JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2011, **44,** 653–657 NUMBER 3 (FALL 2011)

REDUCING STIMULUS OVERSELECTIVITY THROUGH AN INCREASED OBSERVING-RESPONSE REQUIREMENT

ADAM H. DOUGHTY AND MICHELLE N. HOPKINS

COLLEGE OF CHARLESTON

An adult with autism and a mild intellectual disability participated in a 0-s delayed matching-to-sample task. In each trial, two sample stimuli were presented together until the participant completed an observing-response requirement consisting of 1 or 10 mouse clicks in the baseline and experimental phases, respectively. One of the two sample stimuli then appeared randomly as a comparison stimulus (S+), along with two other comparison stimuli (S−). Higher levels of correct responding occurred under the larger observing-response requirement, and the proportion of errors related to one of the two sample stimuli decreased. Thus, stimulus overselectivity was reduced without requiring differential observing responses.

Key words: autism, conditional discrimination, delayed matching to sample, observing response, restricted stimulus control

Stimulus overselectivity refers to the restricted stimulus control that develops under conditions in which behavior could be controlled by multiple stimulus dimensions or by multiple stimuli (Lovaas, Koegel, & Schreibman, 1979). It has been suggested (e.g., Schrandt, Townsend, & Poulson, 2009) that such restricted stimulus control may relate to the core deficits observed in the behavior of persons diagnosed with autism. Consequently, it is crucial to develop baseline assessments of restricted stimulus control as well as to investigate techniques to broaden stimulus control.

Dube and McIlvane (1999) developed a two-sample, delayed matching-to-sample (DMTS) procedure to measure stimulus overselectivity in participants with autism. Baseline trials began with the presentation of two sample stimuli on a computer screen. The computer program removed the two stimuli after a single observing response (i.e., touchscreen press). An observing response is a response to a sample stimulus and usually is taught via instructions, modeling, or prompting. Immediately after the observing response (i.e., 0-s DMTS), one of the two sample stimuli randomly appeared as the correct comparison stimulus (i.e., S+), along with two incorrect comparison stimuli (S−). The experimenters employed a trial-unique procedure such that different stimuli appeared on every trial in a session, as opposed to the same two sample stimuli appearing on every trial. Thus, from a teaching perspective, the ideal form of stimulus control in each trial would be control exerted over comparison-stimulus selection by either sample stimulus from that trial. However, the intermediate baseline accuracy scores for each participant suggested that their comparison-stimulus selections were not controlled sufficiently by both sample stimuli on every trial (i.e., the S+ was chosen on approximately 70% of the trials across participants).

Due to language difficulties in individuals with autism, Dube and McIlvane (1999) and others (e.g., Fisher, Kodak, & Moore, 2007) have evaluated nonverbal techniques to remedy stimulus overselectivity. One relatively successful approach has been a differential observing-

This research was part of a BA essay project completed by the second author under the supervision of the first author. We thank Cynthia Lowenthal and the Department of Psychology at the College of Charleston for funding this project, Laura Villeponteaux at the Charleston County Disabilities Board for help with participant recruitment, and the participant and his family for their time and cooperation.

Address correspondence to Adam Doughty, Department of Psychology, College of Charleston, 57 Coming Street, Charleston, South Carolina 29424 (e-mail: doughtya@cofc.edu).

doi: 10.1901/jaba.2011.44-653

response procedure, wherein different observing responses occur to the different sample stimuli (e.g., clapping or waving in the presence of certain sample stimuli prior to the presentation of the comparison stimuli). Participants in Dube and McIlvane's study completed an identity-matching task (i.e., the differential observing response) prior to DMTS in the experimental condition. Although the differential observing response enhanced accuracy scores relative to baseline, accuracy returned to intermediate levels when the experimenters withdrew treatment. Thus, additional evaluations of treatment procedures to reduce overselectivity are warranted.

