REVERSAL AND NONREVERSAL SHIFTS IN INDIAN AND WHITE CHILDREN

by

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ABSTRACT

This study was designed to explore specific aspects of the relationship between language and cognition. Comparisons of a normal population with populations deficient in verbal ability provide information relevant to the qualification of this relationship. In this respect, B.C. Indian children were an appropriate group for comparison with normal white children since they are apparently deficient in verbal development. It was considered worthwhile to determine if there are cognitive differences between Indian and white children and if there are, to determine if these differences can be attributed to differences in verbal ability in the form of verbal mediation. Evidence of verbal mediation is assumed to be exemplified in the relatively greater ease of executing a R over a NR shift. In a 3 x 2 x 2 factorial design involving age (7,8,9), shift (R-NR), and ethnic group (Indian-white), it was hypothesized that there would be a significant interaction between shift and ethnic group.

A total of sixty-seven Indian and fifty-one white children was initially tested. However, nineteen Indian and three white children failed to learn the first discrimination to criterion within the limit of one hundred trials. The difference between these proportions was highly significant. Analyses were conducted for the resulting self-selected sample of forty-eight Indian and forty-eight white children who succeeded in attaining the first criterion and who went on to the shift task. On original learning, there were no significant differences or interactions for this self-selected sample. On the shift, there was a significant main effect only for the shift factor,

with the R shift performance being superior to NR shift performance for both ethnic groups. There were no differences between Indians and whites in overall performance or in the relative difficulty of R and NR shifts.

Supplementary analyses were performed to explore other possible differences. It was found that the white children were relatively consistent in the speed with which they learned both the original discrimination and shift while, in contrast, the Indian children were not. Those Indian children who were "fast" in original learning became "slow" on the shift, whereas those who were"slow" in original learning became "fast" on the shift. On the basis of post-experimental card sort and verbalization tests, it was also found that the shape dimension was more salient than the size dimension and that Indian children were not as successful in giving an appropriate overt label to the triangle concept.

The specific hypothesis that there would be a significant interaction between shift and ethnic group was not supported. However, in general, the results from the supplementary analyses and the fact that significantly more Indian than white children failed to reach the first criterion suggested that there were cognitive differences between Indian and white children. There was no specific evidence to support a mediational deficiency interpretation of these differences.

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CHAPTER I

INTRODUCTION

Although an intimate relationship between the development of language and cognitive development is generally acknowledged, there is little concensus concerning the nature of this relationship. One promising, but as yet, controversial approach to this problem is in the developmental study of mediation in a variety of learning situations. Of immediate interest is the mediational deficiency hypothesis (MDH), which proposes that relatively early in human development, there is a stage in which verbal responses, although available, do not serve as mediators between external stimuli and overt responses (Kendler and Kendler, 1962; Kuenne, 1946; Reese, 1962). This hypothesis has important assumptions and implications. It assumes that mediation does occur and that mediation is essential in many problem solving tasks. Also, it implies that mediation is necessarily verbal. The important problems and issues generated by the MDH are quite evident. How valid is the mediational interpretation of behaviour in certain problem solving situations? Is mediation necessarily verbal?

One attempt to furnish relevant information is made by H.H. Kendler and T.S. Kendler, among the foremost proponents of the mediation position. Employing inferences from studies involving reversal (R) and nonreversal (NR) shifts, they present a substantial amount of evidence to support the position of verbal mediation. Their research is significant for the theoretical conception of the role of language in cognitive development. It would therefore be worthwhile to assess their work thoroughly.

The primary purpose of this thesis is to describe a study in which cross-cultural comparisons on R and NR shift performance are made. In the following introductory section, a general framework will be provided by a review of the language-thought issue and a discussion of the MDH. Subsequently, the relevance, rationale, evidence, and criticisms of R and NR shift studies will be discussed. More specifically, single unit (S-R) and mediational (two-stage) interpretations of shift differences and experimental evidence for and against mediation theory will be considered. Finally, the reasons for studying B.C. Indian children will be outlined and consequently, the hypothesis of the experiment will be made explicit.

Language and Thought

To say that language and cognition are closely related does not explain the relationship. More specifically, we observe that there are qualitative differences between younger and older children in performance on a number of cognitive tasks and that this performance improves concomitantly with the acquisition of language; but we cannot make causal inferences on the basis of such observations. Two divergent schools of thought seek to clarify the nature of the language-cognition relationship. One claims that the development of cognition depends upon the development of language. The other proposes that language expresses changes occurring in non-linguistic cognitive development.

Piaget, one of the foremost exponents of the latter position, has presented much evidence to support his contentions that "la pensée précède le langage " (Piaget, 1954, p. 54) and that language is essentially "a symptom of underlying orientation" (Flavell, 1963, p. 271)

A more specific statement is given by Bellin:

> ...The Geneva group is committed to the view that verbal processes become articulated with logical thought only after the development of (nonverbal) infralogical and logical schema (Bellin, 1965, p. 319).

Quite similarly, according to Bruner (1964) in his review of a number of recent experiments, language is the ultimate stage in a progressive development of the various modes by which experiential information is represented, integrated, and transformed. It is the tool by which the child is "released from immediacy" (Bruner, 1964, p. 14) and enabled to engage in symbolic cognitive activity.

In contrast, the other school of thought emphasizes the importance of language in the developmental aspects of both cognitive and physical activity (Kendler and Kendler, 1962; Kostyuk, 1959; Muller in Humphrey 1951; Reese, 1962; and others). Luria for example, draws attention to the importance of this abstracting and generalizing function of language ..

> ....It becomes also a means whereby he (the child) organizes his own experience and regulates his own actions. So the child's activity is mediated through words (Luria, 1957, p. 116; also Luria, 1959).

Similarly, Liublinskaya concludes that,

> The introduction of language into the process of visual discrimination re-structures the whole activity of the analyzer and the whole process of sense perception...Simple differentiating -- discriminating -- turns into a reasoning operation, that of comparing. The child learns to isolate common and distinguishing features in two similar stimuli (Liublinskaya, 1957, p. 200).

One of the outgrowths of the emphasis upon language is the MDH. To reiterate, the MDH purports that relatively early in human development, there is a stage at which verbal responses, although available, do not serve as mediators. Two major sources of evidence are germane

to this hypothesis. The first, as is apparent from preceding discussion, involves the study of children before, during, and after the acquisition of language. To a large extent, studies utilizing this approach provide information that is directly relevant to the MDH; many of these will be discussed in greater detail later. The second major source of evidence furnishes information that is both directly and indirectly pertinent to the MDH. It involves the examination of various populations that are, or at least supposedly are, deficient in language in order to determine if cognitive deficiencies exist, and if they do, to determine how deficiencies in language are related to deficiencies in cognition. For example, studies have investigated aphasics (Humphrey, 1951, Ch. VIII; Jenkins and Schuell, 1964; Schuell and Jenkins, 1959) and in concept-formation studies, deaf children (Furth, 1961 and 1964; Kates, Kates, and Michael, 1962; Solov'yev, 1960) and retarded children (Campione, Hyman, and Zeaman, 1965; Milgram and Furth, 1963 and 1964; Zeaman and House, 1963). Some of these will also be considered later.

A third possible line of research, as yet unexplored, but quite conceivably pertinent to the MDH, lies in the study of cross-cultural comparisons. Here, it would be worthwhile for example, to determine if there are cultural differences in performance on various tasks considered to be indices of cognitive functioning and to see if these are related to differences in the use of language as a cognitive tool. Methodologically, the cross-cultural approach poses a problem because the cognitive task employed must allow inferences about the use of language and its relation to mediation, yet preclude the potentially confounding effects of differences in the languages themselves. It

is in this respect that the comparison of the relative ease with which R and NR shifts are made, assumes an important role.

