

THE EFFECTS OF PROGRAMMED INSTRUCTION ON THE ACQUISITION
OF THE REVERSAL SHIFT IN KINDERGARTEN CHILDREN

by

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ABSTRACT

This study is an investigation of the influences that the knowledge of relevant verbal descriptions has on the tendency for young children, Mean Age = 44.3 months, to employ a mediating process, i.e., to display a preference for the reversal shift, in the resolving of a selected problem-solving task. The task is arranged to permit each S to choose one of three shifts: a reversal, a nonreversal, or an inconsistent. After learning the first discrimination, the S is forced to shift to another response. In a reversal shift, the S is required to respond to the same dimension on which he was originally trained, but his overt choice has to be reversed, e.g., he has to shift from choosing a black cup to a white cup. For nonreversal shift, the previously irrelevant dimension becomes relevant, e.g., small becomes positive after black had been positive. An inconsistent shift would be the result of a failure to choose either the reversal or the nonreversal shifts. Each S who does not select the reversal shift in solving the task is presumed to employ a more primitive, non-mediating shift. The non-mediators were tutored by E for a period of eleven weeks and then presented with the same task that had been randomly altered to protect the validity of the results. The post-training tests revealed a significant increase in the proportion of the Ss who employed a mediating process, which was evinced in an increased preference for the reversal shift.

An additional investigation of an older group of preschool children, Mean Age = 67.5 months, revealed that those Ss who displayed a

preference for the reversal shift in solving an identical discriminative task made, during the testing process, a significantly larger number of verbalizations concerning the relevant stimuli than did the non-mediators, i.e., those who displayed a preference for the nonreversal shift.

INTRODUCTION

Relatively few research efforts have combined both learning theory and general developmental behavior theory. This lack of unity is due more to the differences in focus between the two areas than to theoretical or practical incongruities. Developmental theory, for the most part, has focused on the apparent behavioral differences and similarities between various age groups more than on the identification of specific mechanisms that account for these differences. Learning theory, on the other hand, has concerned itself largely with rigorous research into the formation and functioning of the mechanisms that can be described in terms of general laws that are applicable to all developing human beings.

The recent union of the principles and designs of both learning theory and general behavior theory has yielded a growing body of knowledge about the development of the mediating response in children. The development of this cognitive process has been investigated by interrelating the comparative studies--that is, by cross-species comparison of the mediating process with the experimental method of attempting to discover and to manipulate the variables that affect the development of the mediating response.

This union of behavior theory and learning theory was facilitated by the implementation of the hypothetical construct of the mediating response, which is "usually treated as a response which intercedes between the external stimulus and the overt response to provide

stimulation that influences the course of overt behavior" (Kendler, Kendler, and Leonard 1962). The experimental paradigm based on procedures by Buss, and Kendler and D'Amato permits the study of mediation by means of the type of transfer demonstrated from an initial to a subsequent discrimination.

The general technique used in this investigation of cognitive mediation is based on experimental procedures used by Buss, and Kendler and D'Amato. It consists essentially of studying mediation by means of the transfer demonstrated from an initial to a subsequent discrimination. The initial discrimination presents stimuli that differ simultaneously on two dimensions, but only one of the dimensions is relevant. After the criterion of eight of ten correct successive responses is reached, another discrimination is presented that utilizes the same or similar stimuli but requires a shift in response. One type of shift, called a reversal shift, requires \bar{S} to continue to respond to the previously relevant dimensions, but in an opposite way. In another type of shift, called a nonreversal shift, \bar{S} is required to respond to the previously irrelevant dimension. For example, if \bar{S} is initially trained on stimuli that differ in brightness (black vs. white) and size (large vs. small) by being rewarded for responses to black, regardless of size, a reversal shift would consist of learning to respond to white and a nonreversal shift would consist of learning to respond to small. Comparison between these two types of shifts is of particular interest because theories based on a single-unit and on mediated S-R connections yield opposed predictions about their relative efficiency. A single-unit theory that assumes a direct association between the external stimulus and the overt response would predict reversal shift to be more difficult than nonreversal shift. This is because reversal shift requires the replacement of a response that has previously been consistently reinforced with a response that has previously been consistently extinguished. In a nonreversal shift, previous training has reinforced responses to the newly positive and newly negative stimuli equally often. Strengthening one of these associations does not require as much extinction of its competitor as in a reversal shift and should therefore be acquired more easily. Kelleher confirmed the prediction that, for rats, reversal shift was more difficult than nonreversal shift (Kendler, Kendler, and Leonard 1962, pp. 571-572).

