RESPONSE-REINFORCER RELATIONSHIPS AND IMPROVED LEARNING IN AUTISTIC CHILDREN

JULIE A. WILLIAMS, ROBERT L. KOEGEL, AND ANDREW L. EGEL

WEST VIRGINIA UNIVERSITY,
UNIVERSITY OF CALIFORNIA, SANTA BARBARA, AND
UNIVERSITY OF MARYLAND, COLLEGE PARK

In order to affect more rapid response acquisition for autistic children, researchers have recently begun to investigate the functional relationships of reinforcers to other components of the operant conditioning paradigm. Previous research suggested that functional relationships between target behaviors and reinforcers might be especially effective. For example, locating a reward inside a container might be a more efficient way to teach a child to open the container than by handing the child a reward for opening an empty container. The present experiment assessed, within a multiple baseline design, the possibility of improving autistic children's learning by changing arbitrary response-reinforcer relationships (while holding target behaviors and reinforcers constant) so that the target behaviors became functional (i.e., a direct part of the response chain required for the child to procure the reinforcer). The results showed that: (1) arranging functional response-reinforcer relationships produced immediate improvement in the children's learning, and resulted in rapid acquisition of criterion level responding; and (2) high levels of correct responding initially produced by functional response-reinforcer relationships were continued even when previously ineffective arbitrary response-reinforcer conditions were reinstated. The results are discussed in terms of understanding and improving autistic children's learning.

DESCRIPTORS: contingencies, functional responses, natural reinforcers, response-reinforcer relationships, autistic children

There is extensive discussion of the behavioral deficits shown by autistic and severely retarded children (e.g., Baer, 1978; Koegel, Egel, & Dunlap, 1980; Lovaas, Young, & Newsom, 1978;

Rincover & Koegel, 1977). Because remediation of these deficits is generally a laborious and time-consuming process, investigators have searched for methods to improve teaching efficiency (Koegel, Dunlap, & Dyer, 1980; Koegel & Williams, 1980).

This investigation was supported by U.S. Public Health Service Research Grants MH 28210 and MH 28231 (Robert L. Koegel and Laura Schreibman, principal investigators) from the National Institute of Mental Health; by U.S. Office of Education Research Grant G007802084 (Robert L. Koegel and Arnold Rincover, principal investigators) from the Bureau of Education for the Handicapped; and by U.S. Office of Education Model Demonstration Grant No. G008001720 (Andrew L. Egel, principal investigator) from the Bureau of Education for the Handicapped. The authors are grateful for the cooperation and assistance of Patti Hillman and Valley Community Mental Health Center, Morgantown, West Virginia, and to Cynthia Corder and Sharon Behl for their assistance in the collection of the data. Reprints may be obtained from Robert L. Koegel, Social Process Research Institute, University of California, Santa Barbara, California 93106.

To affect more rapid response acquisition, researchers have recently begun to investigate the functional relationship of reinforcers to other components of the operant teaching paradigm (Goetz, Schuler, & Sailor, 1979; Koegel & Williams, 1980; Saunders & Sailor, 1979). For example, in a study designed to investigate the relationship of the reinforcer to the discriminative stimulus, Saunders and Sailor (1979) found that children acquired object labels for toys more rapidly when those particular toys were also used as the reinforcers. In another study Koegel and Williams (1980) suggested that certain response-reinforcer relationships

might be especially helpful in increasing and maintaining appropriate behaviors. They indicated that the most efficient response-reinforcer relationships might be those in which the target response was functional, i.e., occurs directly within the chain of responses required for the child to procure a reinforcer.

The present study was designed to compare systematically arbitrary vs. functional relationships between target behaviors and reinforcers. The specific questions addressed were: (1) Would rearranging existing arbitrary conditions so that given target behaviors became functional in procuring a reinforcer improve learning?; and (2) if so, would behavior changes resulting from reinforcement under functional response-reinforcer relationships continue if arbitrary response-reinforcer conditions were reinstated.

