Effect of stimulus variation upon reversal shift performance of kindergarten children

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Two experiments examined the effects of differences between stimulus conditions present during an initial learning task and a reversal task. Each experiment consisted of four groups of kindergarten children trained in a two-choice discrimination problem. All Ss first learned a simple form discrimination in which the discriminanda were of the same color. Immediately upon reaching criterion, all Ss were required to learn a reversal, i.e., learn to respond to the formerly nonreinforced stimulus. For Group 1, the control group, the stimulus conditions remained constant during reversal. Group 2 had the color of the stimuli changed; Group 3 had the size of the stimuli altered, and Group 4 had both color and size changed during reversal. The results provide support for the idea that reversal speed is a function of the variability between the stimulus conditions of the learning and the reversal tasks.

A recent experiment (Viney, Boyer, & Viney, 1969) demonstrated that reversal shift (RS) performance was a negative function of the commonality of a secondary reinforcement complex associated with training and test problems. It was suggested in this study that RS performance might also be a negative function of the commonality of stimulus characteristics associated with the discriminanda which are utilized in training and test problems. While there is evidence of a relationship between RS performance and stimulus conditions common to training and test problems (Fritz & Blank, 1968), the relationship between the extent of stimulus change and RS performance has not been directly established. The primary purpose of the experiments reported here was to test directly the effect of variation in stimulus characteristics of the discriminanda associated with training and test problems.

In the typical RS problem, S is required to make a discrimination between two stimuli, one associated with reward and one associated with nonreward. Following the initial task, the two stimuli are reversed so that the stimulus formerly associated with reward is now associated with nonreward and the stimulus formerly associated with nonreward is now associated with reward. The RS task may be viewed as involving both extinction of response to the cue formerly associated with reward and acquisition of response to the cue formerly associated with nonreward. Presumably, any condition which facilitates extinction, acquisition, or cue sampling in the test task should facilitate RS performance. Stimulus change factors may well constitute such a condition. Accordingly, it was predicted that the greater the differences in the discriminanda

associated with training and test problems, the faster the learning of the test or reversal problem.

EXPERIMENT 1

Thirty-four male and 30 female kindergarten children from a middle-class public school in Fort Collins, Colorado, served as Ss. The apparatus consisted of a midgray aluminum display panel, 20 x 18 in., containing a window, 4½ in. high x 8 in. wide, through which pairs of stimuli were presented. The window was centered 4 in. from the top of the panel and an opaque Masonite door could be raised or lowered for purposes of changing the stimulus cards. A response button was located 2½ in. below each of the stimuli, which S could push to indicate his choice. Two openings and containers into which marble rewards could be delivered via solenoid-operated mechanisms located behind the panel, were 1½ in. from the bottom of the panel and 4 in. from the sides. The discriminanda consisted of a rectangle and a circle, 5 sq in. each, constructed of plastic Dymo tape centered on 8 x 4 in. Masonite plaques.

Each S was individually tested in a small room and informed that he was about to play a game involving prizes. The E then demonstrated how pushing the button could result in the delivery of a marble and asked S to complete one practice trial. Special emphasis was placed on the importance of winning a marble on every trial. The E then indicated that at the completion of the game the marbles could be exchanged for a prize, and S was allowed to examine an assortment of small and inexpensive plastic objects and animals. Following examination of the prizes, discrimination training began. Each S first learned a simple form discrimination using either a circle or rectangle as the positive stimulus. Both stimuli were of the

same color, and half the Ss were trained with black stimuli, the other half with red stimuli. The noncorrection procedure was used throughout, and the learning criterion consisted of nine successive correct responses for both training and test problems. The intertrial interval was approximately 5 sec. Immediately upon reaching criterion, S was required to learn a reversal. During reversal training, Ss were assigned randomly to one of four conditions. For Group 1, the stimulus conditions remained constant. That is, if a S was initially confronted with red rectangle and red circle, he was still confronted with red rectangle and red circle, the only difference being that the formerly rewarded discriminandum was no longer rewarded, and vice versa. For Group 2, the color of the stimuli was changed, i.e., from black to red or from red to black. For Group 3, the size of the stimuli was reduced by one-half, i.e., from 5 sq in. to 2.5 sq in. For Group 4, both color and size were altered during the RS problem.

Results

An analysis of variance indicated equivalence of performance of the four experimental groups on the training problem ($F < 1.0$). The measure used in analyzing the reversal data was percentage of errors (i.e., number of errors in reversal divided by trials to reversal criterion $\times 100$). Because these scores were heterogeneously variable, a $\sqrt{X} + \sqrt{X + 1}$ transformation was carried out in order to satisfy the homogeneity of variance assumption. An analysis of variance conducted on the transformed scores revealed a significant difference across the four reversal conditions ($F = 4.56$, $df = 3/60$, $p < .01$), indicating that the groups were not equivalent in terms of reversal performance. Dunnett's test revealed that Group 2 (color change) committed fewer errors ($p < .025$) than did controls on test problems. Similarly, Group 4 (both color and size change) reversed faster ($p < .025$) than control Ss. The difference between Ss receiving a reduction in the size of the stimulus (Group 3) and the control group was small and not significant.

