

*NONCONTINGENT REINFORCEMENT WITHOUT EXTINCTION  
PLUS DIFFERENTIAL REINFORCEMENT OF ALTERNATIVE  
BEHAVIOR DURING TREATMENT OF PROBLEM BEHAVIOR*

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The effects of noncontingent reinforcement (NCR) without extinction during treatment of problem behavior maintained by social positive reinforcement were evaluated for five individuals diagnosed with autism spectrum disorder. A continuous NCR schedule was gradually thinned to a fixed-time 5-min schedule. If problem behavior increased during NCR schedule thinning, a continuous NCR schedule was reinstated and NCR schedule thinning was repeated with differential reinforcement of alternative behavior (DRA) included. Results showed an immediate decrease in all participants' problem behavior during continuous NCR, and problem behavior maintained at low levels during NCR schedule thinning for three participants. Problem behavior increased and maintained at higher rates during NCR schedule thinning for two other participants; however, the addition of DRA to the intervention resulted in decreased problem behavior and increased mands.

*Key words:* concurrent schedules, differential reinforcement, noncontingent reinforcement, problem behavior

Problem behavior in the form of aggression, self-injurious behavior (SIB), and disruption is common among individuals with intellectual disabilities and can prevent skill acquisition, hinder the development of social relationships, and affect family relationships (Matson, Wilkins, & Macken, 2009). Due to these and other reasons, assessment and treatment of problem behavior is important to produce improved outcomes for these individuals. Since the development of functional analysis methodology for identifying the reinforcers that maintain problem behavior (Iwata, Dorsey, Slifer, Bauman, &

Richman, 1982/1994), researchers have been able to more precisely develop interventions that effectively decrease the behavior. These interventions often consist of various combinations of extinction, noncontingent reinforcement (NCR), or differential reinforcement (Iwata & Worsdell, 2005).

NCR has been used to treat problem behavior maintained by automatic and social reinforcement (Carr et al., 2000). When problem behavior is maintained by social reinforcement, NCR typically involves the delivery of the functional reinforcer (i.e., the reinforcer that maintains problem behavior) on a time-based schedule, independent of a response (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). NCR schedules have been shown to be effective at reducing problem behavior maintained by social positive reinforcement (e.g., Hagopian, Fisher, & Legacy, 1994; Lalli, Casey, & Kates, 1997; Vollmer et al., 1993) and social negative reinforcement (e.g., Kodak, Miltenberger, & Romaniuk, 2003; O'Callaghan, Allen, Powell, & Salama, 2006; Vollmer, Marcus, & Ringdahl,

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Lynsey Jackson is now at Endeavor Behavioral Institute, Nicole Stiefler is at Spectrum of Hope, Barbara Wimberly is at Trumpet Behavioral Health, and Amy Richardson is at Spectacular Kids. This study was conducted in partial fulfillment of the requirements for the second author's master's degree at the University of Houston-Clear Lake. We thank Kelsey Campbell, Rachel Hoffman, Dorothea Lerman, and Lorena Rodriguez for their assistance with this study.

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doi: 10.1002/jaba.395

1995). There are several potential advantages to NCR. First, it may be easier to implement than procedures requiring response monitoring. Second, it may result in higher rates of reinforcement than differential reinforcement procedures (Vollmer et al., 1993). Finally, it may attenuate side effects of extinction, such as extinction bursts (Vollmer et al., 1998).

Extinction is typically included as a component of NCR and involves withholding reinforcement following problem behavior (i.e., reinforcement is delivered on the time-based schedule but is not delivered contingent on problem behavior; Wallace, Iwata, Hanley, Thompson, & Roscoe, 2012). A few studies have evaluated NCR without extinction; however, there is a paucity of research on this treatment strategy (Carr, Severtson, & Lepper, 2009). Furthermore, results of these studies have been somewhat mixed in that the intervention has been effective in some studies (e.g., Lalli et al., 1997) but not others (e.g., Hagopian, Crockett, Van Stone, DeLeon, & Bowman, 2000; Wallace et al., 2012) as the NCR schedule is thinned. For example, Lalli et al. (1997) evaluated NCR without extinction for one participant. The rate of problem behavior gradually decreased to zero as they thinned the NCR schedule and maintained at low levels at the terminal schedule. Conversely, Hagopian et al. (2000) and Wallace et al. (2012) both observed increases in problem behavior when the NCR schedule was thinned without extinction, and the inclusion of extinction was effective in decreasing problem behavior when it was used. Although NCR with extinction effectively decreased problem behavior in both studies, extinction cannot be implemented in all situations. For example, it might be impossible to prevent physically large individuals from accessing preferred items following problem behavior, such as when they hit or shove a caregiver who is blocking access to preferred items, or caregivers might not be able to refrain from providing attention

