaps to his hands, and mechanical restraints.

Sessions were conducted in a dormitory-style room (4.5 m by 6 m) for all partici-

pants and in the unit's special education classroom for Tony. The dormitory-style room contained a sofa, a table (180 cm long), two chairs, and a bathroom. A participant and a therapist were present during sessions. Observers recorded data from behind a one-way mirror. The classroom consisted of four staff members and from four to six students. Four to five 15-min sessions were conducted daily, 5 days per week, with a minimum of 10 min between sessions (range, 10 min to 180 min between sessions).

Dependent Measures and Data Collection

Donny's aggression consisted of hitting, kicking, biting, scratching, pulling hair, and throwing objects at others. Tony's SIB was defined as forceful contact of his head to an object or contact of his fingers to his ears. Harry's SIB was defined as forceful contact of his hands to his head and face, his head to an object, or his fingers into his eyes, or closure of upper and lower teeth on his hands. To assess procedural integrity, data were also collected on the therapist's reprimands, instructions, praise, withdrawal of instructional materials, and provision of reinforcers.

Observers used a computerized event-recording procedure for all topographies (Repp, Harman, Felce, VanAcker, & Karsh, 1989). A second observer independently collected data during an average of 28% of the sessions, equally distributed across participants and phases (range, 18% to 33% across participants and across phases). Interobserver agreement was determined using the "reliable" program (Repp et al., 1989). Occurrence agreement was scored when two observers recorded the onset of a target behavior within 2 s of each other. Occurrence agreement averaged 93% (range, 85% to 100%) across topographies, phases of the study, and participants. Correct use of the procedures was scored when a therapist implemented the designated procedure within 2 s of a target behavior during the functional analysis and the fixed-time (FT) schedule during treatment. Procedural fidelity data showed that the therapist correctly implemented the procedures on an average of 95% of the opportunities across all participants.

Experimental Designs

We assessed participants' problem behavior via functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994) in a multielement design with additional escape, materials, and control sessions to achieve stability for Tony. For Donny and Harry, we conducted the treatment evaluation using a reversal design (ABAB), with A being a nontreatment baseline and B reflecting NCR plus extinction (or NCR without extinction) conditions. For Tony, we used a multiple baseline across settings design to conduct the treatment evaluation (NCR plus extinction).

Phase 1: Functional Analysis

Procedure

Functional analyses were conducted for all participants and were based on the procedures described by Iwata et al. (1982/1994). In the attention condition, the therapist provided the participant with a preferred item and interacted with him for 2 to 3 min before diverting his or her attention to paperwork. The therapist provided disapproving comments contingent on each occurrence of a participant's SIB or aggression. The objective of this condition was to determine if problem behavior was maintained by attention. During escape conditions (self-care), the therapist provided an instruction to the participant once every 30 s using a three-step prompt sequence (i.e., verbal, gestural, physical), provided descriptive praise for correct responses, and provided a 30-s break from

the task (escape) contingent on each occurrence of problem behavior. Escape conditions were designed to test whether problem behavior was maintained by escape from demands. In the materials condition, the therapist provided the participant with access to his preferred object or activity for approximately 2 min. Then, the therapist removed the object (or brought Tony into the room from his walk) and provided the participant with age-appropriate toys. Donny's and Harry's preferred objects were placed in view but out of reach. The therapist provided descriptive praise contingent on appropriate toy play and neutral comments on an FT 30-s schedule. Contingent on each occurrence of problem behavior, the therapist returned the object for 30 s or took Tony for a 30-s walk in the hall. The participants' parents identified the objects or activity correlated with problem behavior (in their homes) for use in this condition. Donny's and Harry's preferred items were a toy fire truck that produced sirens when rolled and toy musical instruments (e.g., keyboard, drum), respectively. Tony's grandparents identified a brief walk outside as a preferred activity. The objective of the materials condition was to determine whether problem behavior was maintained by access to a preferred object or activity. In the control condition, the therapist provided access to requested items, descriptive praise for appropriate toy play, and neutral comments on an FT 30-s schedule. The therapist did not respond to aggression or SIB during this condition. In the alone condition, the participant was placed in a room without toys or adults.