THEORETICAL APPROACHES TO THE STUDY OF THE REVERSAL SHIFT

The single-unit S-R theory, as illustrated by Spence's discrimination learning theory (Spence 1936), assumes a direct, non-mediated association between physical stimuli and overt responses. This theory predicts that requiring an organism to perform reversal shift would result in slower learning than with a nonreversal shift. This is theoretically based on the assumption that if an organism is required to make a response opposite to that which it has previously learned, the process of extinction will result in negative transfer. Spence's single-unit theory is presently limited to inarticulate organisms. The full applicability of Spence's theory to human beings is questionable because "they learn to make verbal or symbolic responses, overt or covert, to physical stimuli. These responses produce stimuli that mediate between the external stimulus and the overt response" (Kendler and Kendler 1959, p. 56).

A theory that includes a mediating link (or links) between the external stimulus and the overt response leads to a different prediction. The mediating link is conceived of as a perceptual or verbal response, often covert, to the relevant dimension which produces cues that determine the overt response. In a reversal shift, the initial dimension, e.g., brightness, maintains its relevance; hence, so does the mediated response. Only the overt response needs to be changed, and since the experimental situation provides only one alternative overt response, this change presents no great difficulty. In a nonreversal shift, the previously acquired mediation, e.g., to choose size, is no longer

relevant, consequently both the mediating and the overt response must be replaced in changing to a choice based on the dimension of color. Experiments by Buss, Kendler and D'Amato, and Harrow and Friedman, using a more complex variation of the technique of reversal and nonreversal shift with college students as Ss, confirmed the prediction of the mediational analysis (Kendler, Kendler and Leonard 1962).

Although it has not been confirmed that the level of verbal facility or the ability to make symbolic responses is directly associated with mediating responses, a significant amount of data indicates that this may be true. Kendler and D'Amato applied a mediational theory with college students engaged in a card-sorting technique and correctly predicted that they would learn a reversal shift more easily than a nonreversal shift. They concluded that "a reversal shift should occur at a more rapid rate than a nonreversal shift because at the completion of the learning of the first concept, the symbolic cues appropriate to the second concept were available to Ss in the reversal shift groups" (Kendler and Kendler 1959, p. 56).

The experimentally established discontinuity between the performance of rats which evince a preference for the nonreversal shift (Kelleher 1956) and adult humans who largely prefer the reversal shift in simulated discrimination learning tasks (Kendler and D'Amato 1955) led to several investigations with young children to determine if preschool age children, when confronted with similar experimental situations, operate from a single-unit or a mediational formulation. The results indicated that children between three and four years of age respond predominantly in the single-unit manner, i.e., display negative transfer on the

reversal shift (Kendler, Kendler and Leonard 1962), and that children between five and seven years of age divide about evenly with half mediating, i.e., displaying positive transfer for reversal shift, and half not (Kendler, Kendler and Leonard 1962). "These data imply a developmental process in which very young children's behavior is governed by a relatively primitive single-unit S-R process, with increasing maturity leading to increases in the proportion of children who mediate" (Kendler, Kendler and Leonard 1962, p. 572).

THE ROLE OF LANGUAGE IN THE DEVELOPMENT
OF THE REVERSAL SHIFT

Although the developmental nature of these cognitive phenomena has been established, there have been few investigations into the variables that might have a functional relationship with the establishment or non-establishment of the mediating process in the preschool age child. An investigation into the role of focused verbalizations in decreasing the difficulty of children's learning reversal shifts resulted in encouraging but statistically insignificant results (Kendler, Kendler and Wells 1960). The researchers indicated that the apparent lack of relationship between overt verbalization and the acquisition of the reversal shift does not in itself prove the null hypothesis. Rather, the results merely render it tenable. One explanation for the apparent lack of relationship is "that the small island of vocalization between the learning and the tests are insufficient" (Kendler, Kendler and Wells 1960, p. 87).

