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ABSTRACT

This study investigated the effects of between-trials variability on the alternation discrimination of retardates. Brightness and size were variable between trials and irrelevant. Initial response outcome and mental age were also independent variables. Neither between-trials variability nor mental age produced a significant main effect, while the main effect of initial response outcome was significant. Nonreinforcement of the first response was associated with significantly more non-alternation responses than was the condition of reinforcement for the first response. The results were discussed in terms of the Zeaman-House Attention theory and subject response predispositions.

SOME EFFECTS OF BETWEEN-TRIALS VARIABILITY AND INITIAL RESPONSE OUTCOME ON THE ALTERNATION DISCRIMINATION LEARNING OF MENTALLY RETARDED ADOLESCENTS*

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A recent version of the Zeaman-House Attention theory predicts that a discrimination response may be a simultaneous reaction to the observation of cues within two separate stimulus dimensions (House & Zeaman, 1963; Zeaman & House, 1963). Thus, there is a specific theoretical basis for the prediction that discrimination learning responses may be based on bidimensional aspects of discrimination tasks.

Empirical evidence for this position has been reported by Eimas (1964, 1965), House and Zeaman (1963), and Zeaman, Thaller, and House (1964). In each study, subjects were found to make discrimination responses on the basis of bidimensional stimulus characteristics. On another aspect of this phenomenon, House and Zeaman (1963) report that responses to bidimensional cues appear to be positively related to mental age. One interpretation of their work is that the tendency to respond to bidimensional cues may be linearly developmental in nature and should be exhibited in different degrees by retardates at different stages of mental development as defined by mental age.

Evans and Beedle (1970) report findings which suggest that irrelevant dimensions which are constant within trials, but are variable between trials may influence discrimination task difficulty. The condition of between-trials variability produces a bidimensional distraction by breaking down stimulus compounds which would ordinarily be present in every trial. Even

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though an irrelevant dimension is never differentially reinforced on a single trial, the subject is confronted with different stimulus compounds from trial to trial. In other words, the condition of between-trials variability produces bidimensional cues which may divert the subject's attention from task relevant stimulus dimensions.

Conditions of initial response outcome appear to be another factor that may influence discrimination learning behavior. Ellis, Girardeau, and Pryer (1962) and House and Zeaman (1958) found that under certain conditions, the response outcome for the initial trial of a discrimination task appears to influence the discrimination learning behavior that is exhibited throughout the entire task. When a single stimulus is presented initially and is associated with reinforcement or nonreinforcement, discrimination performance is influenced on subsequent stimulus pairs that include the initially presented stimulus (Ellis, Girardeau, & Pryer, 1962; House & Zeaman, 1958). It appears that two-choice discrimination learning performance may be facilitated, when the initially presented stimulus is associated with nonreward (House & Zeaman, 1958; Ellis, Girardeau, & Pryer, 1962). The results of these studies seem to suggest that "avoidance sets" may facilitate learning to a greater degree than "approach sets." Further, reinforcement of an initial response to a single stimulus is associated with perseveration of that response, even if such action does not maximize reward (House & Zeaman, 1958). If these findings are generalizable to an initial two stimulus situation, it would seem that initial reinforcement could be hypothesized to be associated with lower levels of discrimination learning performance than the level of performance associated with initial nonreinforcement.

There is evidence in the area of response predispositions that the response patterns manifested in a two-choice task are related to the mental ages of the subjects in the choice situation. Gerjuoy and Gerjuoy (1965), Shusterman (1965), Jeffrey and Cohen (1965), Gerjuoy, Winters, and Hoats (1966), and Shusterman (1963) have demonstrated that children with mental ages below ten years tend to exhibit one of two response patterns: single alternation or perseveration. The observations of these investigators suggest that mental age levels below five years are associated with perseveration behavior (Shusterman, 1965; Jeffrey & Cohen, 1965; Ellis & Arnoult, 1965). In addition, the mental age range from five to ten years was observed to be associated with single alternation behavior (Gerjuoy & Winters, 1965; Gerjuoy & Gerjuoy, 1965; Shusterman, 1963). Above the mental age level of ten years, there is evidence that this group exhibits complex response patterns in binary choice tasks (Shusterman, 1963; Jeffrey & Cohen, 1965). Specifically, this means that this group did not exhibit a response pattern which could be described as a simple recurrent pattern. Overall, the evidence suggests that a developmental relationship exists between response patterns and mental age. Further, single alternation appears to be a response tendency that is developmentally predominant among adolescent educable retardates.

