*THE ROLE OF RESPONSE DELAY IN IMPROVING THE
DISCRIMINATION PERFORMANCE OF
AUTISTIC CHILDREN*

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This study investigated the influence of a response delay requirement on the discrimination performance of autistic children. In the context of a multiple baseline design with subsequent repeated reversals, two conditions were compared: a no-response-delay condition, where the child was allowed to make the target response immediately after presentation of the discriminative stimulus versus a response-delay condition, where the target response was permitted three seconds following the discriminative stimulus when the therapist would signal the child to respond. The results showed that the response-delay condition produced higher levels of correct responding than the no-response-delay condition. In addition, teachers in the research setting rated the response-delay procedure to be a practical and effective teaching technique that could be implemented in a classroom setting. The results were discussed in relation to the literature on impulsivity, and were interpreted as indicating that the response-delay procedure provides a valuable technique for teaching autistic children.

DESCRIPTORS: response delay, impulsivity, stimulus control, discrimination, autistic children

A common observation made by teachers of autistic children is that their students often seem to respond before actually attending to the task (Oppenheim, 1974). Indeed, this phenomenon is reportedly characteristic of many children receiving special education (Epstein, Cullinan, & Sternberg, 1977; Hallahan, Kauffman, & Ball, 1973; Harcum & Harcum, 1973; Hayes & Prinz, 1975; Keogh & Donlon, 1972). One remedy that has been used is a "response-delay" procedure in which the teacher requires that the child refrain from responding to an instruction for a predetermined amount of time.

Response-delay procedures have been shown

to be effective in improving the performance of mentally retarded children (Harcum & Harcum, 1973) and low socioeconomic status children (Schwebel, 1966; Schwebel & Bernstein, 1970) on a variety of tasks. In addition, Lowry and Ross (1975) found that requiring severely retarded children to delay their responses served to improve their performance on color discrimination tasks. In a related area of investigation, Koegel, Dunlap, Richman, and Dyer (1981) found that requiring autistic children to label relevant cues verbally prior to responding served to facilitate learning on discrimination tasks. Response requirement in this case may have served to delay children's responding.

Therefore, the available literature suggests that a response-delay requirement may be beneficial in improving the learning behavior of autistic children. The present study was designed to test this hypothesis by evaluating the effects of the response-delay variable on the correct responding of three autistic children during discrimination training.

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METHOD

Experimental Setting

Participants

Three children participated in this study. Child 1, a 13-yr-old girl, was diagnosed as "developmentally delayed with autistic behaviors." Child 2, a 14-yr-old boy, and Child 3, a 13-yr-old girl, both had received diagnoses of "childhood psychosis with autistic features." Each child was diagnosed prior to the onset of the study by agencies not associated with the present research. All the children exhibited moderate to low levels of self-stimulatory behavior, and displayed marked deficits in social and self-help skills. Additionally, each child was functioning below age level in speech and language development, characterized by echolalia and limited conversational skills. Child 1 could label a wide variety of objects and showed an understanding of common object function. She spoke spontaneously in full sentences, and was able to respond appropriately to a variety of questions. She was beginning to learn pronouns, prepositions, and plurals. Child 2 displayed spontaneous utterances that were limited to expressing his basic needs, and was beginning to speak in full sentences. Additionally, he was acquiring color, size, and shape discriminations. Child 3 was able to state common object function, and would speak spontaneously in single words and phrases. Conceptually, she showed an understanding of prepositions and categorization. She was learning plurals, verbs, and pronouns. Each child was learning preacademic skills such as writing, sight word recognition, and counting. The children responded too inconsistently on standardized intelligence test measures to give meaningful results. However, on the AAMD Adaptive Behavior Scale (Nihira, Foster, Shellhaas, & Leland, 1975) all three children were estimated to be functioning between the 5- and 7-yr-old levels (i.e., 6 to 9 yr below their chronological age levels). The children were chosen randomly from a population of 39 children residing at the May Institute in Chatham, Massachusetts.

All experimental sessions were conducted in each child's regular classroom. The child was seated facing the therapist at a small table containing the stimulus and recording materials. Sessions ranged in length from 5 to 15 min with no more than three sessions per day and no more than three days between sessions. The therapists were the children's regular teachers, who were trained in behavior modification techniques for autistic children. One therapist was naive with respect to the experimental hypothesis for 33% of the experimental trials. The discrimination tasks were selected for each child from his or her regular classroom curricula, and the criterion for each task was determined by the teachers prior to the onset of the study.