Previous research into the role of language in concept development and the ability to deal with abstractions has minimally supported the hypothesis that the attaching of verbal labels to the distinguishing features of the discrimination facilitates learning (Luiblinkaya 1957). Luria has demonstrated that speech in the early stages of child development is only a means of communication with others, whereby the child masters in a generalized form the experience of other people. "Subsequently it becomes also a means whereby he organizes his own experience

and regulates his own actions. So the child's activity is mediated through words" (Luria 1957, p. 116).

EXPERIMENTAL ANALYSIS OF THE DEVELOPMENT
OF THE REVERSAL SHIFT

The purpose of this study was to determine the possible effects of direct instruction and planned relevant learning experiences that were presumed to be associated with the ability or predisposition to acquire positive transfer for the reversal shift. It was predicted on the basis of the available scattered data that language exercises an indiscernible but important role in the transitional process of concept formation in children. This transitional process begins with the child's predisposition for single-order or rigid thought and, if successful, develops into the child's acquiring cognitive mediation, which facilitates more rapid learning of higher order concepts. The child's cognitive ability becomes, in effect, less rigid.

Subjects

The Ss for the first part of the study were twenty children drawn from a nursery school in Tucson, Arizona. The children ranged in age from thirty-eight to fifty months, with a mean age of 44.3 months. Eleven were female and nine were male. This group was considered to be the experimental group of this study.

The Ss for the second part of the study were eighteen children drawn from a kindergarten in Tucson, Arizona. One of these was disqualified due to a failure to reach criterion. Of the remaining seventeen used in this study, the age range was from fifty-four to seventy-nine

months, with a mean age of 67.5 months. Six were female and eleven were male.

Apparatus

The apparatus used to display the discriminada was an adaptation of a turntable described elsewhere (Kendler and Kendler 1959). For this study, it was an unpainted turntable made of matboard, twenty-four by fourteen inches, mounted on a swivel base and divided in half by a perpendicular matboard, eight inches high and fourteen inches wide. On one of the halves were two hollowed-out depressions, one inch square and eight inches apart. The marble that served as the token reward was placed in one of the depressions and covered by the opaque discriminada. Whenever the marble was being placed in one of the depressions, the half of the board containing the two depressions was turned toward E. The perpendicular board served to screen E's actions.

The discriminada for the initial and final testing of the experimental group and the only testing of the control group were four metal tumblers two and three-fourth inches in diameter. These tumblers varied both in height and brightness. Two of the tumblers were four and seven-eighth inches high (T). The other two were three and one-fourth inches high (S). One of each size was enameled white (W) and the other black (B).

The final item of apparatus was a plastic basket that was large enough to contain the marbles won by the child.

Procedure

Children were tested individually in a room in which E and S were alone. The S sat facing E at a small table with the apparatus between them. After S was comfortably seated and initial greetings had been exchanged, E said, "This is the game that we are going to play, (child's name). Before we start, listen carefully and I will tell you how it is played. See, there are two things on the board. When we start the game, you can choose one of them and pick it up. If you are right, you will find a marble under it. But if you are wrong, you won't find anything under it. You may choose only one each time. Then I will turn it around like this and you will have another turn. The game is for you to try to get a marble each time you choose. When you get a marble, put it in the basket. When we finish the game, you may choose one of the marbles to keep."

Each S was allowed to choose to mediate or not to mediate. This was accomplished by presenting a shift that could be successful on either a reversal or a nonreversal basis. "Since the choice was left with the Ss, each one could be identified as a mediator or a non-mediator, depending on whether he chose a reversal or a nonreversal shift" (Kendler, Kendler and Leonard 1962, p. 573).

Three series of discrimination trials were presented with no announced break in the procedure. Series I provided the initial training in the series; Series II provided exposure to a different (the second) discrimination; and Series III, the test-trials.

During the presentation of Series I, both pairs of stimuli were presented in a pre-arranged random sequence so that (1) each pair was

presented with equal frequency on the right and left but no more than twice in succession on either side, and (2) the correct or rewarded stimulus appeared with equal frequency on the right and left but no more than twice in succession on either side.

