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AUTHOR Goldstein, Sondra B.; Siegel, Alexander W.
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ABSTRACT

In this study, 48 third-grade children learned a successive, two-choice discrimination under one of three conditions: (1) immediate reinforcement (IM), (2) 10-second empty delay (ED), and (3) 10-second delay with the discriminative stimuli in view of S (FD). The performances of groups IM and FD were only marginally different, and were both superior to that of group ED. The reversal performances of the three groups did not differ significantly. Average latencies were significantly longer in groups FD and ED than in IM. It was condluded that in group FD a set to observe stimuli was established during delay which generalized to the preresponse interval and facilitated performance. (Author)

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## OBSERVING BEHAVIOR AND CHILDREN'S DISCRIMINATION LEARNING

SONDRA BLEVINS GOLDSTEIN AND ALEXANDER W. SIEGEL

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Sondra B. Goldstein and Alexander W. Siegel

Learning Research and Development Center

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Sondra Blevins Goldstein and Alexander W. Siegel

University of Pittsburgh

Abstract

Forty-eight third-grade children learned a successive, two-choice discrimination under one of three conditions: immediate reinforcement (IM), 10-second empty delay (ED), and 10-second delay with the discriminative stimuli in view of S (FD). The performances of group IM and FD were only marginally different, and were both superior to that of group ED. The reversal performances of the three groups did not differ significantly. Average latencies were significantly longer in groups FD and ED than in IM. It was concluded that in group FD a set to observe stimuli was established during delay which generalized to the preresponse interval and facilitated performance.

OBSERVING BEHAVIOR AND CHILDREN'S DISCRIMINATION LEARNING[1]

Sondra Blevins Goldstein and Alexander W. Siegel

University of Pittsburgh

Recently, the role of observing responses in children's discrimination learning has been given considerable theoretical consideration. Descriptions of children's discrimination learning and concept formation (Wright, 1964; Cantor, 1965; Trabasso & Bower, 1968) have emphasized the importance of discrimination of cue or dimensional relevance for both learning and transfer. Together with verbal mediating responses, dimensionally selective observing responses (ORs) and perceptual mediating responses have been proposed as subsidiary response systems that facilitate discrimination performance by enhancing the salience of relevant stimulus cues (Kendler & Kendler, 1962; Zeaman & House, 1963).

Tighe & Tighe (1966) categorize mediation theories of discrimination learning as "subtractive" when the theories assume that the mediating response functions as a selective mechanism which subtracts irrelevant stimuli from total stimulation. The label for the mechanism varies from theorist to theorist; for example: Observing response (Wyckoff, 1952; Wright & Smothergill, 1967), the isolation of relevant stimulus dimensions (Sutherland, 1959), and the relative strength of observing versus instrumental responses (Zeaman & House,

1963; Lovejoy, 1966). But whatever the terminology, these interpretations are in essential agreement that the function of (perceptual) mediating responses is to increase the probability that only the relevant stimuli within the discrimination task will control the response.

Previous studies have found that ORs can be induced in different ways, resulting in increased performance. ORs induced by pretraining experience (Wright & Daehler, 1966) increased the probability of observing the relevant stimuli in the discrimination, and thus facilitated oddity problem performance. When ORs were elicited by stimulus availability during a delay of reinforcement period in a simultaneous, two-choice discrimination task, the delay did not produce the usual decrement in performance (Wright and Smothergill, 1967).

Wright and Smothergill (1967) attributed the facilitation in the performance of the stimulus-available delay groups to the generalization of ORs, elicited during delay, to the preresponse interval on the next trial. Delay group Ss who made extensive comparisons of the stimuli prior to choosing had less difficulty differentiating them and reached criterion sooner.

To measure ORs, Wright & Smothergill (1967) used a S- operated lever which brought either stimulus (but not both at once) into focus. The number of lever movements during the preresponse intervals for all Ss, and during the delay period for stimulus-available delay Ss, constituted the OR data. Only the stimulus-available delay groups

received reinforcement directly following manipulation of the lever during the delay period. Thus, it is possible that manipulating the lever became a stronger instrumental response for these delay groups. One might argue that it was not the ORs of stimulus-available delay groups, but rather their instrumental lever response which generalized to the preresponse interval. The superior performance of the stimulus-available delay groups might have been simply the result of additional exposure to stimuli, per se, during delay, providing opportunities for Ss to compare stimuli, and preventing competing responses during delay.

