JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2004, **37,** 213–218 NUMBER 2 (SUMMER 2004)

AN ALTERNATIVE METHOD OF THINNING REINFORCER DELIVERY DURING DIFFERENTIAL REINFORCEMENT

HENRY S. ROANE

MARCUS AND KENNEDY KRIEGER INSTITUTES AND
EMORY UNIVERSITY SCHOOL OF MEDICINE

WAYNE W. FISHER

MARCUS AND KENNEDY KRIEGER INSTITUTES AND
JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE

AND

GINA M. SGRO, TERRY S. FALCOMATA, AND ROBERT R. PABICO

MARCUS INSTITUTE

Differential reinforcement of alternative behavior (DRA) may result in rates of reinforcement that are impractical for caregivers to implement; therefore, recent research has examined methods for thinning reinforcer delivery during DRA. In this study, reinforcer delivery was thinned during DRA by restricting access to the participant's alternative response materials.

DESCRIPTORS: autism, differential reinforcement, reinforcement thinning

Differential reinforcement of alternative behavior (DRA) involves reinforcing a response that is topographically distinct from a targeted maladaptive response. During DRA, alternative responding is typically reinforced on a dense (e.g., fixed-ratio [FR] 1) schedule, which may lead to a rate of reinforcer delivery that is impractical for caregivers to implement. Recent investigations have evaluated methods for thinning reinforcer delivery during DRA. Hanley, Iwata, and Thompson (2001) used a multiple-schedule procedure in which signals associated with either reinforcement for alternative responding or extinction for destructive responding were alternated. Results showed that the multiple-schedule procedure decreased destructive behavior and moderated rates of alternative responding as the reinforcement opportunities for alternative behavior were decreased.

As noted by Hanley et al. (2001), an alternative method of thinning the delivery of reinforcers involves limiting access to augmentative materials (e.g., a communication card) that are necessary for the response. In the current investigation, we evaluated this alternative method of thinning reinforcer delivery by restricting access to such materials. For 1 participant, we also evaluated the effects of providing access to high-preference stimuli while access to the functional reinforcer was delayed.

METHOD

Participants and Settings

Two children who attended an outpatient program 5 days per week participated in this

We thank Mary Mich and Jason Neely for their assistance with data collection. Gina Sgro is now at ORC Macro International, and Terry Falcomata is at the University of Iowa.

Requests for reprints should be sent to Henry S. Roane, Marcus Institute, 1920 Briarcliff Road, Atlanta, Georgia 30329 (e-mail: Henry.Roane@Marcus.org).

investigation. Juan was a 7-year-old boy who had been diagnosed with autism and severe mental retardation, and Carl was an 11-year-old boy who had been diagnosed with autism and mild mental retardation. Both participants exhibited some self-help skills (e.g., feeding and dressing) and communicated through idiosyncratic manual signs and picture exchanges. Sessions were conducted in padded treatment rooms (3 m by 3 m) that contained chairs and other items necessary for the condition in effect (e.g., toys). Sessions for the treatment transfer condition (Juan) were conducted in a clinic waiting area that contained four chairs, a couch, and various individuals who were not directly involved in the current investigation (e.g., parents of other children). Six to eight 10-min sessions were conducted daily.

Response Measurement and Reliability

Frequency data were collected on aggression (defined as hitting, slapping, and sitting on a therapist for Juan and pinching, biting, and grabbing a therapist for Carl), alternative responding (defined for both participants as handing a card to a therapist), reinforcer delivery (defined as therapist delivery of the reinforcer following aggression or alternative responding), and attempts to touch the reinforcer (i.e., reaching toward the item, scored for Carl only). For Juan, duration data were collected on item interaction, which was defined as manipulation of a preferred item in an appropriate manner.

Interobserver agreement for the all measures was calculated by partitioning each session into 60 10-s intervals and dividing the number of intervals in which both observers scored the exact frequency or duration of the target behavior (including zero) within each 10-s interval by the total number of intervals and multiplying by 100%. Interobserver agreement was collected on 21% (Juan) and 27% (Carl) of all sessions, and averages for aggression and alternative responding were 96% and 96% for Juan and 98% and 98% for Carl. Exact agreement on reinforcer delivery averaged 99% for Juan and 100% for Carl. Exact agreement for item interaction averaged 85% for Juan.

