PERFORMANCE OF DEAF AND HEARING CHILDREN ON COLOR-PICTURE AND COLOR-WORD PAIRED ASSOCIATES WITH NATURAL, NEUTRAL AND REVERSED CONDITIONS

by

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ABSTRACT

Prelingual, profoundly deaf children (90 db. loss unaided in the better ear over the speech range) lack one major sensory channel essential for normal learning, therefore they must rely almost exclusively on vision for learning. They must learn to make meaningful visual associations in order to understand the world around them. These associations have particular relevance for language acquisition and communication.

A child with normal hearing makes visual associations too, (e.g. white with milk), however, this child has the additional auditory and vocal information input to assist the learning process. Unlike his deaf counterpart, he often hears the word "milk" without seeing the object which the word represents. Furthermore, if a picture of an object is presented to a child, he can say the word it represents. As a child matures and develops, he learns to read and write these words and has therefore some degree of linguistic competence. Here language will mean the spoken and written language of a culture.

Language affects mediation, which is defined as a response or series of responses which intervene between the external stimulus and the overt response to provide stimulation that influences the eventual course of behaviour, (Kendler and Kendler, 1959). The mediation habits of hearing and deaf children provided a theoretical framework for this study.

Color-Picture (C-P) and Color-Word (C-W) experiential and task paired associates were compared utilizing three conditions: (natural) matched, neutral, and reversed for two age levels of deaf and hearing children, CA 7 and CA 11.

The number of errors in associations was the response measure and the data were analyzed by a 2 x 2 x 2 x 3 analysis of variance with replication. The specific hypotheses tested were:

(1) The deaf Ss would have significantly lower mean error scores on the reversal condition than their hearing peers.

(2) The CA 7 year old group would have significantly higher mean error scores than the CA 11 year group.

(3) The Color-Word task would produce significantly higher mean error scores than the Color-Picture task.

(4) The reversal condition would have significantly more mean errors than the neutral or matched condition.

Justification for these hypotheses are:

(1) The study by Furth and Youniss (1964) found the deaf Ss made fewer errors on the reversal condition. This was interpreted to be a result of less verbally mediated interference by the deaf.

(2) Developmental studies indicate better performance by older groups. (Furth 1964, Reese 1959, Kendler and Kendler 1961).

(3) Furth and Youniss (1964) found an interference condition (reversal) more difficult than a non-interference condition (neutral, matched).

(4) A-priori, Color-Word association requires more abstraction than Color-Picture and is therefore more difficult.

The results of the analysis of variance indicated:

(1) No significant difference was found between hearing Ss and deaf Ss.

(2) A significant difference ($p < .01$) between CA 7 and CA 11, the older group making fewer errors.

(3) The reversal condition was significantly the most difficult of the three conditions ($p < .01$).

(4) A significant difference ($p < .01$) between tasks, the C-W task accounting for more errors.

Significant Two Way Interactions ($p < .01$) were noted:

Age x Hearing Status and Age x Task.

A Three Way Interaction - Age x Task x Conditions was also significant ($p < .05$).

The absence of a significant difference in performance by hearing and deaf Ss was contrary to one of the major hypotheses of the study. This seems to indicate that the mediation habits of the two hearing status groups, whatever their nature, do not significantly differentiate the groups in performance on association type tasks. The significant differences found between Age, Task and Conditions as main effects are not independent but must be qualified by the statistically significant interaction among these three variables.

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INTRODUCTION

An area of psychological research concerned with noting differences and similarities in cognitive functioning has been fruitfully investigated using deaf and hearing subjects. This area of research has been tapped by several investigators, especially in recent years, although often with discrepant results. (Levine 1963; Furth 1964, 1965, 1966, 1967; Youniss 1964). Most of the studies are on an exploratory level, and the complex nature of the study may account for the discrepancies in the findings.

The differences in theoretical framework by the investigators with regard to the acquisition of language and the interrelation of sense modalities affords an explanation of the differences in interpretation of the findings of the studies. There is general agreement, however, about the function of language.

Language is a complex system of human behaviour involving functions of the cognitive processes, sensation, perception, memory and concept formation. Language is used to classify experience, to categorize it with labels or words. These labels or words act as convenient vehicles for conveying the meaning of experiences either vocally or in writing, to oneself as in thinking, or to others. This is not to say that all experience is classified. It is important to remember that language is a representation of experience, it is the association of the experience with signs and symbols. The symbols through use are systematized into a formal structure. Language, most experts agree, facilitates the recording of experience. How it does so is a matter of considerable theoretical speculation. The relationship of language to experience with particular emphasis on the role of mediation provides a general theoretical framework for this study.

