ODDITY LEARNING FOLLOWING SIMPLE DISCRIMINATION LEARNING IN MENTALLY RETARDED CHILDREN

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CHAPTER I

THE PROBLEM

Introduction

This study is an attempt to compare oddity learning with simple discrimination learning in mentally retarded children. Specifically, the extent of transfer to an oddity problem following learning of a simple discrimination problem was investigated.

In a simple discrimination learning problem approach tendencies are conditioned to one stimulus and avoidance tendencies to other stimuli. It is convenient to make a distinction between dimensions and cues of a discrimination problem. Zeaman and House (1963) define dimensions as "broad classes of cues which have a common discriminative property." (p. 168) Examples of commonly employed dimensions are color, form, size, position, and brightness. Cues are specific elements within a dimension, for example, cues in the color dimension might be red, green, or yellow. The typical object discrimination problem can be solved by approaching cues within a dimension. The dimension which can be used as a basis for solving the problem is called the _relevant_ dimension. All other dimensions which cannot be used for solution of the problem are termed _irrelevant_.

Oddity learning differs from simple discrimination learning in that the subject must make a comparison of all objects presented simultaneously and, rather than making approach or avoidance responses to specific objects, must respond to the odd object of the set. The subject must base his response upon the relationships among the various cues present which differ in color, form, size, position or combinations of these dimensions in order to solve the typical oddity problem. A simple two or three choice discrimination problem does not require that the subject respond to these relationships for solution of the problem. This would seem to indicate that oddity learning is more difficult than simple object discrimination learning.

Theoretical Background

Zeaman and House (1963) have proposed an attention theory model for discrimination learning in retarded children. This model postulates that visual discrimination learning requires a chain of two responses; first, attending to or observing the relevant dimension, and second, choosing the correct cue of that dimension. The model is illustrated by a probability tree showing the chain of two responses, and their respective probabilities of occurrence. Figure 1 shows a paradigm of Zeaman and House's model.

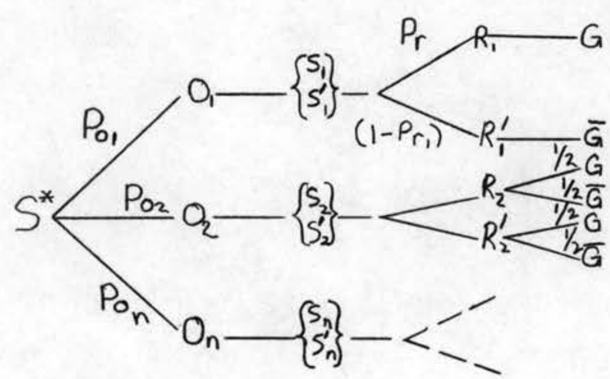

Figure 1. Probability Tree for Attention Theory Model for Discrimination Learning (Zeaman and House, 1963)

$\underline{S}$* represents the stimuli available to $\underline{S}$ at the start of a discrimination learning trial. $\underline{O}_1$ represents an observing response to the relevant dimension while $\underline{O}_2$ and $\underline{O}_n$ represent observing responses to irrelevant dimensions. $\underline{G}$ represents reinforcement following choice of the correct cue and $\overline{G}$ indicates non-reinforcement following choice of the incorrect cue. $\underline{Po}_1$ is the probability of observing the relevant dimension, and $\underline{Po}_2$ and $\underline{Po}_n$ represent the probability of observing any irrelevant dimensions. $\underline{Pr}_1$ is the probability of making the correct instrumental response (choosing correct cue) and 1-$\underline{Pr}_1$ is the probability of choosing the incorrect cue. The .50 probabilities in the $\underline{O}_2$ and $\underline{O}_n$ branches indicate that the irrelevant dimension is variable. The model contains rules for changing the probabilities of making observing responses and instrumental responses depending upon the outcome of the preceding trial. The dependent measure is the probability of making a correct overt response.

House (1963) has expanded the model to explain oddity learning. House postulates that since oddity learning is a relationship between cues within a dimension, it requires two observing responses. The subject must first attend to or observe the dimensions carrying the oddity or what House calls the vehicle dimension and then he must observe the oddity relationship among cues within the vehicle dimension. Thus, in terms of attention theory, oddity learning requires a chain of three responses; observing the vehicle dimension, observing the relationship among cues in that dimension, and choosing one of the cues of the vehicle dimension (instrumental response). Figure 2 illustrates the probability tree for Zeaman and House's (1963) original model with the addition of the second observing response proposed by House (1963).