Reversal and Nonreversal Shifts, and Mediating Responses

The typical procedure of studies involving R and NR shifts consists of presenting a two-choice discrimination learning task. Usually, the stimuli vary simultaneously along two binary dimensions. Subjects are rewarded for responding to one level on one of the dimensions in each pair. After the subject learns the initial discrimination to a criterion, the response-reinforcement contingency is "shifted" without interruption in subsequent presentations. In the R shift, the previously negative level within the same or originally relevant dimension is reinforced. In contrast, a level of the dimension irrelevant in original learning (the initial discrimination) is reinforced in the NR shift[1] (see Figure 1, p. 6).

Precisely what predictions are made as to the relative ease with which a shift is learned depends upon the theoretical position adopted. On one hand, strict S-R or single-unit theory predicts that the NR shift is more easily acquired than an R shift since some of the correct responses in the NR shift were previously reinforced in original learning, whereas none of the correct responses in the R shift was ever reinforced in original learning. Therefore, the habit strength of the "correct" response is stronger in a NR than in an R shift at the time of the attainment of the criterion for the first discrimination (Hunt, 1962; Kendler and Kendler, 1962). Also, where the number of

[1] Some studies, e.g., Campione et al. (1965) provide other definitions for the various shifts which, for present purposes, need not be discussed.

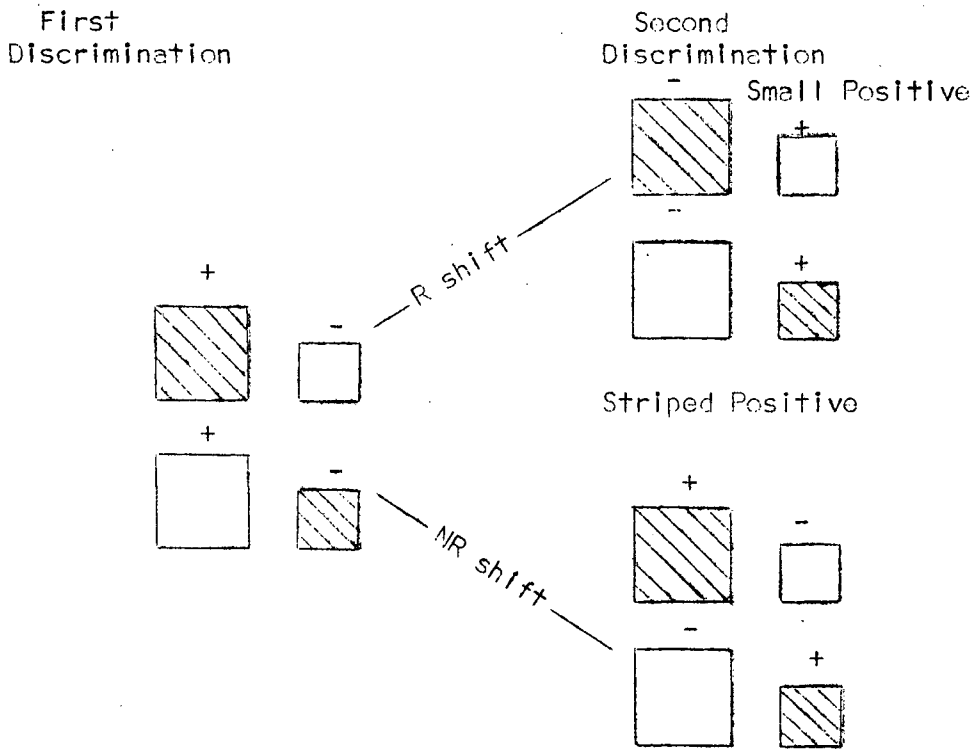

Fig. 1. Examples of a reversal and nonreversal shift (from Kendler and Kendler, 1962, p. 5).

associations between initiating stimuli and overt terminating responses is calculated, "reversal shifts will affect more associations and therefore be more difficult than non-reversal shifts" (Goss, 1961, p. 259). On the other hand, the two-stage mediating response theory advanced primarily by H.H. Kendler and T.S. Kendler in connection with R and NR shifts, predicts that where mediation does occur, R shifts are easier to learn than NR shifts. Here, the same mediated response may be utilized in both original learning and the R shift. However, a new mediated response differing from, and replacing the one employed in original learning, must be acquired in a NR shift. This renders the NR shift more difficult where mediation is operating (Hunt, 1962; Kendler and Kendler, 1962). One objection to this interpretation is that the greater difficulty in NR shifts can be accounted for in terms of partial reinforcement (i.e., "fortuitous" reinforcement on one

level of the irrelevant dimension in original learning, which level becomes relevant but negative in the NR shift).

Studies by Buss (1956) and Kendler, Kendler, and Wells (1960) attempt to deal with this objection by eliminating one dimension in either original learning (Buss, 1956) or shift learning (Kendler et al., 1960). This manipulation, however, destroys the continuity between original learning and the shift and probably communicates to the subject that something has been changed. It may even aid some subjects in focussing upon the relevant dimension (although this would be constant for both R and NR shifts).

Mediational interpretations of shift performance other than the verbal mediation approach are possible. House and Zeaman (1962), Milgram and Furth (1964), and Youniss (1964), for example, suggest that differences between R and NR shifts can be explained in terms of the observing response theory proposed by Wyckoff (1952) and more recently reviewed by Stollnitz (1965). Another interpretation of R and NR shift learning is made by Zeaman and House (1963) and Mackintosh (1965). They attribute a principal role to the concept of selective attention -- in effect, the "internal" equivalent of "external" orienting or observing responses. Finally, there is the perceptual mediation approach. This proposes that perceptual responses, like cue-producing verbal responses, can serve as mediators between overt initiating stimuli and overt terminating responses (Marsh, 1964; McConnell, 1964). It is important to note that these interpretations are not necessarily incompatible with, and in fact may be complementary to, the verbal mediation position.

Both the S-R and the mediated-response S-R positions are diagramatically represented in Figure 2. It is interesting to note

