Fixation and choice selectivity during discrimination transfer

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The Ss received training to compound stimuli in the presence of redundant, but related, stimuli with either simultaneous or go/no-go presentation. During transfer, the two elements of the compounds were presented separately to permit differential fixations. Patterns of selective fixations emerged early in training, with S fixating the reinforcing stimulus more frequently than the other stimuli. Amount of training lowered fixation frequency during transfer, but did not alter the pattern of selective fixations. Selective fixation of related redundant stimuli during training was related to fixation and choice selectivity during transfer.

When components of a stimulus are arrayed spatially, selective eye-movement parameters are related to choices of critical components. This relationship has been demonstrated for pattern recognition (Gould, 1967), problem solving (Kaplan & Schoenfeld, 1966), inspection of aerial photographs (Mackworth & Morandi, 1967), signal monitoring (Schroeder & Holland, in press), and simple discrimination (Schroeder, in press, a, b).

Schroeder (in press, a, b) examined eye movements during discrete-trial discrimination tasks. Results showed that Ss fixated all components of the stimulus initially, but soon came to fixate most often the reinforcing stimulus and then redundant stimuli less often. Decreasing stimulus luminance raised fixation frequency. Practice decreased fixations of all stimuli in an orderly pattern. Irregular patterns of fixations of S during go/no-go presentation were related to stimulus ambiguity. The present experiment extended this research to the study of the effects of redundant relevant-cue (RRC) training on fixation and choice selectivity during transfer to a related task.

SUBJECTS

Undergraduates (16 female and 14 male) from the University of Pittsburgh were assigned randomly to six groups of five each. All had normal vision and were naive with respect to the task and apparatus.

APPARATUS

The Ss were seated 28 in. from a 7.5 x 7.5 in. screen on the corners of which white stimuli (1 x 1 in.) were projected from the rear on a 2 x 2 in. dark background. Programming and recording was performed automatically with relay equipment and the Mackworth eye-movement camera, Model V-1164-2 (see Schroeder, in press, a).

PROCEDURE

The S was seated in an adjustable dental chair and instructed that his pupil diameter would be recorded. He was then told to choose the correct figure on each slide by pressing one of four buttons corresponding to the four corners of the screen. If his choice was correct, a green light would appear in the center of the screen; if incorrect, a red light would appear. A yellow light next to each corner indicated to S which choice he had made.

Correct choices were followed by a green light for 3 sec and an advance to the next slide; incorrect choices were followed by a 30-sec red light and no advance of the slide. During go/no-go presentation, a correct choice on S^{Δ} slides was refraining from button pressing for 3 sec. Each S was paid $1.50 at the end of the session.

Each figure on each slide appeared in each corner area in irregular sequence, but an equal number of times for each block of 20 trials. Groups 1, 2, and 3 received simultaneous presentation of square with vertical line superposed (S^D), circle with horizontal line superposed (S^{Δ}), and triangle and oblique line (redundant stimuli) in the other two corners during training. During transfer, redundant stimuli were dropped, and square, circle, vertical line, and horizontal line were presented simultaneously. Groups 4, 5, and 6 were go/no-go groups. During training, S^D slides contained square with vertical line superposed, hexagon, triangle, and oblique line; S^{Δ} slides contained circle with horizontal line superposed, hexagon, triangle, and oblique line. During transfer, S^D slides contained square, triangle, vertical, and oblique lines; S^{Δ} slides had circle, triangle, horizontal, and oblique lines. Groups 1 and 4 received no training and 80 trials on transfer slides; Groups 2 and 5 received 20 training and 80 transfer trials; Groups 3 and 6 received 80 training and 80 transfer trials.

RESULTS AND DISCUSSION

Choice Behavior

All Ss made 2 or less errors during training and transfer, except for three Ss in Group 4 and one S in Group 6, who made 9 or less errors. Only 8 errors occurred during all transfer trials. Training trials might therefore be considered overtraining.

On transfer slides, Ss chose either square (25 Ss) or vertical line (5 Ss), but never both. The all-or-none nature of choices here is similar to that found in single-cue tests following RRC training (e.g., Trabasso & Bower, 1968), although the present procedure differed in that reinforcement and both relevant cues were present during transfer. The prevalent choice of form over line orientation is probably due to differences in discriminability. Schroeder (in press, a) found, with a very similar task, that reducing the difference in brightness between form and line resulted in choice of either stimulus about equally often.

As a control procedure, a quadrant analysis of choice and fixation data was made to insure that mere position of the stimulus was not affecting the results. In all groups, the number of fixations and choices of each corner of the screen differed very little.

Fixation Frequency

Figure 1 shows the effects of training on level and distribution of fixations for simultaneous and successive (go/no-go) discrimination during transfer. Points in the figure are group means of the total fixations of each stimulus by each S for an entire session. Stimuli were ordered from one to four according to individuals' fixation frequencies. For the simultaneous groups (1, 2, and 3), the order was the same for all Ss: square, circle, vertical line, horizontal line. For the go/no-go groups (4, 5, and 6), the order differs for individuals. Stimuli 1 and 3 are reinforcing stimuli (square, circle, vertical or horizontal line); 2 and 4 are redundant stimuli (triangle or oblique line).

