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THE EFFECT OF A MULTIPLE-SCHEDULE ARRANGEMENT ON MANDS OF A CHILD WITH AUTISM

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Clinical applications of multiple-schedule arrangements have generally been used to produce discriminated manding. The present study evaluated the effects of a multiple-schedule arrangement with rules on the rate of mands for one child diagnosed with autism. We sought to bring the participant's mands under discriminative control of adult behavior that closely matched naturally occurring discriminative stimuli in the participant's home environment. The results showed that discriminated manding emerged and responding continued in the presence of a novel therapist. Copyright © 2015 John Wiley & Sons, Ltd.

Multiple-schedule arrangements have been used to teach consumers to discriminate the conditions under which reinforcement is available for mands during the treatment of problem behavior (e.g., Hanley, Iwata, & Thompson, 2001) and within a language-training context (e.g., Sidener, Shabani, Carr, & Roland, 2006). Generally, such arrangements involve alternating between timed periods of reinforcement and extinction (EXT) and arranging stimuli that signal different reinforcement schedules.

In previous studies, baseline is typically followed by a condition in which arbitrary discriminative stimuli (e.g., colored cards, and floral leis) are paired with each component (and a corresponding rule) of the multiple schedule to occasion (during the reinforcement component) or inhibit (during the EXT component) responding (e.g., Tiger & Hanley, 2004). In a noteworthy extension, Kuhn, Chirighin, and Zelenka (2010) taught two individuals with developmental disabilities to respond to naturally occurring discriminative stimuli following functional communication training. During discrimination training, the therapist alternated between engaging in behavior categorized as nonbusy (e.g., listening to music) or busy (e.g., talking to another person), which signaled the availability or unavailability of reinforcement, respectively. Both participants learned the discrimination as evidenced by their

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allocation of mands to time periods during which the therapist engaged in nonbusy behavior. This evaluation is also noteworthy in that the stimuli associated with the reinforcement and EXT components were present during baseline and were shown to not influence the participants' responding. Leon, Hausman, Kahng, and Becraft (2010) extended Kuhn et al. by demonstrating that treatment effects maintained across novel situations, settings, and experimenters.

Prior evaluations of multiple-schedule arrangements altered the duration of the schedule components through gradual schedule thinning such that the length of the EXT interval was at least twice that of the reinforcement interval at the terminal values (e.g., Grow, LeBlanc, & Carr, 2010; Hanley et al., 2001). One of the potential challenges of gradual schedule thinning is the amount of time required to reach the terminal values. In a recent evaluation, Betz, Fisher, Roane, Mintz, and Owens (2013) showed that it is possible to avoid gradual schedule thinning by establishing sufficient stimulus control over responding under the initial schedule values, which subsequently resulted in discriminated responding at the terminal values. To our knowledge, no research has extended the findings of Betz and colleagues to an evaluation of naturally occurring discriminative stimuli.

The first purpose of the current evaluation was to replicate previous studies (Kuhn et al., 2010; Leon et al., 2010) by teaching a child with autism to respond to naturally occurring discriminative stimuli within a multiple-schedule arrangement. In addition, we sought to replicate and extend Betz et al. (2013) by evaluating whether we could circumvent gradual schedule thinning.

METHOD

Participant and Setting

Ross was a 6-year-old boy who had been diagnosed with autism. He had well-developed tact, mand, and intraverbal repertoires. Ross was included in the study based on parental report and therapist observations that he manded for attention and tangibles (e.g., asked questions at a high rate and requested access to preferred items) at inappropriate times (e.g., when his parents were on the phone and while his therapists were writing).

We conducted all sessions in a private area of an early intervention clinic which contained a table, chairs, and plastic tubs with session materials. During all sessions, the therapist and participant sat adjacent from each other at a table.

Response Measurement and Interobserver Agreement

Observers collected data on the frequency of Ross's mands. A *mand* was defined as the participant saying the name of a tangible items (e.g., toys and movie) or edible

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(e.g., chocolate), saying the name of a tangible or edible within a mand frame (e.g., 'I want') or pointing and saying the name of a tangible or edible. Mands also included the participant asking for information (e.g., 'Where is mom?') or requesting to engage in specific actions (e.g., 'Let us sing'). We converted mands to a rate measure by dividing the frequency of mands by the number of minutes in each session.