Luria (1957) points out that learning language is a socialization process requiring first passive recognition, memory trace, then active perception, and finally speech. He asserts that language enables one to manipulate the environment. Bruner (1964) says that cognitive development is a process through which past experience is recalled according to how

the past experience is coded and processed; the end product he calls a representation. The representation has three modes: 1. enactive, the representation of the past through motor responses; 2. iconic, the selective organization of percepts and images; 3. symbolic, the features of this mode are remoteness from the object and arbitrariness, e.g. words. These modes appear in the developmental life of the child in the above order, one depending upon the other. This is so unless there is some impairment that would disrupt the normal development like blindness, deafness or cortical injury. Theoretical questions that arise are: How does auditory impairment disrupt cognitive development, for example, in the deaf?; How does impairment affect each mode of representation, enactive, iconic, symbolic?; and, Is the image of a word on the lips of someone as strong in association value to a deaf person as the spoken word association strength to a normal hearing person?

In a somewhat similar vein, Myklebust (1964) suggests that experience can be viewed from different levels hierarchically arranged from sensation and perception to imagery and then symbolization and conceptualization. He also asserts that if a lower level of experience is impaired, e.g. sensation, the higher levels will also be affected. He reached these con-

clusions studying the deaf. The deaf lack one sensory channel to receive sensation, hearing. This sensory deficit hinders the normal process of cognitive development, according to Myklebust. That the deaf have less language in comparison with their hearing peers is a matter of simple observation.

Since language and cognitive development are concerned with the ability to associate, retain and recall experience, they are concerned with memory. Because of their sensory deficit, do the deaf have less recall and association ability than hearing persons, and therefore poorer memories? Hiskey (1955) found that deaf children were inferior to hearing children on memory abilities. He noticed that hearing children verbalized audibly the names of colors or numbers while the deaf children could not. This, he concluded, enhanced the performance of the former. Blair (1957) studied the same problem using among other tests, the Knox Cube Test. This is a test of immediate recall. He found that the deaf were superior on this test. He also found that the visual memory of deaf and hearing persons differs depending upon the type of memory task involved. The deaf were inferior on the memory span tests, but equal to or superior to the hearing on the other memory tasks. The particular task of this present study is a paired associate task which requires subjects

to remember associations between presented stimuli and appropriate responses, pictures or words. It should not favor one group over the other. Some of the associations are task oriented, the others familiar from experience.

Concerning perception, Myklebust suggests that when deafness is present, vision is the primary basis for perceptual organization. Myklebust and Brutton (1953) studied whether deaf children were different from hearing in certain aspects of visual perception. They used a figure ground test, a pattern reproduction test, and a perseveration test. It was suggested by the findings of the study that deafness may cause an alteration in the normal response modes of the organism, leading to what was termed "perceptual rigidity" in the deaf. Larr (1956) studied the perceptual and conceptual abilities of residential school children and found the deaf equal to or superior to the hearing children control groups in the area of visual perception. This disagrees with Myklebust, and finds corroboration from McKay's study (1952).

Hughes (1959) investigated the verbal percept-concept sorting performance of deaf and hearing children. The children were tested on the meaning of 241 percept words, and then asked to sort the words they knew into appropriate categories. He found that

the hearing children were superior both in ability to recognize more words and in ability to sort the words correctly. It was also found that the verbal behaviour of the deaf children was more perceptual, i.e. they were able to recognize many more words than they were able to sort. These findings seem consonant with the findings of Oleron (1953) who found that the deaf were inferior to hearing in the ability to manipulate concepts or think abstractly. The preceding studies seem to indicate that in cognitive development, differences may be noted between the deaf and hearing especially when verbal manipulation is required by the task. The construct of mediation seems to offer one possible reason for explaining the differences between the two groups.

Mediation is defined by Kendler (1963) as "a response, or series of responses which intercedes between the external stimulus and the overt response to provide stimulation that influences the eventual course of behaviour." Furth (1964), comparing deaf and hearing children, suggests that "Insofar as the mediator is conceptualized as verbal in nature, deaf as compared to hearing children may be handicapped on tasks in which verbal mediation is presumed to operate because of their impoverished linguistic experience." It seems then that associations are facilitated and strengthen-

ed by verbalization, i.e. the associations made between the word and the object which the word represents are reinforced by auditory cues, also by the child speaking the word. Wier and Stevenson (1959) found that hearing children who verbalized vocally made fewer mistakes on a task than those who did not. However, when the children are told not to vocalize, it is presumed that internal or implicit verbalization takes place. This implicit language may act as a mediator between the stimulus and the overt response. Reese (1959) and Kendler and Kendler (1959) use the construct of verbal mediation to describe the function of language in cognitive development. Reese maintains that verbal mediation is a function of age level. His study found that earlier stages of cognitive development show a deficiency of verbal mediation compared with later stages of development. He proposed "mediation deficiency" to account for the age differences in mediation. This position is disagreed with by Youniss and Furth (1963). They maintain that the construct of mediational deficiency is an oversimplification and that developmental differences in mediation may be accounted for by the differences of the distinctiveness of cues which are the result of experiential deficiency. In other words, younger children have qualitatively and quantitatively less cues to respond to experientially compared with later stages of their development.

