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# An evaluation of strategies to maintain mands at practical levels

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**Abstract**

In order to teach individuals with developmental disabilities to request stimuli they are motivated to obtain (mand), it is often necessary to initially deliver the item requested immediately and frequently. This may result in an undesirably high rate of mands that is impractical to maintain. The purpose of the current investigation was to extend the findings of previous research on the maintenance of low-rate mands within a communication-training context for children diagnosed with autism by evaluating the efficacy of two procedures: (1) signaled delay-to-reinforcement and (2) multiple schedules. The results of our evaluation of multiple schedules replicated those of previous research; this arrangement was found for all participants to be effective in maintaining mands at low rates under multiple schedules with a 270-s extinction component and 30-s reinforcement component. For all participants, signaled delay-to-reinforcement was ineffective in maintaining mands at the terminal criterion, a 270-s delay.


*Keywords:* Mands; Developmental disabilities; Autism; Communication training; Multiple schedules; Stimuli; Control; Delayed reinforcement

Language development is a common focus in the treatment of individuals with developmental disabilities. As a result, a number of language-training interventions have been developed over the years. Conceptualized in terms of Skinner's analysis of verbal behavior, some of the responses often taught include mands, tacts, intraverbals, codic behavior, and duplic behavior (Michael, 1993; Skinner, 1957). The importance of mand training has been

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emphasized by some behavior analysts on the basis that the mand is typically the first type of communication that humans naturally acquire (Bijou & Baer, 1965; Skinner), and may be the easiest type of language to begin teaching a child with a language delay because it directly benefits the child when he can tell others what he wants (Sundberg & Partington, 1998). Skinner (p. 36) defined a mand as ‘‘a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation’’. Michael (p. 101) proposed a revised version of Skinner's definition of a mand as

> ‘‘a type of verbal operant in which a particular response *form* is reinforced by a characteristic consequence and is therefore under the functional control of the *establishing operation relevant to that consequence*. And in contrast with other types of verbal operants, the response *form* has no specified relation to a prior *discriminative* stimulus’’.

In order to teach individuals with developmental disabilities to mand, it is often necessary to initially deliver the item requested immediately and frequently (Miltenberger, 1997). This typically involves delivering the requested item on a continuous reinforcement schedule and may result in an undesirably high rate of mands that is impractical to maintain. This may be problematic because: (1) the item may not always be readily available, (2) continuous consumption of the item may not allow time for other important activities (e.g., daily living skills), (3) it may not be healthy or practical for the individual to be continuously engaged with the item, and (4) the high rate of mands may not contribute toward a goal of similarity with peer rates (Fisher, Thompson, Hagopian, Bowman, & Krug, 2000; LeBlanc, Hagopian, Maglieri, & Poling, 2002). Consider the example of a boy with little vocal–verbal behavior who has been taught, using continuous reinforcement, to mand for his favorite candy by giving his mother a picture of that candy. Consequently, he now presents the picture over 100 times a day. It would probably not be healthy or appear natural for him to do this, or practical for his mother to give him candy every time he requests it. Clinically, we have noted that some caregivers respond to this dilemma by restricting access to the picture or by ignoring mands. Unfortunately, these strategies do not improve the child's language repertoire by teaching waiting or developing appropriate stimulus control over the response. Rather, they temporarily leave him with no appropriate method of communicating his needs and wants to others. Infrequent, delayed, or discontinued reinforcement of mands may result in extinction, but may also result in the occurrence of inappropriate behavior from the same response class (Fisher et al., 2000) or due to extinction-induced aggression. Thus, an important feature of mand training is the arrangement of reinforcement to promote mands at a rate that can be met with available resources, is healthy and practical, allows ample time for other activities, and approximates mand rates of typically developing peers. In addition, it is important for language-training programs to be practical for caregivers to use in the home and at school so they will be implemented with high integrity (LeBlanc et al.).