A second observer simultaneously and independently collected data on mands during 52, 62, and 64% of the work, baby, and phone conditions, respectively. Agreement percentages were calculated by comparing the observers recorded frequencies of mands in each interval. The smaller number of responses was divided by the larger number of responses in each interval, and these fractions were averaged across all intervals in a session. Mean interobserver agreement was 91% for the work (range, 60–100%), 93% for the phone (range, 80–100%), and 90% for the baby (range, 70–100%) conditions.

Procedure

We used a concurrent multiple baseline across stimuli design to evaluate the effects of a multiple schedule and rule on the rate of mands. The therapist engaged in three activities across conditions. In the work condition, the therapist held a clipboard with paper and wrote on the paper with a pen. In the phone condition, the therapist engaged in an unscripted, pretend phone conversation using a real phone as a prop. During the baby condition, the therapist interacted with a baby doll. Interactions included talking, feeding, burping, and rocking the baby. We selected these conditions based on parent and therapist reports of time periods in which Ross engaged in frequent mands at home and school.

Therapists conducted one to six sessions per day, one to two days per week, depending on staff and participant availability. Each session consisted of one activity (work, phone, or baby) and was 5 (during baseline and when the schedule components were 45 fixed ratio [FR] 1/15 EXT) or 15 min (when the schedule components were 60 FR 1/240 EXT). Conditions were conducted in a random order with the exception that no condition be conducted more than twice in a row (condition order across activities is reflected in Figure 1).

Baseline

Each 5-min session involved alternating between 30-s intervals during which the therapist sat at the table and (a) did not engage in an activity or (b) engaged in an activity (specific activity descriptions for each condition are described in the preceding texts). A variety of preferred edibles and toys (based on a multiple stimulus without replacement preference assessment; DeLeon & Iwata, 1996) were present, but out of Ross's reach, on the table during all sessions.

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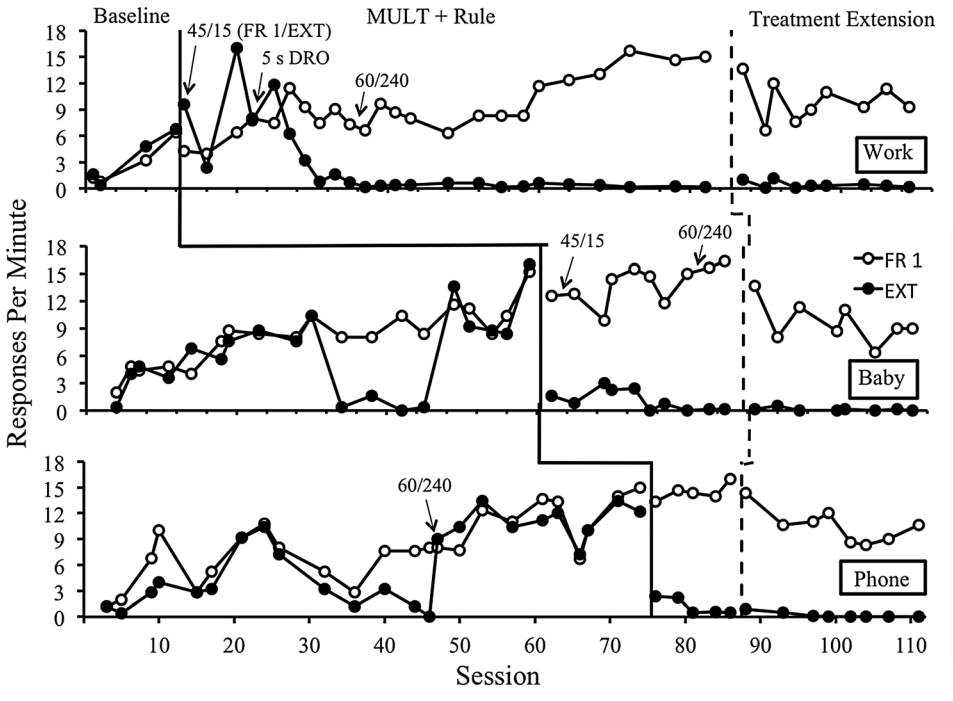

Figure 1. Ross's mands per minute across the work, phone, and baby conditions. The first number in the numerical values associated with the multiple schedule represents the number of seconds in the FR 1 component, and the second number represents the number of seconds in the EXT component. DRO, differential reinforcement of other behavior.