METHOD

Subjects

Three children, aged 4.0, 4.5, and 7.0 yrs participated in this investigation. They were all attending classrooms for the severely handicapped, and were referred for participation in this investigation because they were learning at particularly slow rates. All of the children exhibited behaviors consistent with the diagnostic criteria established by the National Society for Autistic Children for the syndrome "autism" (Ritvo & Freeman, 1978). Each child exhibited moderate to high levels of self-stimulatory behavior (hand-flapping, gazing, rocking) and demonstrated relatively little appropriate play or social behavior. None had any expressive speech, but all were able to follow some simple receptive commands (e.g., "sit down," "come here"). The children's high level of interfering tantrum and self-stimulatory behaviors prevented them from being meaningfully tested on standardized intelligence tests. However, teachers and psychologists estimated that all three children were functioning at or below the 2-yr-level.

Setting and Therapists

The study was conducted in each child's regular classroom. The therapists were the first author (for Child 1) and a graduate student in Special Education (for Children 2 and 3). The therapist for Children 2 and 3 was naive with respect to the experimental hypothesis. However, all therapists had at least three years of experience in the behavior modification treatment of autistic children.

Design

The three children participated in this investigation in a multiple baseline design across subjects and behaviors (Hersen & Barlow, 1976). The design included three tiers of different behaviors for both Child 1 and Child 2; as well as two tiers of the same behavior for two different children (Child 2/Task 1 and Child 3/Task 1). The target behaviors and rewards were determined by the children's classroom teachers. In each case, the target behaviors were selected because the teachers reported that prior to the start of this investigation the children were having difficulty acquiring similar types of behaviors (e.g., other imitations and multiple-choice discriminations).

The treatment procedures used in both conditions (arbitrary vs. functional response-reinforcer relationships) throughout this experiment were based upon the guidelines suggested by Koegel, Russo, and Rincover (1977) and Schreibman and Koegel (1981a). That is, the therapists waited until the child was quiet and attending before presenting an appropriate instruction (see below) for the selected target responses. Correct child responses were then rewarded with edible reinforcers, while incorrect responses were followed by a mild verbal, "no." In the initial trials of both conditions, Child 1 and Child 3 made few attempts to respond at all. Therefore, the therapists manually guided (prompted) these children several times during the early trials of each condition. Child 2 always

made attempts to respond without being prompted. Therefore, he participated in both conditions without any prompts.

Arbitrary condition. Within the multiple baseline design, all of the children initially participated in teaching conditions using an *arbitrary* response-reinforcer relationship. During this condition, the reinforcers were presented contingent on correct responding, but otherwise bearing no specific relationship to the target behavior. For example, if the target behavior involved a mouth movement, the reinforcer might be presented in the child's hand; or, if the target behavior involved a hand movement, the reinforcer might be placed in the child's mouth (see details below for each target behavior). Each child participated in the arbitrary response-reinforcer condition for a predetermined number of unprompted trials (10 trials for Child 1/Task 1; 15 trials for Child 2/Task 1; 20 trials for Child 2/Task 2 and Child 1/Task 2; 50 trials for Child 2/Task 3 and Child 3/Task 1; and 65 trials for Child 1/Task 3) as determined by the multiple baseline design. In both the arbitrary and the subsequent functional conditions, data were gathered over a varying number of days (range: 1 to 10 days) for each child, and over a varying number of trials per task per day (range: 10 to 55 trials per task per day).

Functional condition. During this condition, all of the teaching conditions remained exactly the same except that the presentation of the reinforcer was arranged so that the target behavior became directly functional in procuring the reinforcer. That is, the stimulus conditions were arranged so that en route to procuring the reinforcer, the child would be performing the target response. For example, if the target response involved the child's opening his mouth, the reinforcer was placed in his mouth after he opened it; if the target response involved touching a specific cup, the reinforcer was located in that cup, so that touching that specific cup became a functional step toward procuring the reinforcer in the cup. The specific details of this

arrangement for each target behavior are described below.

Reinstatement of the arbitrary condition. For six of the seven child/task combinations (the other child moved out of the community prior to this assessment) the arbitrary condition was reinstated for an additional 10 to 20 trials for each task. All teaching conditions were identical to the original arbitrary condition (however, since children 1 and 3 increased their responsivity during the functional condition, none of the children required any prompts). This last condition was conducted in order to determine whether initial behavior change resulting from reinforcement with functional response-reinforcer relationships would continue (or would reverse) if arbitrary conditions were reinstated.