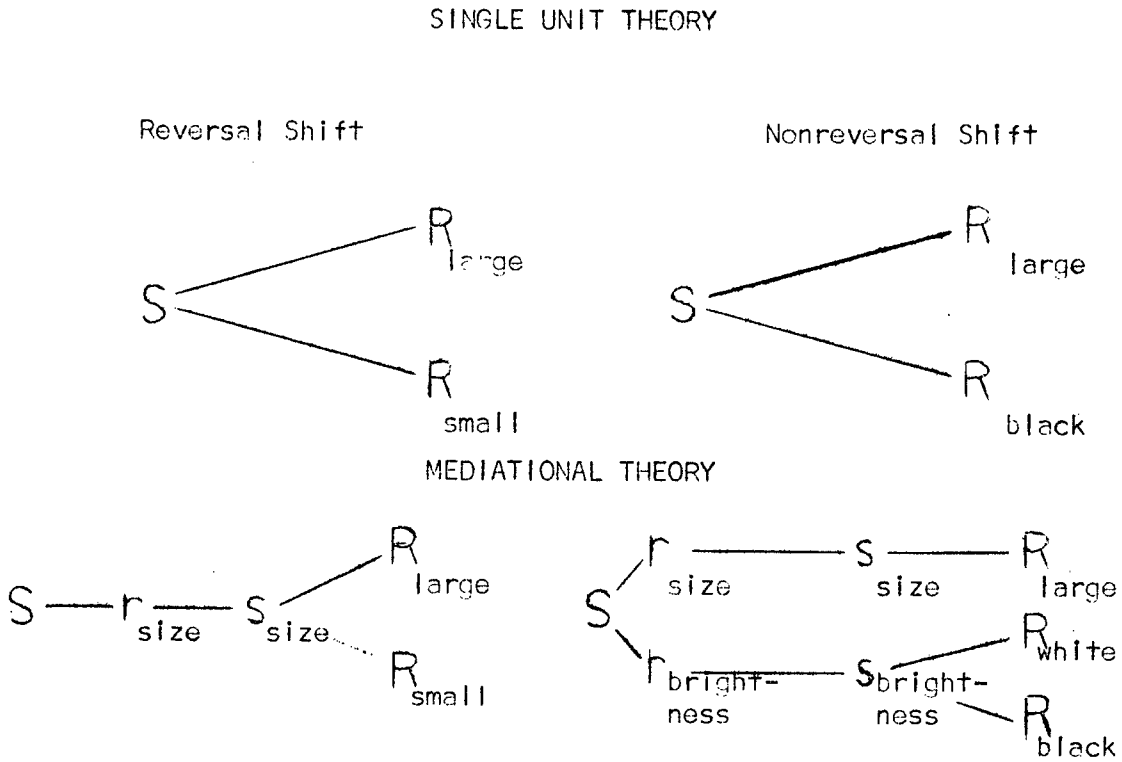

Fig. 2. A single unit and mediational S-R analysis of a reversal and nonreversal shift (from Kendler and Kendler, 1962, p. 6).

in passing that the mediating cue-producing response "r - - s" (usually assumed to be verbal) is essentially the analogue of a number of explanatory constructs evoked to account for more complex behavior, e.g., Hull's "pure stimulus act" (Hunt, 1962; Kendler and Kendler, 1962).

Support for the hypothesis of verbal mediation is quite substantial. Mussen, for example, states that:

> Skill in concept formation is closely linked to the acquisition of language, particularly to labelling. After he has learned the names or labels applied to objects or events, a child is likely to react in the same way to all stimuli having the same labels. This is known as verbal mediation or mediated generalization. Numerous experiments demonstrate that such mediation is of paramount importance in concept formation, problem solving, thinking and learning (Mussen, 1963, p. 37).

Some of the experiments referred to by Mussen are reviewed by Reese (1962), who finds corroboration for the hypothesis that verbal mediation is a function of age level not only in R and NR shift studies, but also in studies of transposition and discrimination sets. The results of other studies also testify to the importance of verbal mediation (Goss, 1961; Lacey, 1961; Marsh, 1964). However, the most concerted and consistent line of research evidence is presented by the Kendlers.

Using the shift methodology in a series of experiments, the Kendlers and others find that there are progressively changing differences through age levels in the ease with which R and NR shifts are learned (Kendler, H.H., 1965; Kendler, Kendler, and Learnard, 1962; Reese, 1962). They suggest that these differences extend through the phylogenetic scale (Kendler, H.H., 1965; Kendler, T.S., 1961) and that the changes appear to be concomitant with the development of verbal facility.[2] More specifically, there is evidence that: (1) infra human subjects (rats) learn NR shifts more readily than R shifts (Kelleher, 1956); (2) children at pre-school and kindergarten age who learn the initial discrimination quickly in comparison with similarly-aged children who learn slowly, perform better in the R condition while children who learn the initial discrimination slowly perform better in the NR condition (Kendler and Kendler, 1959); also, (3) nursery-school aged children learn the NR shift faster (Kendler et al., 1960), while

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[2] H.H. Kendler (1965), however, cautions against the simple conclusion that such changes be attributed only to the acquisition of verbal labels. Confronted with a number of alternative explanations (to be mentioned later in this paper), he contends that observing response and selective attention theories are compatible with his own interpretations.

older kindergarten and first grade children learn the R shift faster, and finally, (4) college students learn R shifts more easily than they learn NR shifts (Buss, 1953; Kendler and D'Amato, 1955).

Although these findings provide reasonably convincing substantiation for mediated-response S-R theory, they are contradicted by negative, although somewhat isolated, results (Issacs and Duncan, 1962; O'Connell, 1964). Furthermore, some of the aspects of the MDH position are susceptible to other criticisms. Youniss and Furth (1963) for example, dispute mediational response interpretations of Kendlers' and Reese's data and describe the mediational deficiency hypothesis (MDH) as, "an over-simplification of a complex issue" (Youniss and Furth, 1963, p. 501). They object that Reese (1962), in his attempt to establish a case for mediated S-R theory, makes no effort to integrate or at least take account of Piaget's theory and research. Since the Geneva school represents one of the major theories of development, this seems, indeed, to be a serious omission.

Youniss and Furth (1963) base their criticisms on evidence from the study of the deaf. In a review of this evidence, Furth (1964) attempts to refute or dispel common notions regarding verbal-conceptual deficits. He argues that there is little or no difference between deaf and hearing subjects in performance on certain conceptual tasks despite the apparent lack of a language system in deaf subjects, and he concludes that:

> (a) Language does not influence intellectual development in any direct, general, or decisive way. (b) The influence of language may be indirect or specific and may accelerate intellectual development: by providing the opportunity for additional experience through giving information and exchange of ideas and by furnishing ready symbols (words) and linguistic habits in specific situations. (Furth, 1964, p. 160)

Thus,

> The ability for intellective behavior is seen as largely independent of language and mainly subject to the general experience of living (Furth, 1964, p. 162)

Furth's case, however, is not so compelling as to escape criticism, for as Blank (1965) points out, the deaf often do possess some form of a specially-trained verbal system.

Kates et al. (1963) also present evidence in which deaf subjects are compared with hearing subjects. In doing so, they advocate that the tests of the cognitive processes must be able to separate verbal from non-verbal influences upon performance. Consistent with Piaget's conception, they demonstrate a dissociation between the processes of categorization and verbalization. Consequently, deterministic interpretations of the role of language in cognition are rejected in favor of a more moderate position. Here, language does not determine, but rather influences, limits, and possibly modifies cognition. Of especial note is their finding that there are few differences, if any, between deaf and hearing adults. With age, education, and experience then, even the differences in verbalization attenuate to the point of insignificance.

Studies of the deaf provide an interesting source of information since they deal with a population that does not possess a command of verbal responses. However, it is essential to remember that the deaf do possess other effective forms of language and communication. In this respect, studies of the deaf do not clearly refute the verbal mediation position.

The Indians of British Columbia: A Sub-Culture for Study

Within the normative framework of the white Canadian population, the B.C. Indians, as a sub-cultural group, constitute a major social problem both in their lack of success in assimilation and in their high rate of social deviance. One possible area for investigation to determine the factors relevant to this problem is the general area of childhood learning, for it is during childhood that the norms of the dominant society are most effectively instilled. It is commonly observed that B.C. Indian children do not compare favorably with their white Canadian counterparts in academic endeavours. They are, on the average, one or two years older than the white children in the same grade and even then rarely achieve superior grades. Their attendance is generally poor (except, of course, in residential schools) and relatively few proceed to university.