Design and Experimental Conditions

To demonstrate replicability of treatment effects, a multiple baseline design across subjects, with subsequent repeated reversals, was used. The three children were each taught a different target behavior. For each child, two conditions were presented, a no-response-delay condition, and a response-delay condition. Each experimental condition used teaching procedures based on guidelines outlined by Koegel, Russo, and Rincover (1977). Specifically, the teacher waited until the child was attending (i.e., sitting quietly and looking at the therapist or stimulus material) and then presented an instruction. Correct responses were reinforced with social praise (e.g., "good work") and/or primary reinforcers. Incorrect responses and off-task behaviors were followed with a verbal reprimand (e.g., "no"). If a child was incorrect for three consecutive trials, prompting procedures (e.g., modeling the correct response) were used.

In the no-response-delay condition, the therapist was instructed to permit the child to respond immediately after the termination of the target instruction. In the response-delay condition, the therapist was instructed to wait 3 sec following the termination of the instruction before signal-

ing the child to make the target response. Thus, the response delay began following the termination of the discriminative stimulus (e.g., "raise your right hand") and ended with the therapist's signal to respond. With Child 2 and Child 3, the exact length of the response delay ranged from 3 to 5 sec. This variation occurred because these children would frequently and spontaneously repeat all or part of the therapist's instruction (or the response alternatives) during the delay period. When this occurred, the therapist allowed the child to respond immediately after finishing the task-related verbalization.

The specific tasks, criterion levels, and procedures for accomplishing the response-delay condition for each child are described in detail below.

Child 1: The task consisted of the discrimination of "his" and "her." In the no response-delay condition, two wooden figures (a male and a female) were placed in front of the child. The therapist presented an instruction such as "Point to his (or her) head." When the child pointed to the appropriate figure's head, her response was scored as correct and she was reinforced with social praise and a check mark (an established method of reinforcement for this child). When she pointed to the inappropriate figure, her response was scored as incorrect and was consequated with a verbal reprimand ("No"). If the child was incorrect for three consecutive trials, the therapist would prompt by pointing to the correct figure while presenting the instruction. The acquisition criterion for this task was 20 correct consecutive trials.

The response-delay condition was accomplished by holding the child's hands during the target instruction and, after a 3-sec interval, releasing the child's hands, allowing her to respond.

Child 2: The child was required to describe the function of two common objects. In the no-response-delay condition, one of two picture cards was placed in front of the child (i.e., a towel or a fork) and the therapist asked the question "What's this for?" After the question

was asked, the child's response was scored as correct if he answered "eat with" when the fork picture was presented, and "dry with" when the towel picture was used. Any other response made after the question was scored as incorrect. Each correct response was reinforced with social praise (e.g., "good"). All incorrect responses were consequated with a verbal reprimand ("No"). When the child was incorrect for three consecutive trials, the therapist prompted the child by modeling the correct response after asking the question, and then faded this prompt over successive trials. The acquisition criterion for this task was 8 out of 10 correct trials.

The response-delay condition for Child 2 consisted of (a) presenting the picture card to the child; (b) waiting 3 to 5 sec (while the child looked at the discriminative stimulus); and (c) asking the question "What's this for?", signaling the child to respond.

Child 3: The task for this child was the discrimination of "right" vs. "left." In the no-response-delay condition, the therapist presented the instruction "Raise your right (or left) hand." When the child raised the appropriate hand, her response was scored as correct and she was reinforced with an edible, paired with the statement "That's correct!" When she raised the inappropriate hand, her response was scored as incorrect and was consequated with the statement "That's wrong." When the child was incorrect for approximately three trials, the therapist prompted the child by manually guiding her to raise the appropriate hand. The acquisition criterion for this task was 30 correct consecutive trials.

In the response-delay condition, the therapist held the child's hands at the beginning of the trial, presented the target instruction, and after a 3- to 5-sec interval, released the child's hands, allowing her to respond.

Reliability of the Dependent Variable (Percent Correct Unprompted Child Responses)

The primary observer for each of the sessions was the therapist. Each trial was tallied as correct, prompted, or incorrect based on the criteria

and the definitions of each task. In each experimental condition, a second observer scored the trials independently along with the therapist for a total of 238 trials. The percent agreement was computed by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. The agreement scores ranged from 90% to 100%, with a mean of 97%.

Reliability of the Independent Variable (Response Delay)

Two observers (including one who was naive as to the purpose of the experiment) independently scored 10 trials from each experimental condition which were recorded on video cassettes. Before viewing the tapes, the delay and no-delay conditions were described to the observers. Trials were then viewed in random order from a video cassette recorder, and scored as a response-delay trial or a no-response-delay trial. The data from the two observers were then compared for reliability on a trial-by-trial basis. The percent agreement (calculated by dividing the number of agreements divided by number of agreements plus disagreements and multiplying by 100) was 100%.

