CUE RETENTION IN RETARDATE DISCRIMINATION LEARNING

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CHAPTER I

THE PROBLEM

Introduction

The study of discrimination learning in various types of organisms is a basic area of research and theoretical interest in psychology. Different theoretical positions have been developed to explain performance in two choice discrimination situations. Traditional S-R theorists (e.g., Spence, 1936) have emphasized the single process of associative habit strength development between the relevant stimuli of a problem and the response tendencies of the organism. Recent experiments (Goodwin & Lawrence, 1955; Kendler & Kendler, 1962; Zeaman & House, 1963) suggest that, in addition to an association process, a mediating response process is also required to explain adequately discrimination performance. The mediating response is postulated to be an implicit response which provides internal stimuli (cues) which affect overt responding.

The present study is concerned with the theoretical systems of Goodwin and Lawrence (1955) and Zeaman and House (1963). Both systems have incorporated the concept of mediating responses with an associative s-r process. Goodwin and Lawrence emphasize that acquired preferences for specific cues are retained across problems in which new learning has occurred. House and Zeaman (1963) have indicated that such retention does not occur. The purpose of this study is twofold: (1) to explore the possibility of cue retention with "retarded" subjects, and (2) to compare and contrast the theoretical adequacy of the Goodwin-Lawrence and Zeaman-House positions with a mentally retarded population.

A useful method for testing the theoretical adequacy of mediating mechanisms is the employment of various transfer operations following acquisition of a discrimination problem. Transfer operations involve the manipulation of "cues" and "dimensions" of a previous discrimination problem. Dimension refers to a common characteristic of a class of stimuli, e.g., color, form, size, etc. Cues refer to specific stimulus aspects within a dimension, e.g., circle, triangle, and square are cues within the dimension of form.

Three commonly employed transfer operations are intradimensional, extradimensional, and reversal shifts. In an intradimensional shift problem, the relevant dimension of the previous problem remains relevant but new cues of the relevant dimension are introduced. An extradimensional shift involves the replacement of the previously relevant dimension with a new relevant dimension. A reversal shift indicates that the reinforcement contingencies associated with the relevant cues of the previous problem are reversed, i.e., the previously positive cue is made negative, and the previously negative cue is made positive for the shift problem.

Theoretical Positions

Zeaman and House (1963) have proposed an attention theory to explain the discrimination learning of mentally retarded individuals. The primary assumption of the theory is "that retardates suffer from a low initial probability of observing certain relevant dimensions rather than from poor ability to learn which of the observed cues is correct." They have postulated that a chain of two responses is required to explain retardate discrimination learning: (1) an attentional or observing response to the relevant dimension, and (2) an instrumental approach response to the correct cue of that dimension. The probability of observing the relevant dimension (P_o) and the probability of approaching the correct cue (P_r) are assumed to develop gradually in direct relation to the occurrence and non-occurrence of reward. For solution of a problem, the organism must learn to observe the relevant dimension and approach the positive cue of that dimension. Both P_o and P_r are assumed to approach unity with the attainment of acquisition criterion. The theory specifies differential effects of various transfer operations on P_o and P_r, and thus provides predictions regarding performance in transfer problems.

Goodwin and Lawrence (1955) have also proposed a dual process mechanism to account for discrimination learning and performance in successive shifts when the relevant stimuli of the second shift are the same as those used in the original training problem. The two processes are: (1) an identification of, or reaction to, a dimension or set of stimuli, and (2) the establishment of preferences between stimuli within the set. The mediating and associational processes occur simultaneously but at different rates; i.e., acquisition and extinction of the identification response occurs more rapidly than the establishment and extinction of stimulus preferences. "The assumption that these two classes of behavior are learned and extinguished at differential rates allows the preference for one stimulus aspect to retain its habit strength and remain nonfunctional even though it is present in the physical environment while Ss are systematically reacting to other stimulus aspects." Thus, in an extradimensional shift, the rapid extinction of the original identification response prevents extinction of preferences for cues within that dimension and provides for positive transfer when the original stimulus dimension is once again relevant.

The observing response of Zeaman and House, and the identification response of Goodwin and Lawrence are similar in that they function selectively to limit the number of cues to which instrumental responses may become associated. Goodwin and Lawrence's emphasis on a rapidly extinguishing mediating response is in contrast to the assumption of Zeaman and House that mediating and association processes may be acquired and extinguished at a similar rate. Finally, the assumption by Goodwin and Lawrence that cue preference can be retained across problems involving learning of new cues has no parallel in the system of Zeaman and House.

Statement of the Problem

The present study was designed to investigate the possibility that specific cue preference is retained across problems involving the learning of new cues by mentally retarded Ss. The problem of cue retention has not been systematically explored with retardates.

All subjects (Ss) received training on a form relevant discrimination problem in which color cues were variable and irrelevant. After initial training, Ss were given either two successive ID shifts or two successive ED shifts. The first ID shift had new form relevant and color irrelevant cues. The first ED shift had new color relevant and form irrelevant cues. In the second shifts, each S in the ID and ED shift conditions was given one of three form relevant, color irrelevant problems which varied according to the type of cue condition used:

(1) The first problem had the identical form cues and reinforcement contingencies of original training. This was referred to as the "Same" cue condition.

(2) The second problem had new form cues and was labeled the "Intradimensional" cue condition.

(3) The third problem had the identical form cues of original training but the reinforcement contingencies associated with these cues were reversed. This was referred to as the "Reversal" cue condition.

The use of two dimensional conditions and three cue conditions in the second shifts resulted in a total of six experimental conditions. These were labeled ID-Same, ID-Intradimensional, ID-Reversal, ED-Same, ED-Intradimensional, and ED-Reversal. These conditions were devised: (1) to determine if performance in either the second ID or ED shift is differentially affected by the introduction of the cues of original learning, and (2) to determine if performance within the second shift problems is differentially affected by ID and ED shifts.

Theoretical Predictions

Zeaman and House

The probability of observing the relevant dimension (P_o) of form and the probability of approaching the correct cue (P_r) of the form dimension should be quite high for all Ss following training on the original discrimination problem. The introduction of the first ID shift problem will involve a high initial P_o since the same relevant dimension of original training is used in the ID shift. However, the introduction of new form cues in the ID shift will produce an initial P_r of .5. In the first ED shift problem, the introduction of a new relevant dimension will produce an initially low P_o and a P_r of approximately .5. Since P_o is high in the first ID shift and low in the first ED shift, and P_r values are approximately equal in both shifts, the performance of Ss in the first ID shift should be superior to the performance of Ss in the first ED shift.

Following training on the first shift problems, the P_o of form should be high for ID shift Ss and low for ED shift Ss. Since form is the relevant dimension in the three problems of the second shifts, the P_o of form should be initially high in the ID-Same, ID-Intradimensional, and ID-Reversal conditions and initially low in the ED-Same, ED-Intradimensional, and ED-Reversal conditions. P_r should be approximately .5 in all six conditions since the cues used in these conditions are different than those used in the preceding problems. The presence or absence of cues of original training should not affect P_r differentially because Zeaman and House do not postulate retention of P_r across problems which involve learning of new cues. Several predictions concerning performance in the second successive shift problems are:

(1) Since P_o is high in the three ID conditions and low in the three ED conditions, performance in the ID-Same, ID-Intradimensional, and ID-Reversal conditions should be superior to performance in the three corresponding ED conditions.

(2) Since P_o is high and P_r is .5 in the three ID conditions, there should be no differences in performance among the ID-Same, ID-Intradimensional, and ID-Reversal groups.

(3) Since P_o is low and P_r is .5 in the three ED conditions, there should be no differences in performance among the ED-Same, ED-Intradimensional, and ED-Reversal groups.

Goodwin and Lawrence

In the original training problem, an identification response to form is acquired in conjunction with the acquisition of specific form-cue preferences. The first ED shift requires: (1) the extinction of the original identification response to form and the acquisition of a new identification response to color, and (2) the acquisition of new cue preferences. The cue preferences of original training are not extinguished due to the rapid extinction of the original identification response. In the first ID shift, the same identification response to form is maintained. The only new learning required is the establishment of new cue preferences. The cue preferences of original training are not extinguished because the cues of original training are absent in the first ID shift. Since the extinction and acquisition of identifying responses occur more rapidly than extinction and acquisition of instrumental habits, it is not deducible from the theory whether differences in performance should be expected between ID and ED shift conditions.