Among the factors which may be interfering with the more effective functioning of the Indian child in a formal academic setting, motivational, emotional, and personality variables have been investigated by Cameron (1964), Cameron and Storm (1965), Storm (1964), and others. However, specific cognitive variables such as the use of verbal mediational hypotheses in problem-solving situations have not yet been studied. It is reasonable to suppose that the effectiveness with which verbal mediational hypotheses are utilized in the solution of conceptual problems, and in fact, whether or not such mediation is employed at all, reflects the degree to which the cultural milieu encourages and facilitates the learning of concepts, e.g., in the fostering of games, toys, or activities involving choices, strategies, and concepts. In the relatively culturally-impoverished environment

of the predominantly rural B.C. Indians, there appear to be few occasions to stimulate such conceptual development.

The Hypothesis

The hypothesis of this study is that on a R-NR shift task, there will be a significant interaction between shift and cultural groups in shift learning, i.e., (in the most clear-cut case) on a R shift, Indian children will require more trials to criterion than white children of the same age, but on a NR shift, the Indian children will require fewer trials to criterion than white children. In advancing this hypothesis, a number of assumptions are made. It is assumed that there will be no differences in original learning. Furthermore, in relating this hypothesis to the questions of language and mediation, it is assumed: that the greater ease of executing a R as compared to a NR shift is evidence of mediation; that this mediation is verbal; and that Indian children are verbally deficient.

In addition to these assumptions, certain qualifications must be made with regard to the lack of specificity of the hypothesis. The form of the interaction predicted is relatively unspecified since it is difficult to know exactly how the Indian children will perform, especially on the shift. It is possible, for example, that given the interaction between shift and ethnic group, the absolute difference between R and NR shift performance is the same for both Indian and white children. However, it is also possible that the difference between R and NR shift performance is simply less for the Indian children than for white children.

Using younger children between the ages of four and seven inclusively ought to provide the ideal and most direct test of the hypo-

thesis since the postulated age of transition from single unit to mediational responding is around the nursery school-kindergarten age (Kendler 1965; Kendler, and Kendler, 1962). Unless other factors are operating, most children beyond six years of age execute a R shift with relatively greater ease than a NR shift. Unfortunately, younger Indian children in the four-to-six year old age category are not readily available for this sort of investigation. The ideal situation is, then, precluded. Nevertheless, some information can be obtained from the study of children in the seven-to-nine age range. In addition to the possibility that Indian children never successfully learn to mediate, it is also conceivable that Indian children are slow, compared to white children, in developing the ability to employ verbal mediational hypotheses in problem-solving. Demonstration of mediation by Indian children in any age group would eliminate the possibility that Indian children never successfully learn to mediate, whereas the demonstration of mediation only in nine or even in both eight and nine year old children would support the possibility that Indian children are slow in developing mediational abilities. The failure to demonstrate mediation would cast doubt upon this latter possibility and increase the likelihood that Indian children never successfully learn to mediate. However, this last conclusion would require the examination of older age groups for confirmation. Thus, although age is included as a three-levelled factor, no explicit hypotheses concerning it are formally proposed.

CHAPTER II

METHOD

Subjects

A total of sixty-seven Indian children and fifty-one white children were tested. Nineteen of the sixty-seven Indian children and three of the fifty-one white children failed to reach the first criterion (ten consecutive or fourteen out of fifteen reinforced responses) within one hundred trials. Therefore, they could not be included in the complete experiment. This means that forty-eight Indian and forty-eight white children successfully completed the original learning task and went on to the shift learning task. The Indian sample, generally one or two academic years behind the white sample, was drawn from three parochial schools (Alberni Indian Residential School, Mission Indian Residential School, and St. Paul's Indian Day School) and one secular school (Southlands Elementary School) while the white sample was drawn from two secular schools (Lord Kitchener Elementary School and Southlands Elementary School).

Design

Each ethnic group was composed of twenty-four males and twenty-four females distributed equally among the three age levels. Thus, except for grade level, the two groups were matched for age and sex. Prior to the experiment, each child was assigned to either the R or the NR group. Except for maintaining the ethnic-age boundaries and the sex balance, these assignments were random. There were then, twelve groups of eight children in a 3 x 2 x 2 factorial design: age (7, 8, 9) ethnic group (Indian-white), and shift (R-NR). The mean age of each group is shown in Table I.

TABLE 1

MEAN AGE (IN YEARS-MONTHS) OF EACH AGE GROUP OF WHITE AND INDIAN CHILDREN

Age Group	White	Indian
7	6-11	7-2
8	8-1	8-3
9	9-1	9-2

Apparatus

Stimuli were presented on a wide screen directly above the plywood response box by a timer-controlled 35 mm Leica slide projector. The response box, approximately 24 inches across, twelve inches deep, and ten inches high, housed a marble magazine and a marble ejection device. On the outside, a small platform the width of the box, protruded about eight inches from the base of the front of the box. Two response keys were mounted about eighteen inches apart on this platform. Between the keys was a plastic tray into which marble reinforcements could be dispensed through a slot at the top edge of the tray. Essentially, the marble ejection device consisted of a small metal cup (just large enough to hold a single marble) attached to the arm of a six volt solenoid. When one of two circuits was made by a "correct" response, the activated solenoid arm pulled the cup with the marble over a hole where the marble was released as an immediate reinforcement. A spring returned both the arm and the cup to their original position where another marble was fed into the

cup from the magazine. A pair of knife switches (one switch for each telegraph key circuit) operated by the experimenter (E) on each trial enabled E to control the reinforcement contingencies.

Procedure:

Each subject (S) was tested individually by the E in a room provided by the school. Unfortunately, in some of the schools, frequent interruptions occurred during test sessions. Ss who, as a consequence, were rejected, are not included for discussion in any part of this study, i.e., they are not included among those classified as failing to reach either the first or the second criterion. Following some introductory remarks which were designed to establish rapport and to arouse curiosity, each S was given a candy, seated in front of the apparatus, and given the following instructions:

> Guess what we're going to do? We're going to play a game in which you can win some more of those candies. Do you see these two buttons (keys)? What do you think happens when you press one of them?

(S was then encouraged to press each key twice in a row; each time he immediately received a marble. He was then asked to try each key twice again; this time, he received no marbles.)

> Sometimes they work and sometimes they don't. The game is to find out how they work in order to get as many marbles as you can. At the end of the game we will see how many marbles you've won and trade the marbles for packages of candy. If you haven't won very many, you might not win any candy; but, if you win lots of marbles, you'll get a whole package of candy; and if you win lots and lots of marbles, you'll get two packages, O.K.?

(Every S received two packages, of course, regardless of the number of marbles.)

(S was then informed that a pair of pictures would be projected onto the screen and was given instructions to the effect that

pressing the left button corresponded with selecting the stimulus on the left side of the screen while the same was true of the right side. He was then questioned to determine if instructions to this point were understood. E then turned the projector on.)

> The name of this game is called, "Pick the winning picture every time". One of these pictures is a winning picture; the other is a losing one. If you pick the winning one, you'll get a marble, but if you pick the losing one, you won't get anything. Remember, if you pick the winning picture, you'll get a marble, but if you pick the losing one, you won't get anything.
>
> Which one do you think is the winner? Try it once. You only get one try until the picture is changed.

(Invariably, S received a marble on his first selection.)

> Now I'm going to change the picture. See if you can pick the winning one again.

(In this second presentation of the pre-test stimuli, only the position of the same previous stimuli was reversed. A third presentation repeated the second presentation exactly in order to determine if the child were merely alternating. If the child did alternate, he was told that he was supposed to look at the pictures carefully and to pick the winning ones - - not just to switch from side to side.)

> Do you think you can pick the winning pictures and win a marble everytime? Now I'm going to show you some more pictures, pictures that are different from these. Look closely and try to pick the winning one every time so that you can get lots of candy later on. But remember, just one try each time the picture is changed.