During Series I, a response to one member of each part was consistently correct and, consequently, always rewarded with a marble. When a response to an incorrect stimulus was made, S was required to return one of his marbles to E. The positive stimuli always shared one aspect and were opposed on the other. Figure 1 represents an illustration of one of the serial presentations of the stimuli and reinforcements, which will be referred to as the "standard" throughout. In the illustration, both positive members are black and size is irrelevant. Both black and white were used as the positive stimulus for half of the Ss, as assigned by random arrangement. S participated in this series until a criterion of eight out of ten successive correct responses was reached.

After criterion was established in Series I, Series II was presented. This series consisted of the presentation of only one pair of stimuli. For all of the Ss, the previously negative stimulus became positive and the previously positive stimulus became negative. In this series, the stimuli differed on two dimensions, and there was no second pair to accentuate one dimension more than another. In the illustration (Fig. 1), the positive stimulus is both small and white. S could respond to either the size or brightness, or both. The third and final series was designed to reveal the basis on which S learned Series II.

Immediately after criterion (eight out of ten successive correct responses) was reached in Series II, Series III began. As in Series I,

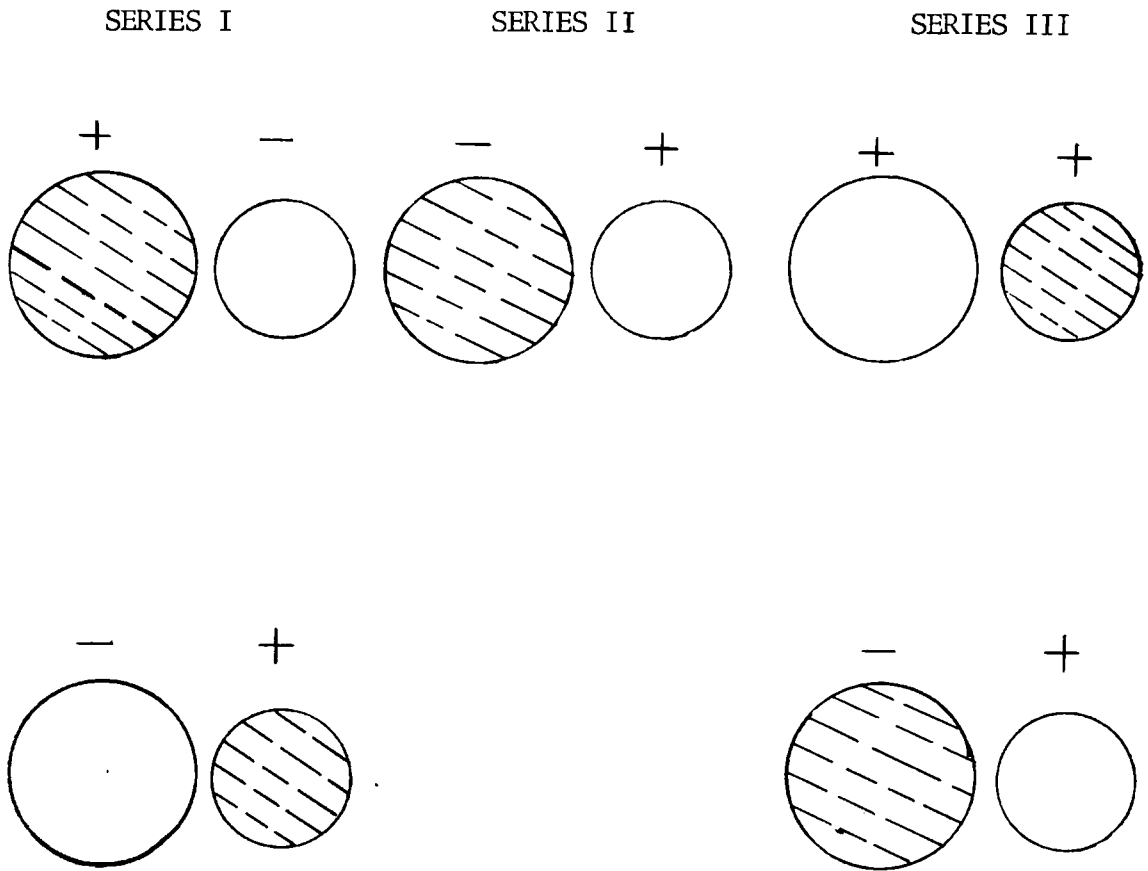


Fig. 1 - Illustration of One of the Arrangements of Stimuli and Reinforcement Used in the Experiment