After training in the first shift problems, the Ss in the ID shift have maintained the identification response to form acquired during original training. However, ED shift Ss have acquired an identification response to color. In the second successive shift problems, the identification response to form may be directly transferred to the ID-Same, ID-Intradimensional, and ID-Reversal conditions since form is the relevant dimension in each of these conditions. Ss in the ED-Same, ED-Intradimensional, and ED-Reversal conditions of the second shift must extinguish the previous identification response to color. In the ID-Same, ID-Reversal, ED-Same, and ED-Reversal conditions, the form cues of original training are used. Since cue preferences have not been extinguished during the preceding problems, the presence of the preferred (positive) cue in the ID-Same and ED-Same conditions should quickly reestablish the old habit and lead to rapid learning. The presence of the preferred cue as the negative cue in the ID-Reversal and ED-Reversal conditions will require that the old preference be extinguished and a new preference be acquired. The presence of new cues in the ID- and ED-Intradimensional conditions will necessitate the acquisition of new cue preferences. It is not possible to determine if performance in the second shift problems will differ as a function of ID and ED conditions since acquisition and extinction of the identification response occur more rapidly than the acquisition and extinction of instrumental S-R associations. The preceding statements lead to the following predictions:

(1) Since the preferred cue of original training is the positive cue of the ID-Same condition, performance in the ID-Same condition should be superior to performance in the ID-Intradimensional and ID-Reversal conditions.

(2) Since the preferred cue of original training is the positive cue of the ED-Same condition, performance in the ED-Same condition should be superior to performance in the ED-Intradimensional and ED-

Reversal conditions.

(3) Since the preferred cue of original training is the negative cue of the ID-Reversal conditions, performance in the ID-Reversal condition should be inferior to performance in the ID-Intradimensional condition.

(4) Since the preferred cue of original training is the negative cue of the ED-Reversal condition, performance in the ED-Reversal condition should be inferior to performance in the ED-Intradimensional shift condition.

A summary of the Zeaman and House, and Goodwin and Lawrence predictions for the six experimental conditions of the second shifts is presented in Table I. In this table, the terms 'positive' and 'negative' transfer are used. Positive transfer indicates that performance will be facilitated due to previous training. Negative transfer refers to a decrement in performance due to previous training.

TABLE I

A SUMMARY OF THE THEORETICAL PREDICTIONS CONCERNING TRANSFER IN THE SECOND SUCCESSIVE SHIFT CONDITIONS

	ZEAMAN AND HOUSE		GOODWIN AND LAWRENCE	
CONDITIONS	OBSERVING RESPONSE	INSTRUMENTAL RESPONSE	IDENTIFICATION RESPONSE	INSTRUMENTAL RESPONSE
ID-SAME	Positive Transfer	No Transfer	?	Positive Transfer
ID-INTRA-DIMENSIONAL	Positive Transfer	No Transfer	?	No Transfer
ID-REVERSAL	Positive Transfer	No Transfer	?	Negative Transfer
ED-SAME	Negative Transfer	No Transfer	?	Positive Transfer
ED-INTRA-DIMENSIONAL	Negative Transfer	No Transfer	?	No Transfer
ED-REVERSAL	Negative Transfer	No Transfer	?	Negative Transfer

CHAPTER II

REVIEW OF THE LITERATURE

Dimensional Shifts

House and Zeaman (1962) investigated the performance of retarded Ss (MA-6-8 yr.) on ID, ED and reversal shifts in a simultaneous two choice visual discrimination situation. In each shift problem the cues of the irrelevant dimension were variable. The problems ranked themselves in order of increasing difficulty: ID shift, reversal shift, and ED shift. Statistically significant differences were found between the ID and ED shift conditions, and the reversal and ED shift conditions. The ED shift group performed more poorly than the ID and reversal groups. There was no significant difference between performance in the ID and reversal shift conditions. Bernsberg (1958), and Campione, Hyman, and Zeaman (1965) also found ID shifts easier than ED shifts with retarded Ss. Similar findings using college Ss have been reported by Eckstrand and Wickens (1954), Kendler and D'Amato (1955), Kurtz (1955), and Isaacs and Duncan (1962). Zeaman and House (1963) discuss the above findings in the context of their attention theory. They reason that if P_o is high following acquisition, the solution of ID and reversal shifts should be superior to ED shifts since, in the ID and reversal shifts, the originally relevant dimension is maintained. In the ED shifts, transfer from the original problem is poor since a new relevant dimension must be learned prior to reaching acquisition criterion. The superiority of ID over reversal shifts is predicted since the probability of approaching the positive cue is quite low in reversal but is at chance level at the initiation of ID shift trials.

Cue Retention

House and Zeaman (1963) investigated learning set formation in retarded Ss (MA=2-6 yr.) in 108 two choice visual discrimination problems. "Stimulus pairs were selected froma single set of 4 multidimensional objects, appearing repetitively throughout training in all possible combinations." The use of only 4 objects provided an opportunity to manipulate stimulus overlap and reinforcement contingencies on successive problems. The possibility of transfer across an intervening problem was assessed "by relating performance on the Nth problem to stimulus overlap between the (N-2)th problem and the Nth." Two methods of analysis were used:

> In one analysis, performance was compared for problems in which relationship between the Nth and (N-2)th problem was either complete reversal of both positive and negative cues or "all new . . .". A second method--was to consider only problems with no overlap with the stimuli of the (N-1)th problem (all new condition), and to relate performance on these problems to stimulus overlap with the (N-2)th problem. Since there is no transfer from the immediately preceding problem, differences may be attributed to transfer from the preceding problem once removed. (p. 737-738)

Both types of analysis revealed no evidence of transfer across an intervening problem.

Goodwin and Lawrence (1955) investigated the performance of rats on successive ED shifts when the stimuli of the second shift were the same as those used in original training. Ss were originally trained on a brightness (white vs. black) discrimination in which "hurdles" (high vs. low) was the variable irrelevant dimension. After acquisition criterion was achieved, Ss were given a second discrimination problem in which the previously irrelevant dimension of "hurdles" was made relevant and the previously relevant dimension of brightness was variable and irrelevant. Following acquisition of the second problem, the Ss were divided into two groups. One group, the Change of Dimension (CD) group, received a third problem which used the same positive and negative brightness cues of original training. A second group, the Change of Dimension with Reversal (CDR) group, had the positive and negative brightness cues of original training reversed in the third discrimination problem. The performance of the CD group was significantly superior to the CDR group on this discrimination and subsequent discriminations using a similar paradigm. Goodwin and Lawrence postulated two learning processes to account for their findings. They indicated that during the first discrimination an identification response to the relevant dimension of brightness was established, and specific cue preferences for white and black were acquired. The introduction of the new relevant dimension of hurdles in the second problem led to a rapid extinction of the original identification response to brightness. With the extinction of the original identification response, the white and black cues selectively determined by it were no longer available to undergo extinction. This resulted in the preservation of the white-black cue preferences of the first discrimination problem. Thus, learning the cues (high, low) of a new dimension (hurdles) on the second discrimination did not nullify the previously learned cue discrimination of the first problem. The introduction of the same positive cue (e.g., white) of the first problem in a third problem resulted in positive transfer since cue preference remained irrespective of the interpolated learning of the irrelevant dimension of hurdles. Negative transfer resulted when the cues of original training were reversed in the third problem since Ss had to reverse their retained preferences for these cues.

CHAPTER III

METHOD

Subjects

Ss were 88 institutionalized "retardates" from the Hissom Memorial Training Center at Sand Springs, Oklahoma. Ss were randomly selected from an MA range of 5½ years-10½ years, irrespective of past experience and clinical diagnostic category. Intelligence estimates were obtained from the records of the institution.

Twenty-eight of the 88 Ss failed to reach acquisition criterion, 24 in original training and 4 in the first ED shift. Sixty Ss were used throughout the experiment. These were randomly assigned to each of six experimental groups with the provision that each group had an equal number of Ss, and that the range of MAs and average MA of each group were approximately equal. The descriptive statistics of the six groups are presented in Table II.

Apparatus

The apparatus was a version of the Wisconsin General Test Apparatus (Harlow, 1942), as modified by Zeaman and House (1963). It consists of a table with a sliding stimulus tray 30 inches by 12 inches with two circular foodwells 2 inches in diameter centered 12 inches apart. A one way screen is positioned across the center of the table which permits observation of S's behavior during testing.

The stimuli were painted forms cut from ¼ inch masonite mounted vertically on 4 inch by 4 inch masonite bases. The maximum height and width of each stimulus was 2 inches. A total stimulus pool of 36 objects was used, six different forms (triangle, circle, square, cross, T, and diamond) in each of six colors (red, blue, yellow, green, black, and white).