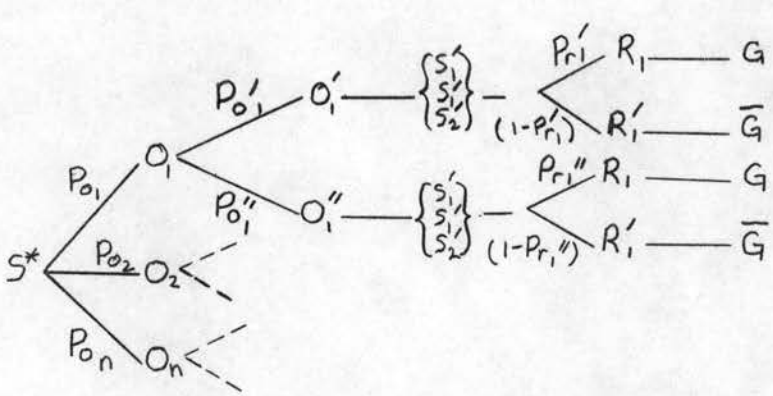

Figure 2. Probability Tree for Oddity Learning as Proposed by House (1963)

In this paradigm, $\underline{O}_1$ represents the response of observing the vehicle dimension, $\underline{O}_1'$ represents the response of observing the relationship among the cues in the vehicle dimension, and $\underline{Po}_1$ and $\underline{Po}_1'$ represent the respective probabilities of making these observing responses.

Figures 3 and 4 illustrate two typical trials in an oddity problem. Figure 3 illustrates a trial in which **S** observed the relevant vehicle dimension, observes the relevant relationship (oddity), and chooses the correct (odd) cue from the cues in the vehicle dimension.

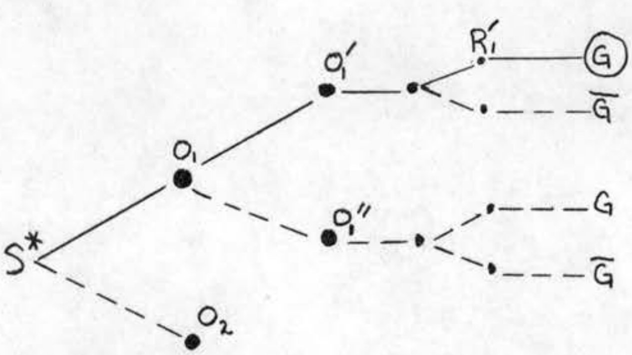

Figure 3. Oddity-Problem Trial in Which **S** Makes Correct Chain of Responses

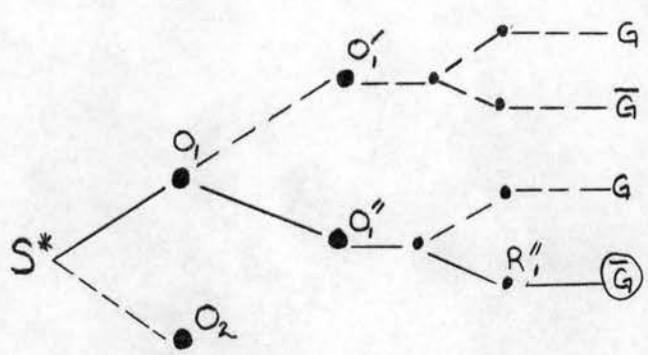

Figure 4. Oddity-Problem Trial in Which <u>S</u> Makes Incorrect Chain of Responses

Figure 4 illustrates a trial in which <u>S</u> observes the relevant vehicle dimension, but fails to observe the oddity relationship, and chooses the incorrect (non-odd) cue.

Purpose

The purpose of this study was to provide a test of some predictions based upon the model as revised by House. This was done by comparing four groups of retardates on different transfer conditions following pretraining on a simple discrimination problem. The four transfer conditions employed were: (1) an <u>intradimensional shift</u> (ID shift)--a shift to a second simple discrimination with the same relevant dimension; (2) an <u>extradimensional shift</u> (ED shift)--a shift to a second simple discrimination problem in which the relevant dimension is the original irrelevant dimension; (3) an <u>ID-oddity</u> shift--a shift to an oddity problem in which the vehicle dimension is the original relevant dimension; (4) an <u>ED-oddity</u> shift--a shift to an oddity problem in which the vehicle dimension is the original irrelevant dimension.