To date, relatively little research has been conducted on the reduction of high-rate mands. Most empirical studies have focused on reducing inappropriately high-rate replacement behavior within the context of functional communication training as treatment for aberrant behavior (e.g., Fisher et al., 2000; Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; Hanley, Iwata, & Thompson, 2001; Roane, Fisher, Sgro, Falcomata, & Pabico, 2004). In many of these studies, a functional analysis of the problem behavior was first conducted in which the reinforcer maintaining the problem behavior was identified. Next, the participant was taught an alternative communication response (e.g., manual sign, picture exchange, vocalization) that produced access to the same reinforcer identified during the functional analysis. Successful training of the alternative response in these studies was typically measured by the occurrence of problem behavior. If the problem behavior remained at low levels following communication training, reinforcement for the alternative response was gradually thinned or delayed. Although sometimes effective, reinforcement thinning and delay-to-reinforcement procedures have sometimes been found to be ineffective in maintaining low rates of problem behavior and practical rates of manding, requiring the addition of punishment procedures (e.g., Fisher et al.; Hagopian et al.).

In 2001, Hanley and colleagues evaluated three methods for reducing mands that were taught as replacement behaviors for the self-injury and aggression of three participants diagnosed with profound mental retardation. Following functional analyses and functional communication training, participants performed their alternative responses at rates that would likely be difficult for caregivers to maintain in the natural environment. The authors then evaluated three methods for thinning the schedule of reinforcement for alternative behavior: (1) unsignaled delay-to-reinforcement, (2) a graduated fixed-interval (FI) schedule of reinforcement, and (3) a multiple schedule (mult FR1 EXT) of reinforcement. Unsignaled delay-to-reinforcement resulted in low rates of problem behavior and increases in the alternative response at short delay times, but ultimately resulted in extinction of the alternative behavior when the delay was increased to 25 s. The graduated FI reinforcement schedule resulted in near-zero rates of problem behavior and extremely high (and impractical) rates of the alternative behavior. During the mult FR1 EXT arrangement, visual signals were provided for alternating periods of reinforcement and extinction. For all participants, response differentiation was demonstrated between schedule components and, as the length of the extinction component was increased from 15 s to 240 s, overall rates of the alternative behavior remained low and steady. Interestingly, differential responding to a mult FR1 EXT arrangement was not replicated with typically developing preschoolers by Tiger and Hanley (2004); however, when rules specifying the contingencies were provided, differential responding emerged.

A feature shared by most studies in this area of research is the reduction of mands in the context of treating problem behavior. Although many programs for individuals with developmental disabilities teach mands that do not function as alternative or replacement responses for problem behavior, to date there have been no evaluations of arrangements to reduce mands solely in a language-training context. Demonstration of methods for reinforcement thinning and establishing delay-to-reinforcement in terms of relevant-dependent variables in this context are necessary (Gutierrez et al., 2001; Sundberg, 1991).

The primary purpose of the current investigation was to extend the findings of Hanley et al. (2001) within a communication-training context for children diagnosed with autism. We sought to evaluate the efficacy of two procedures for maintaining low mand rates: (1) signaled delay-to-reinforcement and (2) multiple FR1 EXT schedules. Although Hanley et al. found the delay-to-reinforcement arrangement to be ineffective in maintaining mands, we included this component with the addition of the presentation of a stimulus during the delay interval. Some research indicates that signaled delays facilitate mands with longer delays than unsignaled delays, and may result in lower rates of problem behavior. In addition, the presentation of stimuli during the delay may serve to maintain responding via a conditioned reinforcement process (Stromer, McComas, & Rehfeldt, 2000).

# 1. Method

## 1.1. Participants, setting, and materials

Participants (Evan, 5 years old; Abby, 5 years old; Amber, 5 years old; Rose, 7 years old) were four children diagnosed with autism who attended special education classrooms at a local public school. All of the participants had significant language deficits and did not exhibit any vocal mands or tacts.

All sessions were conducted in a quiet room in each participant's house, except for Evan whose sessions were conducted in a treatment room at a local university. Sessions lasted approximately 10 min, were conducted two to four times per week, and included at least one therapist. A video camera was present during each session to record sessions for subsequent data collection.

The stimulus materials present during each session included highly preferred food products located in a 17.8 cm × 25.4 cm transparent plastic snack container that was divided into five equal sections, and a picture of the snack container encased in a clear 7.6 cm × 10.2 cm baseball card holder. The card was affixed with Velcro® to a small clipboard and could be easily removed by participants.