TABLE II

MEAN MENTAL AGE AND MEAN CHRONOLOGICAL AGE AND THEIR RESPECTIVE RANGES FOR THE SIX EXPERIMENTAL GROUPS

GROUPS	MENTAL AGE MEAN	MENTAL AGE RANGE	CHRONOLOGICAL AGE MEAN	CHRONOLOGICAL AGE RANGE
ID-SAME	7-2	5-11 to 10-1	15-8	11-3 to 20-3
ID-INTRA-DIMENSIONAL	7-3	5-10 to 9-4	14-7	8-6 to 18-8
ID-REVERSAL	7-3	5-6 to 9-6	13-1	9-2 to 17-10
ED-SAME	7-3	5-10 to 10-3	13-0	9-7 to 17-7
ED-INTRA-DIMENSIONAL	7-3	5-10 to 9-4	14-8	9-5 to 18-9
ED-REVERSAL	7-3	5-11 to 9-6	14-4	11-1 to 16-11

Experimental Design

Ss were divided into six groups of equal size (N=10). These groups were labeled ID-Same, ID-Intradimensional, ID-Reversal, ED-Same, ED-Intradimensional, and ED-Reversal.

All Ss were given original training on a form relevant problem in which color was varied and irrelevant. Training consisted of reaching acquisition criterion plus 100 overlearning trials. After original training, the three ID groups received the first of two successive ID shifts and the three ED groups received the first of two successive ED shifts. The first ID shift was a form relevant problem in which two new form cues were used. Color was varied and irrelevant. In the first ED shift, color was the relevant dimension and form was varied and irrelevant. Training in both of the first shifts consisted of reaching acquisition criterion plus 100 overlearning trials.

Following acquisition and overlearning of the first shift problems, the three ID groups received a second ID shift and the three ED groups received a second ED shift. In the second ID and ED shifts, form was the relevant dimension and color was variable and irrelevant. Ss in the ID-Same and ED-Same groups received the same positive and negative form cues which they had learned during original training. Ss in the ID-Intradimensional and ED-Intradimensional groups were given two new form cues. Ss in the ID-Reversal and ED-Reversal groups were presented with the form cues of original training but the reinforcement contingencies of original training were reversed.

Table III has been arranged to illustrate the training sequences for the six experimental groups. The training sequences have been divided into three stages to represent original training and the two successive shifts. It should be noted in Table III that stage 3 represents a second ID shift for Ss previously receiving an ID shift in stage 2, and a second ED shift for Ss previously receiving an ED shift in stage 2.

TABLE III

TRAINING SEQUENCES FOR SIX EXPERIMENTAL GROUPS

Stage 1		Stage 2		Stage 3
Original training	→	ID shift	→	ID-Same
Original training	→	ID shift	→	ID-Intradimensional
Original training	→	ID shift	→	ID-Reversal
Original training	→	ED shift	→	ED-Same
Original training	→	ED shift	→	ED-Intradimensional
Original training	→	ED shift	→	ED-Reversal

General Procedure

Each S was brought into the experimental room, seated before the apparatus, and informed he was going to play the "candy game". Three pretraining trials were presented prior to the initiation of experimental trials. Each training trial consisted of placing candy in full view of S in one of the two foodwells and instructing S to find the candy. No covering was placed over the foodwells on trial 1. On trial 2, two identical plexiglass wedges partially covered the foodwells. The foodwells were completely covered by the wedges on trial 3. After completion of pretraining, the testing session was begun. Each testing session consisted of 25 trials per day. Acquisition criterion was 20 or more correct responses during a single daily session of 25 trials.

The same procedure was used for all discrimination trials in the experiment. Before beginning a trial, the stimulus tray was pulled behind the one way screen, a candy reward was placed in one of the two foodwells, and the foodwells were covered with the appropriate stimulus objects. A trial consisted of pushing the stimulus tray in front of S and permitting him to make a single choice of the stimulus objects covering the foodwells. A correct choice was defined as the displacement of the stimulus object positively correlated with the reward (M & Ms and Sugar Babies). In addition to the candy reward, the experimenter said "Good" if the response was correct, and "No" if it was not. A noncorrection procedure was used. The position of the correct stimulus was varied accordingto the Gellermann (1933) series.

Stage 1: All Ss recieved intital training on a form relevant problem in which color was varied and irrelevant. Two forms, a circle and triangle, and two colors, red and blue, were chosen independently and randomly from the stimulus pool of six forms and six colors. Each S was randomly assigned one of the two form cues as positive, with the provision that each of the form cues appeared equally often across all Ss as the positive cue. The color cues were variable and irrelevant, i.e., the two color cues, red and blue, were randomly assigned to each of the form cues an equal number of times during training sessions. The same randomization procedure was applied to the irrelevant cues of each problem for each S throughout the experiment. The failure criterion for the original training problem was 200 trials without reaching acquisition criterion. Following acquisition of the original training problem, Ss were given 100 trials of overlearning.

Stage 2: Ss in the three ID groups (ID-Same, ID-Intradimensional, ID-Reversal) were given the first ID shift in which form was relevant and color was variable and irrelevant. The form cues were the same for all three ID groups. Two new form cues, a T and square, were selected from the four form cues (cross, T, square, diamond) which had not been used in original training. Each form cue appeared an equal number of times as the positive cue. The remaining four color cues (yellow, green, white, black) were set in all possible combinations of two and randomly assigned to each S as the variable irrelevant cues. For Ss in the three ED groups (ED-Same, ED-Intradimensional, ED-Reversal), the first ED shift was one in which color was relevant and form was variable and irrelevant. The color cues were the same for all three ED groups. Four color cues (yellow, green, white, black) were set in all possible combinations of two and one set randomly assigned to each S. One color cue from the assigned set was then randomly selected as the positive cue. Each color combination occurred equally often, and each cue of the combination appeared equally often as the positive cue. Two form cues, a T and square, served as the variable irrelevant form cues of the first ED shift.

The failure criterion for the first ID and ED shift problems was 300 trials without reaching the acquisition criterion. One hundred trials of overlearning were given each S after reaching acquisition criterion in stage 2.

Stage 3: In stage 3, the three ID groups were given a second ID shift and the three ED groups were given a second ED shift. Form was the relevant dimension and color was variable and irrelevant in both shifts. The ID-Same and ED-Same groups received the same form cues (triangle, circle) and reinforcement contingencies of original training. Ss in the ID- and ED-Intradimensional groups were given two new form cues, a cross and diamond, which were the only remaining form cues not previously used. Each cue was used as the positive cue an equal number of times. Ss in the ID- and ED-Reversal groups received the form cues (circle, triangle) of original training but the reinforcement contingencies associated with these cues were reversed. Color cues were variable and irrelevant in all problems and were selected for each S in the following manner: (1) by eliminating the color cues employed in the preceding problem, and (2) by selecting randomly one of the possible six combinations of the remaining four colors and assigning this combination to S.

Table IV depicts some of the possible form and color cues that were used in the original training and shift problems.

TABLE IV

COLOR (C) AND FORM (F) CUES FOR TRAINING PROBLEMS

Trials	Original Training					
1		$\overset{+}{C_1F_1}$ Red Triangle			$\overset{-}{C_2F_2}$ Blue Circle	
2		$\overset{+}{C_2F_1}$ Blue Triangle			$\overset{-}{C_1F_2}$ Red Circle	
	ID Shift-No. 1			ED Shift-No. 1		
1	$\overset{+}{C_3F_3}$ White T		$\overset{-}{C_4F_4}$ Black Square	$\overset{+}{C_5F_3}$ Green T		$\overset{-}{C_6F_4}$ Yellow Square
2	$\overset{+}{C_4F_3}$ Black T		$\overset{-}{C_3F_4}$ White Square	$\overset{+}{C_5F_4}$ Green Square		$\overset{-}{C_6F_3}$ Yellow T
	ID Shift-No. 2 and ED Shift-No. 2					
	Same		Intradimensional		Reversal	
1	$\overset{+}{C_1F_1}$ Red Triangle	$\overset{-}{C_2F_2}$ Blue Circle	$\overset{+}{C_2F_5}$ Blue Cross	$\overset{-}{C_4F_6}$ Black Diamond	$\overset{+}{C_1F_2}$ Red Circle	$\overset{-}{C_3F_1}$ White Triangle
2	$\overset{+}{C_2F_1}$ Blue Triangle	$\overset{-}{C_1F_2}$ Red Circle	$\overset{+}{C_4F_5}$ Black Cross	$\overset{-}{C_2F_6}$ Blue Diamond	$\overset{+}{C_3F_2}$ White Circle	$\overset{-}{C_1F_1}$ Red Triangle

CHAPTER IV

RESULTS

Stage 1

The dependent measure used in all analyses was the number of errors to acquisition criterion. A logarithmic (X + 1) transformation of these scores was performed to obtain homogeneity of variance and greater normality of distribution.