The present study investigated the effects on performance of stimulus exposure during the delay of reinforcement period. The study was designed to determine whether stimulus availability during delay would (a) facilitate performance in a standard successive, two-choice discrimination task, (b) result in a generalization of ORs to the preresponse interval as measured by longer average latencies, and (c) facilitate reversal performance by increasing the probability of attending to relevant stimulus cues on the initial reversal trials (Lovejoy, 1960).

## Method

Subjects and design. The Ss were fifty-seven third-grade children from middle-class backgrounds. The average age of the Ss was 8.9 years (S.D. = 0.4 years). The average I.Q. of the Ss as

measured by the Detroit Intelligence Test (a group test) was 120.0 (S.D. = 12.1). Nine Ss who failed to reach criterion on the initial learning task (8 in group ED, 1 in group FD) were eliminated from the final sample in an attempt to obtain 16 "learners" in each group. The final sample consisted of 48 children, with 16 Ss (8 boys and 8 girls) in each of three conditions: immediate reinforcement (IM), empty delay (ED), and filled delay (FD). Group IM received a marble reinforcer immediately after making a correct response to a discriminative stimulus. Group ED received the same reinforcement after a 10-second delay during which the discriminative stimuli were absent from the S's view. Group FD received reinforcement after a 10-second delay during which the stimulus presented on a given trial remained in view in front of the S. A 1/2-second buzzer was used to indicate an incorrect response for all Ss after the delay interval appropriate for each condition.

Apparatus and stimuli. The apparatus consisted of a stimulus display and response console placed on a table at a height comfortable for S. S responded by depressing one of two black buttons (one inch in diameter) spaced 10 inches apart and 5 inches from the front edge of a 20-x 20-inch sloping panel. This panel was mounted on a 20-inch wide plywood frame, 4 1/2 inches high at the front edge, and 8 1/2 inches high at the back edge. Attached to the top of the sloping panel was 20-x 20-inch vertical panel. Centrally located in

this panel was a 6-x 5-inch rectangular opening behind which was mounted a piece of flash-white glass that served as the stimulus-display screen. The stimulus pictures (2-x 2-inch black and white slides) were presented by rear projection onto the screen by a Kodak Carousel projector.

Reinforcers (marbles) were dispensed automatically through a chute into an aluminun box attached to the bottom front edge of the console panel. The children could later exchange the marbles for a small prize such as a coin purse, or model planes and cars. Pressing either response button activated a timer preset for the appropriate response-reinforcement interval (0 or 10 seconds). Time sequencing, projector control, and reinforcer delivery were controlled by programmed automatic switching equipment. Responses, indicated by signal lights at the rear of the apparatus, were recorded by E. Latencies for all responses (time between presentation of the stimulus slide and the S's button press) were obtained from a reset timer and recorded by E.

Two stimuli (a circle and a square) were used as the discriminative stimuli for warm-up. Two similar geometric figures from the Raven's Progressive Matrices Test were used as the discriminative stimuli for the training and reversal phases. One figure was a black square with four lines extending outward from the corners and four lines extending outward from the midpoints of the sides. The other

figure was a black diamond with an area equal to the square. Four straight lines extended outward at right angles from the midpoints of the sides of the diamond. The line extensions from the corners of the square and the midpoints of the diamond sides were equal in length to one square or diamond side. The line extensions from the midpoints of the square sides were half the length of the square sides.

Procedure. The E seated the S in front of the apparatus and began the warm-up series which consisted of a demonstration and explanation of the response buttons, stimuli, reinforcing event, and marble receptacle. The S was told that he would have to start by guessing, but that the correct button would always get him a marble, and that if he earned enough marbles he could exchange them for a prize. In the warm-up phase, the stimuli were presented randomly until the S had four consecutive correct responses. All Ss had the same delay condition in warm-up (0 or 10 seconds) as in the training and reversal phases.