STATEMENT OF PROBLEM

It would seem that the problem of mediation might be better understood by studying deaf children in comparison with hearing children. The deaf, being language deficient, would not be expected to have the same type of mediation as their hearing counterparts. This may be experimentally tested by a paired associate procedure where there is an interference and non-interference condition of a task. In the interference condition of the task, the normal response elicited by a stimulus is in competition with the correct response of the task condition. On this procedure a task association may be set up to cause interference with the expected response. For example, the Ss might be asked to associate a black colored stimulus card with milk and a white colored card with coal. These would then be "correct" associations for the task but contrary to experience and the normal association expectancy. If the Ss then had among an array of response items a piece of coal and a quart of milk, then each time the black card appeared, the

normally expected response "coal" would interfere with the correct task response of "milk". A study by Furth and Youniss (1964) employed this procedure, with 6 and 10 year old Ss, deaf and hearing; they found that the hearing Ss had more difficulty correctly associating the color stimulus with the appropriate task response on the interference condition. They also found that there was no significant difference in performance between the groups on the non-interference (neutral) condition of the task. This study by Furth and Youniss employed colored toy objects as response items. In the non-interference condition of the task, the color brown was to be associated with a toy red fire truck. In the interference condition, the S was told to associate a red stimulus card with a white refrigerator for the correct response. The presence of the toy red firetruck as a possible response gave competitive cues for the correct response, refrigerator. Whether the deaf are better able to make the correct response due to less interference from the type of mediation they have is a point for further investigation. The replacing of the color in the response object by using colorless pictures or black and white drawings would decrease the cue competition present when the colored toy objects are used as responses. The competition response then would be between the

task response and the past experiential associations of the Ss.

In order to allow the normal expectancy of associations to be operative in the association tasks Color-Picture and Color-Word, a normal or matched condition was selected. To control for abnormal associations, the neutral condition was selected. This was similar to the non-interference condition of the Furth and Youniss study, although some experiential interference would be presumed to be operating since the associations were abnormal. The most response competition was hypothesized to be from the reversal condition since the mediated color associations were in direct conflict with the task required association.

Two associations were required for each condition. In the matched condition, the normal association between object and color was to be made, e.g. green with tree and yellow with banana. This condition was used as a control for each S to ensure that normal associations were made. It would also make the reversal condition effective by confirming a normal expectancy since the control condition preceded the reversal in the presentation to the Ss. The neutral condition associated blue with refrigerator and pink with mouse. These associations were arbitrarily selected and would not normally be expected to be associated with

any of the response objects. This condition was used to control for the normal associations required by the reversal condition. That is, the errors in responding would be attributed not to simply the unusual task association requirement. The reversal condition required the Ss to associate red with train and black with firetruck. Subtracting the errors made on neutral condition from those made on the reversal might give an indication of the effectiveness of the latter as a source interference to the Ss normal internal association pattern. This presumes that the findings of the Furth and Youniss study are applicable here. If this reversal condition is found not to be the most difficult, then the theoretical formulations of Kendler and Kendler may provide an explanation.

A child (normal hearing) that is capable of using verbal mediators and abstracting can perform successfully in reversal learning or reversal shift problems. In these reversal problems the child must switch his response to the opposite of what it was before, e.g. from small to large. The task involved a simple discrimination between which of two blocks is "correct". The blocks vary in size (large and small) and in color (black and white). The predetermined correct task response is reinforced by the E. After learning this discrimination (several correct responses of "small"),

the child is then presented with a new problem. The child must make a reversal shift and choose the "large" block while still ignoring color as a relevant cue. In a non-reversal shift the child must switch to a new dimension, i.e. color relevant, size irrelevant.

If the child makes mediated verbal responses, e.g. "size is important" he makes the reversal shift relatively easily. Many nursery school children do not give themselves verbal instructions and have difficulty with reversal shifts; non-reversal shifts are easier for them.

One important finding of the Kendler studies for this present study is that children over 7 make reversal shifts easily but only about half of the children of kindergarten age do the same. Our Ss will be 7 and 11, capable therefore of verbal mediation.

It seems clear from these studies that children with verbal ability can use some form of language in solving cognitive problems. Verbal ability can enhance cognitive functioning, but we cannot state categorically that verbal language is a necessary condition for thought and problem solving. For some children, other kinds of mediation, such as imagery, pictorial representations or non-verbal symbols (signs and gestures) may serve the same purpose. Furth says that while the kinds of symbols used by the deaf are not known,

"successful performance on these tasks (e.g. reversal shift) by deaf persons implies an efficient functioning of a symbolic system other than verbal." (3)

Kendler and Kendler found that a reversal shift may be facilitated by verbal mediation as a function of age level. However, one distinction should be made. Their reversal was a task condition reversal whereas the reversed condition in this experiment is related to the normal experience of the Ss. The normal experiential association is being reversed by the requirements of the tasks.