The performance of the six experimental groups in stage 1 was analyzed to determine if there were differences among these groups prior to the presentation of treatment conditions. Since Ss were randomly assigned to the six groups and received the same problem in stage 1, no differences were expected. A one-way classification analysis of variance is presented in Table V and clearly indicates no effect of "groups" on performance ($F < 1$).

TABLE V

AOV FOR EXPERIMENTAL GROUPS IN STAGE 1

Source of Variance	df	Sums of Squares	Mean Squares	F
Total	59	17.16892		
Groups (6)	5	.75238	.15048	.41
Error	54	16.41654	.36481	

Stage 2

Backward learning curves for Ss in the first ID and ED shifts are presented in Figure 1. The ID and ED curves were obtained by plotting the per cent correct responses in blocks of five trails across Ss of the three ID and three ED groups respectively. The position of the functions on the absissa is that of the median learner of each shift. The median learner in the ID shift reached acquisition criterion on the first day of testing. The median learner in the ED shift reached criterion on the second day of testing. Four Ss failed to reach criterion in the ED shift and were replaced by Ss randomly selected from the existing population of retardates who had not already been assigned to an experimental condition.

The t statistic was chosen to test the difference in performance between the ID shift- and ED shift-groups. Since the variance estimates of the two treatment samples were unequal ($F=3.10$, $p<.01$), an approximation (Cochran and Cox, 1957, p. 101) of the tabulated t value, t', was used. This approximation probably errs slightly on the conservative side, in the sense that the value of t required for significance may be slightly too high. To test the null hypothesis, $H_o: \mu_{ED}=\mu_{ID}$, versus the alternative hypothesis, $H_1: \mu_{ED}>\mu_{ID}$, the approximated tabulated t value ($t'=3.629$, $\alpha=.0005$) was obtained. This value lies between the tabulated t values for the ID shift-group ($t=3.659$, $df=29$, $\alpha=.0005$) and the ED shift-group ($t=3.618$, $df=33$, $\alpha=.0005$). Mean log errors for the ED shift-group were 1.20683 and for the ID shift-group were .37442. The difference between groups was significant ($t=6.801>t'=3.629$, $p<.0005$).

The significant t value verifies what the backward learning curves

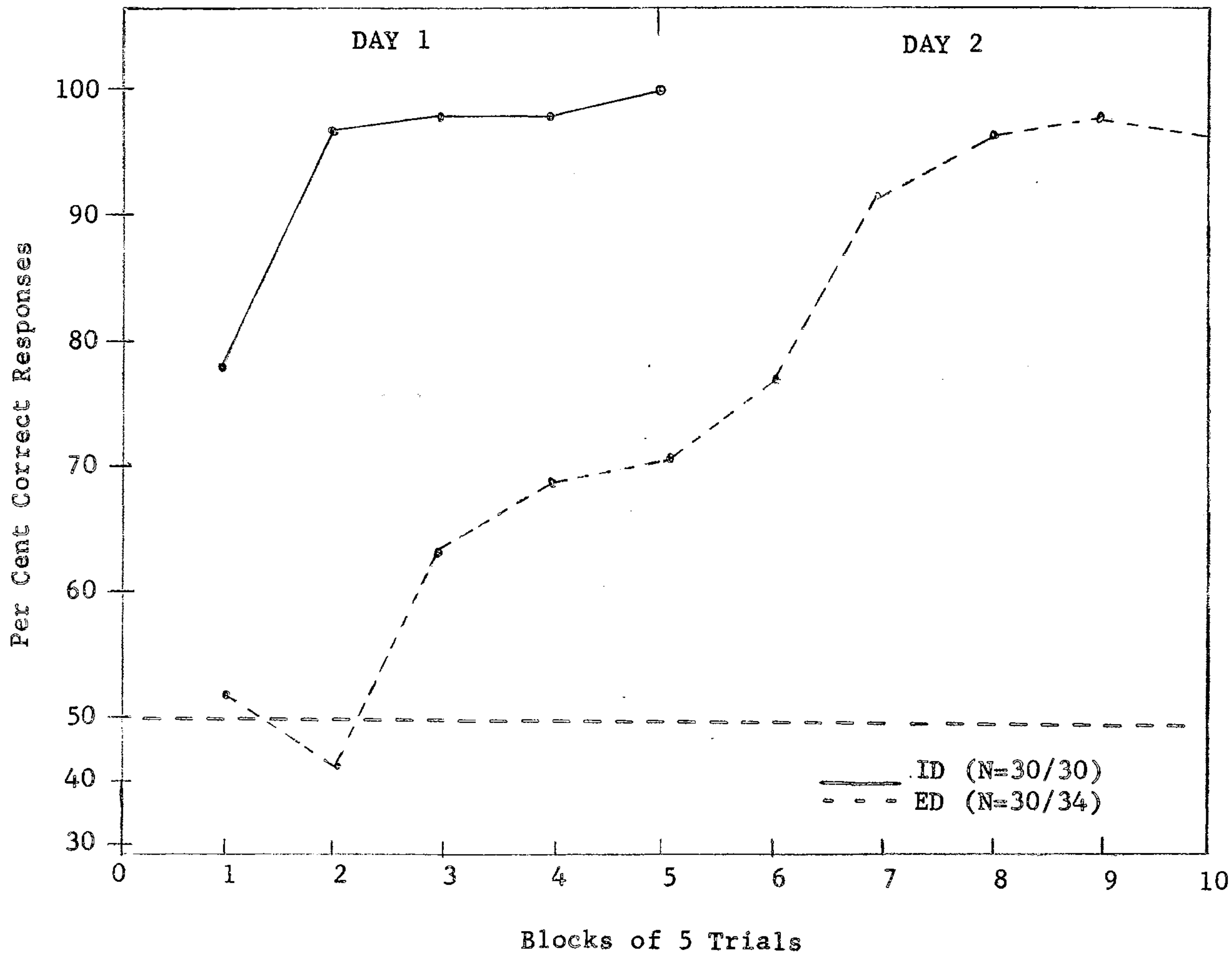

Figure 1. Backward Learning Curves for ID and ED Groups in Stage 2.

suggest, i.e., ID shift-group performance is superior to ED shift-group performance.

Before proceeding to an analysis of stage 3, two single-classification analyses of variance were computed for the three ID groups (Table VI), and the three ED groups (Table VII). Since these groups had not been treated differentially within each shift, the variation due to groups in these analyses was not expected to be significant. Table II indicates that the main effect of groups on performance in the first ID shift was not significant ($F=1.92$, $df=2.27$, $p > .15$). Similarly, the main effect of groups (Table VII) on performance in the first ED shift was not significant ($F < 1$).

TABLE VI

AOV FOR THE THREE ID-GROUPS IN STAGE 2

Source of Variance	df	Sums of Squares	Mean Squares	F
Total	29	1.49069		
Groups (3)	2	.43390	.21695	1.92
Error	27	3.05679	.11321	

TABLE VII

AOV FOR THE THREE ED-GROUPS IN STAGE 2

Source of Variance	df	Sums of Squares	Mean Squares	F
Total	29	7.97294		
Groups (3)	2	.46365	.23183	.83
Error	27	7.50929	.27812	

Stage 3

To test for specific cue retention and shift differences, a completely randomized design with a dimensions (ID, ED) by cues (Same, Intradimensional, Reversal) factorial arrangement was originally planned for analysis of stage 3-performance. However, the performance of the ID-Same group resulted in zero mean and zero variance, i.e., Ss responded to the correct cue without error. Since no variance was present in this group, the assumption of homogeneity of error variance within each of the six treatment groups was rejected. A Bartlett's test for homogeneity of variance of the remaining five treatment groups did not lead to rejection of this assumption (X^2=5.91, df=4, p >.10). A single classification analysis of variance (Table VIII) was performed on the data of these five groups to obtain an estimate of the pooled error variance. Least significant difference (LSD) values were obtained for the interaction term and preplanned comparisons by differentially weighting the pooled error variance estimate. These comparisons are presented in Table IX.