## 1.2. Data collection, interobserver agreement, and treatment integrity

Data were collected on the frequency of participants' *mands* and on therapists' correct *delivery of reinforcers* (i.e., opening the snack container). For Evan, Abby, and Amber, a mand was defined as removing the card from the clipboard and placing it in the hand of the therapist. Because Rose did not learn to engage in the full exchange after several training sessions (described below), a response was scored as a mand when Rose removed the card from the clipboard and held it in her hand.

Data were collected from videotape by trained observers on desktop computers using the Behavioral Evaluation Strategy & Taxonomy® software application. Interobserver agreement (IOA) on the occurrence of mands was calculated using the overall (i.e., point-by-point) agreement method (no. of agreements/[no. of agreements + no. of disagreements] × 100%). An agreement was scored if observers recorded the behavior within 5 s of each other. IOA was assessed for 42% of Evan's sessions and averaged 99% (range, 92.3–100%). IOA was assessed for 26% of Abby's sessions and averaged 98.3% (range, 93.3–100%). IOA was assessed for 38% of Amber's sessions and averaged 97.7% (range, 88.2–100%). IOA was assessed for 26% of Rose's sessions and averaged 96.7% (range, 76.5–100%).

Treatment integrity on the therapists' correct delivery of reinforcers was calculated by dividing the number of times the snack container was opened by the number of mands during reinforcement per session. The mean treatment integrity score was at least 99% for each participant. Mean IOA on treatment integrity data was at least 96.4% and was assessed during at least 26% of sessions for each participant.

## 1.3. Preliminary procedures

### 1.3.1. Preference assessment

A multiple-stimulus (without replacement) preference assessment (MSWO) based on the procedures described by DeLeon and Iwata (1996) was conducted to identify highly preferred food products and moderately preferred toys to be used during the treatment evaluation. Small pieces of the five most highly preferred food products from this assessment were placed in the snack container.

#### *1.3.2. Mand assessment*

A brief picture exchange assessment was conducted to determine each participant's ability to independently exchange the card for access to the snack container. A mand for access to the container with *several* food products was used rather than a mand for a *specific* food product to control for changes in establishing operations (EOs), thus eliminating the necessity for pre-session preference assessments. The mand assessment began with the therapist placing the card in front of the participant with the closed snack container directly behind it. When the participant reached for the container, the therapist physically prompted him or her to remove the card from the clipboard and place it into a second therapist's hand. After two prompted trials, each participant was provided with the opportunity to independently engage in the picture exchange. Evan and Amber independently exchanged the card for access to the snack container during this assessment. When Abby and Rose failed to respond independently, therapists provided additional training consisting of the first phase (i.e., teaching the exchange) described in the *Picture Exchange Communication System* (*PECS*) *Manual* (Bondy & Frost, 1994). This supplemental training was effective for Abby.

Two individual tests were conducted to demonstrate that the card exchange served a mand function. The purpose of the first assessment was to rule out the possibility that the card exchange was primarily under the stimulus control of the snack container. The snack container was removed from view and the participant was presented with the card. If the participant exchanged the card when the snack container was out of view, this suggested that responding was evoked by an EO and not the snack container (i.e., because in the past when the container was in view, presenting the card resulted in snacks). The purpose of the second assessment was to rule out the possibility that the card exchange was under the stimulus control of the card. The participant was provided free access to the open snack container and the card simultaneously (Gutierrez et al., 2001). If the participant continued to present the card when he or she already had access to the snack container, this would suggest that the exchange response was evoked by the card (i.e., because in the past when the card was in view, presenting it to the therapist resulted in snacks) and not by an EO. Responses for all participants suggested that the card exchange served a mand function (i.e., it was evoked by an EO) and no specific mand training was required.

### *1.4. Treatment evaluation*

#### *1.4.1. Experimental design*

The effects of two reductive procedures were evaluated in the context of a multiple-treatment reversal design, with treatment conditions counterbalanced across participants. Participants were exposed to baseline, multiple schedule, and signaled delay-to-reinforcement conditions in an A–B–A–C–A or A–C–A–B–A format. Sessions were discontinued if less than two mands occurred during two consecutive sessions or if zero mands occurred during one session. Sessions were conducted at an extinction or delay time of 270 s until at least seven consecutive sessions above these criteria and visual stability were demonstrated (i.e., negligible trend and little or consistent variability).