Also, from this study, something may be inferred about mediational habits. For example, when a normal hearing subject sees a red stimulus card and has as possible responses an array of black and white pictures of a firetruck, refrigerator, banana, mouse, tree, train, his experiential association of red with firetruck is expected to be stronger than a task required association of a red stimulus card with a train. At least there will be some conflict in choice and the choice is expected to be mediated principally through covert verbalization with hearing children (Reese 1952; Kendler and Kendler) and "perceptually" by the deaf, i.e. whatever means available such as images, semi-verbal cues, etc. (Furth).

Teachers of the students involved in this study indicated that all the Ss were familiar with the objects used in the study and easily recognized the pictures. The 7 year old group of both the hearing and deaf children may be less familiar with the printed words so the associations may be made more perceptually by both groups, i.e. on the basis of the size and shape of the words and the pattern of the letters. In this case, the designed neutral condition of the task would not offer any more difficulty than the reversal interference condition of the task.

The independent variables were two age levels, CA 7 and CA 11, of normal hearing and deaf students who were required to make three types of associations, matched, neutral and reversal on two tasks. One task, Color-Picture, was the association of a color stimulus card with a colorless picture as a response. The second task required the S to associate a colored stimulus card with a printed word response (Color-Word). The words of the second task corresponded to the six pictures of the C-P task.

The dependent variable was the pointing response made by the Ss to the 6 colored stimuli cards presented one at a time. The number of incorrect associations was the response measure. The errors were then

analysed by a 2 x 2 x 2 x 3 anova with repeated measures.

SPECIFIC HYPOTHESES

(1) The deaf Ss would have significantly lower mean error scores on the reversal condition than their hearing peers.

(2) The CA 7 year old group would have significantly higher mean error scores than the CA 11 year group.

(3) The Color-Word task would produce significantly higher mean error scores than the Color-Picture task.

(4) The reversal condition would have significantly more mean errors than the neutral or matched condition.

PILOT STUDY

A pilot study was designed to explore the appropriateness of the variables for study on the paired associate tasks. Several colored stimulus cards were employed to see if an uncontrolled bias might be inadvertently introduced into the design. It was found, for example, that an orange stimulus card as a neutral paired associate was not a good color selection but was sometimes confused with red. Therefore, the Ss would point to the firetruck or the train when presented with the orange stimulus card or point to the mouse when presented with the red stimulus card. Care had to be taken to select a color that would not normally be associated with any of the other association items. Pink fulfilled this requirement.

To ensure that the reversal effect would be operative, the normal color association of red with firetruck and black with train had to be established. Therefore deaf and hearing children from schools other than those used in the study were asked to color the train and firetruck in the way they thought it should be

colored. For the deaf, 7 year old Ss, 8 of 8 colored the firetruck red and the train black or dark brown. 27 of 29 7 year old hearing children colored the reversal items in the same way mentioned above. Of the two children that did not color as expected, one was color-blind, and the second child colored both the train and firetruck red because he "liked red." From these results, it was decided that normal color associations were satisfactory.

METHOD

SUBJECTS:

Subjects for this study included 24 deaf and 24 hearing children at each of two age levels. The 48 deaf children were enrolled in two different schools for the deaf: Maryland State at Frederick, Maryland and Kendall in Washington, D.C. Since no I.Q. scores were available, comparability with hearing groups was based on teachers' judgments that the Ss were in the average range of intelligence. The age range for the groups was 6.9 to 7.4 for the younger group and 10.8 to 11.11 for the older group. Mean chronological age for the younger group was 7.4 and mean chronological age for the older group was 11.3.

The 48 hearing children were enrolled in a parochial school in the Washington, D.C. area. I.Q. scores were not available for the 7 year group, and the judgment of the teachers indicated that the children were in the average range of intelligence. For the 11 year group, I.Q. scores obtained from the Pintner ranged from 89 to 116, with a mean of 102. The age range for the hearing

group was 6.9 to 7.4 with mean chronological age of 7.1 and for the older group 10.6 to 11.2 with a mean chronological age of 11.0.

Both age groups were assigned to either a Color-Word task or a Color-Picture task alternately, according to alphabetical arrangement.

MATERIALS:

The following two six-item association tasks were employed in this study.

