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Exclusive Preference on Concurrent Schedules in Children with Autism Spectrum Disorder

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RESEARCH IN PROGRESS

EXCLUSIVE PREFERENCE ON CONCURRENT SCHEDULES IN CHILDREN WITH AUTISM SPECTRUM DISORDER

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Treatment programs often utilize positive consequences to establish, increase, or maintain behavior. Recently, Dube and McIlvane (2002) examined the sensitivity of individuals with neurodevelopmental disabilities to differences in the frequency and magnitude of reinforcing consequences. Six individuals were exposed to a concurrent-choice procedure during which each option was associated with a range of schedules differing in reinforcer frequency or magnitude. Data were analyzed in accordance with the generalized matching law (Baum, 1974) and the positive slopes of obtained matching functions indicated sensitivity to the programmed reinforcer disparities.

In recent follow-up work, we have been using the methods of Dube and McIlvane (2002) to assess sensitivity to changes in reinforcer frequency in individuals at lower functioning levels. During pretraining, a number of our recent participants developed exclusive or near-exclusive stimulus preferences that have proven difficult to overcome. This "Research in Progress" report is intended to highlight this challenge, describe efforts to overcome it, and to report potentially promising remedial procedures.

METHOD

Participants

Participants SMD, ECI, JTI, OSS, and JST were five students with autism spectrum disorder (ASD) ranging in age from 9 to 20 years.

Apparatus and Software

All sessions took place in an automated teaching laboratory, details of which have been described in an earlier volume of the *Experimental Analysis of Human Behavior Bulletin* (Lionello-DeNolf & McIlvane, 2003). The participant was seated in front of a computer touch screen mounted on a side wall that also contained two speakers for auditory stimulus presentation. To the left of the participant, located on another wall, was a compartment used to deliver edible reinforcers.

A Macintosh G4 computer running software designed to resemble a computer game controlled experimental events and data collection. Stimuli were seven copies of pink circles and green trapezoids that appeared on the left or right thirds of the screen. When touched, a stimulus disappeared with a "popping" sound and reappeared in a new area. When a reinforcer was delivered, the stimulus disappeared, apparently exploding, a chime sounded, and a moving stimulus on the screen immediately preceded delivery of a food reinforcer in the compartment.

PROCEDURE AND RESULTS

Four participants received initial multiple-schedule pretraining with the stimuli, and then concurrent schedules were introduced and the reinforcement schedules shifted from fixed-interval (FI) 5 s to variable-interval (VI) 20 s in steps of 5 s. Responses were reinforced on two identical but independent concurrent schedules (e.g., *conc* VI 5 s VI 5 s). The computer calculated seven schedule values using the Fleshler and Hoffman (1962) algorithm and implemented them in random order throughout the session with the

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Table 1
Schedules, manipulations, and average proportion left responses for each participant during initial pretraining. NP refers to non-preferred stimulus. EXT, VI, FI, and FR refer to extinction, variable-interval, fixed-interval, and fixed-ratio, respectively. Interval schedule values are in seconds.

Participant	Number of Sessions	Left-side schedules	Right-side schedules	Manipulations	Average Proportion Left Responses
ECI	55	FI 5 VI 5 VI 10 VI 15 VI 20 EXT	FI 5 VI 5 VI 10 VI 15 VI 20 VI 20	Reverse stimulus locations Reduce the number of stimulus copies on the NP side	.931
JTI	58	FI 5 VI 5	FI 5 VI 5	Reverse stimulus locations Reduce the number of stimulus copies on the NP side	.964
OSS	23	FI 5 VI 5 VI 10 VI 15 VI 20 VI 60 VI 13 VI 45 VI 12 VI 20 VI 5	FI 5 VI 5 VI 10 VI 15 VI 20 VI 12 VI 45 VI 13 VI 60 EXT EXT	Reverse stimulus locations Reduce the number of stimulus copies on the NP side	.038
SMD	40	FI 5 VI 5 VI 6 VI 7 VI 9 VI 10 VI 12 VI 15 EXT	FI 5 VI 5 VI 6 VI 7 VI 9 VI 10 VI 12 VI 15 FR 1	Reverse stimulus locations Reduce the number of stimulus copies on the NP side Increase presentation area for NP stimulus Add motion for NP stimuli	.931

exception that each value was used once before it was repeated. The criterion for each session was a proportion of left responses between 0.10 and 0.90.

Subsequently, participants were given a varied number of sessions on *conc* VI 20 s VI 20 s and other schedules (e.g., *conc* VI 13 s VI 45 s, *conc* VI 60 s VI 12 s). Our ultimate goal was to establish well-distributed responding in which no fewer than 10% and no more than 90% of responses occurred to either stimulus/location. However, each of the participants developed an exclusive preference at different points: for SMD as the schedules became leaner than VI 6 s, for ECI and JTI at the onset of concurrent schedules, and for OSS in alternation from stimulus to stimulus until unequal schedules were introduced. Initially, various changes were made in the stimulus displays and schedules in an effort to render them less complex or more salient. Table 1 lists these manipulations and shows the average proportion left response during this phase of training. None was effective in reducing the participants' preferences.