During intervals in which the therapist was not engaged in one of the three activities, the therapist sat at the table but did not initiate interactions with Ross. The intervals that included the therapist engaging in an activity (as described in the preceding texts) differed only by the therapist picking up the relevant activity materials (i.e., clipboard and pen, phone, or baby and bottle). Across all intervals, the therapist responded to mands by providing the requested item, information, or action regardless of whether the therapist was demonstrating busy versus nonbusy behavior. If Ross asked for something that could not be fulfilled at the table (e.g., to go home and to go for a walk), the therapist said, 'You cannot do that right now'.

Multiple Schedule Plus Rule

The therapist began each session by placing the stimuli associated with the condition (i.e., the paper and pen, the telephone, or the baby and bottle) on the table and

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stating the corresponding rule (e.g., 'When I am on the phone, I cannot give you things. When I am not on the phone, I can give you things'.). In addition, the therapist prompted Ross (i.e., presented a vocal model) to mand in the presence and absence of the condition stimuli and exposed him to the consequences associated with each. We alternated between fixed ratio 1 (FR 1; always the first presented) and extinction (EXT) intervals during each session. The therapist responded to mands during the FR 1 intervals (similar to baseline). The therapist ignored all mands during the EXT intervals. The same preferred edibles and toys were present as in baseline. These items were placed on the table, but out of Ross's reach.

Similar to Hanley and colleagues (2001), the initial duration of intervals was 45 and 15 s for the FR 1 and EXT components (i.e., 45 FR 1/15 EXT), respectively. Following two consecutive sessions in which the rate of mands remained at or below 85% of the baseline mean during the EXT component, we probed that the terminal schedule value of 60 s of FR 1 and 240 s of EXT (i.e., 60 FR 1/240 EXT). If Ross's rate of mands did not remain at or below 85% of the baseline mean during the terminal probe, we would have thinned the schedule of reinforcement by gradually altering the duration of the components. However, gradual schedule thinning was unnecessary.

Because of unexpected rates of responding, we made two modifications to our procedures. First, we implemented a 5-s differential reinforcement of other behavior (DRO) in session 8 in the work condition. This requirement specified that the EXT interval continue until Ross did not mand during the last 5 s of this interval. This modification was in place throughout the baby and phone treatment conditions. Second, Ross showed discriminated responding during baseline (sessions 11–14 and sessions 12–14 in the baby and phone conditions, respectively) that coincided with changes in responding in the work condition. Therefore, we modified the baseline duration of components in the phone condition to the terminal values (i.e., 60 FR 1/240 EXT), while the baseline contingencies outlined in the preceding texts remained in effect. This change was made to evaluate whether discriminated responding would persistent when the duration of the components was modified. It is important to note that we changed only the duration of the intervals, but the reinforcement contingencies were not modified (i.e., mands were reinforced regardless of whether the therapist was busy or nonbusy). When we later initiated treatment in the phone condition, the duration of intervals remained at the terminal schedule values, but the reinforcement contingencies changed.

Treatment Extension

After Ross demonstrated discriminated responding across conditions, a therapist not associated with training (hereafter referred to as the novel therapist) conducted

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treatment sessions. Ross had previous experience with this therapist outside the context of the current evaluation. During these sessions, the novel therapist implemented the terminal schedule of 60 FR 1/240 EXT.

RESULTS

Figure 1 shows Ross's rate of mands across the three conditions. During baseline in the work condition (Figure 1, top panel), Ross engaged in similar levels of mands when the therapist was engaged and was not engaged with the clipboard and pen. During treatment, Ross began to demonstrate discriminated responding in the work condition during the sixth treatment session. Ross continued to demonstrate highly discriminated responding when we probed the terminal schedule value during the ninth treatment session. Thus, gradual schedule thinning was unnecessary.

Ross demonstrated a similar pattern of undifferentiated responding during baseline in the baby (Figure 1, middle panel) and phone (Figure 1, bottom panel) conditions, with the exception of discriminated responding in certain baseline sessions that we noted in the preceding texts. In the baby and phone conditions, Ross demonstrated differentiated responding from the onset of treatment. Similar to the work condition, gradual schedule thinning also was unnecessary in these conditions.

After Ross demonstrated discriminated responding in all conditions, we extended treatment to include a novel therapist conducting sessions. The results indicated that Ross continued to engage in low levels of manding during the EXT component with the novel therapist, although lower levels of mands occurred during the FR 1 component.