Teacher Satisfaction Survey

To assess the ease of implementing the response-delay procedure in a regular classroom setting, a questionnaire was given 4 mo after the study was completed to 12 teachers in the research setting who used this strategy in their classrooms. The survey included the following questions: "Which condition (delay or no-delay) did you find to be more effective? Which condition did you prefer? Did you find either condition difficult to implement? Have you used the delay procedure since the study was completed?" The respondents to the questionnaire remained anonymous. The survey was scored independently by two raters, and the percent agreement on the scoring of each of the survey questions (total agreements divided by total agreements plus disagreements) was 100%.

RESULTS

The results of this investigation are shown in Figure 1. Blocks of 10 trials are plotted on the abscissa with the percent correct of unprompted trials on the ordinate. The data show that the response-delay condition produced higher percentages of correct responding for each child. In the first graph presented, Child 1 showed low levels of correct responding during the first no-delay condition, averaging 60% across 40 trials. When the condition was changed to the same task using the response-delay procedure, the child's correct responding immediately increased, reaching 90% in the second block of 10 trials. A reversal to the no-delay condition produced a subsequent decrease to an average of 45% correct responding. This was followed by a final reversal to the delay condition, with the child reaching the acquisition criterion of 100% correct responding in the last two blocks of 10 trials.

Examination of the remaining graphs reveals essentially the same effect for the other two children, i.e., the response-delay condition always produced higher levels of correct responding relative to the no-response-delay condition.

Figure 2 presents the results of the teacher satisfaction survey. The data show that: (a) of the 12 teachers, 10 rated the delay procedure as more effective; and (2) had used it subsequent to the termination of the study. Seven of these teachers preferred this procedure over the no-delay procedure and nine reported that the delay procedure had not been difficult to implement.

DISCUSSION

The results show that requiring these autistic children to delay their responding significantly improved their performance on discrimination tasks. Response delay procedures have been used as a characteristic treatment for impulsivity (Digate, Epstein, Cullinan, & Switzky, 1978). Impulsive behavior, characterized by rapid responding, is related to poor performance in normal

Fig. 1. Results of the multiple baseline analysis with subsequent repeated reversals of the influence of a response-delay requirement on the correct responding of autistic children.

children (Kagan, 1965), disadvantaged children (Schwabel, 1966; Schwabel & Bernstein, 1970), and mentally retarded children (Duckworth, Ragland, Sommerfield, & Wyne, 1974; Harcum & Harcum, 1973; Lowry & Ross, 1975). Therefore, the poor performance of the autistic chil-

dren in the present investigation may have been due to problematic impulsive responding during the no-response-delay conditions.

There are several other variables relating to impulsive responding that are relevant here. First, there is a correlation between rapid re-

Fig. 2. Results of the survey assessing teacher satisfaction with the response-delay procedure.

sponse time and errors that initially appears in children at approximately 5 yr of age. In addition, response time reportedly increases as the children get older (Messer, 1976). This is particularly interesting as other authors have suggested that autistic children's deficits may be a result of a developmental lag (Schopler, 1965). Therefore, the success of this procedure may have been due to the fact that the children in this investigation were functioning between 5- and 7-yr-old-levels.

Second, impulsivity is a variable effecting selective attention and the initial labeling of stimulus characteristics (Kagan, 1965). For example, several investigators have shown that impulsive

children display difficulty responding to relevant cues in visual discrimination tasks (Hallahan *et al.*, 1973; Odom, McIntyre, & Neale, 1971; Weiner & Berzonsky, 1975). Further, White (1965) has demonstrated that children respond to different aspects of the stimulus in different time zones after the presentation of the stimulus, and Siegel, Babich, and Kirasic (1974) reported that response time is directly related to the number of relevant cues to which children respond. This may have been the case with the autistic children in the present study, where they may have responded before orienting to the relevant cues of the discriminative stimulus during the no-delay condition. This might

also explain their deterioration in performance when the delay requirement was removed in the third phase of the experiment. Similarly, since autistic children characteristically display problematic overselective responding to a restricted number of cues (Koegel & Wilhelm, 1973; Lovaas, Koegel, & Schreibman, 1979; Lovaas & Schreibman, 1971; Lovaas, Schreibman, Koegel, & Rehm, 1971), the response delay may have provided the children with time to orient to all the relevant cues before making the target response.

Koegel et al., (1981) found that requiring autistic children to make specific verbal orienting responses to problematic relevant cues before responding served to facilitate their learning. These researchers speculated that this procedure served to facilitate learning by reducing impulsivity in these children. This hypothesis is supported by Michenbaum and Goodman (1971) who found that teaching impulsive children to make task-related verbalizations before responding served to improve their performance on a variety of tasks. They speculated that this procedure served to "bring an impulsive child's overt behavior under his own verbal discriminative control." (p. 124).