Results

Figure 1 shows the results of the functional analysis for each participant. Response patterns were similar for the 3 participants: Problem behavior occurred most frequently in the materials condition and occurred infrequently in the escape, attention, and con-

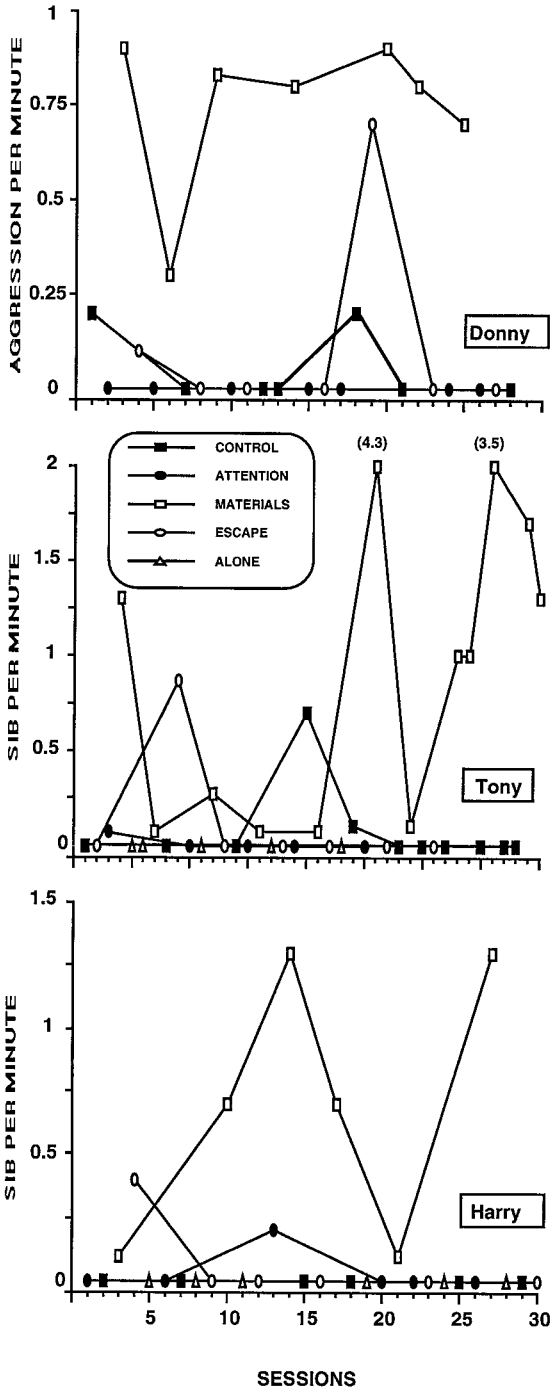

Figure 1. Responses per minute of aggression or SIB during functional analysis for Donny (upper panel), Tony (center panel), and Harry (lower panel).

trol conditions. SIB did not occur in the alone conditions. Donny's aggression averaged 0.8 per minute (range, 0.3 to 0.9 per minute), Tony's SIB averaged 1.2 per minute (range, 0.07 to 4.3 per minute), and Harry's SIB averaged 0.7 per minute (range, 0.1 to 1.3 per minute) in the materials condition. These data showed that problem behavior was maintained by access to preferred objects or an activity.

Phase 2: NCR

Procedure

General procedure. The initial FT interval reflected the mean latency to the first problem behavior during the functional analysis for each participant. This reinforcement interval differed from those used in prior studies in that it was based on some dimension of the participants' behavior during baseline. The initial FT interval was 90 s for Donny and 120 s for Tony and Harry. When the FT interval reached 600 s for Donny and Harry and 720 s for Tony, the duration of access to their reinforcers was increased from 30 s to 5 min. FT intervals were progressively increased by 120 s for Tony and by 60 s for Harry based on three consecutive sessions without SIB. Donny's FT intervals were increased by 30 s or 60 s after two consecutive sessions without aggression. Although it was not needed for any participant, the criterion for decreasing the FT interval was three consecutive sessions with rates of problem behavior equal to or exceeding baseline rates.

Baseline. The procedures (in all cases) were the same as in the materials condition of the functional analysis. This condition served as the initial baseline in all cases except Tony's classroom sessions in which baseline sessions were conducted in that setting.

