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The Effects of Fixed Ratio Values on Concurrent Mand and Play Responses

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Three children diagnosed with pervasive developmental disabilities emitted a high rate of mands and a low-to-zero rate of appropriate play responses when the two responses were reinforced on concurrent Fixed Ratio 1 (FR1) schedules. When mands were reinforced on an FR10 schedule and play responses were concurrently reinforced on an FR1 schedule, play responses increased. Two participants’ mands decreased from baseline levels but were maintained, and the third participant’s mands increased. Implications of the use of choice procedures for clinical settings are discussed.

Keywords: concurrent schedules; ratio schedules; concurrent-ratio schedules; manding; autism

Children with pervasive developmental disorders (PDDs) are typically taught a number of behaviors simultaneously, constituting use of concurrent schedules of reinforcement. During concurrent-ratio schedules, reinforcement is maximized by responding solely on the denser schedule of reinforcement. There is no benefit to switching between schedules as during interval schedules. However, alteration of response effort, reinforcement quality, and schedule values have been shown to similarly shift response allocation during concurrent-ratio schedules (DeLeon, Fisher, Herman, & Crosland, 2000; Perry & Fisher, 2001). Altering values of concurrent-ratio schedules has successfully decreased maladaptive behaviors while increasing functional behaviors, as well as showing control over the allocation of two functional behaviors (Horner & Day, 1991; Mace, McCurdy, & Quigley, 1990). Response allocation also shifts from a less to a more effortful response...
during a concurrent-ratio situation by increasing the rate of reinforcement for the more effortful response (Cuvo, Lerch, Leurquin, Gaffaney, & Poppen, 1998). These studies suggest that manipulation of ratio schedule parameters in concurrent paradigms may yield graded effects on response allocation.

Once children diagnosed with PDDs have acquired mands, they must also learn to emit mands at lower rates, while simultaneously acquiring new responses. During the present study, children with PDDs were exposed to concurrent FR1 FR1 (fixed ratio) schedules for mands and appropriate play. We evaluated whether rate of play responses would increase when the reinforcement schedule for mands was changed from FR1 to FR10 while the schedule value for play remained at FR1 (simultaneously maintaining mands).

Method

Participants and Setting

Three boys, all 3 years old and previously diagnosed with PDD, participated. Participants sat in a chair at a table approximately 2 × 2 m in a quiet room in their home with a television approximately 5 m away. The experimenter sat adjacent to the participant and materials and reinforcers were on the floor.

Materials

Items serving as reinforcers included movie segments presented on the TV, segments of music played on a CD player, books, dolls, toy cars, trains, planes, various music-making toys, cups of juice and soda, and participant’s milk bottles. Play activities included two shape sorters, various puzzles ranging from three to nine pieces, five legos, five blocks, and a pegboard. Play activities were selected based on teacher reports before the experimental sessions of materials the participants had previously been taught to play and were able to currently play with without any help. Reinforcers were selected based on teacher and parent reports of items and activities that were preferred or had served as reinforcers in other situations. No formal preference or reinforcer assessments were conducted before the experiment.

Dependent Measures

Mands. Mands were vocal words or word approximations. Jake’s mands included “movie,” “bottle,” “book,” “cu” (cup), and “music.” Donny’s mands included “movie,” “bottle,” “book-a” (book), “sodum” (soda), “music,” “Elmo”
and “cookie monster” dolls, and toy planes (“Jay Jay,” etc.). Matt’s mands included “jui-sa” (juice), “book,” “ta-pa” (tape), and “choo-choo” (trains).

*Play responses.* Play responses were either correctly placing a single shape in a shape sorter, fitting a single puzzle piece into a puzzle, fitting two legos together, stacking two blocks, or fitting a peg into a pegboard, depending on the materials present.

**Independent Measures**

*Concurrent FR1/FR1 condition.* Both mands and play responses were reinforced on independent concurrent FR1 schedules.

*Concurrent FR1/FR10 condition.* Play responses were reinforced on an independent FR1 schedule and mands were reinforced on an independent FR10 schedule. Reinforcement earned from the FR1 schedule did not affect the FR10 schedule in any way.

**Experimental Design**

A reversal design was used to show experimental control. An ABA design was used for Jake and Donny and a BAB design was used for Matt, where A represents the FR1 FR1 condition and B represents the FR1/FR10 condition.