DISCUSSION

Similar to previous studies (e.g., Tiger & Hanley, 2004), the results of this evaluation demonstrate that a multiple-schedule arrangement with rules is effective in establishing discriminated manding. Also, the current investigation provides additional support (Kuhn et al., 2010; Leon et al., 2010) that arbitrary discriminative stimuli are not necessary to pair with the components of the multiple schedule. Rather, naturally occurring stimuli closely matching those found in the participant's natural environment can be established as discriminative stimuli during treatment. In addition, similar to the findings of Leon and colleagues (2010), Ross continued to engage in discriminated responding with a novel therapist.

Our study extends the literature on multiple schedules by demonstrating that once mands are under the control of the naturally occurring stimuli associated with

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components of the multiple schedule, gradual schedule thinning may be unnecessary. Betz and colleagues (2013) found similar results regarding the extent to which establishing stimulus control over responding in short-interval components decreases or eliminates the need to conduct gradual schedule thinning. Given the extended amount of time that may be necessary to gradually fade schedule values during treatment, future research should evaluate our procedures and those of Betz et al., further.

The current study also extends the multiple-schedule literature by including the schedule-correlated stimuli (e.g., the clipboard and pen, the phone, and the baby and bottle) during baseline. Whereas many of the previous studies introduced the schedule-correlated stimuli (e.g., floral leis) following baseline, by including these stimuli during baseline, we demonstrated that these stimuli did not generally influence the rate of Ross's mands prior to the introduction of the rule and contact with the programmed contingencies. The inclusion of these stimuli may also explain why Ross began to engage in discriminated responding in the baby and phone conditions during baseline. This may have occurred because the S^D was consistent across tiers (i.e., the therapist sitting quietly and looking at Ross), although the S^Δ was not. Thus, discriminated responding may have generalized to novel, naturally occurring discriminative stimuli across conditions. Generalization likely played a role again, when his responding in baseline reversed in both conditions after we modified the component durations (although we continued to reinforce mands regardless of therapist behavior) in only the phone condition. Nevertheless, it should be noted that highly discriminated responding occurred immediately after the introduction of the multiple-schedule procedure. Although this pattern of responding weakens our demonstration of experimental control, this limitation may actually provide practitioners with useful information about how they might arrange this procedure in their clinical work. Future research is needed to evaluate the most appropriate arrangements to maximize generalized responding while maintaining experimental control.

In the current study, the DRO procedure quickly produced discriminated responding; however, it might not have been necessary. Some participants in previous studies (Hanley, Iwata, & Thompson, 2001) did not engage in discriminated responding when the EXT intervals were relatively short but did engage in discriminated responding after several sessions when the interval duration was increased. It is possible increased exposure to the contingencies across several sessions, or increased exposure to EXT during longer intervals is necessary to produce discriminated responding (Herrick, Myers, & Korotkin, 1959). Also, several other studies on this topic (e.g., Betz et al. 2013; Kuhn et al., 2010; Leon et al., 2010; Tiger & Hanley, 2004) included initial EXT intervals that ranged from 60 to 300 s. Future research could also consider arranging longer EXT intervals from the onset in an attempt to identify an optimal initial EXT duration.

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Future research could also document the schedules of reinforcement that occur in consumers' natural environment. For example, one potential interesting area to evaluate would be whether caregivers implement continuous reinforcement (FR 1) during nonbusy activities and EXT during busy activities, as has been arranged in the current and previous (Kuhn et al., 2010; Leon et al., 2010) evaluations. Alternatively, it is possible that caregivers implement intermittent schedules of reinforcement across busy and nonactivities. Another area of future research could include an analysis of procedural integrity levels necessary to produce discriminated responding.

Another potential limitation of the current study was that we paired a rule with the multiple-schedule procedure. Therefore, it is unclear whether either aspect of the treatment alone would have been sufficient to change Ross's rate of mands. Although previous studies incorporated rules during multiple-schedule procedures (e.g., Leon et al., 2010; Tiger & Hanley, 2004), additional research could evaluate the necessity or added benefit of providing a rule during treatment. A third limitation was that we did not evaluate Ross's rate of mands with the novel therapist prior to implementing treatment. Although it is unlikely that Ross would demonstrate discriminated manding with the novel therapist who worked with Ross during his clinic appointments and initially reported that high rates of mands interfered with teaching activities, including baseline data with this therapist would strengthen the conclusion regarding the generalization of discriminated manding across therapists. Finally, because of time constraints we could not extend our evaluation to Ross's home environment. Future studies should address the extent to which discriminated manding generalizes to other natural environments (e.g., home and community) to better evaluate the generality of these procedures.

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