following aggression directed toward them. Therefore, research on additional strategies to improve the effectiveness of NCR without extinction is needed.

One potential solution might be to combine NCR with differential reinforcement of alternative behavior (DRA) without extinction. Studies have shown that this combined intervention strategy can be highly effective in decreasing problem behavior and increasing appropriate behavior when extinction is included (Goh, Iwata, & DeLeon, 2000; Marcus & Vollmer, 1996). For example, Goh et al. (2000) used NCR combined with DRA to decrease problem behavior maintained by social positive reinforcement, but an increase in the alternative response did not occur until the NCR schedule was thinned. It is unknown if the treatment would be similarly effective if extinction was not included.

Although combining DRA with NCR may increase the effort of implementing treatment (compared to NCR alone), it might be a viable alternative when extinction is not possible. In those cases, caregivers interact with the individual when problem behavior occurs, but also on a time-based schedule and following appropriate, alternative behavior (mands). This strategy would be desirable if mands increase and low rates of problem behavior maintain as the NCR schedule is thinned. Furthermore, if the intervention results in significant decreases in problem behavior, the effort of the intervention should decrease as NCR is thinned. Even if mands are emitted at a similar rate as problem behavior during baseline, the intervention should be at least no more difficult to implement than baseline procedures.

The purpose of this study was to evaluate the effects of thinning NCR schedules without extinction for problem behavior maintained by social positive reinforcement. This study extends previous research by evaluating a combined intervention of NCR schedule thinning plus DRA without extinction when NCR

schedule thinning alone is not effective in maintaining low rates of problem behavior.

## METHOD

### *Participants and Setting*

Five individuals who engaged in problem behavior maintained by social positive reinforcement were included in this study. All participants attended day treatment centers for at least 15 hr per week where they had been referred for assessment and treatment of problem behavior. Charley was a 9-year-old male diagnosed with autism whose problem behavior consisted of property destruction. (Charley also infrequently engaged in aggression, which was not included in this study.) Gilbert was a 7-year-old male diagnosed with autism who engaged in screaming. Dyson was a 6-year-old male diagnosed with autism who kicked people and other surfaces. Alan was a 3-year-old male diagnosed with autism who engaged in screaming. Harry was a 7-year-old male diagnosed with autism and obsessive-compulsive disorder who engaged in SIB.

All sessions took place at a day treatment center in rooms (approximately 3 m by 3 m) containing a table, chairs, and the materials necessary to conduct the sessions.

### *Response Measurement and Reliability*

The dependent variables (problem behavior and mands) were measured using frequency or 10-s partial interval recording (Gilbert only). The frequency data were converted to responses per min (RPM) and the partial interval data were converted to percentage of intervals. A secondary analysis of latency (in seconds) from the time leisure items were removed to the first instance of problem behavior also was conducted during the first 5 min of Dyson's baseline (sessions 1, 2, and 4; problem behavior did not occur in session 3) or during the tangible condition sessions of the functional analysis for Alan. Problem behavior included screaming (Gilbert and Alan), property

destruction (Charley), kicking self and objects (Dyson), and SIB (Harry). Screaming was defined as a nonfunctional, vocal response that was paired with an open mouth and negative facial affect (e.g., frowning, crying). Property destruction was defined as audible contact between the participant's hands or feet with objects in the environment, throwing objects, and audible contact between two or more objects in the participant's hands. Kicking was defined as extension of the leg with contact between the participant's foot and surfaces or a person (did not include contact while rolling on the floor). SIB was defined as any audible contact between the hand and head or body of the participant. The mand taught during DRA was defined as placing a card in the therapist's hand. Alan exchanged a card that contained a picture of his preferred items, and Harry exchanged a card that had the word "toys" printed on it.