**Procedures**

All sessions were 15 minutes long. Sessions began following noncontingent 10 seconds access to each of at least three reinforcers in random order while seated at the table. The 15-minute sessions were divided into three, 5-minute intervals. During each 5-minute interval, one randomly chosen play activity remained on the table directly in front of the participant, replaced by a new activity following the interval. The same two play activities were never placed on the table during more than one 5-minute interval within a single session.

The experimenter reinforced mands by turning on or placing the item requested on the table within 3 seconds of the occurrence of every mand in the FR1 FR1 condition, and within 3 seconds of the occurrence of every 10th mand in the FR1 FR10 condition. The participant had access to the reinforcer for 10 seconds before the experimenter turned it off or removed it. No programmed consequences followed mands other than every 10th mand during the FR1 FR10 condition. The experimenter reinforced play responses in the same manner. The experimenter delivered the same reinforcer that was most
previously requested during that session following each play response, despite whether that previous request met the FR10 schedule requirement or not. For example, if a participant requested a book for the first time during the FR1/FR10 schedule, not meeting the FR10 schedule requirements for mands, and subsequently emitted a play response, consequences for the play response were access to the book. No instructions were given during either condition of the experimental sessions.

**Interobserver Agreement (IOA)**

Percentage of agreement was determined by dividing number of agreements by total number of agreements plus disagreements and multiplying by 100%. IOA data were taken during at least two sessions per condition for all participants.

For Jake, IOA was calculated during 39% of the sessions and averaged 100% for play responses and 98.3% for mands. For Donny, IOA was calculated during 32% of the sessions and averaged 100% for play responses and 97.3% for mands. For Matt, IOA was calculated during 29% of the sessions and averaged 100% for play responses and 99% for mands.

**Results and Discussion**

Figure 1 shows each participant’s rate of mands and rate of play responses per minute during all experimental sessions. Rates of responding were calculated by subtracting total reinforcement time from each 15-minute session and dividing the frequency of each response by the remaining session length. For each participant, there was an increase in the rate of play responses during FR1 FR10 sessions compared with FR1 FR1 sessions. For Donny and Matt, this increase in rate of play responses was accompanied by a decrease, but not elimination of mands during the FR1 FR10 conditions. Jake’s rate of mands remained high throughout all experimental conditions, despite an increase in play responses during the FR1 FR10 condition. In fact, there was an increasing trend in the rate of mands for Jake during the FR1 FR10 condition. Because number of sessions per condition varied across both conditions and participants, it is possible that the rate of play responses was correlated with number of sessions for the data shown in Figure 1. Figure 2 shows that this was not the case. When data were restricted to play responses during sessions 2, 3, and 4 for all participants, the mean rate of play responses was greater during all FR1 FR10 conditions than during the FR1 FR1 conditions for all participants.
Figure 1
The Rate of Mands Per Minute and the Rate of Play Responses Per Minute for Each Session for Jake and Donny Exposed to an ABA Order of Conditions (Top and Middle Graphs) and for Matt Exposed to a BAB Order of Conditions (Bottom Graph)

Note: During the FR1 FR1 conditions, both mands and play responses were reinforced on an FR1 schedule of reinforcement. During the FR1/FR10 condition, play responses were reinforced on an FR1 schedule of reinforcement and mands were reinforced on an FR10 schedule of reinforcement.
These results are consistent with previous applied research. Schedule manipulation for one response (mands) during a concurrent-ratio schedule resulted in an increase in the rate of an alternative appropriate response (play). However, rate of mands was higher than the rate of play responses.
during 76% of all sessions for each participant, regardless of the schedule values. This implies that additional variables also affected response rate. For example, it is possible that play responses required greater effort than mands. Cuvo et al. (1998) showed that a greater number of responses were allocated to a less effortful response than to a more effortful response under concurrent FR1 schedules of reinforcement. When the schedule value for the less effortful response was increased to FR5 and FR10 values in that study, participants emitted a greater number of the more effortful response reinforced on an FR1 schedule.

This study is limited in its applicability to clinical settings in that only two behaviors were measured under arbitrarily chosen schedules and schedule values and participants remained in their seats where a limited number of behaviors were available. Generalization was neither programmed nor assessed. These data are consistent with research on concurrent schedules of reinforcement in applied settings. Future research may profit from the application of behavioral economic principles to the analysis of behavior analytic procedures in clinical settings involving a variety of behaviors and schedules.

References


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