TABLE I

Stimulus and Associated Response for Task Conditions

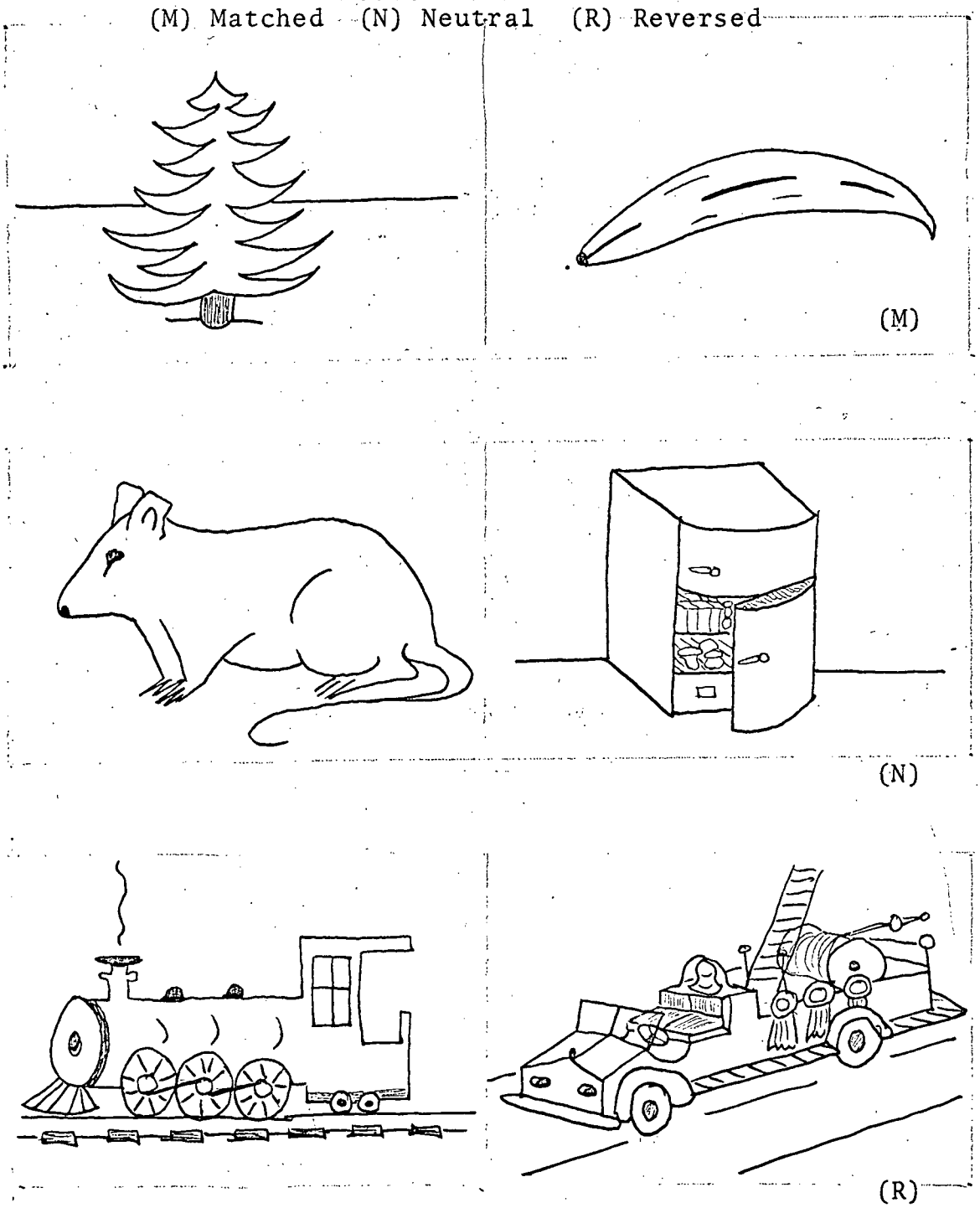
Task Conditions	Color Stimulus (5"x8" card)	Picture/Word Response
Matched	yellow	banana
Matched	green	tree
Neutral	pink	mouse
Neutral	blue	refrigerator
Reversal	black	firetruck
Reversal	red	train

First Task:

There were six 5"x 8" colored card stimuli and six ink drawings for responses. (See Figure I). Two of the six paired associates were natural or matched, i.e. yellow

Figure I

Response Items for Color-Picture Association Task
(M) Matched (N) Neutral (R) Reversed



with banana and green with tree. Two associations were neutral, i.e. arbitrarily assigned, blue refrigerator and pink mouse. Two of the associations were reversed, i.e. red train and black firetruck. This task was given to 48 Ss, 24 deaf and 24 hearing, i.e. 2 groups of 12 Ss at CA 7 and 2 groups of 12 Ss at CA 11, 7 years and 11 years.

Second Task:

The second association task was given to 48 different Ss but grouped in the same way mentioned above; the same six colored stimulus cards were paired, this time with printed words. The task conditions were the same, two matched, two neutral, and two reversal. (See Table I). A score sheet was used which had a systematically randomized order for presenting the stimuli to all Ss and which had space for recording responses. Each item appeared once in 6 blocks of trials. The order of presentation was the same for each S.

PROCEDURE:

Each S was seen individually and seated at a table in front of the E. S was shown the stimulus colored cards and the drawings or word response items. The directions were "signed" to the deaf and spoken to the hearing.

children. The directions were, "Here are some colored cards, (shows to S fanned out), and here are some pictures (words), (shows response cards to S). I will tell you which one of these (colored cards) goes with each of these (response cards), and I want you to try and remember which one goes with which." E. showed S the stimulus cards one at a time while saying, "This one," (red), "goes with this" (train), and placed it next to the response picture. When all the colored cards had been shown one by one, a neutral first, then matched, and then reversal for the instruction association, the colored stimulus cards were then hidden from view on E's lap below the table and shown one at a time in systematically randomized order.