A second independent observer collected data for 18% to 100% of sessions during each condition to assess reliability. Proportional agreement scores for frequency data were determined by comparing the observers' recorded frequencies for each response in each 10-s interval. The smaller number of responses was divided by the larger number of responses in each interval, the fractions were averaged across intervals, and the result was multiplied by 100. Interval agreement scores for partial interval data were determined by comparing the observers' recording of occurrence or nonoccurrence of the response in each interval. If the records matched within the interval, the interval was scored as an agreement. The number of agreement intervals was divided by the total number of intervals in the session and multiplied by 100. For latency measures, two observers recorded the number of seconds from leisure item removal until problem behavior occurred, and agreement was scored if the observers' records differed by 5 s or less.

Mean interobserver agreement scores for problem behavior were 92% (range, 76%-

100%) in baseline, 99% (range, 90%-100%) in NCR, and 98% (range, 80%-100%) in NCR plus DRA (Alan and Harry only). Mean interobserver agreement scores for mands were 99% (range, 90%-100%) in NCR plus DRA (Alan and Harry only). Mean interobserver agreement scores for latency to problem behavior were 90% (range, 67%-100%).

### *Procedure*

A functional analysis (FA) was conducted with all participants prior to treatment using procedures similar to those described by Iwata et al. (1982/1994). A tangible condition also was included for all participants because their caregivers reported that problem behavior occurred when preferred items were removed, and all participants engaged in problem behavior at the highest rates (or almost exclusively) in the tangible condition. Results are available from the corresponding author.

During the treatment evaluation, the same highly preferred items were delivered on the NCR schedule (all conditions), contingent on problem behavior (all conditions), and contingent on mands (NCR plus DRA only). Sessions were 5 min (Alan only) or 10 min in duration. Experimental control was demonstrated using a nonconcurrent multiple baseline across participants design.

*Baseline.* Participants were given at least 30-s, pre-session access to a variety of highly preferred leisure items. The items were removed at the start of the session and remained visible but out of the participant's reach. Participants were given 20-s access to the preferred items contingent on problem behavior. All other behavior was ignored, and the therapist did not interact with the participant during session. Baseline sessions were conducted until stable or increasing rates of problem behavior were observed.

*NCR.* During this condition, preferred items were delivered for 20 s on a time-based schedule and for 20 s contingent on problem

behavior. The therapist wore a vibrating pager to discretely signal when the preferred items should be delivered on the NCR schedule. The initial NCR schedule for all participants was three reinforcer deliveries per min (i.e., continuous reinforcement in which the participant had uninterrupted access to the preferred items). Problem behavior that occurred during the reinforcement interval was scored but did not result in additional reinforcement time (i.e., the items were removed after 20-s access, regardless of whether problem behavior occurred during the reinforcement interval). The NCR schedule thinning procedure was identical to the procedures used by Marcus and Vollmer (1996), in which the NCR schedule was thinned to two deliveries per min, 1 per min, 0.5 per min, 0.33 per min, 0.25 per min, and 0.2 per min, if problem behavior maintained at or below 20% of baseline rates for at least three consecutive sessions. If at any time during the schedule thinning rates of problem behavior were greater than 20% of baseline levels and were without a decreasing trend for at least five consecutive sessions, mand training was initiated.

*Mand training.* Prior to the NCR plus DRA condition, mands for access to the preferred items were taught to the participants using a backward chaining procedure (Hagopian, Fisher, Sullivan, Acquistio, & LeBlanc, 1998). The three steps were: (a) moving the participant's hand toward the card, (b) picking up the card, and (c) handing the card to the therapist. Initially, the minimal amount of physical guidance necessary was used to prompt the participant to engage in each step of the alternative communication procedure. Next, minimal physical guidance was used to prompt the participant through all steps except the final step in the chain (step c). If the participant failed to independently complete the final step within 5 s, physical guidance was used. The final stage involved guiding the participant to complete the first step in the chain (step a), and then