At the beginning of training a resume of instructions was given to all Ss. For half the Ss in each condition, one of the two discriminative stimuli was arbitrarily assigned as correct. A random order of slides was used in all phases with the restriction that no stimulus appeared more than twice in a row.

The criterion for all Ss during training and reversal was 9 out of 10 consecutive correct responses. If the criterion was not met in 80 trials, training was discontinued. Immediately after criterion was met, reversal trials were begun. If Ss did not meet criterion in 30 trials, reversal trials were discontinued.

## Results

All learning measures--trials to criterion on the initial discrimination, trials to reversal, and latencies--were subjected to 3 (Condition) X 2 (Sex) analyses of variance.

Discrimination trials. The mean number of trials to criterion on the initial discrimination for each Condition X Sex subgroup is presented in Table 1. The significant main effect of Condition ($F$ =

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Insert Table 1 about here

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8.64, $df$ = 2/42, $p$<.01) indicated that group ED took significantly more trials to reach criterion (50.06) than did either group FD (28.56) or group IM (21.37) ($t \geq 2.46$, $df$ = 30, $p$<.05), whereas the difference between groups IM and FD was only marginally significant ($t$ = 2.04, $df$ = 30, .05<$p$<.10). Although the main effect of Sex was not significant, the significant Condition X Sex interaction ($F$ = 3.72, $df$ = 2/42. $p$<.05) indicated that whereas in group ED, boys took more trials to learn than did girls, and in group FD girls took more

trials to learn than did boys, in neither case was this difference significant ($t \leq 1.96$, $df = 14$, $.05<p<.10$). While the performance of boys in groups IM and FD was significantly superior to that of boys in group ED ($t \geq 4.01$, $df = 14$, $p<.01$), the performance of girls in the three experimental groups did not differ significantly ($t \leq 1.58$, $df = 14$, $p>.10$). While all Ss in groups IM and FD reached criterion, four Ss in group ED failed to reach the criterion of 9 out of 10 consecutive correct responses in the maximum possible 80 trials. The four Ss in group ED who did not meet criterion were not given reversal training. Although an analysis of variance with number of correct responses in five-trial blocks as the repeated measure was not performed, it is apparent from Figure 1 that the acquisition function for the three groups is markedly different.

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Insert Figure 1 about here

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Reversal trials. Contrary to prediction, the analysis yielded a nonsignificant Condition effect ($F = 2.15$, $df = 2/38$, $p>.10$), indicating that the three groups did not differ significantly on number of trials to reversal criterion. Neither the main effect of Sex nor the interaction was significant. While all 16 Ss in group IM reached reversal criterion within 30 trials, 6 of the 12 Ss in group ED and 7 of the 16 Ss in group FD failed to do so.

Latencies. Analyses of mean latencies during the initial discrimination and reversal both yielded significant main effects of Condition ($F \geq 8.25$, $df = 2/42$, $p < .01$). For both discrimination and reversal trials, the mean latencies of group IM (2.93 and 2.76 seconds, respectively) were significantly shorter than those of both groups FD (4.62, 3.96) and ED (3.89, 3.79) ($t \geq 3.09$, $df = 30$, $p < .01$), whereas there were no significant differences between these latter groups ($t \leq 1.73$, $df = 30$, $p > .10$). For both discrimination and reversal trials, neither the main effect of Sex nor the Sex X Condition interaction was significant.

## Discussion

The present study found that stimulus availability during delay of reinforcement clearly facilitated performance, with the result that only a minimal (and nonsignificant) delay decrement was found in group FD as compared to an immediate reinforcement group IM. The usual delay decrement in performance was found in group ED. The three experimental groups did not differ significantly on number of trials to reversal criterion. Thus, no support was found for the hypothesis that additional exposure to stimuli during delay would facilitate reversal performance.

The present study found significantly longer response latencies in group FD than in group IM, whereas the latencies of groups FD and ED did not differ. These findings are congruent with those of

Wright & Smothergill (1967): The preresponse ORs for stimulus-available delay groups were more extensive than those of an immediate reinforcement group. It is possible that the same explanation applies to both the longer preresponse latencies in group FD (present study) and more extensive preresponse ORs (Wright & Smothergill, 1967): The main effect of making stimuli available during delay is to strengthen the tendency to make ORs whenever the stimuli are available, and thus to lengthen response latencies (or enhance preresponse looking behavior).