Increased observing-response requirements have improved accuracy under DMTS and MTS procedures in some basic studies with nonhuman animals (e.g., Maki, Gillund, Hauge, & Siders, 1977; Sacks, Kamil, & Mack, 1972). Under a DMTS procedure with an increased observing-response requirement, the completion of a fixed-ratio (FR) schedule greater than one removes the sample stimulus. To our knowledge, only Osborne, Heaps, and Phelps-Bowden (1978) have extended the use of an increased observing-response requirement during DMTS tasks to human participants. Osborne et al., however, did not examine stimulus overselectivity. Thus, the purpose of the present experiment was to assess whether an increased observing-response requirement would increase the accuracy of an adult with autism who exhibited stimulus overselectivity on a two-sample DMTS task.

METHOD

Participant

Rollin was a 25-year-old man who had been diagnosed with autism and a mild intellectual disability. He followed simple vocal instructions (e.g., "sit down") and answered simple social questions (e.g., "What did you do at work today?"); however, he rarely initiated conversations. Rollin had prior experience with procedures similar to those implemented during baseline (described below).

Procedure

Rollin participated in several 30-trial sessions per day in which an iMac computer with MTS software presented a two-stimulus 0-s DMTS task (Dube, 1991). Nine sessions were conducted approximately every other day, with a 2-min break between sessions. The target response was a mouse click over a stimulus, and the intertrial interval (ITI) was 3 s. The stimuli were nonrepresentational shapes drawn from a pool of 120 shapes. A stimulus appeared only once in a session, was approximately 4 cm by 4 cm, and was black on a white screen. Each trial began with the presentation of two sample stimuli in the center of the screen. The sample stimuli remained until the participant completed an observing-response requirement (he never failed to complete the requirement). The computer program removed the sample stimuli immediately after completion of the observing-response requirement and presented three comparison stimuli. Each comparison stimulus was a single stimulus presented in the upper left, lower left, and lower right corners of the screen. One of the comparison stimuli was identical to one of the two sample stimuli. The left and right sample stimuli appeared equally often as the S+ in the comparison array in each session. The location of the S+ in the two-sample stimulus (i.e., the left or right stimulus) and the screen-corner location of the S+ could not be the same on more than three consecutive trials. Selection of the S+ produced a star display on the screen immediately along with a series of high-pitched tones; in addition, the experimenter sat next to Rollin during each session and delivered a token when the star was displayed (she did not interact with Rollin during the session in any other way). Selection of an S− immediately darkened the screen for 1.5 s (time-out). Rollin exchanged his accumulated tokens for items at the end of each day's