Noncontingent reinforcement plus extinction. Donny and Tony participated in this phase. The objective of this phase was to test if NCR schedules based on the mean latency to respond could reduce rates of problem behavior. Therefore, we used the initial FT intervals described above to observe their effects on the participants' problem behavior. Procedures were the same as in the materials condition of the functional analysis with the following exceptions. At the start of each session, the therapist said, "Donny [or Tony] you can have—[the preferred object or a walk] when the timer rings, but you have to play with these [other age-appropriate toys] first." The therapist set a timer to a predetermined interval and provided access to the preferred object or activity (for 30 s) when the timer sounded, independent of the participant's behavior. Thus, access to the preferred object or activity was provided according to an FT schedule. The therapist did not respond to aggression or SIB during these conditions.

Parent training. This phase started when the FT schedules reached 600 s (10 min) for Donny and 720 s (12 min) for Tony. Vocal and written instructions, modeling, role playing, and feedback were used to train the parents.

Results

Results presented in Figure 2 show lower rates of problem behavior during NCR plus extinction conditions compared with baseline for Donny and Tony. Donny's data show an immediate decrease in rates of aggression upon the initial introduction of treatment. Withdrawal of treatment (Sessions 14 through 17) produced rates of aggression that approached those in the original baseline. The reintroduction of treatment produced an immediate decrease in rates of aggression (similar to the initial treament phase) that were maintained until the FT schedule reached 270 s. At that point, we observed a temporary increase in rates of aggression for two sessions. No fur-