(The experiment was then begun and no other words were said by E except for a reminder every ten trials, that S could win a marble every time if he tried and that he would have to look at the pictures carefully in order to find out what the winning picture was.)

As in earlier studies, the paired discriminanda in this experiment in both original learning and shift learning were varied simultaneously along two binary dimensions: shape (triangle and square) and size (large and small)[1].

Including the controls for position, there were four possible types of stimulus presentations: large triangle left, small square right; small triangle left, large square right; large square left, small triangle right; and small square left, large triangle right. The same presentation never occurred twice in successive trials and each type of presentation appeared once every four trials. There was no intertrial interval, i.e., stimuli were presented one after another with no pause between trials. Stimuli were exposed for a relatively fixed period of between eight and ten seconds.[2] Ss usually responded well within this interval after the first few trials. For the exceptions who required more time during the early trials, the exposure period was augmented temporarily by E.

For all Ss, responses to triangles (large and small) were rewarded in the first discrimination task. Upon attaining the criterion of either ten consecutive or fourteen out of fifteen "correct" responses, the reinforcement contingencies were shifted (without notice

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[1] Because it was possible that the shift was oversimplified or that the R and NR shifts were perhaps differentially affected by drawing attention to either the new or the remaining dimension (as the case may be), methodologies similar to those proposed by Buss (1956) and Kendler et al. (1960) to control for partial reinforcement were not adopted.

[2] A fixed stimulus exposure interval, as opposed to the self-paced interval in some other studies, was utilized in order to facilitate procedure; which method is employed appears to be of little consequence since Bourne, Guy, Dodd, and Justesen (1965) do find that there are no differences between the two modes of controlling the duration of stimulus patterns.

or interruption of procedure) to squares (large or small) for the R groups or small figures (triangles or squares) for the NR groups. The criterion for the shift task was the same as that for the first task.

Following completion of the experiment, Ss were congratulated on their success, told that they would receive two packages of candy, and asked to play one more game - - a "card game" consisting simply of two sets of the four discriminanda (large triangles, large squares, small triangles, small squares) that were scrambled by E in S's presence. S was then asked to "put all the pictures that belong together into one pile and put all the others that also belong together into another pile". If S were able to do this the cards were again scrambled and he was again asked to put the cards together into two separate piles, different from the way he placed the cards together the first time. In both cases, S was asked why the cards went together after he had sorted them. Ss that were unable to verbalize the levels of the dimensions in giving their reasons were then asked, "What do you call this?" or "What does this remind you of?" for each of the discriminanda.

All Ss were finally requested to pledge secrecy, at least until everyone had had a chance to play to game, and then were awareded their two packages of candy.

CHAPTER III

RESULTS

Original Learning:

Nineteen out of sixty-seven Indian children and three out of fifty-one white children failed to reach criterion (in original learning) within the limit of one hundred trials and so did not proceed to the shift. Their results were excluded from the analysis of performance in original learning. The difference between the proportions of Indian and white children failing to reach the first criterion was highly significant ($z = 42.29$, $p < .001$). Of the nineteen Indian children rejected, eleven were seven years old; three were eight years old, and five were nine years old. There were no other distributional differences with regard to school or sex for these Ss.

Analyses were made on both the number of trials to criterion and the number of errors to criterion. However, because the results did not differ according to which measure was employed, only the analyses of the trials will be reported. The means and standard deviations of the 3 x 2 x 2 groups on original learning are presented in Table 2.

TABLE 2

MEANS AND STANDARD DEVIATIONS OF TRIALS TO CRITERION ON ORIGINAL LEARNING

AGE	REVERSAL				NONREVERSAL			
	Indian		White		Indian		White	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
7	42.0	36.3	27.5	17.5	41.4	30.0	36.3	22.6
8	28.1	17.3	26.1	15.7	47.3	28.0	45.5	21.6
9	33.0	19.1	35.4	29.6	31.3	25.3	30.1	27.7

The three-way analysis of variance (fixed effects model) summarized in Table 3 yielded no significant main effects or interactions in the

TABLE 3

ANOVA OF TRIALS TO CRITERION ON ORIGINAL LEARNING

Source	df	MS	F
A (age)	2	199.82	< 1
B (ethnic group)	1	326.34	< 1
C (shift)	1	1,046.76	1.68
A X B	2	237.59	< 1
A X C	2	1,073.89	1.72
B X C	1	25.01	< 1
A X B X C	2	175.40	< 1
Error	84	622.89	
Total	95		

first discrimination learning task. It is essential to note that in no way does this legitimately allow the conclusion that there were no differences on original learning since nineteen out of sixty-seven Indian children failed to reach the first criterion, whereas only three out of fifty-one white children failed to do so.

Shift Learning:

With regard to shift learning, only the differences in number of trials to criterion between R and NR shifts were significant in the three-way analysis of variance. The hypothesis of a significant interaction between ethnic group and shift was without support within

the context of the particular body of data analyzed. It must be reiterated that the substantially greater failure rate among Indian children in attaining criterion on the initial discrimination, their consequent exclusion from the shift task, and their rejection from further consideration in the analyses, must necessarily complicate the interpretation of these results. Table 4 gives the means and standard deviations for each of the twelve sub-groups and Figure 3 illustrates the relationships among those means. Table 5 presents the analysis of variance summary for shift learning.

TABLE 4

MEANS AND STANDARD DEVIATIONS OF TRIALS

TO CRITERION ON SHIFT LEARNING

AGE	REVERSAL				NONREVERSAL			
	Indian		White		Indian		White	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
7	30.8	28.9	31.1	28.4	47.6	33.4	49.8	33.9
8	20.8	14.4	23.6	30.9	33.8	32.8	45.3	35.7
9	15.8	5.7	17.1	8.4	44.1	35.0	54.9	32.6

A number of studies (e.g.,Kendler and Kendler, 1959; Osler and Fivel, 1961) differentiate between children who learn the initial discrimination quickly and children who learn the initial discrimination slowly. Preliminary inspection of the data suggested that similar relationships might exist in these data. Dichotomizing the four

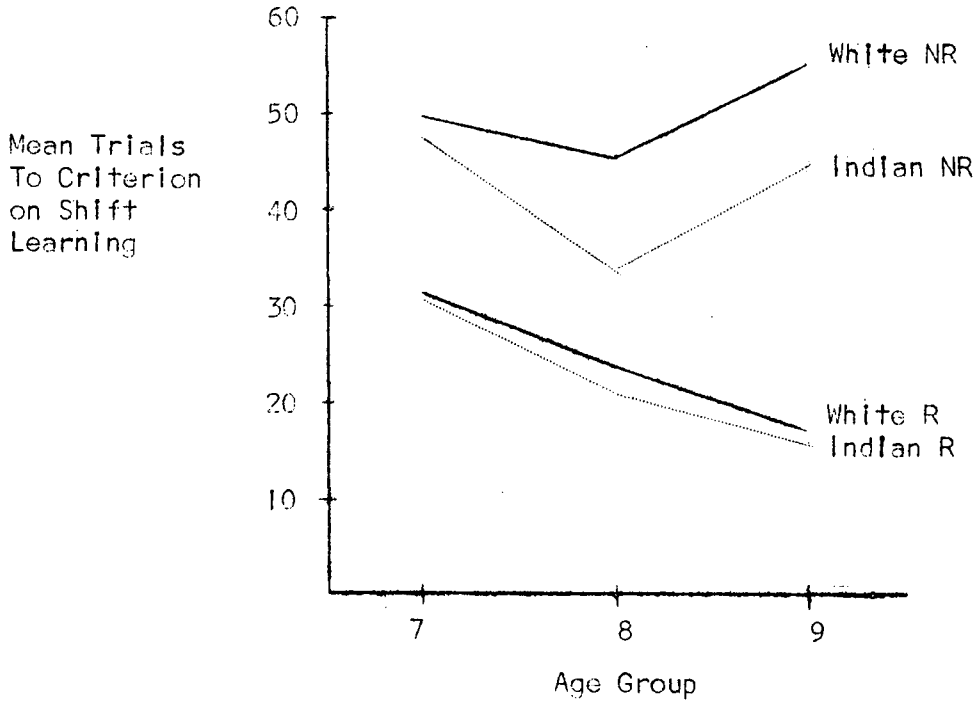

Fig. 3 . Mean trials to criterion on shift learning as a function of age, ethnic group, and shift