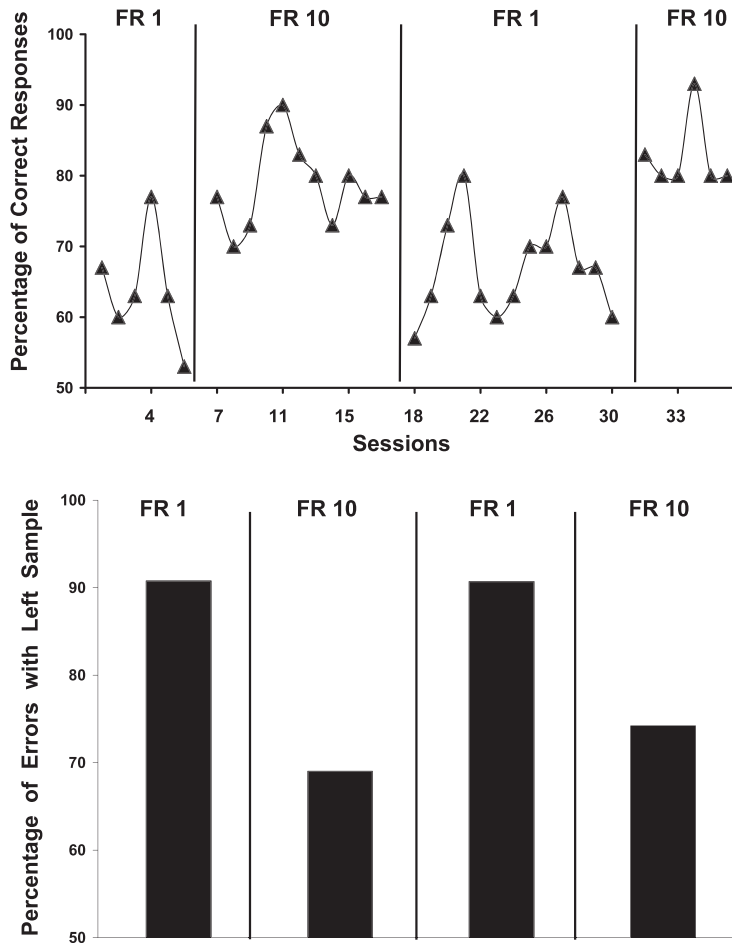

Figure 1. Session-by-session accuracy scores (top) and an analysis of the errors that occurred across conditions (bottom). In the bottom graph, left refers to the location of the S+ in the two-sample stimuli (see text for details).

sessions (the items had been recommended by his family and staff).

Pretests. Four pretests, similar to those described by Dube and McIlvane (1999), consisted of simultaneous or 0-s DMTS with one or two sample stimuli. Each pretest session consisted of 30 trials, during which the participant was required to exhibit a single observing response to produce three comparison stimuli. These pretests indicated that Rollin exhibited both identity-matching skills and stimulus overselectivity.

Baseline: FR 1 observing-response requirement. On each trial of the session, a single mouse click over the sample stimuli served as the observing-response requirement (i.e., an FR 1 schedule terminated the sample stimuli and produced the comparisons).

FR 10 observing-response requirement. Ten mouse clicks over the sample stimuli served as the observing-response requirement (i.e., an FR 10 schedule terminated the sample stimuli and produced the comparisons).

RESULTS AND DISCUSSION

Figure 1 (top) shows Rollin's session-by-session accuracy scores. His intermediate accuracy scores (i.e., mean of 64% correct responding) in the first baseline phase resembled the

baseline results obtained by Dube and McIlvane (1999). Correct responding abruptly increased with the FR 10 observing-response requirement and then stabilized near 80% (M = 79%). His correct responding decreased when the observing-response requirement returned to an FR 1 schedule (M = 67%). The replication of the FR 10 observing-response requirement produced an immediate increase in correct responding (M = 83%), along with a reduction in response variability.

Figure 1 (bottom) displays the percentage of errors Rollin made in each phase when the left sample stimulus was the S+. Specifically, the number of errors made when the left sample stimulus was the S+ was divided by the total number of errors, and this percentage is displayed. In each phase, more errors occurred when the S+ was presented in the left portion of the two-sample stimulus relative to the right portion, although the difference was smaller during the FR 10 phases. Specifically, 92% and 71% of the errors occurred in the FR 1 and FR 10 phases, respectively, when the S+ was presented in the left portion of the two-sample stimulus. Thus, increasing the observing-response requirement from FR 1 to FR 10 reduced the number of errors per session and the relative likelihood of making an error when the S+ was presented in the left portion of the two-sample stimulus.

Results replicate findings with nonhuman animals showing a positive relation between discrimination accuracy and observing-response requirements (e.g., Maki et al., 1977; Sacks et al., 1972). We also extended the results of Osborne et al. (1978) by evaluating the relation between discrimination accuracy and observing-response requirements in an individual who displays stimulus overselectivity. These findings suggest that an increased observing-response requirement is another means of reducing stimulus overselectivity in individuals with autism. This increased observing-response requirement produced longer sample-stimulus display times, which some investigators have suggested are the source of the higher accuracy scores (see Mackay, 1991). The mean sample-stimulus display times across the four conditions were 0.85 s (FR 1), 5.78 s (FR 10), 1.14 s (FR 1), and 5.91 s (FR 10).