The Ss responded to the E's presentation of the stimulus card by pointing to one of the six response items laying in random arrangement on the table. If a hearing child spoke, he was asked to indicate his choice by pointing only. If the correct response was given, the E. nodded and said: "That's right."; if the incorrect response was given, the child was corrected by shaking the head "no" and the stimulus card was placed in front of the correct response card. After each three responses of the child, the response cards were re-arranged to avoid positional cues. The stimulus cards were shown for 6 blocks of 6 trials or until the Ss had made 12

consecutive correct responses. (The blocks were in the same order). The number of incorrect responses and correct responses were recorded on the score sheet. The rate of presentation was paced by the Ss.

RESULTS

The number of errors was used as the response measure. The mean number of errors for all groups is shown in Table II.

TABLE II

Cell Means for Color-Word and Color-Picture Tasks and Matched (M), Neutral (N) and Reversal (R) Conditions for Two Age Levels of Hearing and Deaf Subjects.

COLOR-WORD

	Hearing			Deaf		
	M	N	R	M	N	R
CA 7	2.75	4.08	3.66	1.91	3.66	3.50
CA 11	.33	.33	1.50	.75	1.16	2.91

COLOR-PICTURE

	Hearing			Deaf		
	M	N	R	M	N	R
CA 7	.66	1.58	3.25	.08	.08	.33
CA 11	.08	.58	.75	.33	.58	1.41

In order to evaluate the data, an overall analysis of variance with repeated measures was Task x Hearing Status x Age x Conditions. A summary of the analysis is reported in Table III.

TABLE III

Anova Summary

Source		Sum of S	DF	F	P
Hearing Status	(H)	4.01	1	.61	—
Age	(A)	110.01	1	16.85	$<.01$
Task	(T)	141.68	1	21.71	$<.01$
Conditions	(C)	81.38	2	22.65	$<.001$
H x A		49.99	1	7.66	$<.01$
H x T		14.22	1	2.17	—
A x T		53.38	1	8.18	$<.01$
H x C		.01	2	.02	—
A x C		7.38	2	2.05	—
T x C		2.63	2	.73	—
H x A x T		1.68	1	.25	—
H x A x C		7.89	2	2.19	—
H x T x C		9.67	2	2.69	$<.05$
A x T x C		14.71	2	4.09	—
H x A x T x C		4.67	2	1.30	—
PC (AMT) Error Term		316.17	176		

(1) Contrary to the first hypothesis, there was no significant difference between performance by hearing Ss and deaf Ss.

(2) Comparing the performance of age groups, the 11 year old groups committed significantly fewer errors ($p<.01$, df 1/88) than the 7 year old groups. This finding was as expected.

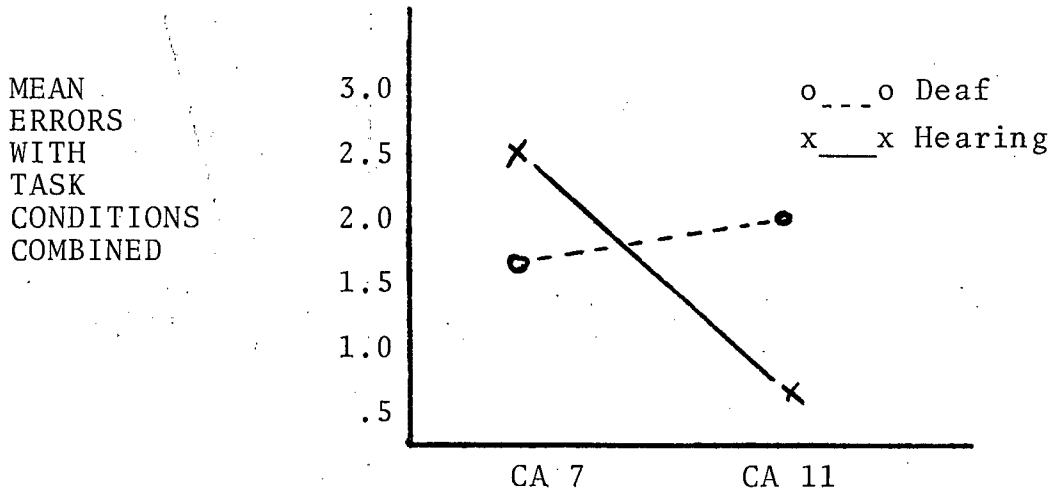
(3) Task conditions (M,N,R,) were found to be significantly different ($p<.01$, df 2/176) in the predicted direction. The order of difficulty being reversal, neutral, and matched with reversal most difficult.