#### 1.4.2. Baseline

During all sessions, a therapist sat on the floor or in a chair with the snack container and the card and did not talk or make eye contact with the participant. Three moderately preferred toys identified via the MSWO preference assessment were placed around the room. During baseline, independent card exchanges resulted in access to the snack container on a fixed-ratio 1 (FR1) schedule, during which the participant was permitted to take one piece of food from the container. During initial sessions, physical prompts to take only one piece of food were used when necessary; however, participants quickly learned to do this independently. If the participant did not reach toward the open snack container to take a piece of food, the container was closed within 5 s.

#### 1.4.3. Multiple schedules

The multiple schedule arrangement consisted of alternating periods of reinforcement and extinction and was similar to the procedure described by Hanley et al. (2001). During this mult FR1 EXT condition, two different colored cards were correlated with differential outcomes for mands. The cards were affixed to the same clipboard as the picture of the snack container. When the yellow card was present, mands resulted in FR1 access to the snack container; when the blue card was present, mands resulted in the therapist immediately returning the card to the clipboard without opening the snack container (extinction). The reinforcement components remained at 30 s in duration throughout the evaluation. The duration of the extinction component began at 15 s and was gradually increased to 270 s.

#### 1.4.4. Signaled delay-to-reinforcement

The delay-to-reinforcement arrangement consisted of inserting a brief delay between the mand and delivery of the reinforcer (i.e., access to the snack container). During this condition, when the participant made a response, the therapist said, ‘‘Wait’’ and held a digital countdown timer directly in front of the participant for the duration of the delay interval. The card was returned to the clipboard and the snack container was not opened. Mands during the delay interval were ignored and resulted in the therapist returning the card to the clipboard. After the timer sounded, the participant was given access to the snack container. The delay interval began at 1 s and was gradually increased to 270 s.

#### 1.4.5. Schedule thinning

To decrease the intensity of each independent variable, the schedule-thinning procedure proposed by LeBlanc et al. (2002) was used. The minimum response criterion to move to a lengthier extinction component or delay interval was two mands per session during reinforcement components for two consecutive sessions. This criterion was chosen rather than one mand per session because it allowed the participant to come in contact with reinforcement at each opportunity. With 10-min sessions, a terminal delay or extinction period of 270 s would allow time for the participant to mand at least once during each of the two reinforcement periods in the session. Extinction and delay intervals were increased by 30–100% at each schedule value, with two sessions conducted at each value. After every third schedule value, a probe three values higher was conducted to determine whether the minimum response criterion could be met. If the criterion was met for two consecutive sessions at the probe value, the next highest increment after the probe value was evaluated. If the criterion was not met, the next highest increment after the previous (pre-probe) value was evaluated.

## 2. Results

Session-by-session data for each participant are depicted in Figs. 1 and 2. The same data are presented separately as mands during reinforcement and extinction/delay periods for each participant in Fig. 3.

As seen in the top panel of Fig. 1, Evan's mands were variable during the FR 1 baseline, occurring at a mean of 30.4 (S.D. = 14.4) per session. During the multiple-schedule evaluation, mands substantially decreased during the fifth session and continued at a low and consistent rate close to the minimum response criterion as the extinction value was increased to 270 s. Stability at this level was demonstrated at the terminal extinction value for seven consecutive sessions. During the multiple-schedule phase, mands occurred at an overall mean of 11.4 (S.D. = 9.6) per session (across components). As seen in the top panel of Fig. 3, Evan responded differentially to the yellow and blue cards during the first session, and few mands were emitted during the extinction components throughout the evaluation. When mands were again reinforced on an FR 1 schedule, responding quickly increased above baseline level ($M = 43.2$; S.D. = 10.6). Next, the effect of signaled delay-to-reinforcement was evaluated beginning with a 5-s delay. This resulted