The following predictions were made:

1. The ID shift should result in fewer errors on the second problem than the ED shift.
2. A shift from a simple discrimination problem to a non-oddity (ID shift and ED shift) problem should result in fewer errors than a shift from a simple discrimination problem to an oddity problem (ID-oddity shift and ED-oddity shift).
3. A shift from a simple discrimination problem to an oddity problem in which the vehicle dimension is the original relevant dimension (ID-oddity shift) should result in fewer errors than a shift to an oddity problem in which the vehicle dimension is the original irrelevant dimension.

CHAPTER II

REVIEW OF THE LITERATURE

Harlow (1951) reviewed the studies of oddity problem solution in animals. His work has shown that while oddity problems are more difficult than simple discrimination learning for monkeys and chimpanzees, the fact that they can solve oddity problems indicates that verbalization is not a prerequisite to oddity learning.

Several researchers have studied oddity learning in children as a function of developmental status. Ellis and Sloan (1959) tested mentally retarded and normal children on a form relevant oddity problem. Results indicated that (a) retardates with an MA of approximately four years made no appreciable progress on the task, (b) retarded children with mean MA's of 6.1, 7.7 and 9.7 years produced typical negatively accelerated learning curves with an inverse relationship between MA and speed of learning, and (c) normal Ss reached approximately the same levels of performance as the equal MA retarded groups.

Another study of the effects of mental age on oddity learning was done by Lipsitt and Serunian (1963). The Ss were normal children from five age categories: third grade, first grade, old and young kindergarten children, and preschool children. The task consisted of three-choice, color relevant oddity problem in which the colors were flashed on small opaque windows in the apparatus with buttons located beneath each window. Ss were rewarded verbally for pressing the button under the correct window (i.e., the one containing the odd color). The results indicated that "The mean number of correct responses increases and the mean number of trials to criterion decreases progressively with age," (Lipsitt and Serunian, 1963, p. 203).

Martin and Blum (1961) report an experiment in which they found a significant relationship between MA and performance on a series of oddity problems in mentally normal and subnormal children. They found an increase in performance (decrease in errors over problems) as the MA of the children increased from three to ten years.

In a study comparing methods of training the oddity habit in retardates, House (1963) found that the Successive Reversal Method was superior to the Random Method of presenting training problems. The Successive Reversal Method consisted of a series of stimulus reversal problems with oddity as an additional cue. Ss were trained on a problem such as ABB, BBA, BBA, ABB... until they learned to choose A to a certain criterion and then the problem was reversed to AAB, BAA, AAB, BAA... with B as the correct cue. The Random Method consisted of drawing objects for each trial from a pool of objects so that the subject did not learn approach or avoidance tendencies to any one object, but rather, the only cue for solution of the problem was the oddity concept (ABB, CDD, DBB, EFF). The results showed that a higher percent of the Ss in the Successive Reversal Method group learned the oddity problems than in the Random Method group. This led House to postulate that the differences were due to an attentional response which was learned by the Successive Reversal group but not by the Random group.

These studies indicate that oddity learning is in part a function of mental age and that the speed of learning oddity problems may depend upon some attentional response by the subject. None of the studies reviewed provide data relevant to the present problem.

CHAPTER III

METHOD

Ss were 48 institutionalized retardates selected randomly from the children at the Hissom Memorial Training Center at Sand Springs, Oklahoma. The mean MA was 7 years 9 months (range: 6-0 to 10-1). All Ss had previous experience in learning simple discrimination problems, but no experience with oddity learning.

Apparatus

The apparatus was a modified Wisconsin General Test Apparatus (WGTA; Zeaman and House, 1963), the principal components of which were a table containing a one-way vision screen separating E from S and a sliding tray for stimulus presentation. Three 3" food cups, centered 8" apart, were set into a tray 30" wide. The tray could be pulled out of sight of S behind the screen for baiting.

The stimulus objects were colored forms cut from 1/4" Masonite and mounted vertically on 4" by 4" gray Masonite bases. All stimuli had maximum dimensions of 2" in height and width. Six forms--square, circle, triangle, cross, diamond, and T were each available in six colors--red, green, yellow, blue, black, and white, making a total of 36 stimulus objects.

General Procedure

At the start of a trial, E pushed the baited tray in front of S. Three stimulus objects were displayed, covering the three reward wells. Only one of the two outer objects was baited on each trial. The reward well beneath the center stimulus was never baited, and was never correct. Candy reward (an M & M) was placed in the reward well beneath the correct stimulus. The correct (baited) stimulus object appeared irregularly on the left or right according to a Gellermann series. In addition, E said "Good" if the first choice was correct, and "No" following an incorrect response. Immediate correction of incorrect responses was allowed. Responses to the center stimulus were not counted as either correct or incorrect, but E said "No" following such responses.