The purpose of the present study was to investigate the effects of Between-Trials Variability (B.T.V.), Initial Response Outcome, and Mental Age Level on the two-choice spatial alternation discrimination learning of retardates.

METHOD

Subjects

The sixty subjects used in the present study were mentally retarded students from a residential training facility in eastern Pennsylvania. The subjects were selected randomly from an available pool of students with extrapolated mental ages of five years or greater based on the Wechsler Intelligence Scale for Children. In addition, teachers described all eligible subjects as having no serious emotional, speech, hearing, or physical disabilities. The intelligence quotient and chronological age means and ranges for the sample were respectively, 67.48 (range: 44-85) and 186.70 months (range: 144-215 months). A summary of subject characteristics is provided in Table I.

See Table I

The sixty subjects were assigned to one of the twelve cells of the experimental design. First, subjects were randomly assigned to one of three Between-Trials Variability conditions ("high," "intermediate," and "low"). In each of the three groups, one half of the subjects were assigned randomly to either the initial reinforcement condition or to the initial nonreinforcement condition. Finally, each reinforcement-complexity treatment group was divided into above and below median mental age subgroups. For example, the 10 subjects who received the high Between-Trials Variability condition in combination with the condition of initial response reinforcement were divided into above and below median mental age subgroups, based on the median mental age for this particular group of subjects.

Factorial analyses of variance performed on chronological age, mental age, and intelligence revealed no significant differences as a function of random assignment.

Stimuli

The subjects were exposed to one of three stimulus conditions: "low," "intermediate," or "high" Between-Trials Variability. Each stimulus condition consisted of two-choice tasks in which the stimuli were pairs of arrows. Based on a random sequence, one arrow was oriented downward and the other arrow was oriented upward. The sequence of directionality was identical for all conditions. In the "low" condition, the stimulus pairs consisted of equal sized, large, black arrows. Fifty percent of the stimulus pairs in the intermediate condition were identical to the low condition and the other half were pairs of small black arrows of equal size. In the "high" condition, 50 percent of the stimulus set were pairs of large, black, equal sized arrows, while the remainder of the stimulus pairs were dyads of small arrows of identical size and color -- half of the pairs were black and the other pairs were white. The sequence of size, brightness, and vertical directionality was determined by a Fellows (1962) series. Figure I presents samples of the stimulus conditions.

See Figure I

Apparatus

The basic apparatus was a Modern Teaching Associates (MTA) 400 Scholar teaching machine. This apparatus consisted of a console containing four transparent, plexiglas response panels, with a transparent display panel centered above the response panels. The upper display panel and both the leftmost and rightmost response panels were masked from view. The discrimination stimulus pairs were presented under the two center response panels. A subject responded by depressing the response panel directly above one of the discrimination choices. Depression of the response panel automatically advanced the MTA 400 Scholar to present the next discrimination learning trial.

In addition to the MTA 400 Scholar, a remote controlled "M & M" candy dispenser also was used. The candy dispenser was mounted on the right side of the MTA 400 Scholar and was situated within easy reaching distance of the subject.

The experimenter manually activated the candy dispenser to reinforce each single alternation response made by the subject. A single piece of "M & M" candy was yielded each time the candy dispenser was activated. The candy dispenser was activated by a silent button switch which was kept concealed beneath the experimenter's clipboard.

Procedure

The subjects were given experimental treatments in individual sessions. The order of the treatment sessions were randomly assigned to all participating subjects.