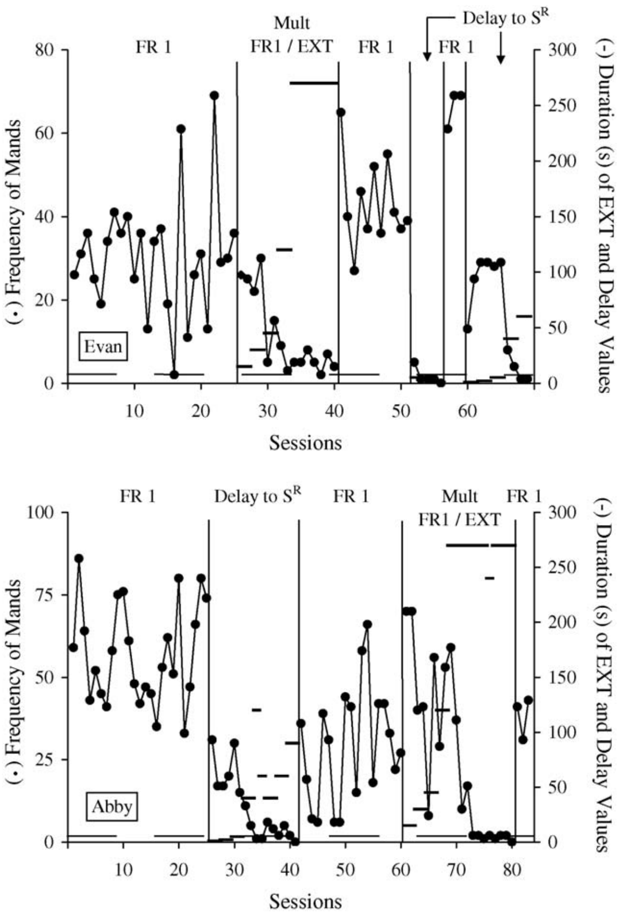


Fig. 1. Frequency of mands and duration of extinction/delay values per session for Evan and Abby.

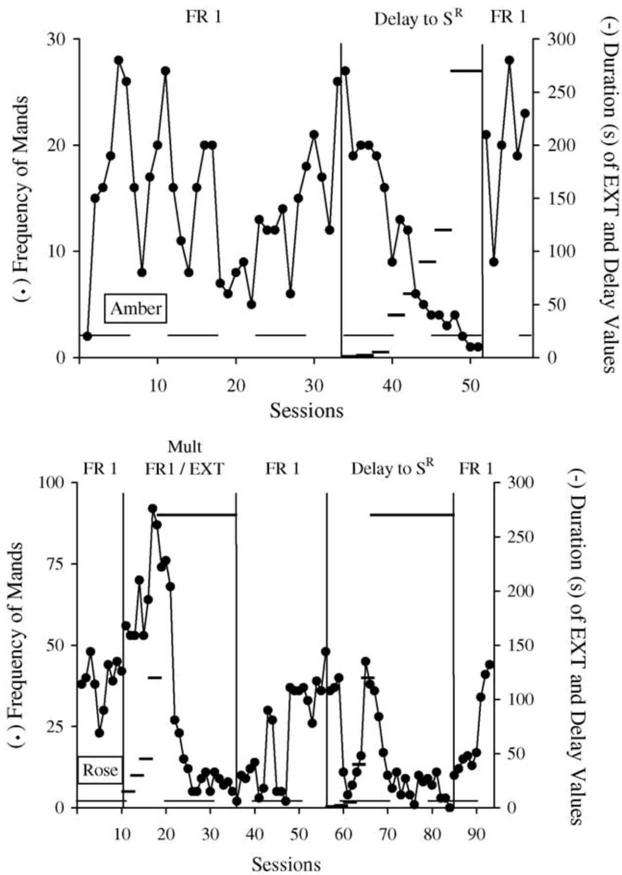


Fig. 2. Frequency of mands and duration of extinction/delay values per session for Amber and Rose.

in an immediate and substantial decrease in mands, which continued to zero levels even when the delay was decreased to 3 s and subsequently 1 s. Consequently, baseline (FR 1) was reinstated and responding was recaptured at a higher level than previously observed (*M* = 66.3; S.D. = 4.6). Delay-to-reinforcement was then reintroduced, beginning with a 1-s delay. This resulted in a decrease in mands that briefly fell below the minimum response criterion at the 60-s delay value. Interestingly, Evan manded only once during delay components throughout the evaluation (see Fig. 3). During this phase, mands occurred at an overall mean of 16.7 (S.D. = 12.45) per session. A final return to baseline was not possible because Evan's family relocated at this point of the study.