Analysis of a participant's error patterns in stimulus-overselectivity assessments may help investigators to improve the restricted forms of stimulus control that develop in individuals with autism (e.g., Dickson, Wang, Lombard, & Dube, 2006). Rollin was considerably more likely to make an error when the S+ was presented in the left portion of the two-sample stimulus (i.e., the right sample stimulus more effectively controlled comparison-stimulus selection). Thus, these results suggest that for individuals who display overselectivity, procedures could be developed that target specific features of stimuli that may be less likely to exert control over behavior, such as the orientation of certain letters (e.g., *b* and *d* or *p* and *q*).

There were several limitations to the present experiment. First, the evaluation included only one participant. Second, the effects of the increased observing-response requirement on performance did not persist after the requirement was reduced to FR 1. These findings resemble the results of Dube and McIlvane (1999) in showing the persistence of restricted attending behavior in persons with autism. Third, correct responding was not at mastery levels (e.g., correct responding at or above 90%) even when the observing-response requirement was at FR 10. Future research may reveal whether observing-response requirements higher than FR 10 are sufficient to promote higher accuracy levels in persons with autism.

The present investigation was a translational study, and the skills targeted were not socially significant. Future applied investigations of stimulus overselectivity should examine the effects of differential observing responses and increased observing-response requirements with more clinically relevant tasks (e.g., attending to

various aspects of an individual's facial features in social situations). In addition, future research could evaluate whether there are additive effects from combining these two procedures. We also illustrated the value of a more detailed analysis of the errors that occur during stimulus-overselectivity assessments. The results of such an analysis may inform the development of additional assessments and treatments for stimulus overselectivity.

REFERENCES

Dickson, C. A., Wang, S. S., Lombard, K. M., & Dube, W. V. (2006). Overselective stimulus control in residential school students with intellectual disabilities. *Research in Developmental Disabilities*, *27*, 618–631.

Dube, W. V. (1991). Computer software for stimulus control research with Macintosh computers. *Experimental Analysis of Human Behavior*, *9*, 28–30.

Dube, W. V., & McIlvane, W. J. (1999). Reduction of stimulus overselectivity with nonverbal differential observing responses. *Journal of Applied Behavior Analysis*, *32*, 25–33.

Fisher, W. W., Kodak, T., & Moore, J. W. (2007). Embedding an identity-matching task within a prompting hierarchy to facilitate acquisition of conditional discriminations in children with autism. *Journal of Applied Behavior Analysis*, *40*, 489–499.

Lovaas, O. I., Koegel, R. L., & Schreibman, L. (1979). Stimulus overselectivity in autism: A review of research. *Psychological Bulletin*, *86*, 1236–1254.

Mackay, H. A. (1991). Conditional stimulus control. In I. H. Iversen & K. A. Lattal (Eds.), *Experimental analysis of behavior, Parts 1 & 2. Techniques in the behavioral and neural sciences* (Vol. 6, pp. 301–350). New York: Elsevier Science.

Maki, W. S., Gillund, G., Jr., Hauge, G., & Siders, W. A. (1977). Matching to sample after extinction of observing responses. *Journal of Experimental Psychology: Animal Behavior Processes*, *3*, 285–296.

Osborne, J. G., Heaps, R. S., & Phelps-Bowden, J. (1978). Effect of sample response requirement on matching-to-sample accuracy of exceptional children. *Psychological Reports*, *42*, 1267–1276.

Sacks, R. A., Kamil, A. C., & Mack, R. (1972). The effects of fixed-ratio sample requirements on matching to sample in the pigeon. *Psychonomic Science*, *26*, 291–293.

Schrandt, J. A., Townsend, D. B., & Poulson, C. L. (2009). Teaching empathy skills to children with autism. *Journal of Applied Behavior Analysis*, *42*, 17–32.

Received May 24, 2010
Final acceptance August 13, 2010
Action Editor, Tiffany Kodak