TABLE VIII

AOV FOR ID-INTRADIMENSIONAL, ID-REVERSAL, ED-SAME, ED-INTRADIMENSIONAL, AND ED-REVERSAL TREATMENT COMBINATIONS OF STAGE 3

Source of Variance	df	Sums of Squares	Mean Squares
Total	49	13.32813	
Treatments	4	2.32587	
Error	45	11.00267	.24449

TABLE IX

LSD ANALYSIS OF MEAN LOG ERRORS TO CRITERION

Mean Log Errors to Criterion for the Six Groups

ID-Same (A_1)	ID-Intradimensional (A_2)	ID-Reversal (A_3)
.00000	.18573	.48083
ED-Same (A_4)	**ED-Intradimensional (A_5)**	**ED-Reversal (A_6)**
.34082	.63543	.80069

No.	Alternative Hypotheses	Difference	<	>	LSD Value	α Level
1	$A_4+A_5+A_6 > A_1+A_2+A_3$	1.11038		>	.84438	.01**
2	$-A_1+2A_2-A_3 \neq A_4-2A_5+A_6$	.01998	<		1.04548	.05
3	$A_2+A_3 > 2A_1$	.66656		>	.53403	.01**
4	$A_5+A_6 > 2A_4$	.75448		>	.64384	.05*
5	$A_3 > A_2$	.29510	<		.37172	.05
6	$A_3 > A_1$	.48083		>	.37759	.01**
7	$A_2 > A_1$	.18573	<		.26282	.05
8	$A_6 > A_5$	.16526	<		.37172	.05
9	$A_6 > A_4$	.45987		>	.37172	.05*
10	$A_5 > A_4$	.29461	<		.37172	.05

* Significant at beyond the .05 level

** Significant at beyond the .01 level

The four principal comparisons are presented as the first four hypotheses in Table IX. Comparisons of "difference" values with LSD values for these hypotheses indicate the following:

(1) The average performance of the ID groups is superior ($p < .01$) to the average performance of the ED groups.

(2) There is no evidence of interaction ($p > .50$) between ID and ED groups.

(3) The average performance of the ID-Same group is superior ($p < .01$) to the average combined performance of the ID-Intradimensional and ID-Reversal groups.

(4) The average performance of the ED-Same group is superior ($p < .05$) to the average combined performance of the ED-Intradimensional and ED-Reversal groups.

Hypotheses 5, 6, and 7 constituted all possible comparisons among the three ID groups. Hypotheses 8, 9, and 10 constituted all possible comparisons among the three ED groups. These comparisons were made to investigate further the findings of hypotheses 3 and 4, i.e., that the average performances of the ID- and ED-Same groups were superior to the average combined performances of the ID- and ED-Intradimensional and Reversal groups. The alpha levels for hypotheses 5 thru 10 were not interpreted literally but were used as guidelines for evaluating the magnitude of performance differences between groups.

Comparisons of the group performance differences with LSD values for hypotheses 5, 7, 8 and 10 indicate that small differences exist: (1) between the ID-Intradimensional group and the ID-Same or ID-Reversal groups, and (2) between the ED-Intradimensional group and the ED-Same or ED-Reversal groups. The comparisons made in hypotheses 6 and 9 indicate however that large differences in performance exist between the ID-Same and ID-Reversal groups, and between the ED-Same and ED-Reversal groups. Thus, the principal factor contributing to the significant findings of hypotheses 3 and 4 is the large differences found between the ID- and ED-Same and Reversal groups.

The simple main effects for the six treatment groups are presented in Figure 2.

Transfer Across Stage 2

The combined performance of the three ID and three ED groups in stage 1 and stage 2, and the average performance of each of these groups in stage 3 is presented in Figure 3. In order to assess cue and dimensional transfer from stage 1 to stage 3, "savings" scores were computed for each of the Ss in the six groups by obtaining performance differences between stage 2 and stage 3. Since different cues were used in stage 2 than were used in stages 1 and 3, savings differences among the three groups within the ID or ED shifts may be attributed to the retention of the cues of original training.

Goodwin and Lawrence should predict positive transfer for the ID-Same and ED-Same groups since the preferred (positive) cue of original training in stage 1 is the positive cue for these groups in stage 3. Negative transfer should occur in the ID-Reversal and ED-Reversal groups since the preferred cue of stage 1 is the negative cue for these groups in stage 3. Two statements concerning savings scores are derived from the Goodwin and Lawrence position:

(1) The ID-Same group should have a greater average savings score than the ID-Reversal group.

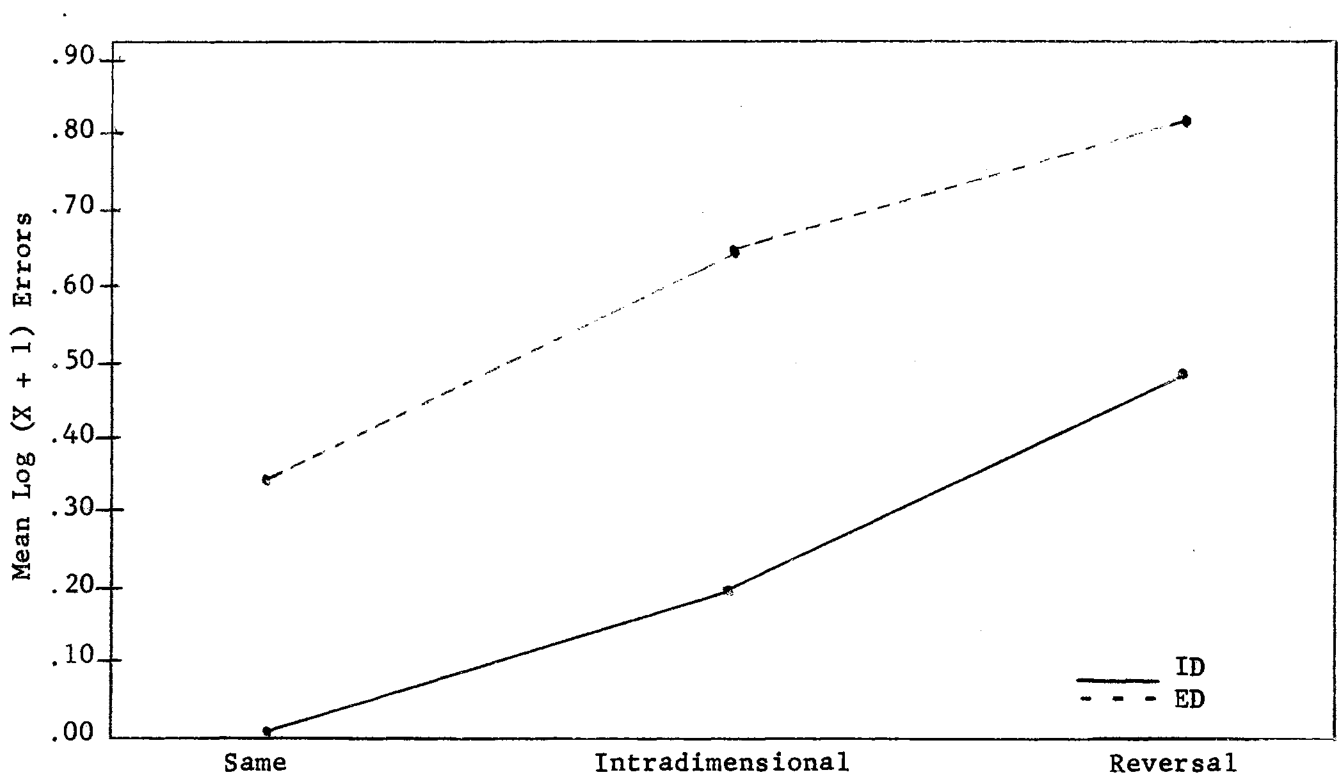

Figure 2. Profiles of Simple Main Effects for All Groups in Stage 3.