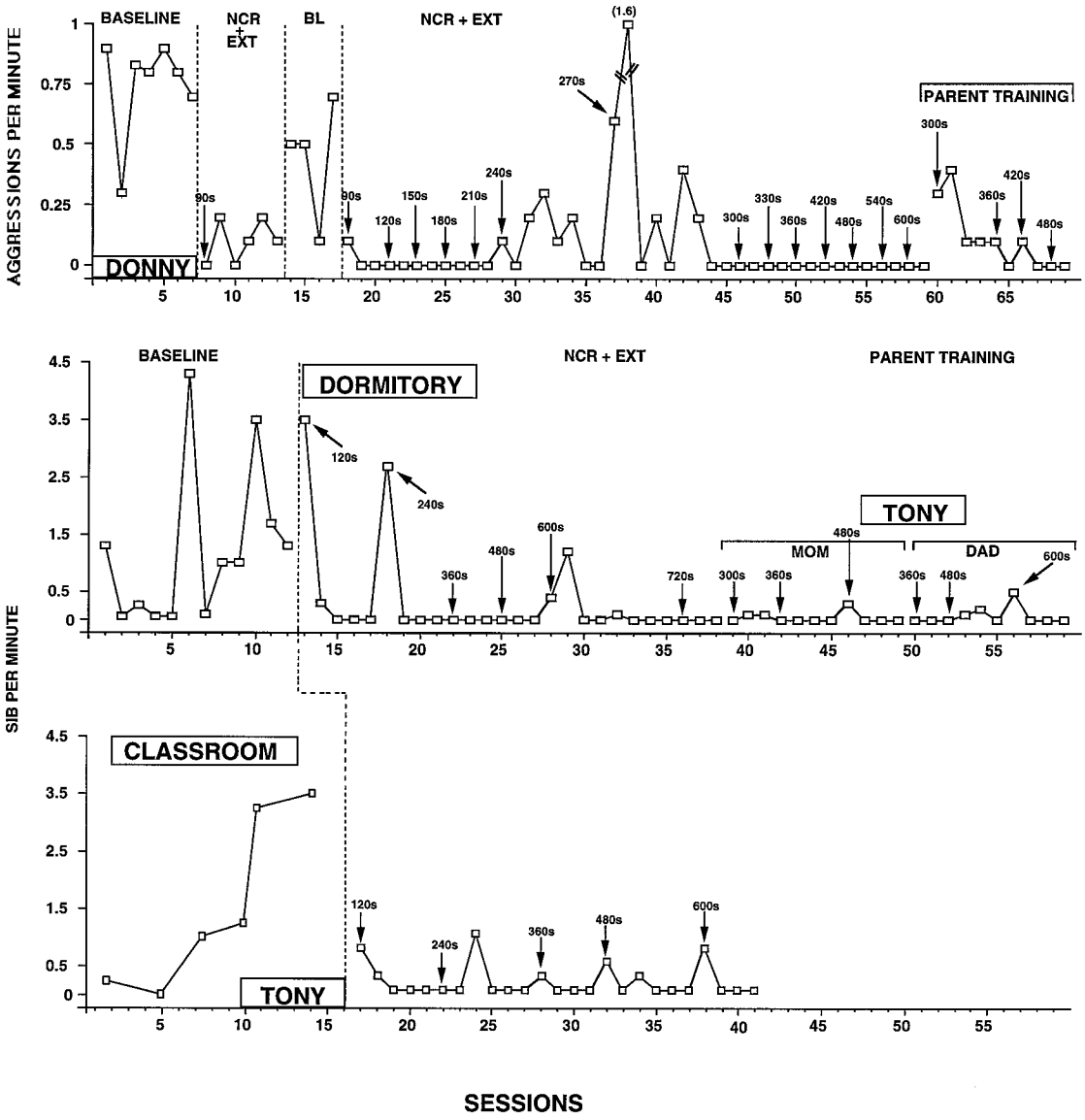

Figure 2. Responses per minute of aggression for Donny (upper panel) and SIB for Tony in dormitory (middle panel) and classroom settings (lower panel) during baseline (BL) and noncontingent reinforcement (NCR) plus extinction (EXT) conditions. Lines marked with time intervals show when FT intervals were changed.

ther increases occurred until parent training was conducted. Upon the introduction of parent training, we observed an immediate increase in rates of aggression. Again, however, the increase was only temporary. Tony's data show an initially high rate of SIB during the first treatment session (FT 120 s) and when the FT interval was increased to 240 s and 600 s in the dormitory. However, SIB quickly decreased at the respective FT intervals and remained low in both settings throughout the study. Parent training with Tony's mother and father produced low rates of SIB throughout the gradual increase from an FT 300-s to an FT 600-s schedule.

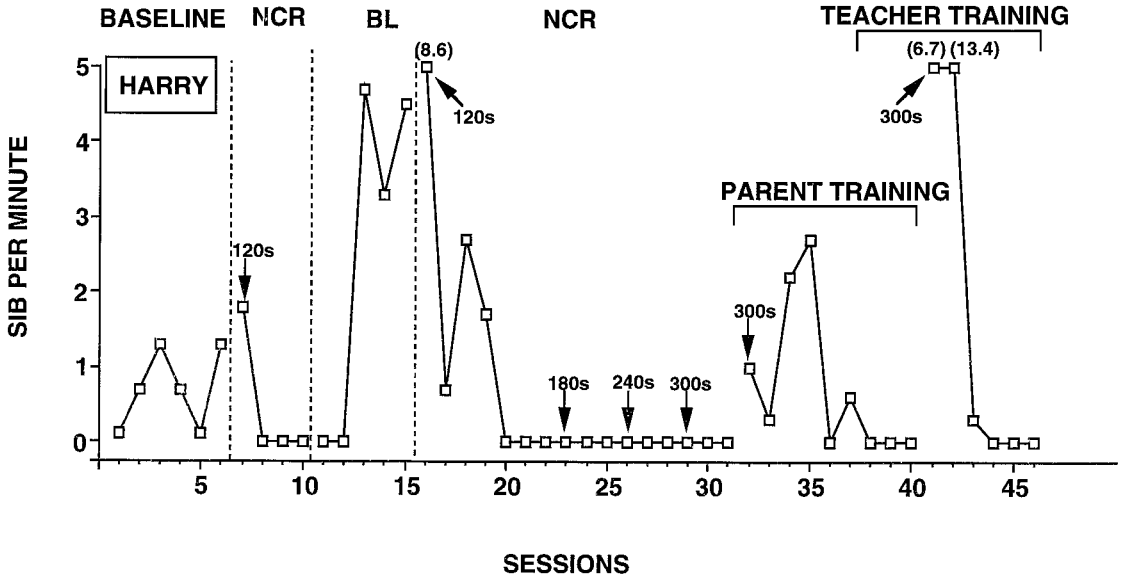

Figure 3. Responses per minute of SIB during baseline (BL) and NCR without extinction conditions for Harry. Lines marked with time intervals show when FT intervals were changed.