allowing 5 s to pass for the participant to independently emit the correct response before prompting was provided. Each session consisted of 10 trials. The criterion for moving through each stage in the mand training process was independent completion of the targeted steps for at least 80% of trials for two consecutive sessions. During mand training, all participants were given 5 s to independently engage in the response before any prompting was provided to promote independent responding. Preferred items were delivered following each prompted and unprompted response. The mand was considered mastered when independent (unprompted) responding occurred for at least 80% of trials for two consecutive sessions. The therapist blocked problem behavior that occurred during mand training sessions, did not provide access to the preferred items, and did not provide eye contact or any other attention.

*NCR plus DRA.* During this condition, preferred items were delivered (a) contingent on problem behavior, (b) on the fixed-time (FT) schedule of reinforcement, and (c) contingent on a mand. The participants had continuous access to the reinforcers at the beginning of this phase, and the subsequent NCR schedule thinning procedure was identical to the NCR-only condition. The card was available throughout sessions once NCR schedule thinning began for Alan (i.e., the card was not available during continuous NCR due to experimenter error) and during all sessions for Harry (i.e., the card was available during continuous NCR and all subsequent sessions). Problem behavior and mands that occurred during the reinforcement interval were scored but did not result in additional reinforcement time (i.e., the items were removed after 20-s access).

## RESULTS

Results of baseline and treatment are depicted in Figure 1 for Charley, Gilbert, and

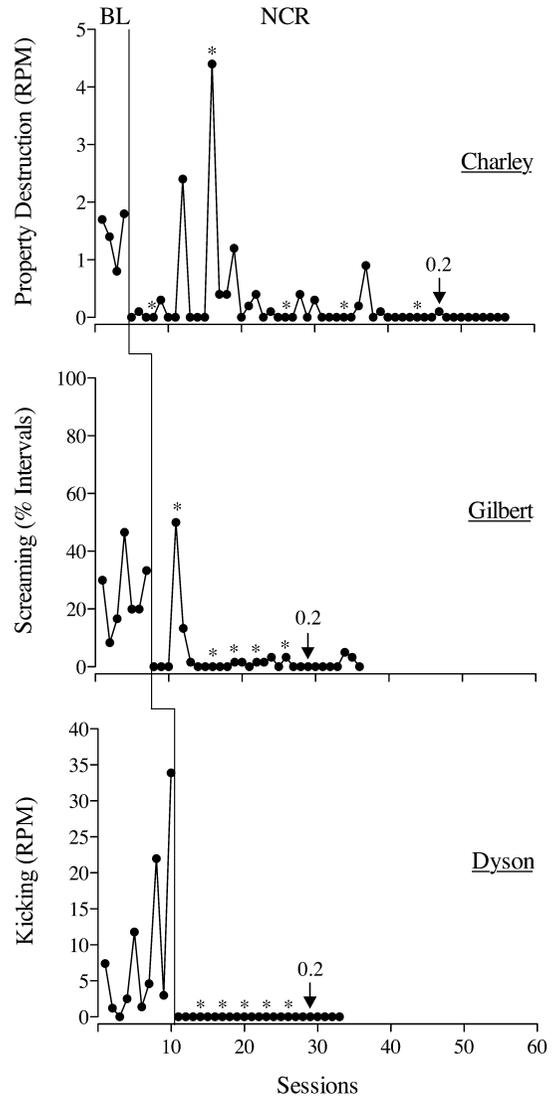


Figure 1. Results of treatment during NCR. Asterisks indicate sessions in which the NCR schedule was thinned. Arrows indicate sessions in which the terminal NCR schedule was initiated.