both pairs of stimuli were presented alternately, except that during this series, any response was rewarded to the pair of stimuli that had not appeared in Series II. "Responses to this test-pair served to determine the basis of response in Series II, since these discriminanda separated the critical aspects of the stimuli that were previously merged, and the procedure required a choice of one" (Kendler, Kendler and Leonard 1962, p. 576). In the illustration provided, if S responded to the whiteness of the positive stimulus in Series II, he could be expected to choose LW in Series III. He could be expected to choose SB if he were responding to size. If he had not been responding to both size and brightness, he would distribute his choices between both members.

The presentation of the other pair of stimuli was alternated randomly with the test-pair. The pattern of reward was retained and the presentation was designed to keep S responding on the same basis as in Series II. Each pair was presented ten times in an alternating sequence that was identical with Series I.

At the completion of Series III, the Ss were asked questions about the stimuli used in Series II, to provide information about both the possible verbal processes involved in the learning of either the reversal and/or the nonreversal shifts and to indicate to E the extent of their familiarity with the different aspects of the stimuli. They were asked: "Which one was the winner?" If the child merely pointed, he was asked, "How do you know?" The extent of the verbal responses was recorded and included as part of the data.

Classification

S's choices on the test-pair used in Series III functioned as the basis for classification into one of three categories: reversal, non-reversal, and inconsistent.

Reversal

If, on the test-pair of Series III, S made eight or more responses to the stimulus that was incorrect in Series I, he was classified as a reverser. If, for example, as in Figure 1, B was positive in Series I and S chose LW consistently in the test-pair of Series III, it would indicate that Series II had been learned by shifting from B to W, or, for the purposes of this study, by making a reversal shift.

Nonreversal

If, on the test-pair of Series III, S made eight or more responses to the previously irrelevant stimulus of Series I, he was classified as a nonreverser. In reference to Figure 1, this S would choose the SB in the test-series, which would indicate that although Series I was acquired by learning to respond to brightness, Series II had been acquired by responding primarily to the size of the positive or rewarded stimulus. "This learning is based on a shift to the previously irrelevant dimension and has in previous research been called a nonreversal shift" (Kendler, Kendler and Leonard 1962, p. 577).

Inconsistent

The last possibility is that S's choices in Series III may lack consistency, i.e., neither stimulus of the test-pair may be chosen more

than seven times. This behavior would indicate that by the end of Series II, S was responding equally, or almost so, to both the size and brightness of the positive stimulus.

RESULTS OF TRIAL-TESTING AND DISCUSSION

Table I represents the results of the initial testing of the twenty children. Each category will be considered separately and will be compared to results of previous research with this age-group.

For reasons stated here and in previous research, reversers are assumed to have the ability to make mediated responses. "These are children who, when faced with a shift, continue to respond to the same dimension in a reverse manner, e.g., shift from black to white" (Kendler, Kendler and Leonard 1962, p. 577). The pre-testing expectation about this category based on previous research and theoretical assumptions was that approximately thirty-seven percent of the three-year-olds would mediate and that this proportion would increase to fifty percent at four years (Kendler, Kendler and Leonard 1962). The results of the present study were that twenty percent of the investigated group (Mean Age = 44.3 months) mediated. This variance between a previous study and this study could possibly be due to the smaller N of the present study. The results of the pre-testing are not at variance with the general expectations based on previous research which indicated that fewer than fifty percent of the children between the ages of three and four would, when faced with a shift, make a mediated response.