Experimental Design

Training Conditions - Subjects were divided into two groups of 24 subjects each. One group was trained on a color relevant object discrimination problem, and the other group on a form relevant object discrimination problem.

The color relevant problem consisted of two stimuli which differed in color and form. The positive (rewarded) cue was one of the two colors, and the form was variable and irrelevant. A third stimulus was present on each trial, but was constant over trials, non-rewarded, and differed in color and form from both of the relevant stimuli. Figure 5 represents four trials of a color relevant object discrimination problem.

The form group was trained on a form relevant object discrimination problem with color variable and irrelevant. In every other respect,

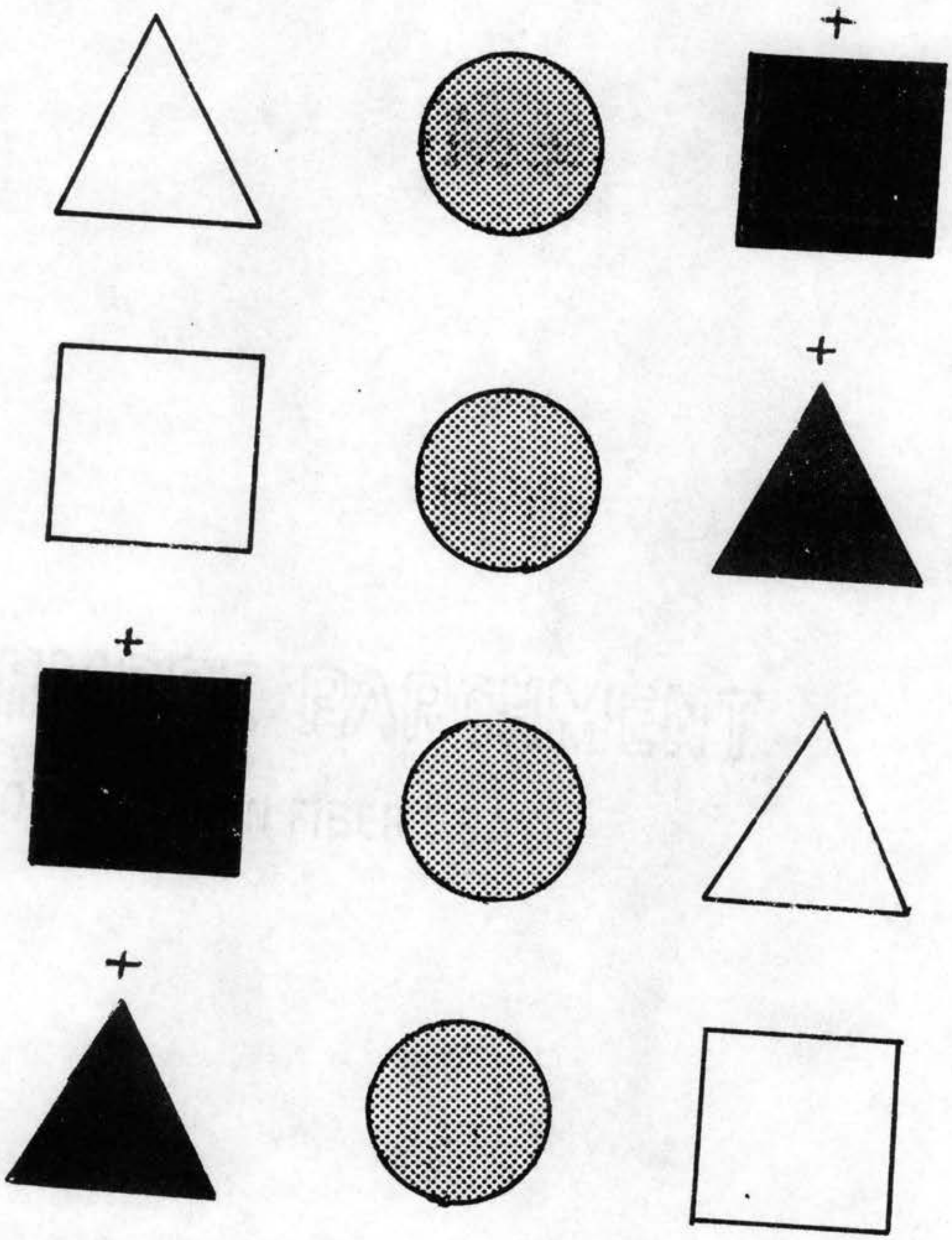

Figure 5. Four Trials of a Color Relevant Object Discrimination Problem

the form training was identical to the color relevant training.