Dyson. NCR schedule thinning without extinction was effective in reducing the problem behavior of these three participants. Charley's property destruction averaged 1.4 RPM during baseline, and continuous NCR produced near-zero levels of problem behavior. As the NCR schedule was thinned, Charley intermittently engaged in moderate to high levels of problem

behavior; however, problem behavior returned to below 20% of baseline rates. The NCR schedule was successfully thinned to the terminal schedule of 0.2 reinforcers per min in 42 sessions. Gilbert's screaming averaged 25% of intervals during baseline and immediately decreased to zero when continuous NCR was introduced. Screaming increased to baseline levels during the first NCR thinning session; however, problem behavior decreased in the subsequent session and remained at near-zero levels for the remainder of the treatment. The NCR schedule was thinned to the terminal criterion in 21 sessions for Gilbert. Dyson's kicking occurred at increasing rates during baseline and averaged 8.8 RPM. His problem behavior decreased to zero immediately when continuous NCR was introduced and remained at zero as the schedule was thinned. The terminal NCR schedule was reached in 18 sessions for Dyson.

Results of baseline and treatment are depicted in Figure 2 for Alan and Harry. Although NCR was initially effective when they had continuous access to the reinforcers, problem behavior increased once the NCR schedule was thinned. Alan's screaming averaged 1.4 RPM during baseline and immediately decreased to zero during continuous NCR. During the first NCR schedule thinning session, Alan's screaming increased to baseline levels and maintained at steady rates for eight sessions. After mand training, continuous NCR again was implemented, which produced near-zero rates of screaming, and the picture card was introduced during the first step of NCR schedule thinning (i.e., the card was not available during continuous NCR). Alan engaged in zero rates of screaming and increasing rates of mands during the NCR schedule thinning plus DRA condition.

Harry's SIB averaged 4.3 RPM during baseline and immediately decreased to zero during continuous NCR. Although SIB initially remained low during the first step of NCR schedule thinning, it subsequently increased

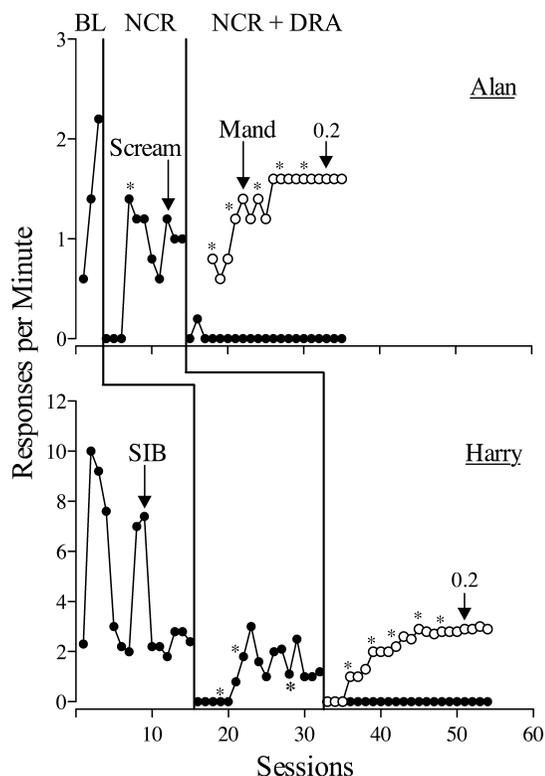


Figure 2. Results of treatment during NCR and NCR + DRA. Asterisks indicate sessions in which the NCR schedule was thinned, and a bold asterisk (session 28 for Harry) indicates a return to the previous NCR schedule.

and maintained during sessions when NCR was thinned further. We returned to the first step of NCR schedule thinning in session 28; however, SIB persisted at near baseline levels for five sessions under these conditions. Therefore, the card was available and continuous NCR was again implemented after mand training. Harry did not engage in SIB during the remainder of treatment. He also did not engage in mands during continuous NCR; however, mands gradually increased as the NCR schedule was thinned. The terminal criterion for the NCR schedule was reached in 18 sessions for both Alan and Harry.