Single alternation based on position was the designated correct response for all treatments. The subjects received an"M & M"candy reinforcement for each single alternation response and no reinforcement for non-alternation behavior. A noncorrection procedure was used in all treatments. The learning criterion was ten consecutive correct responses. The subjects who met this criterion prior to the completion of sixty trials received no further training and were considered "learners." The subjects who failed to meet this criterion were given a total of sixty trials and were considered "nonlearners." The subjects who reached criterion were detrained through continuation of the task without reinforcement for single alternation. Detraining involved a minimum of ten trials and was used to minimize the possibility of intersubject communication that might have contaminated untested subjects.

The instructions for the experiment were as follows:

> See this machine? We're going to use this to do a game. See this? (Experimenter points to the plastic windows and the pair of arrows.) You will choose one of these by pressing on the one that you want. (A demonstration.) If you pick the correct one, you will get an"M & M"candy. Here is a paper bag to put your candy in. After you make a pick, two new arrows will come up to pick from. Any questions? (Pause.) The game is to see if you can figure out how to get candy every time. Any questions? (Pause.) O.K., let's start.

RESULTS

The experimental arrangement for the present investigation corresponded to a 3 x 2 x 2 factorial analysis of variance, with Between-Trials Variability, Initial Response Outcome, and Mental Age as the three independent variables. The dependent variable was the number of non-alternation responses or "errors" produced prior to the attainment of learning criterion or to the completion of sixty trials. Table II presents the raw score means and standard deviations for the treatment groups.

See Table II

A logarithmic transformation was performed on the raw error scores, because the error score distribution was positively skewed and contained extreme scores. A summary of the factorial analysis of variance, performed on the transformed scores, is presented in Table III.

See Table III

Inspection of Table III reveals that the main effect of Initial Response Outcome was significant at the .05 level ($F = 4.57$; df = 1,48), with the initial nonreinforcement condition associated with more non-alternation responses than were associated with the initial reinforcement condition. Neither the main effects of Mental Age ($F = 1.70$; df = 1,48), nor Between-Trials Variability were statistically significant. In addition, none of the interaction terms were statistically significant.

DISCUSSION

Alternation discrimination learning appears to be an extremely easy task for adolescent, educable retardates. Ninety percent (54 of 60) of the subjects in the present study reached the relatively stringent learning criterion of ten consecutive correct responses. Further, the experimental sample produced a mean of only 3.4 non-alternation responses, and 67 percent (40 of 60) of the sample alternated in the first two trials. These results are consistent with the observations by Clinton and Evans (1970), where 87 percent (50 of 57) reached criterion, over 90 percent (52 of 57) alternated in the first two trials, and a mean of 4.89 non-alternation responses were made in a task of identical length. However, unlike the studies by Gerjuoy and Winters (1965), Gerjuoy and Gerjuoy (1965), and Shusterman (1963) which found single alternation behavior to be greatest in the five to ten year mental age range, the present study revealed no significant differences in alternation behavior between subjects in the five to ten year mental age range and higher mental age subjects.

The absence of a significant Mental Age Level effect may have been attributable to insufficient separation between the above median and below median mental age groups. Since the subjects were drawn from a relatively homogeneous pool of students, the formation of groups on the basis of median mental age may not have produced sufficiently divergent groups. If a larger, more heterogeneous subject pool had been available, perhaps sufficiently divergent groups could have been formed without sacrificing sample size.

Initial Response Outcome, the second independent variable, produced statistically significant differences in single alternation behavior. The non-reinforcement of initial response treatment was associated with more non-alternation responses than was the reinforcement of initial response treatment. A possible explanation of this effect lies in the amount of reinforcement received in the first two trials. Under initial reinforcement, a relevant task approach, such as an unconditional alternation strategy, would result in reinforcement for each of the first two trials; however, under initial nonreinforcement, the same strategy would result in only a single instance of reinforcement. Thus, if the continuation of a task strategy is related to the amount of reinforcement received under that strategy, it would be expected that relevant task approaches are more likely to be continued under initial reinforcement, than under initial nonreinforcement.

Inspection of the first two responses of all subjects revealed that 40 (67 percent) of the experimental sample alternated in the first two trials. Within the Initial Response Outcome conditions, 19 of 30 subjects alternated initially in the nonreinforcement condition, and 21 of 30 subjects initially alternated in the initial reinforcement condition. Since, it was observed that subjects in both Initial Response Outcome groups demonstrated high and approximately equivalent levels of single alternation in the first two trials, the hypothesis that the majority of subjects possessed an unconditional alternation set would seem to have some empirical support.