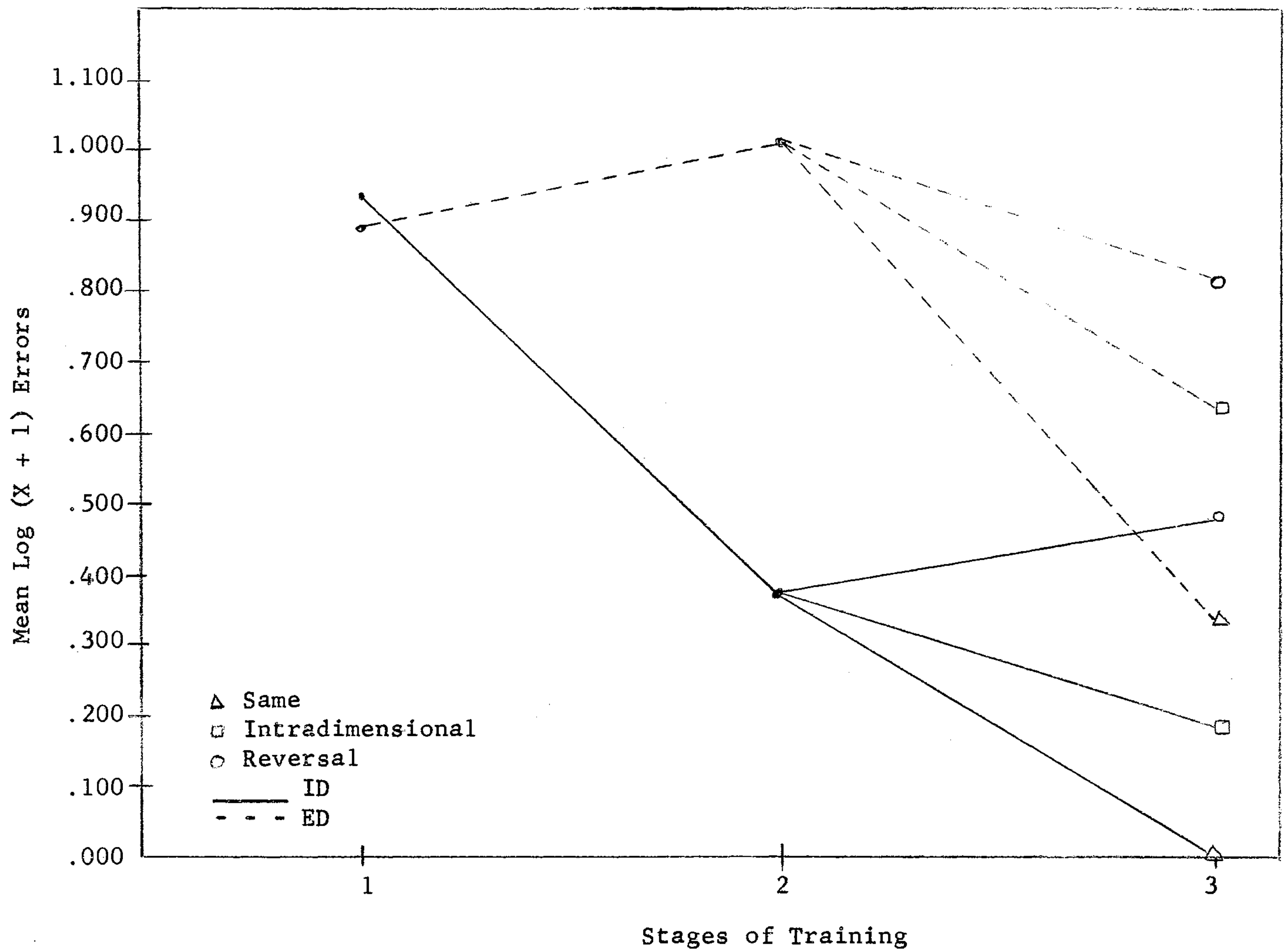

Figure 3. The Average Performance of the Three ID and Three ED groups in Stage 1 and Stage 2, and the Average Performance of Each of these Groups in Stage 3.

(2) The ED-Same group should have a greater average savings score than the ED-Reversal group.

Since Zeaman and House do not postulate retention of previously learned cues, no differences among the three ID groups or the three ED groups is expected. No differences in savings is expected between the first ID or ED shift of stage 2 and the second ID or ED shift of stage 3. The same amount of new learning should be required in each of the successive ID and ED shifts.

A single classification analysis of variance was performed on the savings scores of the ID-Intradimensional, ID-Reversal, ED-Same, ED-Intradimensional, and ED-Reversal groups. Data from the ID-Same group was atypical. The mean savings score and the variance estimate for the ID-Same group were computed separately. The analysis of variance for the 5 treatment groups is presented in Table X. No F test was made since the purpose of the analysis was to obtain an estimate of the pooled error variance.

TABLE X

AOV FOR SAVINGS SCORES OF 5 GROUPS

Source of Variance	df	Sums of Squares	Mean Squares
Total	49	19.55183	
Groups	4	4.85587	1.21397
Error	45	14.69596	.32658

The two estimated error variances were weighted differentially, according to the treatment comparisons which were to be made. LSD values for comparisons in which the ID-Same group was a member were computed using t' values. The t' value corresponded to a tabulated t which lay between the degrees of freedom associated with the ID-Same group (df=9) and the degrees of freedom associated with the pooled error mean square (df=45). The LSD values for the preplanned comparisons are presented in Table XI.

The four hypotheses are interpreted according to the order of appearance in Table XI:

(1) There is no evidence of interaction ($p > .25$) between the three ID and the three ED groups.

(2) The average savings score of the three ED groups was greater ($p < .05$) than the average savings score of the three ID groups.

(3) The average savings score of the ID-Same group was greater ($p < .01$) than the average savings score ofthe ID-Reversal group.

(4) The average savings score of the ED-Same group tended to be greater ($.05 < p < .10$) than the average savings score of the ED-Reversal group.

TABLE XI

LSD ANALYSIS OF SAVINGS SCORES

Mean Savings Scores for the Six Groups

ID-Same (A_1)	ID-Intradimensional (A_2)	ID-Reversal (A_3)
.52287	.04260	-.11637
ED-Same (A_4)	ED-Intradimensional (A_5)	ED-Reversal (A_6)
.66452	.61560	.17168

No.	Hypothesis	Difference	$<$,	$>$	LSD Value	α Level
1	$-A_1+2A_2-A_3 \neq A_4-2A_5+A_6$	.07370	$<$		1.24939	.05
2	$A_1+A_2+A_3 \neq A_4+A_5+A_6$	1.00270		$>$	.87444	.05*
3	$A_1 > A_3$	.63924		$>$	.53240	.01**
4	$A_4 > A_6$	.49284	$<$		.51525	.05

* Significant at beyond the .05 level
** Significant at beyond the .01 level

CHAPTER V

DISCUSSION

Dimensional Shifts

The use of ID and ED shifts in stage 2 and stage 3 provided an opportunity to evaluate theoretical prodictions concerning dimensional shift performance. The theorizing of Zeaman and House suggested performance differences as a function of ID and ED shifts. No definitive predictions concerning ID and ED shift-performance were derived from the theoretical statements of Goodwin and Lawrence.

Stage 2: According to Zeaman and House, ID shift-performance should be superior to ED shift-performance since the relevant dimension of form in stage 1 was the relevant dimension of the ID shift in stage 2. Ss in the ID shift-group could transfer the high P_o for the relevant dimension of form from stage 1 to stage 2. In the ED shift, the previously relevant dimension of form in stage 1 was made the variable irrelevant dimension of stage 2, and the previously irrelevant dimension of color was made the new relevant dimension. Ss in the ED shift-group had to extinguish the high P_o for form of stage 1 and acquire a high P_o for color in stage 2. Since new relevant cues were used in each shift, the same amount of instrumental learning was required for both groups. The backward learning curves of Figure 1 and the significant t test ($p < .0005$) between group performances support the Zeaman-House prediction of superiority of ID shift-performance.

The difference in stage 2 between ID shift-performance and ED shift-performance may be influenced by the use of color problems in the ED shift. Color problems have been reported (Zeaman and House, 1963) to be more difficult to learn than form problems. This implies, in attention-theory terms, that the dimension of color has less attentional value than the dimension of form, i.e., the initial P_o for color is less than the initial P_o for form. The extremely significant difference between the performance of the ID shift- and ED shift-groups could be attributed to a combination of two factors: (1) the use of dimensional shifts in which the P_o for the relevant dimension varies from high in the ID shift to low in the ED shift, and (2) the use of color as the relevant dimension of the ED shift in stage 2.

Stage 3: The second successive ID and ED shifts were given in stage 3. The theoretical prodiction of stage 2 was equally applicable to the ID and ED shifts of stage 3, i.e., performance in the ID shift should be superior to performance in the ED shift. This prediction was confirmed. Hypothesis No. 1 of Table IX indicates that the average performance of the three ID groups was superior ($p < .01$) to the average performance of the three ED groups.