Discrimination Assessment:

Insurance of Stimulus Control

Finally, at the end of the experiment several target behaviors were randomly alternated with other acquired behaviors to insure that the children had in fact learned the stimulus conditions for the respective target responses they had acquired, and were not simply repeating a given response set. For Child 1, hand and mouth imitations (see target behaviors) were randomly alternated; for Child 2, "bending" vs. "touch head" and "touch cup" vs. "touch ball" trials were randomly alternated. Correct responses continued to be reinforced as they were in the arbitrary conditions, with 10 to 20 trials conducted for each individual target behavior.

Target Behaviors

Child 1/Task 1. Within an overall program designed to establish generalized imitation (Baer & Sherman, 1964), Child 1 was taught a number of imitative behaviors. For the first task, Child 1 was taught imitatively to put one hand out in front of his body, palm up. During the *arbitrary* condition, the therapist placed an M & M into the child's mouth contingent upon a correct response. In the following *functional* condition, an M & M was placed in the child's

outstretched hand contingent on that specific target response. Thus, stretching his hand out became functional in procuring the reinforcer.

Child 1/Task 2. The therapist also attempted to teach Child 1 to discriminate a pink box from a green box. During the *arbitrary* condition, the therapist contingently reinforced correct responses (picking up the pink box when instructed to, "Pick up pink") by placing an M & M in the child's mouth. In the subsequent *functional* condition, prior to the start of each trial (and shielded from the child's view) an M & M was placed under the pink box. Thus, in the functional condition, when the child emitted the target response of picking up the pink box, it was a functional step toward procuring the reinforcer located under the pink box.

Child 1/Task 3. Finally an attempt was made to teach Child 1 to open his mouth imitatively. In the *arbitrary* condition the therapist handed the child an M & M contingent upon a correct response. In the *functional* condition the M & M was placed directly in the child's mouth contingent on appropriate imitation. Thus, the child's opening his mouth was functional in procuring the reinforcer placed in his mouth.

Child 2/Task 1 and Child 3/Task 1. These children were taught to discriminate between a cup and a spoon, using juice as a reinforcer. During the *arbitrary* condition, a correct response to the instruction, "touch cup," was rewarded by handing the child a different cup containing a small amount of juice. In the following *functional* condition, a small amount of juice was located in the bottom (so that it was not visible from the child's seat) of the *same* cup that the therapist requested. Thus, touching that cup was a functional step toward procuring the reinforcer (juice) located within that cup.

Child 2/Task 2. Child 2 was taught to bend over imitatively. In the *arbitrary* condition, the therapist rewarded correct imitation by contingently handing the child a raisin. In the *functional* condition, the raisin was placed on a mat on the floor, and the child was permitted to pick up and eat the raisin, when he bent over.

Child 2/Task 3. Finally, Child 2 was taught to touch his head imitatively. In the *arbitrary* condition, a potato chip was handed to the child following a correct response, and in the *functional* condition, the chip was placed on top of his head. Thus, in the functional condition, the child needed to touch his head in order to procure the potato chip.

Reliability

The therapists recorded correct, incorrect, and prompted responses for every trial in the experiment. In addition, a reliability observer who was naive with respect to the experimental hypothesis sat beside the therapist and independently (i.e., with data sheets shielded from each other) recorded responding in all conditions for a total of 79% of the trials in this study (at least 33% of the trials for each target response). Percent agreement was calculated on a trial-by-trial basis, separately for correct and incorrect responding, using the formula agreements divided by agreements plus disagreements. Mean interobserver reliability was 99% (range: 80% to 100% across individual sessions).

RESULTS

The multiple baseline analysis of response acquisition under *arbitrary* vs. *functional* response-reinforcer conditions is presented in Figure 1. Blocks of five trials are plotted on the abscissa and percent correct (unprompted) responding is shown on the ordinate.

During the initial *arbitrary* condition, the percentage of correct responses for all children was consistently low (typically below 40%), with little or no evidence of acquisition of any of the target behaviors. None of the children came close to the 90% criterion for acquisition of any target behavior within their respective number of trials in the multiple baseline design.

In marked contrast, during the subsequent *functional* condition, all of the children began to show immediate evidence of acquiring the

Fig. 1. The results of the multiple baseline analysis of acquisition with functional vs. arbitrary response-reinforcer relationships.

target behavior as soon as the condition was instated. Further, all of the children rapidly achieved (and exceeded) the 90% criterion within a range of 5 to 25 trials.