Schedule Manipulations

In follow-up work, we sought to encourage well-distributed responding by manipulating the reinforcement schedules directly for the preferred and non-preferred stimuli with ECI, JTI, and OSS. The schedule for the preferred side was changed to extinction and the schedule for the non-preferred side was reduced to FR 1 or VI 5 s. When less than 10% responses were emitted to the stimulus associated with extinction, the lean schedule became richer and the rich schedule became leaner in a series of steps until both schedules were equal (*conc* VI 20 s VI 20 s).

For JTI, there was an immediate effect: proportion left responses dropped from 1.0 to 0.676 in one session and continued to decline. More importantly, by the time he reached *conc* VI 20 s VI 20 s, responding stabilized such that over the last 6 sessions, proportion left responses was 0.384. For OSS, the effect of the training protocol was similar. By the time he reached *conc* VI 20 s VI 20 s, proportion left responses was 0.539.

The proportion left responses for ECI went from 1.0 to 0.0 in one session when extinction was introduced and did not change over the remaining sessions. Thus, this training procedure was successful in eliminating an exclusive preference in 2 of 3 participants.

Reversal training protocol

Although the schedule manipulation remedial procedure proved ultimately effective, we wondered whether the original problem could be bypassed. To that end, we explored a pretraining procedure in which (a) the schedules were initially unequal, (b) the rich and lean stimulus/locations reversed frequently (to produce an approximately equal reinforcement history for each stimulus), and (c) the schedules were progressively moved toward equality.

An experimentally naïve participant, JST, was trained as follows: Initially, schedules were extinction versus FR 1, and the stimulus associated with each schedule was alternated daily. For example, in session 1, the left stimulus was on FR1 and the right stimulus was on extinction. In session 2, the left stimulus was on extinction and the right stimulus was on FR1. Sessions were conducted (four minimum) until the proportion responses to the stimulus associated with extinction was less than 0.1 for at least two sessions. Then, the lean schedule was made richer and the rich schedule was made leaner; the "lean" and "rich" stimuli alternated daily. As expected, JST showed a near exclusive preference for the stimulus associated with reinforcement when the opposite schedule was extinction (sessions 1-12 in Table 2). However, as the level of reinforcement for each stimulus was moved closer to equality, JST did not exhibit a strong preference for either stimulus. Over six *conc* VI 20 s VI 20 s sessions, the proportion left responses was 0.386.

DISCUSSION

With the reversal training protocol, the naïve participant JST developed a pattern of well-distributed responding during concurrent schedule pretraining that remained stable over several sessions of training with relatively lean concurrent schedules. This result can be contrasted with that of the original pretraining protocol, with which four participants did develop exclusive preferences. Of course, more participants need to be trained on the reversal protocol before definitive conclusions can be made. We are currently assessing the effectiveness of the reversal training protocol with ECI, SMD, and an additional naïve participant.

Even if the reversal training protocol does not fulfill its recent promise, however, the results of

Table 2
New training protocol and average proportion responses for JST. EXT, VI, FI, and FR refer to extinction, variable-interval, fixed-interval, and fixed-ratio, respectively. Interval schedule values are in seconds.

Session Numbers	Schedules	Average Responses to Stimulus Associated with Reinforcement	Average Proportion Left Responses
1-12	*conc* EXT FR 1 alternated with *conc* FR 1 EXT	.965	
	conc EXT FI 5 alternated with *conc* FI 5 EXT		
	conc EXT VI 5 alternated with *conc* VI 5 EXT		
13-24	*conc* VI 60 VI 5 alternated with *conc* VI 5 VI 60		.452
	conc VI 45 VI 10 alternated with *conc* VI 10 VI 45		
	conc VI 30 VI 15 alternated with *conc* VI 15 VI 30		
25-30	*conc* VI 20 VI 20		.386

this study are informative nonetheless. They show that the pretraining methods used to establish VI concurrent schedule performances may be very important for some participants, perhaps especially if they are at lower levels of functioning. What seems clear from these and other data collected in the Shriver laboratories with similar participants is that exclusive side bias is a very frequent outcome. It may not be a coincidence that all of our children had ASD diagnoses – which are associated with behavioral inflexibility and stereotyped responding. With the sample in hand, we cannot yet say that a clinical diagnosis of ASD is a variable associated with development of troublesome side (or stimulus) biases, but that remains a possibility. Even if children with ASD diagnoses do prove to be relatively more vulnerable to stereotypical responding, however, our data suggest that there are ways to remediate and/or bypass such problems. Such procedures may not only render children able to conform more closely to the generalized matching law in experimental studies but also have clinical implications (e.g., for overcoming similar problems when they are encounter in the core of ABA therapy).

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