(4) It was expected that the Color-Word task would be more difficult than the Color-Picture task. This hypothesis was statistically confirmed as can be seen in Table III - ($p<.01$, df 1/88). It is interesting to note that the hearing 7 year old group performed quite similarly on the reversal condition of both tasks: C-W M=3.66; C-P M=3.50. Whereas for the deaf 7 year old group there was a significant difference in their performance on the C-W task, M=3.50 errors compared with C-P, M=.33. This would explain the Age x Task interaction.

An interaction between Hearing Status and Age was significant ($p<.01$). The deaf made fewer errors than the hearing at the 7 year level and more errors than the hearing at the 11 year level. This interaction is graphed in Figure III.

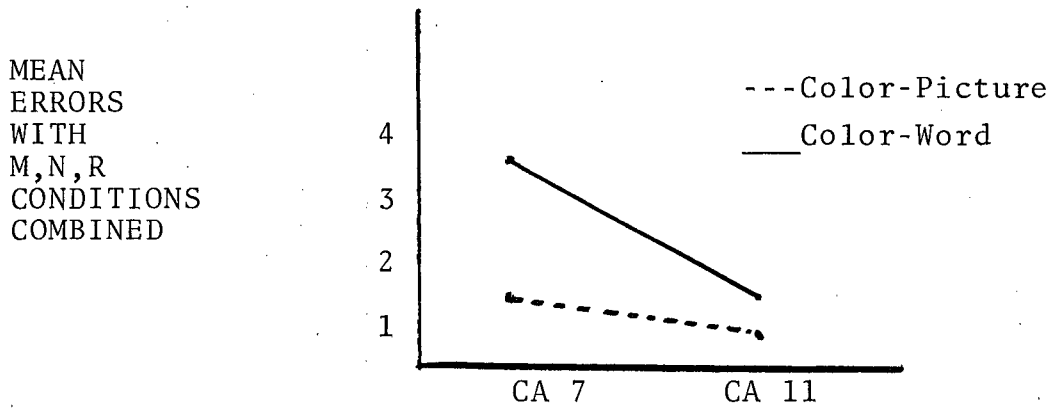
FIGURE II

Interactions - Hearing x Age



An interaction between Age and Task was significant ($p < .05$, df 1/88). On the Color-Picture task the difference in performance between the CA 7 and CA 11 groups was slight whereas on the Color-Word task, a greater difference can be seen. (See Figure III).