Anecdotal observation revealed that the children in this study would frequently spontaneously verbalize the relevant cues during the delay period. Thus, an interesting area for future research would be to assess the role of a response-delay requirement on stimulus overselectivity. One child (Child 2) in this investigation was reported to have verbalized the response alternatives during the delay period. Therefore, a third conceptualization could be that the delay period allowed the children time to reflect over alternative solution hypotheses (Kagan, 1965).

If the delay period did aid by allowing more time to attend to all the necessary cues and to consider the response alternatives, a possible area of investigation would be to determine if a longer delay period would prove to be more beneficial. However, pilot data from our re-

search setting show that a 6-sec delay produces a deterioration of correct responding, suggesting a "response-delay threshold" that may vary as a function of child/task characteristics.

Additional Data Pertaining to Maintenance and an Alternative Strategy to Accomplish the Delay

In the present investigation an immediate decrease in correct responding was witnessed after the delay requirement was removed. These results suggest the necessity of research designed to establish maintenance of correct responding. To remedy this problem the following strategy was tested in our research setting: Two additional children were taught the discrimination of "on" versus "under" with the response delay procedure. After reaching criterion on this task, the delay requirement was removed for 50 trials to determine whether high levels of correct responding would be maintained during the no-delay condition.

The data in Figure 3 show the results of this strategy. Child 4 reached criterion during the delay condition in 280 trials. When the delay requirement was removed, there was an initial decrease in correct responding to 70% during the first 10 trials, but high levels of correct responding were rapidly attained, averaging 90% across the last 40 trials. The results for Child 5 are less clear. This child, after reaching criterion during the delay condition, evidenced an initial drop to 60% correct responding during the first 10 trials of the no-delay condition. However, high levels of correct responding were rapidly attained, averaging 83% across the last 30 trials.

The success of this procedure could have resulted from teaching the children to delay their responding during the initial phases of the discrimination task. This could build a response chain in which the child would respond with a delay to a particular stimulus each time it was presented. Therefore, the child would continue to respond with a delay to this discriminative stimulus when the delay requirement is finally

Fig. 3. Effects on the maintenance of correct responding implementing the no-response-delay procedure after reaching criterion using the response-delay procedure.

removed. Further, as the target response becomes firmly established, it would soon occur with a shorter latency (White, 1965), preventing reversals of treatment gains during typically encountered no-delay conditions. The therapists who tested this maintenance strategy reported anecdotally that the children responded with a delay during the initial trials in the no-delay condition, and gradually responded with shorter latencies during the final trials of this condition.

While testing the above maintenance strategy with these two children, a procedure other than holding down the child's hands was used to accomplish the delay. This was implemented because three of the 12 teachers reported in the teacher satisfaction survey that this procedure produced attempts by the child to avoid physical contact, suggesting that the procedure functioned as a punisher. Therefore, the strategy used by Lowry and Ross (1975), where the stimulus materials were held out of reach during the delay period, was implemented. This procedure

was successful in accomplishing the delay with these two children. It is therefore important to consider child and task characteristics when determining how to accomplish the delay procedure.

The teachers who completed the satisfaction survey indicated that the response-delay technique is a practical method that they used in their classrooms. These reports were validated one year following the study when the teachers were observed using this procedure. They reported that response delay was particularly effective with autistic children who exhibited problems with impulsivity, such as responding before visually scanning the stimulus materials or before the teacher completed the target instruction. They did not, however, find the procedure effective with "lower level" children who displayed high rates of self-stimulatory behavior and had not yet acquired attentional skills prerequisite to learning, such as sustained eye contact with the therapist and/or stimulus materials.

This observation is consistent with research conducted by White (1965) which showed that while normal 4½- to 6½-yr-old children showed correlations between correct responding and response time during discrimination training, 3½- to 4½-yr-old children did not show this correlation. Further, the participants in this study were "higher level" autistic children who were functioning between 5- and 7-yr-old levels. Therefore, an important area of future research would be to compare high- and low-level autistic children using the response-delay procedure.

These results have important implications for the education and development of classroom curricula because the response-delay technique provides a simple, effective method for improving the performance of autistic children. Indeed, teaching children to delay their responding across every teaching interaction may significantly improve the overall behavior of autistic children in their learning environments. Because the results of the present investigation suggest that impulsivity may play a leading role in the learning difficulties characteristic of autistic children, examination of the variable may be a very promising area of future research.

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