During the reinstatement of the *arbitrary* condition, the children showed clear evidence of continued correct responding. For the six child/task combinations that were assessed, the percentage of correct responding remained consistently above 80%, and averaged well over 90%. Four of the child/task combinations showed stable 100% correct responding throughout the condition.

Table 1 presents the results of the assessment of *stimulus control*. The data from this discrimination assessment show that high rates of correct responding were maintained when target behaviors and other acquired behaviors were randomly alternated. For example, Child 1 averaged 90% correct responding (range: 80% to 100%) when the hand and mouth imitation tasks were randomly alternated. Child 2 showed 100% correct responding both when the bending and touch head imitation tasks were randomly alternated, and when "touch cup" was randomly alternated with "touch ball." These data suggest that responding was not maintained merely on the basis of a previously learned response set, but rather had come under the stimulus control of the therapist's instructions.

In summary, the results showed that: (1) only the functional response-reinforcer relationship produced rapid acquisition of the target behav-

ior; and (2) the high levels of correct responding produced by the functional response-reinforcer relationships were continued when the arbitrary conditions were subsequently reinstated.

DISCUSSION

The present investigation clearly demonstrated that functional response-reinforcer relationships resulted in very rapid response acquisition for these severely handicapped children. The experiment also demonstrated that once the response was acquired, it was learned sufficiently well to be maintained under the previously unsuccessful arbitrary response-reinforcer conditions.

There are several possible explanations for such results. First, when the target response is functional in (i.e., directly within the response chain leading to) procuring the reinforcer, it seems conceivable that the delay between the response and the reinforcer presentation may be minimized. Because of this possibility, in the present study latencies between the response and the reinforcer presentation were recorded; however, no systematic differences between the two conditions were found. For one task (Child 1/Task 2), the mean delay was longer during the functional condition. For other tasks, the delay was shorter (Child 1/Task 3; Child 2/Task 3). For still other tasks (Child 1/Task 1; Child 2/Task 1) the delays were equivalent in the two conditions. These observations suggest that the present results should not be attributed to a difference in delay of the reinforcer.

A second possible explanation for the present results has been suggested by Kazdin (1977). He noted that the efficacy of reinforcing one behavior is limited if an inappropriate response happens to be included as a part of the reinforced response chain. Relating this to the present results, we note that no irrelevant responses occur between the response and reinforcer when the response is a direct part of the response chain leading to procuring the reinforcer (functional condition). However, in the arbitrary condition,

Table 1

Assessment of stimulus control. The percent correct responding is shown separately for each target behavior when target behaviors were randomly alternated with other previously acquired behaviors.

Behavior		# of Trials	% Correct
Child 1	Hand Imitation	10	100
	Mouth Imitation	10	80
Child 2	Bending Imitation	20	100
	Touch Head Imitation	20	100
	Touch Cup	10	100
	Touch Ball	10	100

the child first has to make the target response, and then make an independent response to procure the reinforcer. Because this independent response is the last response in the chain, it may interfere with the acquisition of the target response.

A related explanation for the present results is that the functional relationship may increase attention to the specific task being reinforced. That is, although the *therapist* always knows exactly which specific behavior is being reinforced, from the *child's* point of view it may be more difficult to determine the exact target behavior that will be reinforced during the arbitrary condition because the child engages in many behaviors (cf. Baer, 1978). This latter explanation relates to the frequently reported difficulty autistic children evidence when confronted with multiple cues in learning situations (cf. Lovaas, Koegel, & Schreibman, 1979; Rincover & Koegel, 1975; Schreibman & Koegel, 1981b). Under such conditions, autistic children have great difficulty learning exactly which cues are relevant. Schreibman (1975) and Rincover (1978) suggested that "within stimulus prompts," which exaggerate relevant cues, may solve such problems by focusing the autistic child's attention on relevant portions of the teaching task. Similarly, a functional response-reinforcer relationship may serve to highlight the contingency between the reinforcer and the intended target behavior. The fact that correct responding continued at a high level even after the arbitrary conditions were reinstated is consistent with the notion that the functional relationship may have served to direct initial attention to the target response.

It is also possible to see other parallels that might help to understand the present results (Ferster, 1967; Skinner, Note 1). From a practical point of view, the major point of this article is that a relatively simple rearrangement of the stimulus conditions could serve to greatly enhance learning in autistic children. Continued investigation in this direction may prove to be a profitable area for future research.