Phase 3: NCR Without Extinction

Procedure

Noncontingent reinforcement without extinction. The objective of this condition was to determine whether NCR without extinction could reduce rates of SIB; this condition was in effect only for Harry. Procedures consisted of those described in the NCR plus extinction condition with one exception. In the NCR without extinction condition, the therapist provided access to the preferred object (for 30 s) contingent on each occurrence of SIB and according to the FT schedule.

Parent and teacher training. This phase started when the FT schedule reached 300 s (5 min) for Harry. Procedures were the same as those used to train Donny's and Tony's parents. Harry's parent and teacher training included the use of extinction for his SIB.

Results

Harry's data show an increase in rates of SIB during the first session of the initial NCR without extinction phase (see Figure 3); however, SIB did not occur in the remaining sessions of this phase. Withdrawal of treatment resulted in rates of SIB that were substantially higher than those in the initial baseline phase. High rates of SIB were observed in the first four sessions when NCR was reintroduced following baseline. SIB did not occur in any other treatment session. Parent and teacher training data show similar response patterns: initially high rates of SIB that reached zero within five sessions with his mother and within three sessions with his teacher and that were maintained at an FT 300-s schedule.

DISCUSSION

We addressed two questions: (a) Can a latency-based rather than a more dense NCR schedule be used at the onset of treatment? (b) Can similar patterns of responding be obtained without implementing extinction? We conducted the study across three phases. In Phase 1, we assessed the participants' problem behavior via functional analyses (Iwata et al., 1982/1994). For Don-

ny and Harry, access to preferred toys maintained their problem behavior, whereas going for a walk maintained Tony's SIB. Although leaving a room to go for a walk may suggest an escape contingency (which may have contributed to the reinforcing value of a walk), it was not the purpose of this study to conduct a component analysis of the contingencies. Thus, it is unclear whether Tony's SIB was positively or negatively reinforced.

In Phase 2, we provided a preliminary investigation of initiating treatment with leaner schedules of reinforcement (i.e., FT intervals) than those used in previous research. Several studies have shown that starting treatment with reinforcers available continuously (Marcus & Vollmer, 1996; Vollmer et al., 1993, Vollmer, Marcus, & Ringdahl, 1995) was effective for reducing problem behavior. In addition, Hagopian et al. (1994) showed that starting with a continuous schedule and then fading to an FT 5-min schedule was more effective than starting with the FT 5-min terminal schedule. In the present study, we assessed the effects of starting treatment with initial schedules based on the mean latency to the first occurrence of problem behavior during baseline. We selected this measure because our goal was to have participants tolerate a delay in reinforcer delivery. Using the mean latency allowed us to identify the baseline interval in which the participants did not emit problem behavior (after an item was restricted). Thus, we were able to effectively start treatment with initial FT schedules that were leaner than had been previously shown to be necessary for behavior reduction. Therefore, the typical continuous initial schedule does not appear to be a necessary component; however, we did not compare continuous versus latency-based schedules, so definitive statements about the relative effects of schedules cannot be made. For example, could the initially high rates of Donny's aggression or Harry's SIB during parent and teacher training have been avoided with a denser schedule of reinforcement?

Phase 3 of the present study extended the analysis from Phase 2 to 1 participant by using NCR without extinction. Harry's data showed that after initial increases in rates of SIB (compared with baseline), rates eventually reached zero and were maintained throughout the fading to the terminal schedule (FT 300 s). However, because we used NCR without extinction for only 1 participant, these findings are considered preliminary and warrant further study. For example, future research may study NCR without extinction under various schedule conditions. We started treatment with an FT 120-s schedule and observed high rates of SIB immediately upon the initial application (Session 7) and reintroduction of NCR without extinction (Sessions 16 through 19). Future research may assess what initial schedule of reinforcement is required to produce an immediate reduction in rates of problem behavior. Another area for future study would be the terminal FT schedule. Specifically, how much could the schedule be faded while maintaining treatment gains?

The results of the present study have clinical and conceptual implications for the use of NCR. Clinically, the study showed that treatment can be started with relatively lean schedules of reinforcement (e.g., FT 90 s, FT 120 s) and that these schedules can be rapidly faded. For example, we increased the FT intervals by 30 s, 60 s, or 120 s for Donny, Harry, and Tony, respectively. These findings suggest that NCR may be more easily introduced and applied than has been previously demonstrated.