The most distinctive difference between the performance of the children who were classified as reversers and that of the nonreversers and the one who was classified as inconsistent is in the number of trials to reach criterion. Table I illustrates the differences in speed of

TABLE I
 NUMBER OF TRIALS TO REACH CRITERION ON SERIES I AND II
 AS RELATED TO CHOICE-BEHAVIOR IN SERIES III

CHOICE	N	SERIES I			SERIES II		
		M	Mdn.	Range	M	Mdn.	Range
Reversal	4	17.0	18.5	0-30	16.4	14.5	0-40
Nonreversal	15	74.4	75.0	0-94	65.1	63.5	0-87
Inconsistent	1	---	---	0-178	---	---	0-112

TABLE II
 PERCENTAGE OF Ss GIVING DESCRIPTIONS OF THE STIMULI
 AS A FUNCTION OF THEIR CHOICE IN SERIES III

CHOICE	VERBAL DESCRIPTIONS		
	Correct	Incorrect	No verbalization
Reversal (4)	75.0	25.0	---
Nonreversal (15)	40.0	46.7	13.3
Inconsistent (1)	---	---	100.0

learning in Series I and II for children whose later responses to Series III placed them in one of the three previously described categories of choice. In both series, the children who mediated, i.e., the reversers, learned fastest.

In addition to these results, the observation was made, as in previous studies, that the reversers engaged in more verbalization about the stimuli dimensions and the task in which they were engaged than did the other two groups. These ad hoc observations were interpreted as representing at least a suggestion of the nature of the mediating process and of its development. The Kendlers (1959) have hypothesized that fast learners, i.e., the reversers, approach the experimental task with verbal labels for the correct stimulus already strongly attached, due to prior experience with these stimuli.

The data presented in Table II is based on the answers given by the children about what the "winner" looked like after Series III was presented. These questions were asked in the presence of the last pair of stimuli with which they had been previously presented. The children were classified according to the descriptions they offered (Kendler, Kendler and Leonard 1962). The responses were classified as follows:

Verbalized correct dimension. This category refers to responses which included either one or both of the dimensions that had apparently influenced S's behavior in Series II and III, e.g., of a child who had been responding to brightness in the preceding series and used the terms "black" or "white."

Verbalized incorrect dimension. This category refers to responses of children who described the dimension that was inconsistent

with their overt choice, e.g., of a child who had been responding to brightness but who mentioned only size in his verbal description.

No verbalization. This category included the responses of two groups of children: those who offered no verbal response and those who merely pointed at the stimulus.

It can be observed from Table II that the majority of the non-reversers failed to produce any relevant verbalization. If verbalization or the functional knowledge of the relevant stimuli is important for the mediating process, then it could be expected that non-mediators would be relatively inarticulate. Conversely, mediating children should produce a large proportion of verbal comment that was relevant to their previous performance. The data recorded in Table II indicates that this is the case.

Training Procedure

The training procedure was designed to assist the sixteen non-reversers in learning the relevant dimensions of the stimuli that had been employed during the pre-testing series. The Ss were individually tutored by E and an assistant five days per week over a period of eleven weeks. The tutoring sessions were of no definite period of time because each session was terminated whenever the Ss displayed disinterest or fatigue. Generally, however, the tutoring sessions lasted not less than five minutes and not more than twenty minutes.

The question dealing with whether verbal mediation involves dimensional identification or antonym-association as a means of discriminating relevant from irrelevant cue dimensions has previously been raised (Kendler 1963). The tutoring of the sixteen nonreversing Ss of

the present study was focused on these two hypothetical cognitive skills. The Ss were encouraged to learn to identify various objects, i.e., cups of various sizes and colors, rubber balls, cookie cutters, scissors, pieces of cardboard squares, in multi-dimensional ways. The Ss, for example, were encouraged to learn to verbally identify objects by both size (large or small) and color (black, red, white, or blue). After an S had acquired the ability to identify an object with more than one label, he or she was then tutored on the concept of antonym-association. This latter phase of the training focused on the Es assisting the Ss in learning to recognize and to give verbal labels to the training objects that differed both in size and color. The Ss, for example, learned to recognize paired antonyms, i.e., large-small, black-white, and to attach appropriate verbal labels to the various discriminanda that were employed during the training procedure.