Transfer across stage 2: Hypothesis No. 2 of Table XI indicates that the average savings score of the three ED groups was greater ($p < .05$) than the average savings score of the three ID groups. Figure 3 illustrates the trend for each of the three ED groups to perform with less errors in stage 3 than in stage 2. The finding of a decrement in errors for groups in the second ED shift was an unexpected finding, not readily accounted for by the Zeaman-House position. According to attention theory, P_o should be low and P_r should be .5 at the start of both the first and second ED shifts. With both P_o and P_r at similar levels in the first and second ED shifts, performance in each of these shifts should be approximately the same. Intuitively, it seems plausible to suggest that proceeding from a color problem to a form problem may be an easier transfer to accomplish than a transfer from a form problem to a color problem. Form, since it has higher attentional value than color, may have had a greater facilitating effect on performance in the second ED shift relative to the effect of color on performance in the first ED shift. However, to be consistent within the framework of attention theory, the low P_o for color and the low P_o for form which were present at the start of the first and second ED shifts respectively should both be equally disruptive of performance.

To account for the positive transfer from the first to the second ED shift, it was hypothesized that retention of the P_o for form acquired during stage 1 may have facilitated performance in the form problems of stage 3. It is evident in Figure 3 that the average performance of each of the three ED groups in stage 3 is superior to the average performance of these groups in stage 1. Since the P_o for form should be low in the second ED shift of stage 3, performance on the form problems of this stage should not be superior to performance on the form problems of stage 1, unless some retention of the observing response of stage 1 has occurred. To test for this possibility, the performance of the ED-<u>Intradimensional</u> group in stage 2 and stage 3 was compared. This group was selected since it was the only one of the three ED groups which received new form cues in stage 3. Thus, a difference in performance between stage 2- and stage 3-performance could not be attributed to cue retention but must be attributed to dimensional retention. A two tailed t test for correlated observations between performance in stage 2 and stage 3 indicated that performance was superior ($t=2.92$, $df=9$, $p<.02$) in the form problems of stage 3. This finding strongly suggests that dimensional retention does exist.

Cue Retention

Stage 3: Goodwin and Lawrence have suggested that previously acquired cue preferences can be retained across problems involving the learning of new cues. House and Zeaman (1963) have suggested that cue retention does not exist. A direct test for cue retention involved comparisons of stage 3-performance between the Same and Reversal groups in the ID and ED shifts. These groups had the relevant form cues of stage 1 as the relevant cues of stage 3. However, the Reversal groups received in stage 3 a reversal of the reinforcement contingencies associated with the positive and negative cues of stage 1. According to Goodwin and Lawrence, the rapid extinction of the original identification response in stage 2 and the absence of the relevant cues of stage 1 in stage 2 will result in the retention of the cue preferences of stage 1. The retention of cue preferences in stage 3 should: (1) facilitate performance in the ID- and ED-Same groups, and (2) retard performance in the ID- and ED-Reversal groups.

Table IX indicates that, within the ID and ED shifts: (1) the performance of the Same groups is superior to the performance of the Reversal groups. Figure 2 illustrates the profiles for the simple main effects of the three ID and three ED groups. It can be seen from this graph that: (1) the best performing groups of each shift were the Same groups, (2) the groups having the most errors in each shift were the

Reversal groups, (3) there was little difference in each shift between the performance of the Intradimensional groups and the Same and Reversal groups, and (4) there was no interaction, i.e., group performances arranged themselves similarly within each shift. These results support the predictions of Goodwin and Lawrence and strongly suggest that cue retention does exist with retarded Ss.

The predictions of Goodwin and Lawrence concerning transfer were also supported by the analysis of savings scores presented in Table XI. Hypotheses-No. 3 and 4 of this table indicate: (1) a greater amount of positive transfer ($p < .01$) occurred for the ID-Same group than for the ID-Reversal group, and (2) there was a trend ($.05 < p < .10$) toward greater transfer for the ED-Same group than for the ED-Reversal group.

Theoretical Conclusions

Dimensional shifts: The Zeaman-House attention theory accurately predicts performance differences between the ID and ED shifts of stages 2 and 3. The ability to predict differences between ID and ED shifts is attributed to their assumption that the acquisition and extinction of the observing response operates in a manner similar to the acquisition and extinction of instrumental habits. Prior to the solution of an ED shift, the observing response of the previous problem must be extinguished and a new observing response acquired. In an ID shift, the observing response established during original learning is transferred to the shift problem. The difference between ID and ED shift performance is due therefore to the extinction and acquisition of observing responses in an ED shift. In the Goodwin-Lawrence system, the acquisition and extinction of the identification response occurs more rapidly than the acquisition and extinction of instrumental habits. Since no definition of a "rapidly" extinguishing identification response is presented, predictions concerning differences between ID and ED shift performance can not be made. Such an ambiguous, ill-defined operation of the identification response prevents predictions in situations in which relevant dimensions are altered. In order to increase the explanatory power of the Goodwin and Lawrence position, some modification or redefinition of the manner of operation of the identification response must be made.

Cue retention: The Goodwin-Lawrence system accurately predicts the relative levels of performance in the Same, Intradimensional, and Reversal cue conditions of the experiment. The ability to predict performance in these conditions rests on the assumption that cue preferences from a previous stage of training can be retained across problems involving the learning of new cues. This assumption is verified by the present findings. However, the mechanism responsible for cue retention in the Goodwin-Lawrence system is the rapidly extinguished identification response. Since this mechanism has been proven invalid via the contrast of ID and ED shifts, it is concluded that the theory, as presently formulated, is unable to explain the retention of cue preferences.

In the Zeaman-House attention theory, the performance of the Same, Intradimensional, and Reversal groups in the ID and ED shifts of stage 3 can not be explained. According to Zeaman and House, these groups should have performed similarly within each of the shifts. Initially, P_o should have been low and P_r .5 for the three ED groups, while the P_o and P_r values for the three ID groups should have been high and .5 respectively. The difference between the average performance of the three ID and three ED groups indicates that the P_o-values assigned these groups were tenable. However, the differences found among the three ID and three ED groups suggest that a P_r-value of .5 was not appropriate for all groups.

In order to explain differential performance among the ID and ED groups, a retention postulate could be introduced which would provide for the retention of P_r from stage 1 to stage 3. This postulate would require the assumption of independent probability systems for each different relevant set of cues. Thus, a high P_r for the positive cue of stage 1 would not be extinguished by training on the new relevant cues of stage 2. With the introduction of the relevant set of cues of stage 1 in stage 3, the instrumental probabilities associated with these cues will be the same as in stage 1. Within each set of relevant cues, the probabilities of approaching the positive and negative cues are mutually exclusive, i.e., P_r for the positive cue and $1-P_r$ for the negative cue.

This roughly sketched mechanism will now be used to explain the performance of the ID- and ED-Same, Intradimensional, and Reversal groups. The distinction, ID and ED, will not be made in this discussion since attention theory has demonstrated its ability to handle performance differences between these shifts. In stage 1 of training, let us assume that the Same, Intradimensional, and Reversal groups received training on the same positive and negative cues. After acquisition and overlearning in stage 1, the instrumental probabilities for this set of cues were established. The probabilities of approaching the positive cue and negative cue were approximately 1 and 0 respectively. In stage 2, a new set of relevant cues was introduced and, via acquisition and overlearning, a second and independent set of instrumental probabilities was established. In stage 3, the Same and Reversal groups were given the same set of relevant cues as were used in stage 1. The Same groups received the same positive and negative cues of stage 1. Since the instrumental probabilities associated with these cues had not been extinguished in stage 2, initially high and low probabilities were retained for approaching the positive cue and negative cue respectively. Reversal groups had the old positive cue as the negative cue, and the old negative cue as the positive cue of stage 3. Since instrumental probabilities were retained across stage 2, the initial probabilities of approaching the positive and negative cues of stage 3 were 0 and 1 respectively. The Intradimensional group received a set of new relevant cues in stage 3. Since no previous learning had occurred with these cues, the initial probability was .5 of approaching either the positive or negative cue. Table XII illustrates the instrumental probabilities for the relevant cues of stage 1 and stage 2 after acquisition and overlearning, and the instrumental probabilities for the Same, Intradimensional, and Reversal groups at the start of training in stage 3.