A repeated-measures analysis of variance (Lindquist, 1956), comparing 0, 20, and 80 training trial groups, distribution of fixations to the four stimuli, and simultaneous vs go/no-go presentation, showed only fixations to the four stimuli to differ significantly ($F = 93.59$, $df = 3,72$, $p < .005$). Duncan's multiple-range test (Edwards, 1960), however, showed the no-training groups' means to differ from the 80-trial training groups' means at the $p < .05$ level for simultaneous and $p < .01$ level for the go/no-go presentation group. Training, therefore, lowered the level of fixation frequency during transfer. However, it did not alter the distribution of selective fixations since no interactions were significant.

Analysis of fixation frequency by 20-trial blocks showed that fixation frequency decreased early in training, and this lower level transferred to the second task. Premack & Collier (1966), using an observing-response procedure, where the S pressed a key for a brief flash of light on the discriminanda, found a similar result for reversal learning in humans. Their contention was that discrimination learning

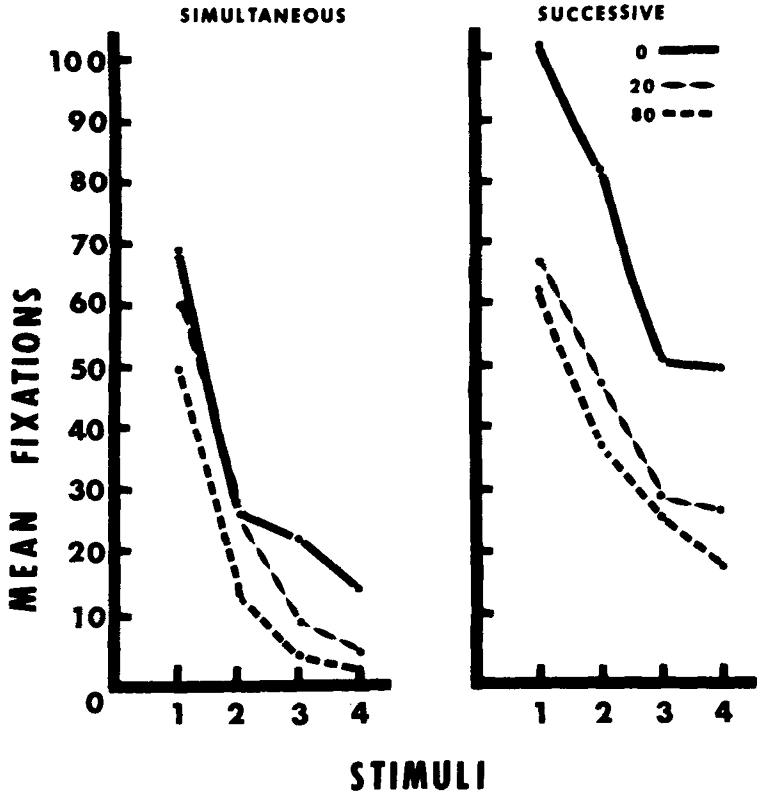

Fig. 1. Distribution of fixations to each transfer stimulus for simultaneous and successive (go/no-go) discrimination for each training group (0, 20, 80 training trials).

is a two-stage process. The first involves familiarization with stimulus and response contingencies in the task; the second is the solution to the problem involved.

Fixation selectivity during training transferred to selectivity on the second task. If S fixated redundant form stimuli more often than redundant line stimuli during training, he chose and fixated form stimuli more often during transfer. The same held for line stimuli. All Ss in Groups 2, 3, 5, and 6, choosing square during transfer (17 of 20), fixated the triangle more than the oblique line during training. Of the three Ss choosing vertical line during transfer, two fixated the oblique line more than the triangle during training. While the differences between fixation frequencies of redundant stimuli were small, the consistency of fixation patterns from one S to the next raises the interesting possibility that differential fixation frequency of related redundant stimuli, when presented with compound stimuli, may provide an estimate of which aspect of the compound is exerting more stimulus control.

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NOTES

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Direct reinforcement, sex of model, sex of subject, and learning by vicarious reinforcement[1]

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This experiment compared imitation of male and female models under a vicarious-reinforcement (VR) and a combination VR/direct-reinforcement (DR) condition. Both sexes were used as Ss, and female Ss performed significantly better than did male Ss. The sex of the model was only significant in the VR condition, where the female model was superior. The VR-DR treatment proved to be significantly more effective than VR alone.

Vicarious reinforcement (VR) is the observation of contingent reinforcement for certain responses of a model. Research on VR has demonstrated it to be more effective in producing imitation than has observation of a nonreinforced model, and, as a result, VR has been the object of considerable recent research (cf. the review of Flanders, 1968). As yet, however, no research has been conducted on model characteristics that may effect learning by VR. One of the most obvious model characteristics to investigate is sex, and Bandura, Ross, & Ross (1961) have hypothesized that, because of past reinforcement history, "one would expect . . . subjects to imitate the behavior of a same sex model to a greater degree than the model of the opposite sex [p. 575]." However, the little research on sex-of-model effects with nonreinforced