Training was conducted at the rate of 25 trials per day with the exception of a few children who were accelerated to 50 trials per day for the last 2 days in order to accommodate the summer vacation schedule. Ss were run to a criterion of 20/25 correct responses in a single daily session with the last 10 consecutively correct.

If the subject failed to reach criterion on the training problem within 150 trials, a special training procedure was introduced (Eimas, 1966). The limit of 150 trials was imposed for several reasons: (a) Experience had shown that Ss who fail to reach criterion within 150 trials rarely reach it within 250-300 trials. (b) Discarding all Ss who failed to reach criterion by 250 trials would have limited the generality of the results. (c) Time was limited due to the fact that many high-level children were taken out of the institution for the summer.

Special Training Procedure - At the beginning of day 7, S was shown the positive stimuli and without mentioning the colors or forms E said, "These are the correct ones; the candy will always be under these." The incorrect stimuli were then displayed with E saying, "These are the wrong ones; the candy will never be under these." In all cases but three this resulted in immediate learning of the training problem. The three subjects who failed to learn the training problem after the special training procedure was introduced were replaced.

A correction procedure was used on both training and transfer problems.

Overlearning - After Ss reached criterion on the training problem, they were given 50 overlearning trials.

Transfer Conditions - After Ss had reached criterion on the training problem and given overtraining, they were immediately transferred to one of the following four conditions: ID shift, ED shift, ID-oddity shift, ED-oddity shift. The transfer conditions were identical for the two groups and will only be described for the color group. Exact conditions for the form group may be obtained by substituting the word "form" for "color" and vice versa.

Ss in the color relevant training group were transferred to one of the following conditions: (1) ID shift - a second color relevant object discrimination problem with three new forms and two new colors. Two stimulus sets were used, one in which the center object matched the correct cue in color, and the other in which the center object matched the incorrect cue in color. On each trial, the set used was determined by a Gellermann series, as was the position of the correct cue (either right or left of center). Two independent Gellermann series were employed, one superimposed upon the other. Form was variable and irrelevant. (2) ED shift - a form relevant object discrimination problem with color variable and irrelevant. Three new colors and two new forms were employed. Two stimulus sets were again used, the first in which the center object matched the correct cue in form, and the other in which the center object matched the incorrect cue in form. The position of the correct cue and the stimulus set was determined by two superimposed Gellermann series. (3) ID-oddity shift - a color relevant oddity problem with form variable and irrelevant. Two new colors and three new forms were employed. Two stimulus sets were employed, one in which the center object and the incorrect cue were of one color, and the second set in which they were of the other color.

In all cases, the correct cue was different in color from the other two stimuli. The center object was constant in form over trials and differed in form from both of the other stimuli. Figure 6 depicts four trials of a color oddity problem. (4) ED-oddity shift - a form relevant oddity problem employing two new forms and three new colors. Two stimulus sets were used, the first in which the center object and the incorrect cue were of one form, and the second set in which they were both of the other form. The center object was constant in color over trials, and differed from both other stimuli in color. In both sets the correct cue differed in form from the other two stimuli.

Subjects who failed to reach criterion within 150 trials were terminated and their errors recorded.

The response measure for all groups was the number of errors to criterion on the transfer task, or if S failed to reach criterion on the transfer problem within 150 trials, the number of errors to 150 trials.