TABLE 5

ANOVA OF TRIALS TO CRITERION FOR SHIFT LEARNING

Source	df	MS	F
A (age)	2	702.89	< 1
B (ethnic group)	1	560.67	< 1
C (shift)	1	12,376.04	15.12***
A X B	2	79.57	< 1
A X C	2	643.64	< 1
B X C	1	260.04	< 1
A X B X C	2	35.32	< 1
Error	84	818.53	
Total	95		

*** p <.001

ethnic-shift sub-groups on the basis of original learning speed, collapsing over age, and subsequently performing a three-way analysis of variance (fixed effects model) using number of trials to the second criterion, the rather interesting results presented in Table 6 were found. Here the differences between shifts were again, sig-

TABLE 6

ANOVA OF TRIALS TO CRITERION ON SHIFT LEARNING FOLLOWING CLASSIFICATION OF SUBJECTS AS "FAST" OR "SLOW" LEARNERS ON THE BASIS OF ORIGINAL LEARNING (AGE FACTOR COLLAPSED).

Source	df	MS	F
A ("fast" - "slow")	1	1,426.04	2.03
B (ethnic group)	1	560.67	< 1
C (shift)	1	12,376.04	17.64***
A X B	1	7,597.04	10.83***
A X C	1	704.17	= 1
B X C	1	260.04	< 1
A X B X C	1	215.10	< 1
Error	88	701.54	
Total	95		

*** $p < .001$

nificant; but there was also a highly significant interaction between ethnic group and "type" of learner, i.e., "slow" or "fast" as classified on the basis of speed of original learning. The meaning

of this result is conveyed in Figure 4. It should be noted that

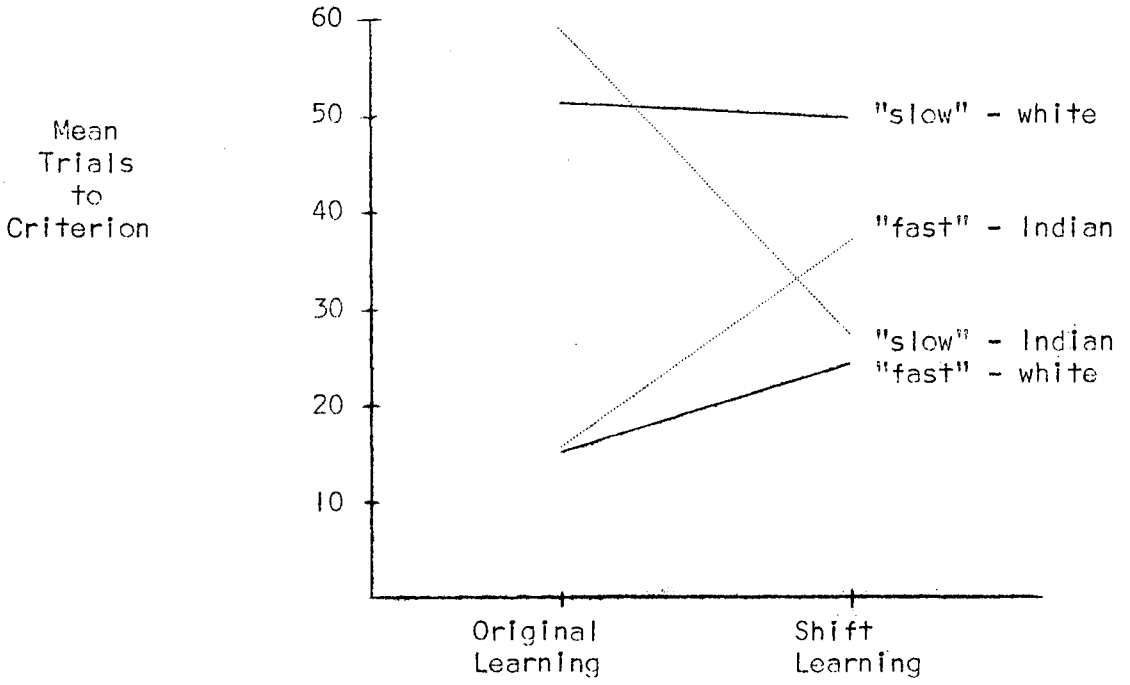

Fig. 4. Mean trials to criterion before and after shift for fast and slow Indian and white children (shift collapsed).

Figure 4 is not an illustration of the results presented in Table 6. Rather, it is included to depict more clearly the relationships among speed of original learning, speed of shift learning, and ethnic group. It is apparent that while the white children were relatively consistent in speed of learning in both the initial discrimination and the shift, the Indian children were not. In fact, the Indian children who were "slow" on the first task demonstrated positive transfer and became "fast" on the shift whereas the Indian children who were "fast" on the first task demonstrated negative transfer and became "slow" on the shift.

Card Sort and Verbalization Analyses:

The number of cases in the Indian sample for both the card sort and verbalization analyses was reduced from the original N of 48 for a variety of reasons, e.g., interruptions, lack of time, and the like.

Initially, all children who did a card sort were classified into one of five categories according to how they sorted the discriminanda. The categories were: both dimensions used, shape first; shape only; both dimensions used, size first; size only; and haphazard. A complete summary of the frequencies with which Ss in each group were classified is presented in the Appendix. The most pertinent of these findings have been condensed to Table 7 below, which presents the frequencies of Indian children and white children (in both R and NR

TABLE 7

FREQUENCIES OF INDIAN AND WHITE CHILDREN IN BOTH SHIFT CONDITIONS WHO SORT ON THE BASIS OF SHAPE OR NOT ON THE FIRST SORT

		Shape	Not Shape (Size, Haphazardly)
Indian	Reversal	19	2
	Nonreversal	13	10
White	Reversal	19	5
	Nonreversal	18	6

shifts) who first sorted the discriminanda by shape or not i.e., some other means such as size or haphazardly. It is evident that both Indian and white children in the R shift condition and the white

children in the NR shift condition sorted predominantly by shape. (The binomial probabilities for each of these differences between proportions <.01). The Indian children in the NR shift condition showed only a slight tendency to sort by shape. The significant x^2 ($p < .05$) for the shift x sort matrix for the Indian children indicated that how Indian children sorted was related to what shift condition they were in. (It should be noted, however, that four of the ten NR Indian Ss sorted haphazardly; none of the other children sorted in this manner. A calculation of the x^2 based on the six who sorted by size reduces the level of significance to .16).