After the conclusion of the eleven-week training session, the twenty Ss were re-tested. The procedure was identical with the pre-trials previously described. The only deviation from the initial three series of trials was in the form of altering the rewarded stimulus in Series I. The Ss who had learned to respond to "black" in Series I during the pre-trials were, on the testing trials, presented with "white" as the correct stimulus in Series I of the testing trials. The opposite was true for the Ss who had learned to respond to "white" in Series I during the pre-trials.

Table III illustrates the Ss' performance on the trials that were administered at the conclusion of the training period.

TABLE III

(POST TRAINING) NUMBER OF TRIALS TO REACH CRITERION ON SERIES I AND II
AS RELATED TO CHOICE-BEHAVIOR IN SERIES III

CHOICE	N	SERIES I			SERIES II		
		M	Mdn.	Range	M	Mdn.	Range
Reversal	17	23.2	19.8	0-43	20.5	19.5	0-34
Nonreversal	2	68.0	---	0-72	59.5	---	0-69
Inconsistent	1	28.0	---	0-28	23.0	---	0-23

TABLE IV

NUMBER OF RELEVANT VERBALIZATIONS MADE BY OLDER Ss
DURING TEST-TRIALS

CHOICE	N	M	Mdn.	Range
Reversal	10	16.8	17.5	0-21
Nonreversal	7	7.3	7.0	0-12
Inconsistent	0	---	---	---

Comparison of the pre-training performance of the Ss on the tests for mediation (Table I) with their post-training performance on the tests for mediation (Table III) illustrates the differences in results. It can be seen that thirteen of the fifteen initially tested Ss changed from nonreversal to reversal Ss.

Because of the small N, Yates' correction for continuity (Garrett 1967) was included with the chi-square test which was applied to the raw data to prepare them for statistical analysis of variance.

The analysis of variance between the pre-trained Ss and the trained Ss suggests that the predicted interaction between correct verbalizations and knowledge of the verbal labels for the relevant stimuli and the displaying of positive transfer for the reversal shift is statistically reliable ($P=.01$).

The results of previous research on mediated responses in children are not identical with this research. The Kendlers, with a larger N factor, found that 37.5 percent of the three-year-olds mediated, i.e., displayed a preference for the reversal shift, and this proportion increased to fifty percent at four years, remained level at six years, and then rose gradually to 62.5 percent at age ten years (Kendler, Kendler and Leonard 1962).

That a significantly larger proportion (eighty-five percent) of the Ss of the present study displayed a preference for the reversal shift at least indicates that the learning experiences that the training provided were, either directly or indirectly, instrumental in determining the increase.

AN ANALYSIS OF THE DIFFERENCES IN VERBAL FACILITY
BETWEEN REVERSERS AND NONREVERSERS

In an attempt to enlarge upon the hypothesis that language, e.g., the knowledge of and the ability to apply correct verbal labels or symbolic cues to relevant stimuli, is functionally related to the process of mediation, e.g., displaying a preference for the reversal shift, an additional study was included with the previous research.

As previously noted in the description of the subjects, the Ss for this second part of the study were seventeen children drawn from a different kindergarten. Because of the older ages of this group of children (Mean Age = 67.5 months), it was assumed that a larger proportion of them would display a preference for the reversal shift and that they would engage in more verbalization during the solving of the previously described problems. In the 1920s, L.S. Vigotsky and his collaborators first directed attention to the role of language in the solving of problems.

Study of the way a pre-school child solves practical problems (modeling in plasticene, tracing a drawing, and so on) led to the conclusion that a child only performs his actions in silence until he meets with some difficulty. As soon as he is presented with such a difficulty ... his activity at once begins to be accompanied by speech. Speech appears to play an important role in the child's subsequent activity. By fixing the new situation, it mobilizes the systematized connections built up during the past experience, gives the child direction among the possible ways out of the impasse, and makes possible the choice of methods enabling him to solve his problems (Luria 1957).