If this explanation is correct, the equally long response latencies of group ED require a separate explanation. Simple stimulus deprivation, unique to group ED, may explain the longer response latencies (Odom, 1964). Either a deprivation manipulation (a 10-second empty delay) or an extra opportunity to practice ORs during delay (a 10-second stimulus-available delay) may increase preresponse looking behavior and so lengthen response latencies. However, as is shown by their slower learning, the preresponse ORs of group ED did not appear to be primarily information-getting in nature.

In conclusion, the present study found that stimulus presence during delay of reinforcement intervals enhanced performance, and to a large extent prevented the usual delay-produced decrement. An explanation offered for this effect was that stimulus presence during delay acts as a bridging mechanism, and strengthens the tendency to

make ORs whenever the stimuli are available. This enhances preresponse looking behavior, resulting in longer response latencies, and ensures faster establishment of stimulus cue relevance which facilitates discrimination learning over the empty delay condition.

Goldstein

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Footnote

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Table 1

Mean Number of Trials to Criterion on Original

Discrimination and Reversal Learning

| Experimental Group | Discrimination Learning | | | | | | Reversal Learning | |
|---|---|---|---|---|---|---|---|---|
| | All Ss | | Boys | | Girls | | All Ss | |
| | $\bar{X}$ | S.D. | $\bar{X}$ | S.D. | $\bar{X}$ | S.D. | $\bar{X}$ | S.D. |
| IM | 21.37 | 12.39 | 20.87 | 11.75 | 21.87 | 14.56 | 16.81 | 5.41 |
| FD | 28.56 | 17.45 | 20.87 | 10.59 | 36.25 | 21.18 | 21.18 | 8.88 |
| ED | 50.06 | 28.64 | 61.75 | 28.11 | 38.37 | 27.79 | 22.50 | 8.60 |

Figure Caption

Figure 1. Acquisition functions in initial discrimination.