Procedure

For both participants, the results of a prior functional analysis suggested that positive reinforcement, in the form of access to attention (Juan) and access to preferred items (Carl), maintained aggression. Thus, DRA was implemented. Prior to the DRA analyses for both participants, the alternative response was taught using a graduated prompting procedure (successive spoken, gestured, and physical prompts) similar to that described by Shirley, Iwata, Kahng, Mazaleski, and Lerman (1997).

Juan. During baseline, Juan had continuous access to moderately preferred stimuli (identified in a preference assessment based on procedures described by Fisher et al., 1992). Two caregivers (a therapist and Juan's father) were present in the room but were engaged in conversation. Contingent on aggression, Juan received a brief verbal reprimand (e.g., "Not now, Juan; we're talking") and was moved away from the caregivers. All other responses were ignored. The alternative response material was not available during baseline. The DRA condition was similar to baseline in that Juan had continuous access to moderately preferred stimuli and received verbal and physical attention contingent on aggression (i.e., there was no extinction component). However, Juan also received 20 s of attention (e.g., praise and tickling) contingent on the alternative response. Thus, during the DRA condition, concurrent reinforcement schedules were in place for alterative responding and aggression. An additional DRA condition—DRA plus noncontingent toys (NCT)—was conducted to evaluate the relative contribution of high-

preference stimuli on the probability of problem behavior during the delay (Fisher, Thompson, Hagopian, Bowman, & Krug, 2000). This condition was identical to the DRA condition except that, in addition to the moderately preferred stimuli, Juan had continuous access to high-preference stimuli. Juan's treatment analysis was conducted in a combined reversal and multielement design.

Carl. During baseline, the therapist removed access to preferred stimuli at the beginning of the session. Contingent on the occurrence of aggression, the therapist returned the preferred stimuli for 20 s. All other responses were ignored, and the alternative response materials were not available. During DRA Carl could obtain the preferred stimuli for 20 s by handing the card to the therapist, and aggression was placed on extinction. Carl's analysis was conducted in a multielement design.

Alternative response restriction. To make the treatments more practical for caregivers, reinforcer delivery was thinned by restricting access to the participant's response card for a specified period of time (i.e., reinforcement for alternative responding was unavailable because the response could not occur). For both participants, the alternative response materials were initially available continuously. Following the continuous access phase, the initial restriction interval for Juan was 3 s, followed by 5 s; thereafter the length of the restriction period was doubled after two consecutive sessions in which destructive behavior was at least 80% lower than the mean for the initial baseline, until the terminal delay of 320 s was reached. At that point, Juan's treatment was maintained at a delay of 300 s, and the treatment was transferred to the waiting area. The restriction interval increased independently across the DRA and DRA plus NCT conditions for Juan. Following three sessions of continuous access, the first restriction interval for Carl was set at 20 s, and thereafter the length of the restriction period was doubled following three consecutive sessions in which aggression was at least 80% lower than the mean baseline rate, until the terminal delay of 320 s was achieved.

RESULTS AND DISCUSSION

The upper panel of Figure 1 shows the results of the DRA and alternative response restriction analyses for Juan. Variable and increasing rates of aggression occurred in the initial baseline (M = 3.2 responses per minute). Treatment reduced aggression across both conditions (Ms = 0.9 in DRA and 0.2 in DRA plus NCT), followed by a gradual reemergence of aggression during the reversal to baseline (M = 0.7). During subsequent thinning, low rates of aggression were observed (Ms = 0.1 in DRA and 0.1 in DRA plus NCT). When the treatment was transferred to the waiting area, slightly higher rates of aggression were observed during DRA (M = 0.5) than in DRA plus NCT (M = 0.1). Moderate levels of alternative responding occurred across both conditions throughout the various increases in the restriction interval (M = 0.6), and alternative responding occurred at a lower rate once the restriction period reached the terminal value in the final phase (M = 0.1). Reinforcer delivery averaged 0.7 during the no-restriction phase across both conditions, and reinforcer delivery decreased (M = 0.1) across all sessions conducted during the final (treatment transfer) phase. Throughout the entire treatment analysis, item interaction averaged 51% of each session.