Inspection of the verbalization data indicated the need for a more detailed examination of the ability to label, in some way, the concept of triangle. The chi-square analysis of the number of Indian and the white children who either verbalized or did not verbalize the concept of triangle, as shown in Table 8, yields highly significant

TABLE 8

FREQUENCIES OF INDIAN AND WHITE CHILDREN WHO VERBALIZED OR DID NOT VERBALIZE THE CONCEPT "TRIANGLE"

	Indian	White
Verbalized Triangle	14	46
Did not Verbalize Triangle	25	2

$x^2 = 33.37$, $p < .001$ (1df)

results beyond the .001 level, indicating that while almost all white children verbalized the concept of triangle in some acceptable way, the Indian children did not.

CHAPTER IV

DISCUSSION

One important difference between the two ethnic groups with much relevance for subsequent comparisons concerns the children who failed to learn the initial discrimination. Nineteen out of sixty-seven Indian children, compared with three out of fifty-one white children, failed to reach criterion in original learning. In this respect, the forty-eight Indian children who successfully reached the first criterion and who therefore comprised the group that was ultimately compared to the white children, constituted a sample unrepresentative of the population of Indian children.

The comparisons between the Indian and white children who did reach the first criterion successfully will be considered first. In original learning, there were no differences. On the shift, there were no differences between the ethnic groups, but for both groups, the R shift was learned with relatively greater ease than the NR shift. If superior performance in the R shift relative to performance in the NR shift can be taken as evidence of the use of verbal mediation, then it would appear that both the Indian and the white children who were able to learn the initial discrimination adequately were alike in mediational ability, i.e., with regard to the MDH, these Indian children did not appear to be deficient in verbal mediation.

At a qualitative level, it was observed that Indian children were considerably less verbal than white children. The Indian children were extremely reluctant to engage in conversation with the E and almost never spontaneously verbalized their feelings about the

task or the rules for winning during the course of the experiment, as the white children occasionally did. To a certain extent, this was also reflected in the post-experimental verbalization tests. In contrast to twenty-five out of thirty-nine Indian children, only two out of forty-eight white children did not verbalize "triangle" in some acceptable manner. Therefore, even though considerable latitude was allowed in classifying responses as acceptable or not, there was a clear indication of the lack of an apparent or overt label for the concept of "triangle" (e.g., "tent", "teepee", and "hat" were allowed). In short, there is some suggestion that a high level of verbal skill is not necessary for mediation to occur. (It should be cautioned, however, that verbalization is not necessarily equivalent to mediation.)

There is also some evidence to demonstrate that one of the dimensions was more salient than the other and that this salience may have had effects upon Indian performance different from the effects upon white performance. To recapitulate briefly, all Ss were reinforced for responding to the shape, "triangle", in original learning. Subsequently, R shift Ss were reinforced for responding to the shape, "square", while NR shift Ss were reinforced for responding to the size, "small". On the card sort, the white children in both shift conditions sorted predominantly on the basis of shape. The Indian children in the R shift condition also sorted clearly on the basis of shape while the Indian children in the NR shift condition displayed a more moderate tendency to do so. Since the R shift Ss of both ethnic groups were reinforced only for responses to the shape

dimension, the result that the preponderance of R shift Ss sorted by shape was not unexpected. However, the sorting behaviour of the NR Ss was unexpected, although less so in the case of the Indian Ss. Here, it might have been expected that because the Ss were reinforced in both dimensions and because the size dimension was the more recently learned one, more of the NR shift Ss would have sorted by size rather than shape. This was not entirely the case for the Indian children and clearly not the case for the white children. Thus it is apparent that the shape dimension was more salient than the size dimension.[1]

From this follows a plausible, although somewhat more complicated alternative to the interpretation that Indian and white children are alike in mediational ability. Both ethnic groups executed the R shift with greater ease than the NR shift. It is possible that for the white children, this was evidence of mediation; whereas for Indian children, this merely reflected the effects of salience on the shifts.[2] In other words, salience may have had the effect of facilitating the R shift more for the Indian children than for the white children, thereby decreasing the difference between the ethnic groups with respect

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[1]This finding is consistent with results obtained recently by Lee (1965) and Stevenson and Odom (1965).

[2]The rationale for the differential effects of salience is as follows: The seven-to-nine year old group of white children, according to the results and observations of the Kendlers and others, was already past the stage of transition, i.e., it was at the stage in which Ss, as an age group, unequivocally learn a R shift with relatively greater ease than a NR shift, as compared with the younger transitional stage in which neither a R or NR shift is learned with relatively greater ease. Therefore, the white children in the R shift had little to gain as a result of the greater salience of shape. In contrast, there was some question as to the mediatonal abilities of the Indian children. If they were deficient in the ability to mediate -- a possibility suggested by their lack of verbal facility -- then they stood to benefit more from the greater salience of shape than did the white children.

to ease of learning R shifts.

Even if the Indian children were similar to the white children on the shift, there is evidence that they were not identical to the white children. This is indicated by an interaction between ethnic group and "type" of learner (as classified on the basis of speed of original learning). The Indian children who were "fast" in original learning became "slow" on the shift whereas the Indian children who were "slow" in original learning became "fast" on the shift. In contrast, the white children were either consistently fast or slow from original to shift learning. They performed like the white college Ss used by O'Connell, who found that his "...Ss are consistently good or poor in their performance during acquisition and the shift period" (O'Connell, 1965, p. 149).

The performance of the Indian children is an unusual and perplexing finding which, by virtue of its novelty, demands replication. Even in the framework of other theoretical positions, e.g., the selective attention or observing response theory, this result is difficult to explain. At best, only the very tenuous speculation which follows can be offered.

An error at the shift may serve as a cue either that "E has shifted concepts" or that "the concepts have not been learned" (Goss, 1961, p. 260). It is conceivable that the Indian Ss who showed negative transfer (i.e., those who were fast in acquisition, but slow in the second discrimination) did not have enough time to "warm up" or "learn how to learn". In effect, they may have been operating on the premise that the correct concept had not yet been learned; or, the first error produced by the shift may have served no cue function

whatsoever. In contrast, it is conceivable that the Indian children who showed positive transfer did have sufficient opportunity to "learn how to learn". For these Ss, the first error produced by the shift may have signalled a change in the reinforcement contingency and they would have changed accordingly by responding to another concept. Unfortunately, the critical question as to why the Indians operated on the basis of these factors while white children did not, is not easily answered at the present time.

We will now consider possible population differences between Indian and white children with regard to mediational ability. Any such consideration must take into account the fact that nineteen out of sixty-seven Indian children failed to reach the first criterion while only three out of fifty-one white children failed to do so. The primary concern of this section will be with the characteristics (related to mediational ability) of the nineteen Indian Ss.

Ss were rejected unless they were able to respond to the concept, "triangle", for ten consecutive trials or fourteen out of fifteen trials within the limit of one hundred trials. If this limit of one hundred trials had been extended, there would have been two possible outcomes, either the Ss (who ordinarily would have been rejected) would eventually have reached criterion or they would have continued to fail. The former possibility is both more plausible and more relevant to the hypothesis of this study. Therefore, the implications of the assumption that the nineteen Indian children would have reached criterion (and in this respect, were like the slow learners previously considered) will be explored. An experiment by Kendler and Kendler (1959) provides a possible basis for interpreting speed of original learning. In their experiment, slow learners of kindergarten

age found the NR shift easier while fast learners found the R shift easier. The implication was that the slow learners had not yet developed, or at least were in the process of developing to full capacity, the ability to mediate, i.e., compared to the fast learners, they were non-mediators. In relation to the present study, one interpretation would be that there are proportionally more non-mediators among Indian children than among white children in this particular age range. However, two considerations should be taken into account.