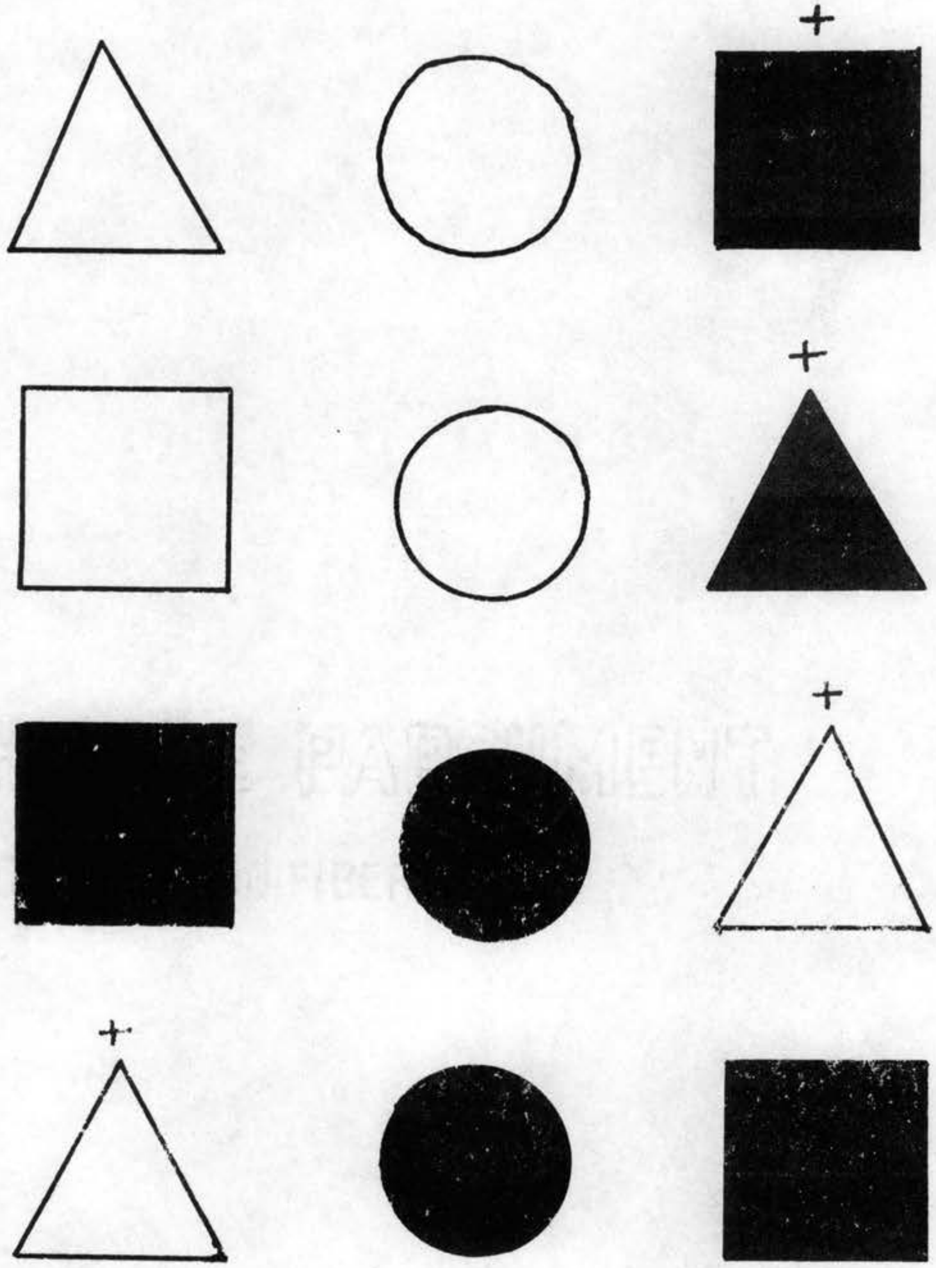

Figure 6. Four Trials of a Color-Oddity Problem

CHAPTER IV

RESULTS

The results will be presented first for the training stage and then for the transfer stage. The dependent measure for all analyses was number of errors.

Training Stage

A 4 x 2 (4 groups x 2 dimensions) analysis of variance (AOV) was done on the total number of errors made to criterion performance in training. There were no significant differences found either between groups or dimensions (color-form). This analysis indicated a lack of differences in speed of original learning among the four experimental groups and a lack of effect due to the nature of the relevant dimension. For all further analyses, the dimension variable will not be analysed.

Transfer Stage

Table I summarizes the results of a split plot double classification analysis of variance performed on errors over trials during transfer.

The main plot analysis allows a comparison of performance over trials as a function of oddity and non-oddity problems and between ID and ED shifts. Both of the comparisons indicated significant main effects between groups. The subplot analysis indicated a significant trials effect and a significant second order interaction.

TABLE I

ANALYSIS OF VARIANCE FOR NUMBER OF ERRORS MADE IN TRANSFER STAGE

Source of Variation	df	MS	F
A (oddity-nonoddity)	1	475.04	6.448 **
B (ID - ED)	1	3527.99	47.889 ***
Within cells	44	73.67	
D (trials)	5	11.67	2.279 *
AxBxD	5	19.47	3.802 ***
Sub-plot error	220	5.12	

* $p < .05$
** $p < .025$
*** $p < .005$

A more detailed analysis of total errors to criterion was performed using Duncan's New Multiple Range Test. This analysis showed the following comparisons to be significant ($p < .01$).