The apparent differences in observations on the effects of Initial Response Outcome, as compared to House and Zeaman (1958) and Ellis, Girardeau, and Pryer (1962), may be reflections of methodological differences. In those two studies, the methodology in the first two trials focused more on approach-avoidance behavior, than on alternation based on position. By contrast, the present study was concerned entirely with position based alternation, both in the initial two trials and throughout the remainder of the experimental task.

Between-Trials Variability produced no significant effects. This absence of significant effects may have been influenced by several factors. First, the single alternation task may have been so easy that Between-Trials Variability was not an effective competitor for the attention of subjects. In effect, so much "attention" was directed at a position alternation relevant dimension, that relatively little "attention" was available for Between-Trials Variability. If this floor effect did occur, it might be predicted that Between-Trials Variability would be a more effective distractor of attention in tasks which require behavior that is more complex than single alternation. Second, there may not have been adequate separation between the levels of the Between-Trials Variability factor. That is, the levels of Between-Trials Variability may not have been sufficiently dissimilar to contribute a differential effect. Third, the lack of a between-trials constant and within-trials constant control group prevents the determination of whether the latter possibility occurred, or whether all Between-Trials Variability conditions would have produced more non-alternation than an appropriate control group.

In terms of implications, knowledge of single alternation phenomenon may be employed to facilitate learning (a) through the development of pretraining techniques to minimize alternation tendencies that might compete with a desired behavior, (b) through the development of educational material formats that reduce the possibility of irrelevant single alternation behavior, (c) through training techniques that employ single alternation behavior to increase the probability of correct stimulus-response matches in the early stages of learning.

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FOOTNOTE

[1] This paper is based on a Doctoral thesis submitted to Teachers College, June 1970.

TABLE I

CHARACTERISTICS OF THE TWELVE TREATMENT GROUPS

		"Low" B.T.V.		"Inter." B.T.V.		"High" B.T.V.	
		"High" MA	"Low" MA	"High" MA	"Low" MA	"High" MA	"Low" MA
Initial Response Reinforcement	Mean CA	183.00	184.20	194.40	191.20	193.40	168.00
	S. D.	21.70	21.57	13.32	26.13	7.54	23.45
	Mean IQ	76.40	56.60	74.20	55.80	71.60	66.00
	S. D.	6.10	9.18	10.13	13.29	5.41	14.05
	Mean MA	139.42	105.60	144.02	104.12	138.64	108.46
	S. D.	16.63	8.61	20.52	11.70	14.16	12.35
Initial Response Non-Reinforcement	Mean CA	194.80	181.80	194.00	185.20	182.60	182.80
	S. D.	7.73	12.62	11.25	20.62	10.38	14.81
	Mean IQ	74.00	62.00	76.40	60.00	76.00	60.80
	S. D.	8.28	6.20	3.36	7.31	7.81	8.32
	Mean MA	144.08	112.26	148.02	111.36	138.22	110.70
	S. D.	16.49	8.27	6.78	21.67	8.77	14.28

TABLE II

MEANS AND STANDARD DEVIATIONS FOR NON-ALTERNATION RESPONSES

(Collapsed Over Mental Age Levels)

	"Low" Complexity		"Medium" Complexity		"High" Complexity	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Initial Response Reinforcement	1.00	1.33	1.70	2.71	1.30	1.64
Initial Response Non-Reinforcement	4.20	9.32	8.70	11.96	3.50	5.82

TABLE III

ANALYSIS OF VARIANCE ON LOG ERRORS

Source of Variation	df	MS	F
A Reinforcement	1	0.472	4.57*
B Mental Age	1	0.175	1.70
C Between-Trials Variability	2	0.131	1.26
A x B	1	0.104	1.01
A x C	2	0.062	0.60
B x C	2	0.013	0.13
A x B x C	2	0.014	0.14
Error (Within Cell)	48	0.103	

*$p < .05$

FIGURE I

STIMULUS CONDITIONS