As seen in the bottom panel of Fig. 1, Abby's mands were high and variable during baseline, occurring at a mean of 56.9 (S.D. = 15) per session. During the delay-to-reinforcement evaluation, mands decreased as the delay time was increased; however, when the 120-s value was probed, mands fell below the minimum response criterion. When the delay interval returned to 60 s, mands increased. However, when the delay interval was increased to 90 s, mands were eliminated. As seen in the second panel of Fig. 3, Abby rarely manded during delay components throughout the evaluation. During this phase, mands occurred at an overall mean of 11.4 (S.D. = 10.2) per session. When mands were again reinforced on an FR 1 schedule, responding

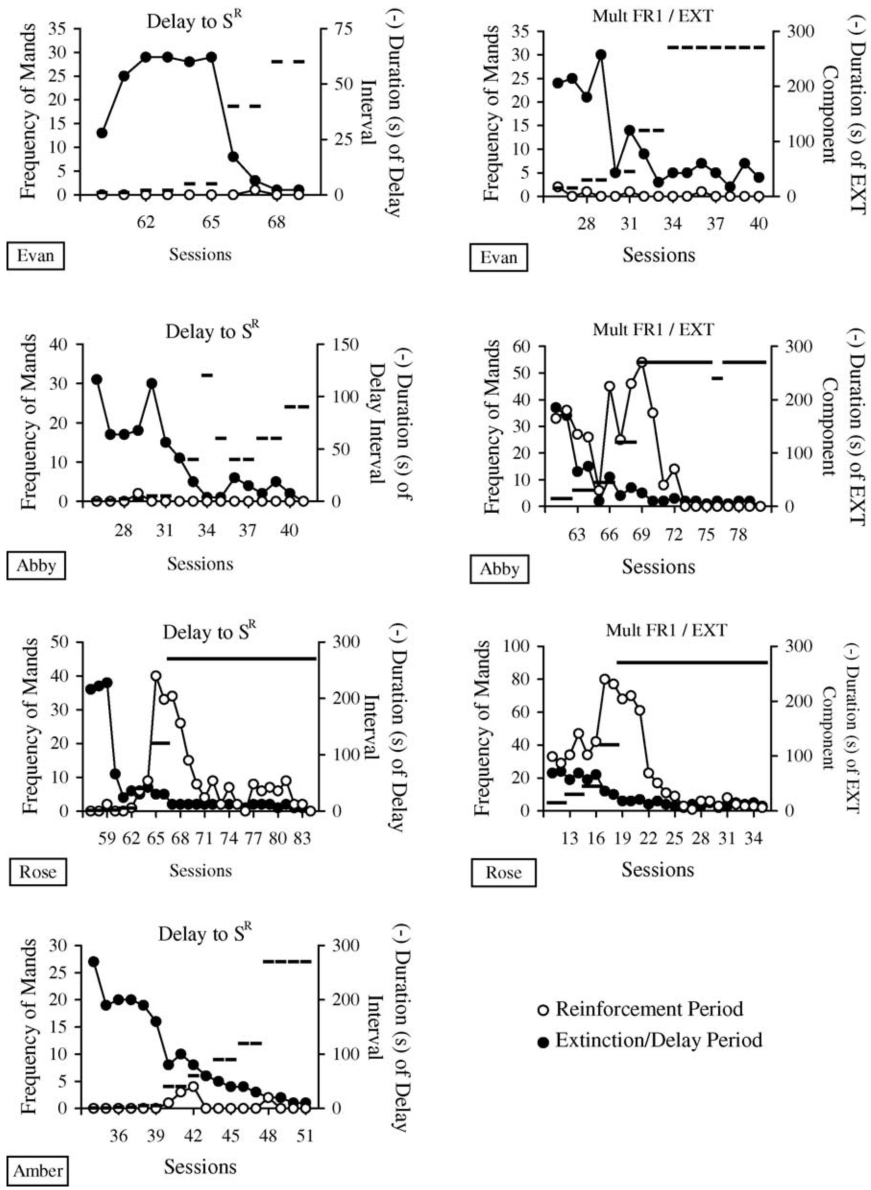


Fig. 3. Mands during reinforcement and extinction/delay periods for each participant.