1. ID versus ED

2. ID-oddity versus ED-oddity

3. ID versus ID-oddity

4. ED versus ED-oddity

Figure 7 illustrates learning curves for the four groups plotted over trials. It can be seen that the ID group rose quickly to asymptote while the ED and ID-oddity groups rose more slowly. The ED-oddity group remained at a chance level of performance throughout the transfer trials.

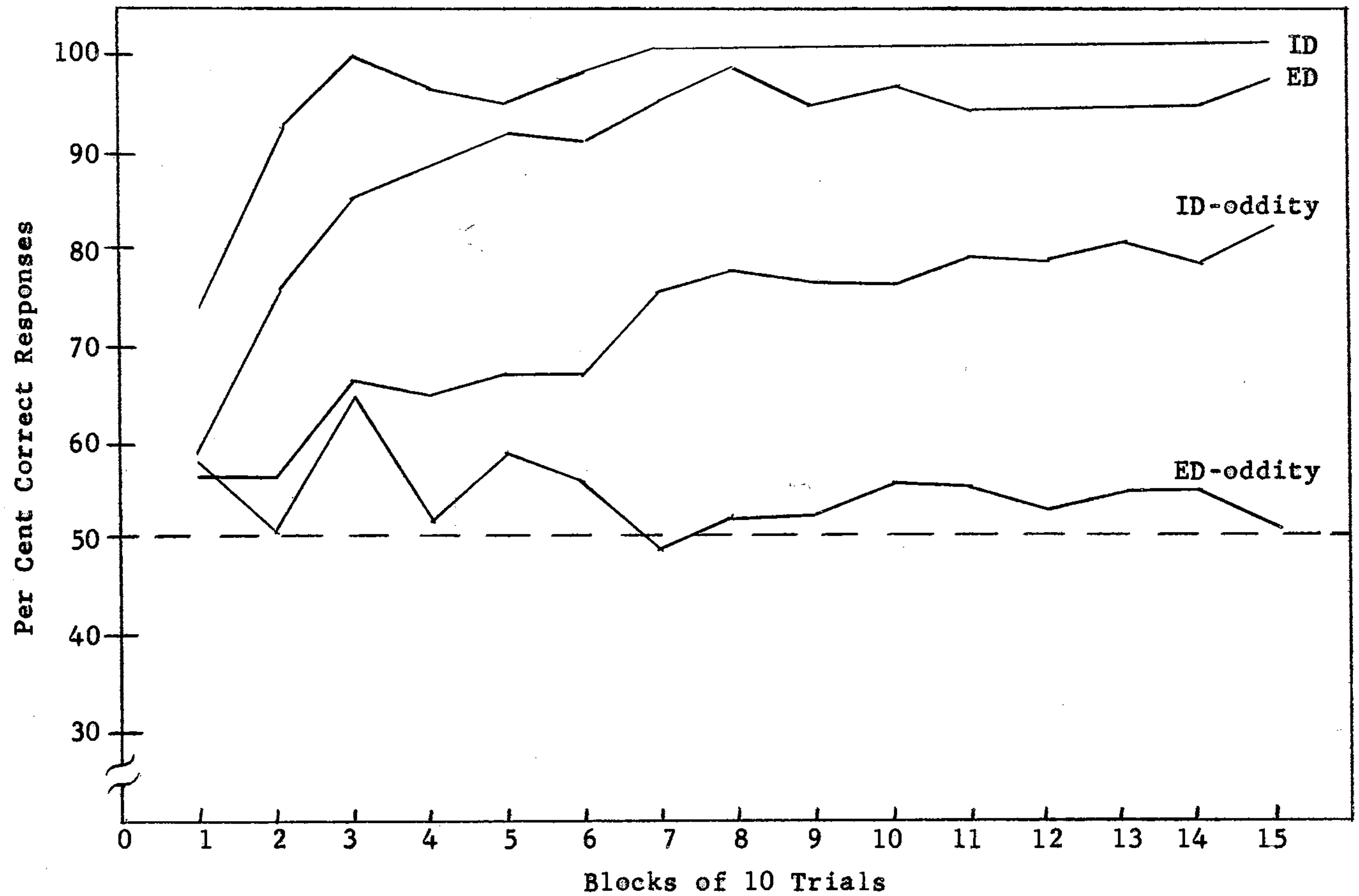

Figure 7. Learning Curves for Transfer Conditions

CHAPTER V

DISCUSSION

This study was designed to test predictions derived from a model proposed by House (1963) to explain oddity learning in terms of attention theory (Zeaman and House, 1963). The results will be discussed in terms of attentional processes in an attempt to integrate them into the attention theory model of discrimination learning and, specifically, to provide an addition to the model proposed by House.