It was interesting that NCR schedule thinning without extinction was effective for three

of the five participants, especially in eliminating Dyson's problem behavior. It seemed possible that the latency to problem behavior from the removal of the preferred items might predict if NCR thinning without extinction might be an effective intervention. Therefore, we calculated the latency from toy removal until the first instance of problem behavior occurred during the sessions for the best and worst responders during NCR schedule thinning without extinction (i.e., Dyson, whose problem behavior never occurred, and Alan, whose problem behavior increased to baseline rates as soon as NCR thinning started). We analyzed the first three sessions of baseline in which problem behavior occurred for Dyson (i.e., sessions 1, 2, and 4 of baseline, because problem behavior never occurred in session 3; shown in Figure 1) and the three sessions of the tangible condition from the FA for Alan in which he received 30-s access to preferred items contingent on problem behavior (overall rate of problem behavior was 1.2, 1.8, and 1.2 RPM in these sessions, respectively). These sessions were selected because greater differences in responding might be expected during early exposure to the reinforcement contingency for problem behavior (i.e., before problem behavior became more efficient due to a recent history of reinforcement), and this is when a clinician would likely make a determination regarding potential treatment strategies (i.e., lengthy baselines are not common in clinical practice). Results are shown in Figure 3. The average latency to problem behavior following the removal of preferred items was 246 s for Dyson and 14 s for Alan. Furthermore, the shortest latency to Dyson's kicking was 173 s, and Alan consistently engaged in screaming within a few seconds of toy removal (median latency was 5 s).

## DISCUSSION

NCR without extinction was effective in reducing problem behavior maintained by social

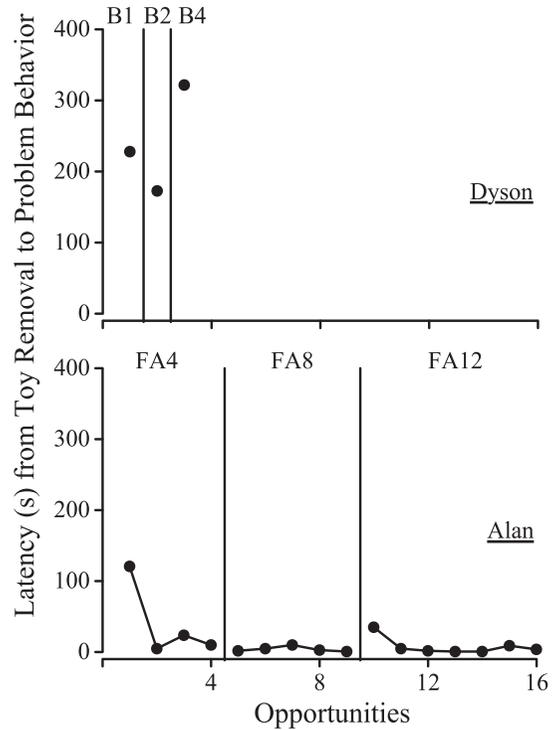


Figure 3. Latency in seconds from toy removal to problem behavior during the first 5 min of baseline sessions 1, 2, and 4 for Dyson and functional analysis sessions 4, 8, and 12 (tangible condition) for Alan.

positive reinforcement for three of five participants—replicating the results of some previous studies (Hagopian, LeBlanc, & Maglieri, 2000; Lalli *et al.*, 1997). Systematically thinning the NCR schedule resulted in continued low levels of problem behavior for three participants, even though problem behavior occurred at moderate to high levels and contacted the reinforcement contingency during some sessions of the schedule thinning process for two of three participants. The terminal NCR schedule of FT 5 min was achieved in an average of 30 sessions for these three participants and accounted for only 3–7 hr of treatment. These results are promising for situations in which NCR is a desirable intervention but extinction is not feasible or caregivers do not implement extinction with integrity.

For the two participants for whom NCR schedule thinning without extinction was not effective in maintaining low rates of problem behavior, the addition of a DRA component was effective in decreasing problem behavior to zero rates and maintaining mands. This provides a promising approach to treatment without extinction that requires a relatively short time commitment, as the terminal NCR schedule of FT 5 min was achieved in only 1.5-3 hr (18 sessions) for both participants.

These results extend the findings of previous studies that showed a combined strategy of NCR thinning and DRA with extinction can be effective in decreasing problem behavior (Goh et al., 2000; Marcus & Vollmer, 1996) by showing this treatment can be effective without extinction. Furthermore, these results extend the work of Wallace et al. (2012) by demonstrating that lean schedules of NCR can be effective in reducing problem behavior without extinction when the NCR schedule is gradually thinned and combined with DRA. Given the elimination of problem behavior during this treatment, it is possible that the systematic thinning of the NCR schedule might have been a critical treatment component, as other studies that have used DRA without extinction have not produced such favorable outcomes (e.g., Hagopian et al., 1998; Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997; Worsdell, Iwata, Hanley, Thompson, & Kahng, 2000).