Method

The method employed in testing the Ss and the system of classification was identical with that of the first group, which has been previously described. The recording of the data for this group included one additional variable: that of noting each relevant verbalization that the Ss made during the three series of presentations of stimuli. The Ss were not verbally prompted by E. Relevant verbalizations were those that correctly labeled the stimuli at hand, such as "black," "white," "large," "small," or any correct combinations of these words. The category, relevant verbalizations, also included statements made by the Ss which verbally described the changes in rewarded stimuli or which correctly illustrated that the S was aware of the testing process. Examples of these relevant statements are illustrated by the following: "Now it (the marble) is under the black one," "You keep putting it under the black," "I thought you were putting it under the black," and "I knew you would keep it under the white."

The data concerning the number of relevant verbal responses made by the seventeen Ss and their classification as mediators or non-mediators are illustrated by Table IV.

Entering the data in a four-fold contingency table with Yates' correction for continuity, the chi square (X^2_c) test for significance between the two groups, based on an estimate of the "true" proportion drawn from the total group, yielded a one-tail $p=0.001$.

SUMMARY

The primary concern of this research was with the influence of the knowledge of relevant verbal cues or labels on the acquisition of the mediating response in selected groups of preschool children. The first group of children, who experienced subsequent training in the acquisition of relevant verbal labels and antonym concepts, were presented with an initial discriminative task that included a relevant and an irrelevant stimulus-dimension. After reaching criterion, they were presented with a shift in which the same stimuli were employed but the reinforcement pattern was reversed. The shift could be accomplished by responding to the previously relevant dimension in an opposite manner (a reversal shift); by responding positively to the previously irrelevant stimulus-dimension (a nonreversal shift); or by responding indiscriminately to both stimulus-dimensions (an inconsistent shift). S had control of the choice of which shift he made. On the basis of previous theoretical analysis, reversal shift was interpreted to be indicative of a mediating process intervening between the external stimuli and the overt response. The same theoretical analysis presumed the non-mediating processes, e.g., the nonreversal and inconsistent shifts, to be indicative of a more cognitively primitive single-unit S-R process.

The present research attempted to throw further light on the failure of a large proportion of three- and four-year-olds to employ a mediating process in the solving of a selected discriminative task. The lack of mediating ability was presumed to be a function of insufficient

verbal ability (in the form of a lack of symbolic cues) rather than chronological age. The results of the post-training tests seem to support this hypothesis.

The preliminary learning data suggested, as in previous studies, that there is a functional relationship between the ability to connect words with actions and the tendency to favor the reversal shift, i.e., to make mediated choices. An analysis of the verbalizations of an older group of children involved with the same discriminative task as the younger group indicates that there is a functional relationship between the two phenomena.

GLOSSARY OF TERMS

- discriminada - The objects that are employed to serve as the stimuli for a problem-solving situation. In this research, the discriminada that were designated as the stimuli were the four cups that varied in both size and brightness.
- discriminative task - A problem-solving situation that can be solved only by the ability to discriminate between the relevant dimensions of the pertinent stimuli.
- hypothetical construct - A theory that is used to predict an event or situation that is not directly observable, e.g., theory of cognitive mediation.
- nonreversal shift - This problem-solving operation is illustrated by a previously irrelevant dimension of a discriminative task becoming relevant, e.g., large (size) becomes positive after white (brightness) had been positive.
- responses - The observable activity (behavior) of an organism.
- reversal shift - A theoretical cognitive operation that is involved in a selected concept learning situation. In the example illustrated by the present research, the learning situation involves the two dimensions, size and brightness. In a reversal shift, the subject is required to respond to the same dimension on which he was originally trained, but his overt choice has to be reversed, e.g., he has to shift from choosing a black cup to choosing a white cup.
- single-unit S-R theory - K.W. Spence's theory of discrimination learning that is based on the hypothesis that there are no intermediary, i.e., cognitive, events between a stimulus and an overt response to that stimulus. This theory is applied primarily to infrahuman organisms, but it is occasionally employed to explain the behavioral differences between pre-verbal and highly verbal children.
- stimuli - Events in the environment that affect behavior.
- theory of mediated responses - An intervening variable that is used to account for the fact that a single-unit (S-R) theory is insufficient in the explanation of human behavior. The mediated

response is assumed to exist within the central nervous system. The mediated response--either overt or covert--affects human overt responses. It is a theory that is used to explain the phenomena of stimuli and responses that occur "inside" human beings and that, consequently, affect behavior.

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