Attention Theory

Zeaman and House (1963) make several predictions about the speed of learning a simple object discrimination problem following training on another simple discrimination problem. Their predictions are based on the number of new responses that must be learned to solve the second problem. The ID shift involves the learning of only the instrumental response, the second response in the chain, since the relevant dimension is the same as in the original problem. Thus, the ID shift should result in faster learning of the second problem than the ED shift, which requires the acquisition of both responses in the chain (the observing response, since the relevant dimension has changed, and the instrumental response, since new cues are present). The results of the transfer data for the ID shift versus the ED shift groups support this prediction.

Oddity Learning

House (1963) proposes the addition of a third branch to the probability tree for the attention theory model (Figure 2) to explain oddity learning. This means that in terms of attentional processes, a subject must learn a chain of three responses: (1) observing the vehicle dimension, or the dimension carrying the oddity; (2) observing the relationship among cues in the vehicle dimension; (3) selecting the correct cue (instrumental response). In terms of these attentional processes, the same sort of predictions can be made as in the original model, that is that the speed of learning an object discrimination problem following training on a simple object discrimination problem is inversely proportional to the number of new attentional responses that must be learned to solve the second problem. Specifically, the prediction can be made that learning a non-oddity problem following training on a simple discrimination problem will result in faster learning and fewer errors than learning an oddity problem following training on a simple discrimination problem. This prediction was supported by the data which showed that the non-oddity transfer groups (ID and ED shifts) made significantly fewer errors over trials than the oddity transfer groups (ID-oddity and ED-oddity).

Finally, integrating House's model for oddity learning into the original attention theory model, the prediction can be made that learning an oddity problem in which the vehicle dimension is the same as the relevant dimension in the training problem (ID-oddity) will result in fewer errors than learning an oddity problem in which the vehicle dimension is the original irrelevant dimension (ED-oddity).

This prediction was supported by comparing the transfer data for the ID-oddity and the ED-oddity transfer groups. The fact that the two non-oddity groups (ID and ED) and the ID-oddity group learned the transfer problem within 150 trials while the ED-oddity group did not can be used to explain the second order interaction found in the sub-plot analysis (see Figure 5).

Future Research

It would be interesting as a further test of an attention theory explanation of oddity learning to compare the performance of subjects trained on an oddity problem and then transferred to one of three conditions: (1) an ED shift - a shift to a second oddity problem in which the vehicle dimension is the original irrelevant dimension; (2) a Reversal shift - a problem in which the same cues are present, but in which the solution is based upon similarity rather than oddity; (3) an ED + Reversal shift - a shift to a similarity problem in which the vehicle dimension is the original irrelevant dimension. Each of these transfers involves a change in one or more of the responses in the chain, and would yield further evidence relevant to the existence of an attentional response for oddity learning. A comparison of the ED shift and Reversal shift groups would yield some information about the difficulty of shifting the observing response in the vehicle dimension versus shifting the observing response in the relational dimension, although no prediction of the direction of this difference can be made. The ED + Reversal shift should be more difficult than either of the other two.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of the present study was to investigate the extent of transfer to an oddity problem following learning of a simple discrimination problem. Forty-eight mentally retarded children were used as Ss.

The study involved two stages. In the training stage Ss were divided into two groups. One group was trained on a color relevant discrimination problem and the other on a form relevant problem. Three stimuli were present on each trial, only two of which were relevant. The third stimulus, located in the center of the display tray, was constant over trials, and was never correct.

In the transfer stage Ss were transferred to one of four transfer conditions: (1) ID - a simple discrimination problem with the same relevant dimension; (2) ED - a simple discrimination problem in which the relevant dimension is the original irrelevant dimension; (3) ID-oddity - an oddity problem in which the vehicle dimension is the original relevant dimension; (4) ED-oddity - an oddity problem in which the vehicle dimension is the original irrelevant dimension.

Data from the training stage revealed no significant differences between groups or between the color and form dimensions.

In transfer the major finding were significant error differences between the ID and ED groups and between the oddity and non-oddity groups. Significant differences were also found between the ID-oddity and ED-oddity groups.

In general the results supported the model proposed by House (1963) to explain oddity learning in terms of attention theory (Zeaman and House, 1963).

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