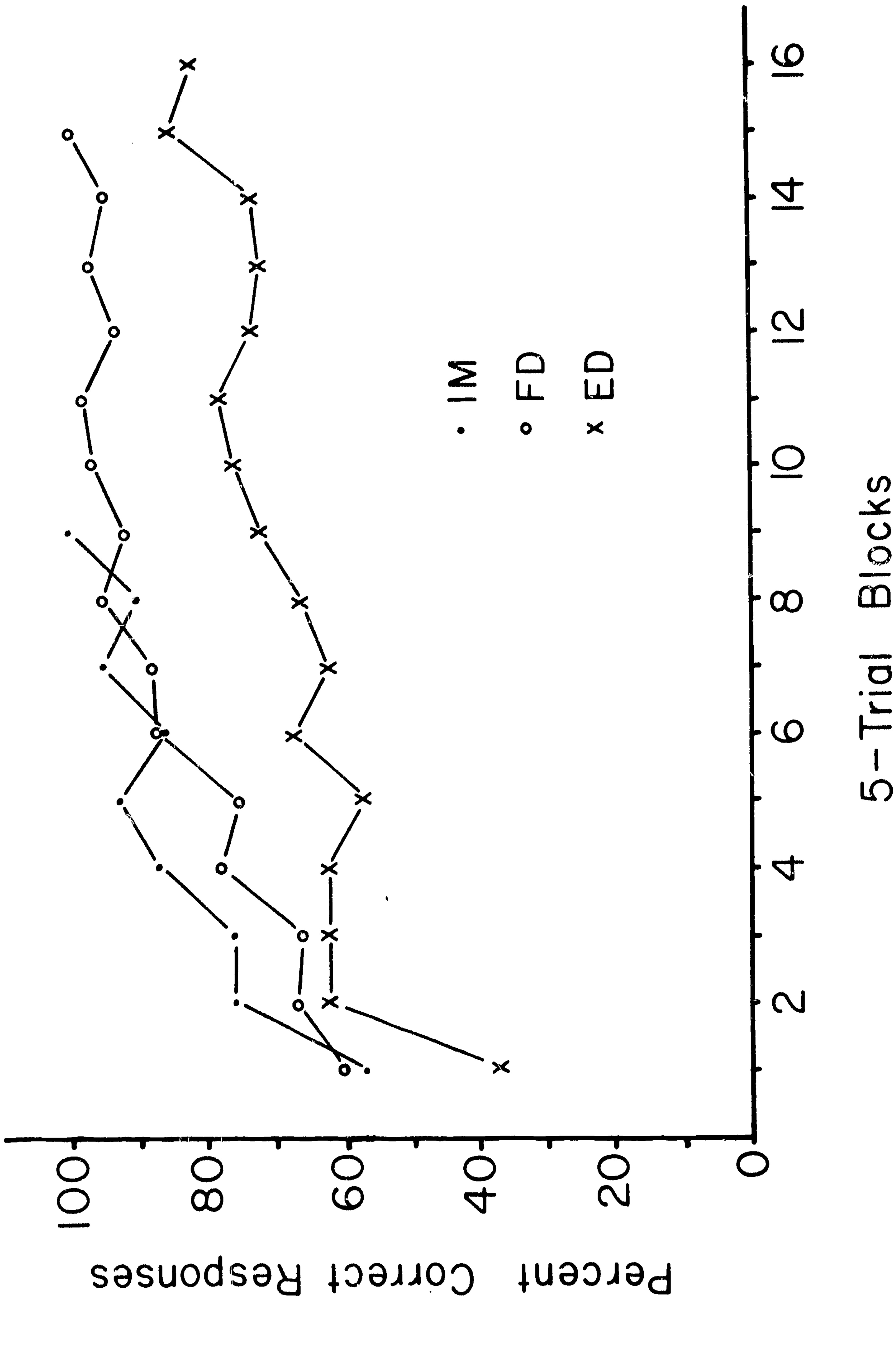


Figure 1. Acquisition functions in initial discrimination.

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6780 Cortona Drive
Santa Barbara Research Park
Goleta, California 93107

MISCELLANEOUS

1 Dr. Henry S. Odbert
National Science Foundation
1800 "G" Street, N. W.
Washington, D. C. 20550

1 Dr. Gabriel D. Ofiesh
Center for Educational Technology
Catholic University
4001 Harewood Road, N. E.
Washington, D. C. 20017

1 Dr. Joseph W. Rigney
Electronics Personnel Research Group
University of Southern California
University Park
Los Angeles, California 90007

1 Dr. Arthur I. Siegel
Applied Psychological Services
Science Center
404 East Lancaster Avenue
Wayne, Pennsylvania 19087

1 Dr. Arthur W. Staats
Department of Psychology
University of Hawaii
Honolulu, Hawaii 96822

1 Dr. Lawrence M. Stolurow
Harvard Computing Center
6 Appian Way
Cambridge, Massachusetts 02138

1 Dr. Ledyard R. Tucker
Department of Psychology
University of Illinois
Urbana, Illinois 61801

1 Dr. Benton J. Underwood
Department of Psychology
Northwestern University
Evanston, Illinois 60201

1 Dr. Joseph A. Van Campen
Institute for Math Studies in the
Social Sciences
Stanford University
Stanford, California 94305

1 Dr. John Annett
Department of Psychology
Hull University
Yorkshire
England

1 Dr. M. C. Shelesnyak
Interdisciplinary Communications Program
Smithsonian Institution
1025 Fifteenth Street, N. W.
Suite 700
Washington, D. C. 20005

1 Dr. Lee J. Cronbach
School of Education
Stanford University
Stanford, California 94305

1 Dr. John C. Flanagan
Applied Institutes for Research
P. O. Box 1113
Palo Alto, California 94302

1 Dr. M. D. Havron
Human Sciences Research, Inc.
Westgate Industrial Park
7710 Old Springhouse Road
McLean, Virginia 22101

1 Dr. Roger A. Kaufman
Department of Education
Institute of Instructional System
Technology & Research
Chapman College
Orange, California 92666