quickly increased ($M = 29.4$; S.D. = 17.7); however, stability was reached at a level substantially lower than that observed during baseline. Next, the effects of multiple schedules were evaluated. Although mands remained at or above the minimum response criterion at the terminal extinction time for nine sessions, mands dropped below the criterion for three (non-consecutive) sessions, and no mands occurred during the final session. As seen in Fig. 3, Abby consistently manded at higher rates during the extinction components during initial sessions; however, during the evaluation of the 270 s extinction interval, her pattern of mands reversed to occur solely during reinforcement components. During this phase, mands occurred at an overall mean of 25.1 (S.D. = 25.7) per session (across components). During a final return to the FR 1 schedule, mands increased to the level observed during the second baseline ($M$ = 38.3; S.D. = 6.4).

As seen in the top panel of Fig. 2, Amber's mands during baseline occurred at a mean of 14.7 (S.D. = 6.7) per session. During the delay-to-reinforcement evaluation, mands decreased as the delay time was increased, and briefly remained above two mands per session at the terminal delay value; however, as more sessions were conducted with a delay interval of 270 s, mands fell below the minimum response criterion. As can be seen in the bottom panel of Fig. 3, Amber rarely manded during the delay components throughout the evaluation. During this phase, mands occurred at an overall mean of 10.3 (S.D. = 8.1) per session. During a final return to the FR 1 schedule, mands increased to the level observed during the baseline ($M$ = 20; S.D. = 6.3).

As seen in the bottom panel of Fig. 2, Rose's mands during baseline occurred at a mean of 38.7 (S.D. = 7.4) mands per session. During the multiple-schedule evaluation, overall mands increased above baseline level as the extinction value increased. However, after several sessions at the 270-s extinction value, mands substantially decreased and continued to occur above the minimum response criterion. Stability at this level was demonstrated at the terminal extinction value for 10 consecutive sessions. Although during initial phases of this evaluation, Rose manded at higher rates during reinforcement components, during final sessions at the 270-s extinction value, mands during reinforcement and extinction occurred at comparable rates (see Fig. 3, third panel). During this phase, mands occurred at an overall mean of 35.9 (S.D. = 30.6) mands per session (across components). When mands were again reinforced on an FR 1 schedule, mands were variable, requiring approximately 20 sessions to become stable at baseline level ($M$ = 21.6; S.D. = 15.3). Next, the effects of signaled delay-to-reinforcement were evaluated beginning with a 1-s delay. Although mands remained above the minimum response criterion across several sessions at the terminal delay value, no mands occurred during the final session. Fig. 3 demonstrates that although mands initially occurred at higher rates during reinforcement components, as the delay time increased, mands during delay components increased, as well. During this phase, mands occurred at an overall mean of 13.8 (S.D. = 13.4) mands per session. During a final return to the FR 1 schedule, mands increased to the level observed during baseline ($M$ = 22.4; S.D. = 13.3).

All three participants exposed to the multiple-schedule arrangement reached the terminal extinction time of 270 s within nine sessions. Only two of the four participants exposed to the delay-to-reinforcement arrangement reached terminal delay value. Rose and Amber required 11 and 15 sessions, respectively, to reach the terminal delay value.

## 3. Discussion

The results of our evaluation of multiple schedules replicated those of Hanley et al. (2001). All of the participants learned to respond differentially to the yellow and blue cards and corresponding schedules of reinforcement. This arrangement was effective in maintaining mands at low rates under a 270-s extinction value across all evaluations. Interestingly, Abby initially responded at a higher rate during the extinction component of the multiple schedules and then responded at a higher rate during the reinforcement component for the final 12 sessions. This may have been due to extinction-related bursting or the partial reinforcement extinction effect.