First, the Kendlers were dealing with a substantially different age range. Speed of learning during acquisition may have different implications for different age ranges. Secondly, the interaction between speed of original learning and shift was not replicated. Instead, an interaction between speed of original learning and ethnic group was found. Thus, there is no specific evidence indicating unequivocally that the nineteen Indian children were non-mediators or that their hypothetical inclusion would have made a crucial difference in shift performance. Also, it appears that the forty-eight Indian children who did reach the first criterion were not unrepresentative of the population with respect to mediational ability.

We have considered the data of those children who were tested on shift performance and as well, the possible relevance to that comparison of the substantial proportion of Indian children who failed to proceed to the shift. This failure is of interest in itself.

Unfortunately, adequate verbalization or sorting data were not collected for the rejected Ss since, at the time, it was not anticipated that so many Indian children would fail to reach criterion. However, there is one very plausible explanation for the failures. It is based on the fact that more Indian children than white children

did not verbalize, the triangle concept. This is important since "triangle" was the positive (reinforced) stimulus for all Ss in original learning. In effect, the apparent unavailability of a label for the triangle concept may have resulted in the higher proportion of failures among Indian children in original learning. The major reason for the common inability among Indian children to verbalize "triangle" may reside in the factor of academic training. The majority of the Indian children, rejected or not, were generally one or even two or three grades behind the same-aged white children. Especially in the seven year old group, many had not yet formally been taught the concept of triangle. Furthermore, eleven of the nineteen Indian children rejected were seven years of age and usually in grade one. These observations lead to the suggestion that the performance of the Indian children may have been affected by more general factors, e.g., intelligence. Wilson (1952) provides some support for this possibility. She finds that Indian children score significantly lower on Raven's Progressive Matrices, a non-verbal test of mental ability. The present data, however, still leave open the question of the reasons for the deficiency.

We turn now to a consideration of the general implications and the avenues of research generated from this study. An issue raised in the introduction concerned the nature of the relationship between language and cognitive development. One school of thought assigned language to a crucial role in cognitive development by making language the necessary and determining antecedent of cognition. The other school of thought relegated language to a less critical, although still important role by postulating the possible, but not necessary,

dependence of language on cognitive development. Proponents of the first position advanced evidence to support the MDH (which emphasizes the importance of verbal responses as mediators) while proponents of the latter position presented evidence such as cognitive development in apparently language-deficient populations. It was within this context that the present study was designed to explore possible differences between Indian and white children in performance on R and NR shifts. Indian children were considered to be an appropriate group for study since they had often been found to be deficient in verbal ability. Also, the shift methodology seemed appropriate since it provided a technique whereby differences in shift performance might be attributed to differences in mediational ability.

We addressed ourselves to three related questions: Are there cognitive differences between Indian and white children? If there are, can they be attributed to differences in language and the use of verbal mediation? What are the implications of this study for the language - thought controversy?

It is apparent that there probably are cognitive differences between Indian and white children if sample differences in (1) ability to reach the first criterion, (2) verbalization, and (3) speed of shift learning relative to speed of original learning, are evidence of population differences. However, with regard to the second question, there is no specific evidence for differences in mediation. Thus, in relation to the third question, there is no evidence in this study that cognitive development depends on prior language development.

The need for replication with control for salience of stimulus dimensions is indicated. Furthermore, in order to test the original hypothesis adequately, a study of children in the four-to-six year age range is necessary. Other research might also be directed toward finding out more about fast and slow learners on one hand, and the children who fail to learn the first discrimination on the other hand, especially in relation to sorting and verbalization behaviour.

In the present study, we attempted to relate verbalization with shift performance. In contrast, it would be worthwhile to employ verbalization as an independent variable. This might take the form of supplying labels (to determine if this facilitates performance, as has already been done in other studies, e.g., Gollin and Liss (1962), Kendler and Kendler (1961), Kendler (1964) or of manipulating the "verbalizability" of the stimulus. In effect, this latter manipulation would be analogous to the manipulation of meaningfulness of nonsense syllables in verbal learning studies. For example, where both ethnic groups are presented with a stimulus for which there is no readily available label, it would be interesting to determine if the white children tend to assign some sort of label anyway (and thereby facilitate their performance) while the Indian children make no attempt to apply a label to the unfamiliar, "low-verbalizable" referent.

Only the most tentative conclusions can be drawn from the present study both with respect to language and cognitive development and with respect to Indian-white differences. It is evident from some of the difficulties encountered that cross-cultural research brings to light considerations that are not apparent from the study of a

single cultural group. However, it is also evident that many fruitful hypotheses can be generated from these considerations, providing, as a result, the basis for genuine contributions and advances in our knowledge.

CHAPTER V

SUMMARY

This study was designed to explore specific aspects of the relationship between language and cognition. Comparisons of a normal population with populations deficient in verbal ability provide information relevant to the qualification of this relationship. In this respect, B.C. Indian children were an appropriate group for comparison with normal white children since they are apparently deficient in verbal development. It was considered worthwhile to determine if there are cognitive differences between Indian and white children and if there are, to determine if these differences can be attributed to differences in verbal ability in the form of verbal mediation. Evidence of verbal mediation is assumed to be exemplified in the relatively greater ease of executing a R over a NR shift. In a 3 x 2 x 2 factorial design involving age (7,8,9), shift (R-NR), and ethnic group (Indian-white), it was hypothesized that there would be a significant interaction between shift and ethnic group.

A total of sixty-seven Indian and fifty-one white children was initially tested. However, nineteen Indian and three white children failed to learn the first discrimination to criterion within the limit of one hundred trials. The difference between these proportions was highly significant. Analyses were conducted for the resulting self-selected sample of forty-eight Indian and forty-eight white children who succeeded in attaining the first criterion and who went on to the shift task. On original learning, there were no significant differences or interactions for this self-selected sample. On the shift, there was a significant main effect only for the shift factor,

with the R shift performance being superior to NR shift performance for both ethnic groups. There were no differences between Indians and whites in overall performance or in the relative difficulty of R and NR shifts.

Supplementary analyses were performed to explore other possible differences. It was found that the white children were relatively consistent in the speed with which they learned both the original discrimination and the shift while, in contrast, the Indian children were not. Those Indian children who were "fast" in original learning became "slow" on the shift, whereas those who were "slow" in original learning became "fast" on the shift. On the basis of post-experimental card sort and verbalization tests, it was also found that the shape dimension was more salient than the size dimension and that Indian children were not as successful in giving an appropriate overt label to the triangle concept.

The specific hypothesis that there would be a significant interaction between shift and ethnic group was not supported. However, in general, the results from the supplementary analyses and the fact that significantly more Indian than white children failed to reach the first criterion suggested that there were cognitive differences between Indian and white children. There was no specific evidence to support a mediational deficiency interpretation of these differences.

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APPENDIX I

TABLE 9

FREQUENCIES OF INDIAN AND WHITE CHILDREN IN BOTH SHIFT CONDITIONS WHO SORT ON THE BASIS OF: BOTH DIMENSIONS (SHAPE OR SIZE FIRST), SHAPE OR SIZE ONLY, OR HAPHAZARDLY

	REVERSAL		NONREVERSAL	
	INDIAN	WHITE	INDIAN	WHITE
Both Dimensions used: Shape used First.	8	11	5	12
Shape Only	11	8	8	6
Both Dimensions used: Size used First	1	4	4	4
Size Only	0	1	2	2
Haphazard	1	0	4	0
Total	21	24	23	24