The bottom panel of Figure 1 shows the outcome of the DRA and alternative response restriction analysis for Carl. Because the addition of preferred stimuli did not significantly affect Juan's responding, the DRA plus NCT condition was not conducted for Carl. Stable rates of aggression were observed during baseline (M = 2.4 responses

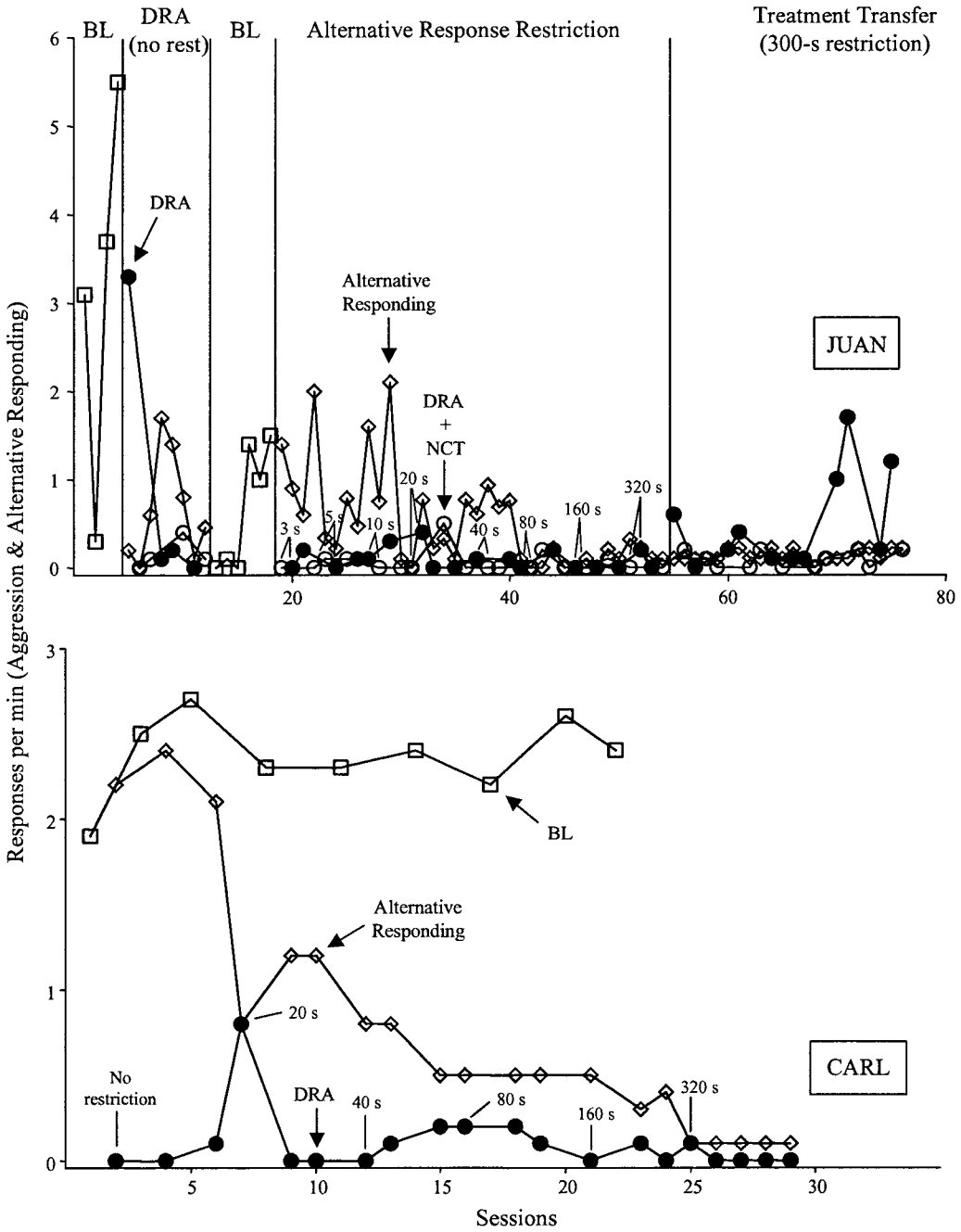

Figure 1. Rates of aggression and alternative responses during the DRA and alternative response restriction analyses for Juan (top panel) and Carl (bottom panel).

per minute). Introduction of DRA with no restriction produced low rates of aggression. This pattern continued across the various increases in the delay (M = 0.1 throughout the thinning analysis). Moderated rates of alternative responding occurred throughout the DRA condition (M = 1.0) until the terminal delay was reached (M = 0.1). Across all baseline sessions, reinforcer delivery averaged 2.3 per minute. During the first three

DRA sessions (no restriction), reinforcer delivery occurred at a rate that was similar to baseline ($M = 2.3$); however, the rate of reinforcer delivery decreased ($M = 0.1$) as access to the alternative response materials was restricted during the last five sessions (320-s restriction). During the initial DRA sessions with no restriction, Carl did not attempt to touch the reinforcer when it was unavailable. However, as the interval increased, attempts increased ($M = 0.4$ over the last three sessions of the analysis; data not shown in Figure 1).