For all participants, delay-to-reinforcement was ineffective in maintaining mands at the terminal criterion of 270 s. Basic research indicates that presenting a stimulus during the delay may help to maintain the response–reinforcer contingency, possibly via a conditioned reinforcement process (Stromer et al., 2000). The timer in the current study was intended to serve this purpose. Anecdotally, we noticed that all of the participants watched the timer at briefer delay times and continued to mand. However, as the delay time increased, participants ceased watching the timer and played with toys until the timer sounded. Furthermore, at brief delay times, the presentation of the timer was quickly followed by the presentation of the food; however, at longer delay times, the presentation of the timer was not quickly followed by food. That is, the timer was present both before times when food was presented and before times when food was not presented. Thus, it is possible that the failure of participants to maintain contact with the timer and the progressive ''thinning'' of timer–food contiguity contributed to the ineffectiveness of the signaled delay-to-reinforcement arrangement.

With the first participant, Evan, the initial delay time of 5 s quickly resulted in extinction; however, when the delay was re-evaluated, beginning with 1 s and gradually increased, responding maintained at a delay of 40 s. This may have occurred because beginning with a delay time of 5 s separated the presentation of the neutral stimulus (i.e., the timer) and the reinforcing stimulus (i.e., the food) by too long to establish the neutral stimulus as a conditioned reinforcer. However, beginning with a 1-s delay may have provided the conditioning necessary to establish the timer as a conditioned reinforcer.

We sought to recruit participants with few mands and tacts in an attempt to eliminate the role of rule-governed behavior and more confidently change behavior via direct-contingency control. However, the role of language is worth examining in the case of Amber, who appeared to make approximations to saying ''wait'' after the experimenter and counting during the delay. Specifically, she made different sounds that corresponded with changes on the digital display; her mother reported that this was a novel behavior for Amber. Interestingly, Amber also maintained manding at longer delay times than the other participants, suggesting that her counting may have functioned to maintain manding.

There are several limitations of the current study that should be considered in evaluating the results and their contribution to the literature on reducing and maintaining mands. First, a specific reinforcement-thinning model (LeBlanc et al., 2002) was used, which may have altered the effects of the interventions. Second, the criterion for terminating the evaluation of a schedule (i.e., less than two mands per session across two consecutive sessions or zero mands during one session) may have been too conservative and may not accurately reflect ''practical'' levels of mands for some caregivers. When utilized clinically, caregivers could be consulted to determine desired terminal values. Third, because the participants did not consistently remain in contact with the signal during the delay-to-reinforcement evaluation, it is not possible to make global statements about the efficacy of delay-to-reinforcement.

Future research in this area might examine other ways to decrease mands. For example, some studies have examined differential reinforcement of low rates of behavior (DRL) to reduce but maintain behavior. Although at least three variations of DRL have been described (full session, interval, and spaced responding; Deitz, 1977), they may not be equally practical for caregivers to implement. For example, although interval and spaced-responding DRL may be more effective, the necessary calculation of interresponse times may reduce the practicality of these interventions. Applied research on DRL has been limited (Tarbox & Hayes, 2003), with most studies including a statement of the contingency to the participants rather than relying solely on contingency control. Evaluating DRL in the context of maintaining mands at practical rates might provide an important contribution to both literatures.

Although we have found signaled delay-to-reinforcement to be ineffective, several modifications might increase its effectiveness. For example, researchers have presented other activities throughout the delay interval (e.g., Dixon & Cummings, 2001; Fisher et al., 2000). Signaled delay-to-reinforcement could also be examined using signals of other sensory modalities that learners could more easily remain in contact with during the delay interval, and thus maintain the mand–reinforcer contingency at longer delay times. Examples of this might include a vibrating timer or other auditory or tactile stimuli that could be worn by the learner and remain with him or her when leaving the immediate experimental area. For example, Bondy and Frost (2001) suggest presenting a ''wait'' card during the delay, combined with praise for waiting and gradually increasing delay times. The ''wait'' card (visual stimulus) and auditory or tactile stimuli could be evaluated to determine the most effective way to use them in the context of a picture-based system.

Given the success of multiple schedules in this and previous studies, a next step might be to continue to empirically evaluate its usefulness with multiple mands in a more natural context (e.g., Tiger & Hanley, 2004). For example, Bondy and Frost (2001) suggest using different colored dots on PECS icons to signal exchanges that will result in reinforcement (discriminative stimuli) and those that will not (S-deltas). Alternatively, different colored pages could be used in a PECS book to function as discriminative stimuli for reinforcement and extinction. Finally, the use of multiple schedule arrangements could be extended to other topographies such as manual signs or speech.

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