Due to the retention of the instrumental probabilities of stage 1, the high probability of appraoching the positive cue (P_r) should facilitate the performance of the Same groups. In the Reversal groups, the retention of the old instrumental probabilities should retard performance since the probability of approachingthe positive cue of stage 3 is 0. The performance of the Intradimensional groups should not be differentially affected by the instrumental probabilities associated with the new positive and negative cues since each cue has an equal probability of being selected. The same predictions can now be stated for these groups as were derived from the Goodwin-Lawrence system: (1) the performance of the Same groups should be superior to the performance of the Intradimensional and Reversal groups, and (2) the performance of the Reversal groups should be inferior to the performance of the Intradimensional groups.

TABLE XII

INSTRUMENTAL PROBABILITIES OF THE POSITIVE (P_r) AND NEGATIVE ($1-P_r$) CUES FOR THE SAME, INTRADIMENSIONAL, AND REVERSAL GROUPS IN THE THREE TRAINING STAGES

Groups	Stages of Training					
	1		2		3	
	P_r	$1-P_r$	$P_{r'}$	$1-P_{r'}$	P_r	$1-P_r$
SAME	1	0	1	0	1	0
INTRA-DIMENSIONAL	1	0	1	0	.5	.5
REVERSAL	1	0	1	0	0	1

The above predictions were also the findings of the present study. Thus, the assumption of independent probability systems and the postulation of retention of cue probabilities can be used to explain the performance of the Same, Intradimensional, and Reversal groups of both shifts.

Future research: The retention of instrumental probabilities is dependent upon the assumption that independent probability systems exist for different sets of cues. This assumption can be tested by the use of a design in which a previously relevant set of cues is used as the variable irrelevant cues of an ED shift. The use of the positive and negative cues of a previous problem as the variable irrelevant cues of an ED shift should produce a probability of .5 of approaching either cue. When these cues are used in a subsequent problem, no retention of the high probability of approaching the cue which was positive prior to the ED shift will be exhibited. Goodwin and Lawrence (1955) suggest the contrary view, i.e., retention of cue preferences will occur in subsequent problems although the relevant cues of an original training problem are used as the variable irrelevant cues of an intervening ED shift.

The suggested experiment will utilize four groups of retarded Ss. There will be three stages of training. In stage 1, the four groups will be given identical training on a form relevant problem in which color is variable and irrelevant. In stage 2, Group I and Group II will receive an ED shift in which new color cues and new form cues are used as the relevant and variable irrelevant cues respectively. Group III and Group IV will receive an ED shift in which new relevant color cues are used and the originally relevant form cues of stage 1 are used as the variable irrelevant cues. After training in stage 2, the four groups will receive the second ED shifts. In stage 3, Group I and Group III will receive the same positive and negative form cues of stage 1 and new variable irrelevant color cues. Group II and Group IV will have the positive and negative form cues of stage 1 reversed in stage 3. New color cues will be the variable irrelevant cues. The training stages and the relevant and irrelevant cues of each stage are illustrated in Table XIII.

No differences are expected among the four groups in stage 1 since similar problems are given to all groups. Attention theory, with or without the addition of a retention postulate, predicts no differences

TABLE XIII

COLOR (C) AND FORM (F) CUES FOR TRAINING PROBLEMS

Trials								
	Stage 1 (All Groups)							
1	+ C_1F_1 Red Triangle				− C_2F_2 Blue Circle			
2	+ C_2F_1 Blue Triangle				− C_1F_2 Red Circle			
	Stage 2							
	Group I and Group II				Group III and Group IV			
1	+ C_3F_3 Green T		− C_4F_4 Yellow Diamond		+ C_3F_1 Green Triangle		− C_4F_2 Yellow Circle	
2	+ C_3F_4 Green Diamond		− C_4F_3 Yellow T		+ C_3F_2 Green Circle		− C_4F_1 Yellow Triangle	
	Stage 3							
	Group I		Group II		Group III		Group IV	
1	+ C_5F_1 White Triangle	− C_6F_2 Black Circle	+ C_5F_2 White Circle	− C_6F_1 Black Triangle	+ C_5F_1 White Triangle	− C_6F_2 Black Circle	+ C_5F_2 White Circle	− C_6F_1 Black Triangle
2	+ C_6F_1 Black Triangle	− C_6F_2 White Circle	+ C_5F_6 Black Circle	− C_6F_1 White Triangle	+ C_5F_1 Black Triangle	− C_6F_2 White Circle	+ C_5F_2 Black Circle	− C_6F_1 White Triangle

among the four groups in stage 2. All four groups are receiving ED shifts in which P_o is low and P_r is .5. Goodwin and Lawrence similarly expect no differences among the four groups of stage 2. Each of the groups must extinguish the old identification response to form of stage 1 add acquire a new identification response to color. New cue preferences must also be acquired by all groups since new relevant color cues are in all problems of stage 2.

In stage 3, theoretical predictions differ markedly. Assuming no cue retention, the Zeaman-House attention theory predicts no differences among the performances of the four groups. P_o should be low for all four groups since the relevant dimension of stage 3 was the variable irrelevant dimension of stage 2. P_r should be .5 for all groups since, relative to the cues used in stage 2, the relevant form cues of stage 3 are new cues and have no initially high or low probabilities of being approached. However, if a retention postulate is added to attention theory, differences among the groups are expected. Since the relevant cues of stage 1 were not used as the irrelevant cues of stage 2 for Group I and Group II, the original probabilities associated with these cues in stage 1 should be retained in stage 3. This retention of P_r from stage 1 will facilitate performance in Group I since the positive cue of stage 1 is the positive cue of stage 3. However, Group II-performance will be retarded as a result of the retention of the P_r of stage 1 since the positive cue of stage 1 is the negative cue of stage 3. No retention of the instrumental response probabilities of stage 1 will occur in stage 3 for Group III and Group IV since the relevant cues of stage 1 were used as the variable irrelevant cues of stage 2. P_r will be .5 for either cue as a result of the random reward schedule given the variable irrelevant cues. From the discussion above, the following prediction can be made for stage 3:

(1) Since the probability of approaching the positive cue is approximately 1 for Group I and 0 for Group II, Group I performance should be superior to Group II performance.

(2) Since the probability of approaching the positive or negative cue is .5 for Group III and Group IV, no difference in performance between Group III and Group IV is expected.

Goodwin and Lawrence would suggest that the rapid extinction of the identification response to form in stage 2 will prevent the loss of the cue preferences for the positive and negative form cues of stage 1 for all groups. Therefore, in stage 3, the rapid acquisition of an identification response to form will reestablish the old cue preferences for all groups. Since the positive cue of stage 1 is the positive cue of stage 3 for Groups I and III, performance should be facilitated as a result of the retention of the cue preferences of stage 1. Group II-performance and Group IV-performance should be retarded as a result of the retention of the cue preferences of stage 1 since the positive and negative cues have been reversed for both groups. Goodwin and Lawrence would predict therefore that the average performance of Group I and Group III will be superior to the average performance of Group II and Group IV.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of the present study was twofold: (1) to determine if mentally retarded individuals retain specific cue preferences across problems involving the learning of new cues, and (2) to compare and contrast the adequacy of the Zeaman-House and Goodwin-Lawrence theoretical systems to explain performance in situations which provided for cue specific and dimensional transfer.

Sixty mentally retarded Ss were divided into six groups of equal size. These groups were referred to as the ID-Same, ID-Intradimensional, ID-Reversal, ED-Same, ED-Intradimensional, and ED-Reversal groups. All groups received the same original training. After original training, the three ID groups were given two successive ID shifts and the three ED groups were given two successive ED shifts. In the second-successive shifts, the ID- and ED-Same groups were given the same set of cues and reinforcement contingencies which they had during original training. The ID- and ED-Intradimensional groups received a new set of relevant cues; and the ID- and ED-Reversal groups received the same set of cues as were present during original training but the reinforcement contingencies were reversed.

The comparison of ID and ED shift performance differences was used to evaluate dimensional transfer. The use of different sets of relevant cues in the second successive shifts provided a test for cue retention.

The principle findings of the present investigation were: (1) ID shift performance was consistently superior to ED shift performance, (2) the performance of the ID- and ED-Same groups was superior to the ID- and ED-Reversal groups, and (3) there was greater transfer from the first to the second shifts for the ID- and ED-Same groups than for the ID- and ED-Reversal groups.

It was concluded from these findings that:

(1) Cue retention does exist for retarded Ss.

(2) Neither the Zeaman-House nor Goodwin-Lawrence positions can explain the findings of both dimensional transfer and cue retention.

(3) In the Goodwin-Lawrence system, a redefinition of the manner of operation of the identification response must be made.

(4) In the Zeaman-House attention theory, a retention postulate must be introduced which will provide for the retention of instrumental probabilities associated with distinct sets of cues.

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