EXPERIMENT 2

The design of the second experiment was essentially the same as that of Experiment 1, and its main purpose was to determine if an increase in the size of the stimuli during test problems would affect reversal performance.

The Ss were 10 male and 34 female kindergarten children from a Fort Collins public school. The apparatus, stimuli, instructions,

Table 1
Transformed Means and SDs for Four Reversal Conditions for Two Experiments

Condition	Experiment 1		Experiment 2	
	Mean	SD	Mean	SD
No Change (Control)	9.59	2.03	9.35	2.62
Size Change Alone	9.49	2.86	7.40	1.08
Color Change Alone	7.34	2.41	6.67	.61
Color and Size Change	7.44	1.46	8.36	2.05

problems, and procedure were identical to those used in the previous experiment with the following exceptions: (1) the stimuli were initially one-half the size of those employed in Experiment 1, i.e., 2.5 sq in.; and (2) instead of reducing the size of the stimuli, as was the case for Group 3 in Experiment 1, the stimuli were doubled in size during reversal.

Results

An analysis of variance of the training phase scores indicated no differences ($F < 1.0$) among the four treatment groups. The percentage of errors during reversal was again subjected to a $\sqrt{X} + \sqrt{X+1}$ transformation. An analysis of variance of these transformed scores indicated a significant difference ($F = 84.75$, $df = 3/40$, $p < .001$) over the four reversal conditions. Each of the experimental groups was then compared with the control group, using Dunnett's procedure. The color change ($p < .01$) and size change ($p < .05$) groups were both reliably different from the control group. However, contrary to prediction and the results of Experiment 1, the combined color-change and size-increase group failed to differ from the no-change group.

DISCUSSION

The main hypothesis in the present experiments was that the more similar the initial training condition and the reversal condition, the slower the reversal speed. This has partially been confirmed. The results indicate that color change alone, during test problems, produced the most rapid reversal learning. Size change alone also facilitated reversal in one experiment, but in another its only influence appeared to be when associated with a color change. However, further examination of the mean values suggests that the facilitatory effect was largely due to the color cue. The discrepant result produced by manipulating the size variable may be a function of the direction in which the change occurred. When size change alone was effective, the direction of change was from small to large. When size appeared to have minimal influence, the direction of change was from large to small. Consequently, it is possible

that when size is decreased, its saliency is reduced in a compound stimulus situation.

It is not clear why the effectiveness of the combined color and size cue change was restricted to the size decrease condition. One possible explanation is that reduction in the size cue may have allowed the more distinctive color cue to overshadow the weaker size cue, thereby permitting the color cue to control RS performance. Conversely, in the size-increase condition in Experiment 2, where the combined color-size effect was not significant, a novel color cue in combination with a relatively salient size cue may have provided some competition between the cues or served as distractors for S's attention, thus eliminating any significant facilitatory effect. These findings appear to indicate that the combined effects of both color and size change during test problems did not produce maximum reversal speed

as expected. Although speculative, it is plausible that the very young child's attention or cue sampling is restricted to one highly salient background cue during reversal trials.

The results of the two studies suggest that variation in the dominant cues associated with discriminanda utilized in training and test problems can influence reversal speed, possibly by increasing the probability of cue sampling in the test problem and reducing the number of repetitive errors. Such evidence is relevant to studies which attempt to compare RS with nonreversal shift (NRS) learning. Since the stimuli associated with both training and test problems are typically more similar for one type of shift (RS) than another (NRS), comparisons between shifts may be partially explained on the basis of variations in stimulus conditions.

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The effects of disorganizing cues on the utilization of a mnemonic structure*

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To test the hypothesis that disorganizing cues would impair total recall and disrupt the utilization of a mnemonic structure, four groups of Ss were given a list in a free-recall task which was a combination of mnemonic structure (serial or random order) and cuing paradigm (organizing or disorganizing cues). Results revealed that (1) the mnemonic structure enhanced total recall, (2) disorganizing cues tended to disrupt the utilization of the mnemonic structure, and (3) a significant relationship was seen between the nature of the cue and whether or not the S attempted to utilize it.

In a recent investigation of mnemonic structuring (Haney &

Bruning, 1970), it was found that "cue saliency," the extent to which Ss were aware of the relationship between task-associated cues and stimuli to be recalled, was directly related to (1) organizational efficiency of output and (2) total recall. These results were interpreted to suggest that Ss tended to employ a wide range of their own

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