If practical implementation was a primary concern, additional treatment strategies would be necessary for these individuals to reduce the reinforcement rate provided. For example, Alan engaged in nearly identical rates of problem behavior (1.4 RPM) in baseline as rates of mands during the last three sessions of NCR plus DRA (1.6 RPM). Similar results were observed with Harry (4.3 RPM of problem behavior in baseline and 2.3 RPM of mands in the last four treatment sessions). Therefore, this treatment strategy did not reduce the overall reinforcement rate for either participant from

baseline to the final treatment phase. Additional strategies, such as establishing stimulus control of the mand through the use of multiple schedules (e.g., Hanley, Iwata, & Thompson, 2001; Saini, Miller, & Fisher, 2016) or strengthening other contextually appropriate behavior through contingency-based delays (Ghaemmaghani, Hanley, & Jessel, 2016) might be effective in reducing rates of mands while maintaining treatment effects. Future research might evaluate this possibility in the absence of reinforcement for problem behavior.

Results of the secondary analyses suggest that patterns of responding during early exposure to contingent reinforcement for problem behavior (i.e., FA or baseline sessions) might be useful in predicting if NCR schedule thinning without extinction will be an effective intervention. Specifically, results of the secondary analysis suggested that longer latencies from removal of preferred items until problem behavior occurred might be predictive of the relative effectiveness of NCR schedule thinning without extinction. The latency to Dyson's problem behavior (average of 246 s) was significantly longer than the latency to Alan's problem behavior (average of 14 s) following the removal of preferred items, and NCR schedule thinning without extinction eliminated Dyson's problem behavior. Future research should examine this possibility more systematically with additional individuals in order to draw more definitive conclusions.

It also is unknown whether NCR schedule thinning without extinction would have been as effective at leaner schedules. We selected FT 5 min as the terminal NCR schedule based on the termination criteria of previous research; however, longer NCR schedules might be more desirable for caregivers, especially when the reinforcer is access to highly preferred activities. The FT 5-min schedule might be more appropriate for problem behavior maintained by attention, and future research might examine social validity related to this issue.

The reason NCR plus DRA without extinction was effective for the remaining two participants remains unknown. As noted previously, it is possible that it was simply the combination of gradually thinning the NCR schedule while simultaneously providing contingent reinforcement for a relatively low-effort response (card exchange). However, there are no data to show that the mand was less effortful than problem behavior for the current participants, and it seems a tenuous hypothesis that card exchange was less effortful than screaming for Alan.

Another possibility is that the mand training procedures influenced responding during this condition. Although backward chaining and prompting strategies were used to teach the card exchange response, extinction was in place for problem behavior during training (i.e., reinforcement was not delivered following problem behavior for both participants, and Harry's SIB was blocked). This preceding history might have caused a sequence effect in which problem behavior was lower than it otherwise might have been at the start of the NCR thinning plus DRA intervention, potentially as a result of stimulus control (i.e., the card might have functioned as an S-delta). It is possible that the mand could have been taught without extinction or blocking, using procedures similar to Richman, Wacker, and Winborn (2001). In that study, one participant engaged in aggression to access preferred items, and the researchers taught the participant to hand a card to the caregiver without the use of extinction. Under conditions of continuous reinforcement for mands and aggression, the participant generally engaged in the mand and little problem behavior occurred. Therefore, the prior exposure to extinction for our participants might have accounted for why problem behavior never occurred during the NCR thinning plus DRA phase rather than occurring at low rates, as in the Richman *et al.* study.

Despite these limitations, results of this study suggest that adding DRA to NCR is a

promising approach to the treatment of problem behavior without extinction, especially during the schedule thinning process. NCR is often viewed as a straightforward and reinforcement-based behavioral intervention, and this study provides a means of programming the intervention when caregivers cannot or will not implement extinction to produce clinically significant reductions in problem behavior.

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Received March 21, 2016

Final acceptance April 18, 2017

Action Editor, SungWoo Kahng