REFERENCE NOTE

1. Skinner, B. F. *The role of the contrived reinforcer*. Paper presented at the Southern California Conference on Behavior Modification, Los Angeles, February 1979.

REFERENCES

- Baer, D. M. The behavioral analysis of trouble. In E. Allen, V. Holme, & R. Schiefelbusch (Eds.), *Early intervention: A team approach*. Baltimore: University Park Press, 1978.
- Baer, D. M., & Sherman, J. Reinforcement control of generalized imitation in young children. *Journal of Experimental Child Psychology*, 1964, 1, 37-49.
- Ferster, C. B. Arbitrary and natural reinforcement. *Psychological Record*, 1967, 17, 341-347.
- Goetz, L., Schuler, A., & Sailor, W. Teaching functional speech to the severely handicapped: Current issues. *Journal of Autism and Developmental Disorders*, 1979, 9, 325-343.
- Hersen, M., & Barlow, D. H. *Single case experimental designs: Strategies for studying behavior change*. New York: Pergamon Press, 1976.
- Kazdin, A. E. The influence of behavior preceding a reinforced response on behavior change in the classroom. *Journal of Applied Behavior Analysis*, 1977, 10, 299-310.
- Koegel, R. L., Dunlap, G., & Dyer, K. Intertrial interval duration and learning in autistic children. *Journal of Applied Behavior Analysis*, 1980, 13, 91-99.
- Koegel, R. L., Egel, A. L., & Dunlap, G. Learning characteristics of autistic children. In W. S. Sailor, B. Wilcox, & L. J. Brown (Eds.), *Methods of instruction with severely handicapped students*. Baltimore: Brookes Publishers, 1980.
- Koegel, R. L., Russo, D. C., & Rincover, A. Assessing and training teachers in the generalized use of behavior modification with autistic children. *Journal of Applied Behavior Analysis*, 1977, 10, 197-205.
- Koegel, R. L., & Williams, J. A. Direct vs. indirect response-reinforcer relationships in teaching autistic children. *Journal of Abnormal Child Psychology*, 1980, 8, 537-547.
- Lovaas, O. I., Koegel, R. L., & Schreibman, L. Stimulus overselectivity: A review of research. *Psychological Bulletin*, 1979, 86, 1236-1254.
- Lovaas, O. I., Young, D., & Newsom, C. D. Childhood psychosis: Behavioral treatment. In B. B. Wolman, J. Egan, & A. O. Ross (Eds.), *Handbook of treatment of mental disorders of childhood and adolescence*. Englewood Cliffs, N.J.: Prentice-Hall, 1978.
- Rincover, A. Variables affecting stimulus-fading and

- discriminative responding in psychotic children. *Journal of Abnormal Psychology*, 1978, 87, 541-553.
- Rincover, A., & Koegel, R. L. Setting generality and stimulus control in autistic children. *Journal of Applied Behavior Analysis*, 1975, 8, 235-246.
- Rincover, A., & Koegel, R. L. Research on the education of autistic children: Recent advances and future directions. In B. B. Lahey & A. E. Kazdin (Eds.), *Advances in clinical child psychology*, Vol. 1. New York: Plenum Press, 1977.
- Ritvo, E. R., & Freeman, B. J. National society for autistic children definition for the syndrome of autism. *Journal of Autism and Childhood Schizophrenia*, 1978, 8, 162-167.
- Saunders, R., & Sailor, W. A comparison of three strategies of reinforcement on two-choice language problems with severely retarded children. *AAESPH Review*, 1979, 4, 323-333.
- Schreibman, L. Effects of within-stimulus and extra-stimulus prompting on discrimination learning in autistic children. *Journal of Applied Behavior Analysis*, 1975, 8, 91-112.
- Schreibman, L., & Koegel, R. A guideline for planning behavior modification programs for autistic children. In S. M. Turner, K. S. Calhoun, & H. E. Adams (Eds.), *Handbook of clinical behavior therapy*. New York: John Wiley and Sons, 1981. (a)
- Schreibman, L., & Koegel, R. L. Multiple cue responding in autistic children. In P. Karoly & J. Steffen (Eds.), *Advances in child behavior analysis and therapy*. New York: Gardner Press, 1981. (b)

Received April 11, 1980

Final acceptance August 28, 1980