For both participants, gradually decreasing the opportunities for reinforcement was effective at maintaining low levels of destructive behavior while producing moderate rates of alternative responding (e.g., Hanley et al., 2001). Throughout both restriction analyses, the rate of alternative responding decreased in proportion to an increase in the restriction interval. That is, as the restriction interval increased in length, the participants had less opportunity to emit the alternative response. However, alternative responding was maintained at a rate that was dictated by the restriction interval in place.

From a practical perspective, limiting access to alternative responses may enhance DRA procedures because caregivers are able to decrease their involvement in treatment (e.g., attention delivery) while low levels of problem behavior are maintained. As a result, caregivers would be able to engage in activities other than implementation of the treatment (e.g., instruction of other children). In addition, the restriction of response materials moderated rates of reinforcer delivery such that the participants would not obtain excessive amounts of reinforcement. Such procedures would be useful for individuals whose problem behavior is maintained by access to food or who may be otherwise prone to satiation effects.

Procedurally, restricting access to response materials may counteract the contingency-weakening effects that occur when a response is not immediately reinforced or when a response is exposed to a lean schedule of reinforcement. In the current investigation, alternative responding was always reinforced on an FR 1 schedule; only the availability of the response materials was decreased. It should be noted that this method of reinforcement thinning requires that the therapist have control over the materials and would not be applicable to situations in which the alternative response is constantly available (e.g., a manual sign).

When the alternative response materials were restricted, low levels of problem behavior were observed for both participants. Previous research (e.g., Dixon, Rehfeldt, & Randich, 2003; Fisher et al., 2000) has demonstrated that intervening activities may facilitate delay tolerance. The current results showed a similar benefit of using high-preference stimuli as intervening events, although these items influenced responding only when the delay was maintained at 300 s.

Juan's data suggested that he engaged in item interaction during the restriction interval. It is possible that the presence of moderately preferred toys in the DRA condition may have mediated against problem behavior during the thinning analysis. This is supported by the fact that low rates of problem behavior persisted even when reinforcement was available exclusively for this response (i.e., extinction was not programmed). During the restriction interval, Carl engaged in increasing levels of attempts to obtain the reinforcer, which may be problematic in some settings. Future research should examine participant behavior during periods in which reinforcement is unavailable. Such information would be useful for programming activities (e.g., educational tasks) during periods of delayed reinforcement. Future research should examine the generality of thinning reinforcer delivery. For example, addi-

tional research could be conducted to show the extent to which a range of caregivers (e.g., parents and teachers) can implement such procedures with fidelity in less restrictive settings.

REFERENCES

Dixon, M. R., Rehfeldt, R. A., & Randich, L. (2003). Enhancing tolerance to delayed reinforcers: The role of intervening activities. *Journal of Applied Behavior Analysis, 36,* 263–266.

Fisher, W. W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25,* 491–498.

Fisher, W. W., Thompson, R. H., Hagopian, L. P., Bowman, L. G., & Krug, A. (2000). Facilitating tolerance of delayed reinforcement during functional communication training. *Behavior Modification, 24,* 3–29.

Hanley, G. P., Iwata, B. A., & Thompson, R. H. (2001). Reinforcement schedule thinning following treatment with functional communication training. *Journal of Applied Behavior Analysis, 34,* 17–38.

Shirley, M. J., Iwata, B. A., Kahng, S., Mazaleski, J. L., & Lerman, D. C. (1997). Does functional communication training compete with ongoing contingencies of reinforcement? An analysis during response acquisition and maintenance. *Journal of Applied Behavior Analysis, 30,* 93–104.

Received May 28, 2003
Final acceptance February 9, 2004
Action Editor, Craig Kennedy