On a conceptual basis, previous researchers have attributed treatment effects to a combination of satiation and extinction (Hagopian et al., 1994; Mace & Lalli, 1991; Vollmer et al., 1993; Vollmer, Marcus, & Ringdahl, 1995). In the present study, Harry's data showed that extinction was not nec-

essary to either produce or maintain low rates of SIB, thus suggesting satiation as the component that was responsible for behavior reduction. When NCR is used with extinction, an analysis of the initial response pattern and how these are affected by schedule changes may identify the operative treatment component. For example, one response pattern is an immediate reduction in rates of problem behavior that are maintained as the reinforcement schedules are faded (e.g., Vollmer et al., 1993; Vollmer, Marcus, & Ringdahl, 1995). In the present study, Tony's classroom data fit this pattern. Noncontingent reinforcement may have accounted for the immediate reduction because reinforcement was initially provided on a schedule that was sufficient to alter the establishing operation (Michael, 1982) from deprivation to satiation. However, this explanation does not account for the continued low rates when reinforcement schedules were thinned. Hagopian et al. (1994) suggested that under lean schedule conditions, NCR may attenuate the state of deprivation rather than eliminate it (as with rich schedule conditions). Thus, Harry's (and possibly Tony's) data suggested that extinction was not necessary to reduce rates of problem behavior.

A second response pattern is initial low rates of problem behavior with a temporary increase when reinforcement schedules are thinned (e.g., Vollmer, Marcus, & Ringdahl, 1995). For example, when Donny's FT interval reached 270 s, we observed increased rates of aggression that persisted across seven sessions. Aggression eventually returned to zero, suggesting that extinction may have influenced responding. Thus, for Donny it appears that the rich schedule was initially sufficient to reduce aggression; however, extinction was responsible when a lean schedule failed to suppress aggression.

A third response pattern is high rates of problem behavior immediately upon the introduction of treatment (i.e., extinction burst). For example, Tony's dormitory data showed high rates of SIB in the first FT 120-s session, suggesting that extinction was responsible for the subsequent reduction in SIB. Thus, the three response patterns described above may be useful for identifying the operative component of a treatment package. This type of analysis may be further augmented by using a minute-by-minute analysis of response rates within a session, as suggested by Vollmer, Marcus, Ringdahl, and Roane (1995).

An interesting finding of our study was the initial burst in Donny's aggression and Harry's SIB upon the introduction of parent and teacher training. The initially high rates of aggression and SIB were observed after several sessions of no problem behavior with the participants' respective therapists. Because the parents and teacher were implementing the treatment procedures correctly, these response patterns suggested stimulus control as a potential variable for investigation. That is, the participants' parents and teacher were stimuli whose presence signaled the availability of reinforcement for problem behavior. However, rates of aggression and SIB decreased to zero after repeated exposure to the treatment package in the parents' and teacher's presence.

One area for future study is the influence of instructions during periods of deprivation. In the present study, we provided an instruction at the beginning of a session by saying that the item would be available when a timer sounded. Therefore, the instruction (and the timer) may have functioned as a signal that helped participants to predict upcoming events. Previous research has shown that predictability signals (e.g., photographic activity schedules) were effective for reducing escape behavior (Flannery & Horner, 1994; Lalli, Casey, Goh, & Merlino, 1994). Based on the present study's findings, further evaluation of discriminative stimuli that help

individuals predict that positive reinforcers are forthcoming is warranted.

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STUDY QUESTIONS

1. In what ways did noncontingent reinforcement (NCR) in this study differ from that used in previous applications?
2. What types of experimental designs were used across the different phases of the study?
3. Briefly describe the results of the functional analysis.
4. How were the initial fixed-time schedules of NCR determined, how were they increased, and at what values did they reach their maximum?
5. What was the main difference between the NCR procedure implemented with Donny and Tony and that implemented with Harry?
6. Briefly summarize the results obtained during Phases 2 and 3 and their implications for treatment.
7. The authors indicated that an analysis of response patterns might suggest whether NCR suppressed behavior through satiation, extinction, or a combination of both. What response

patterns were discussed, and which one (based on procedures used in the study) most clearly suggested a specific mechanism of behavior change?

8. In light of the results obtained in this study, suggest a strategy for determining whether or not NCR can be implemented and then faded without using extinction.

Questions prepared by Han-Leong Goh and Michele Wallace, University of Florida