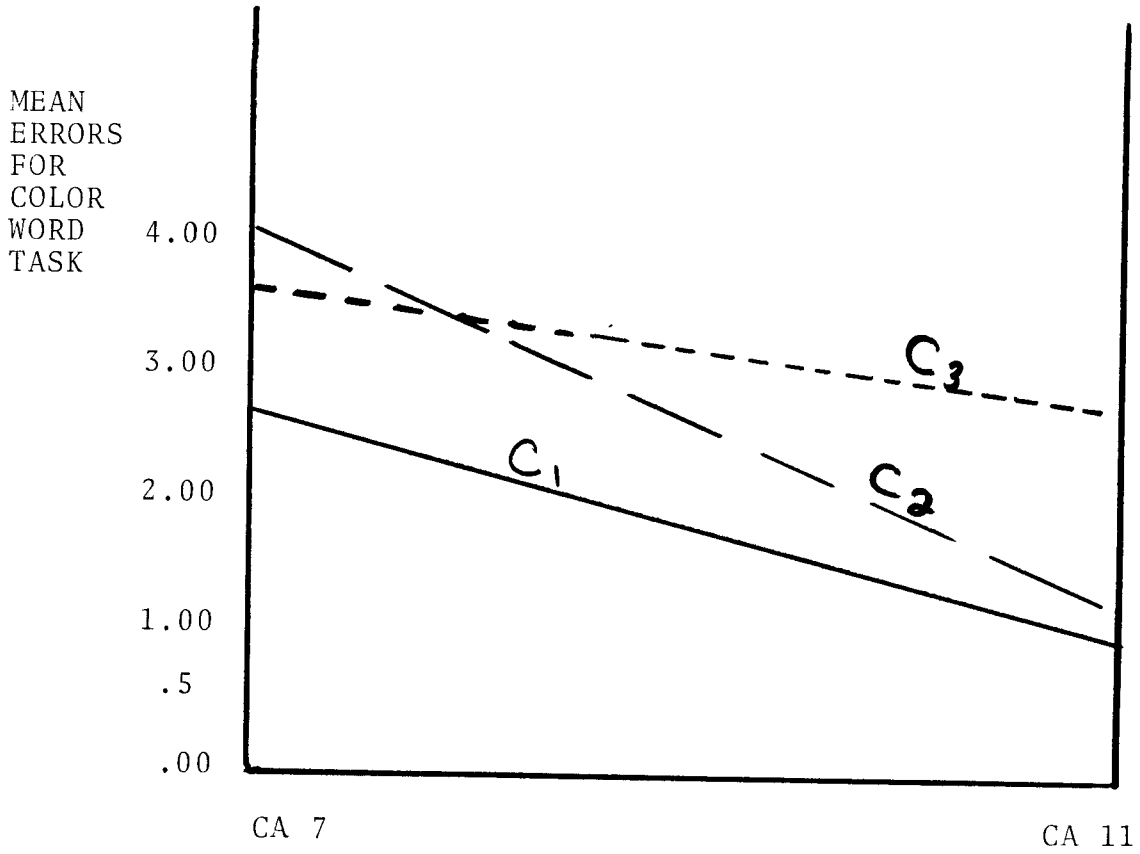
FIGURE III



A three-way interaction Age x Task x Conditions was significant ($p < .05$, df 2/176). (See Figure IV.) Within Color-Word task at the CA 7 level, there were more errors made on the neutral condition than on the reversal. At the CA 11 level, there were more errors made on the reversal condition. This is irrespective of hearing status. Within the Color-Picture task, there is no such interaction. (See Figure IV.)

FIGURE IV

Three-Way Interaction
Age x Task x Conditions

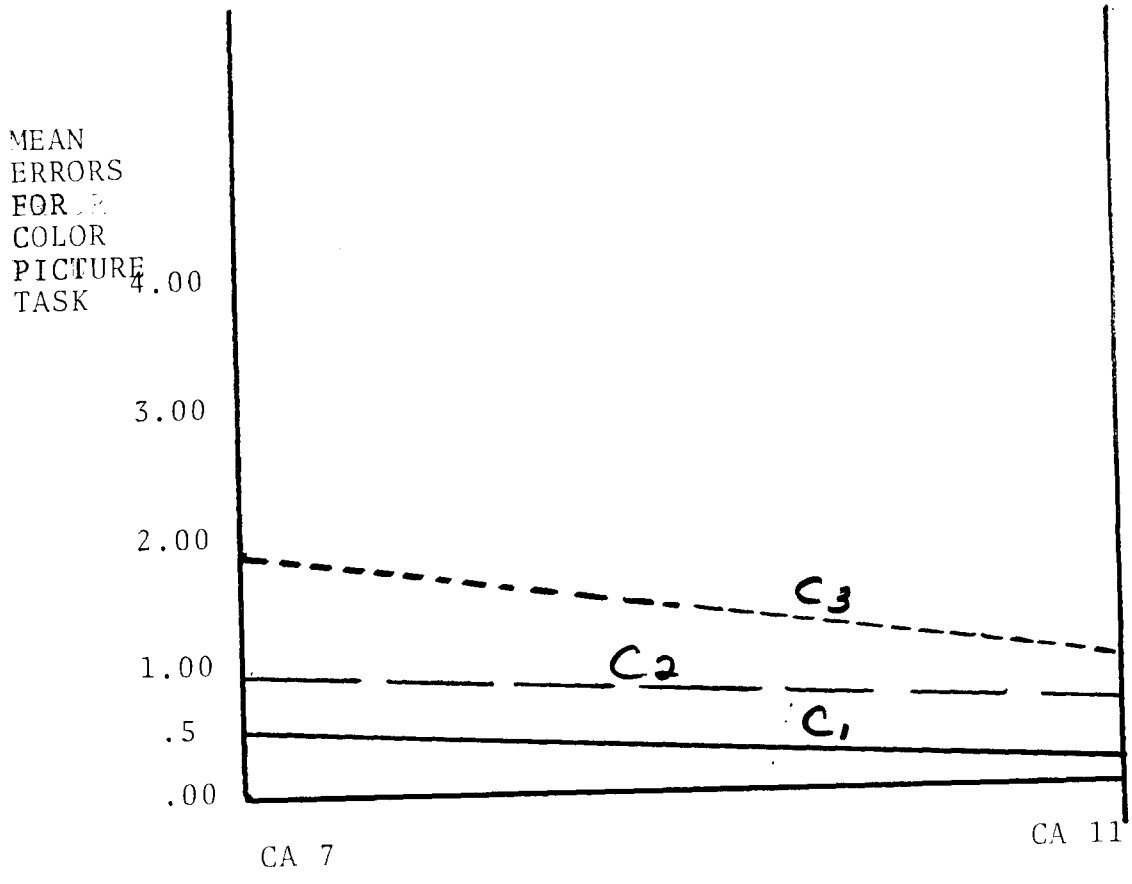


Conditions

C_1 = Matched
C_2 = Neutral
C_3 = Reversal

FIGURE IV

Three-Way Interaction
Age x Task x Conditions



Conditions

C_1 = Matched
C_2 = Neutral
C_3 = Reversal

DISCUSSION

The most interesting finding of the study was a lack of statistically significant difference in performance by the hearing and deaf Ss at either age level. This would tend to indicate that whatever the nature of the mediation, verbal, iconic or whatever, between the two different hearing status groups, one group is not superior to the other in effective performance. This would be expected at these age levels by Kendler's theory. It does not support Furth's hypothesis.

The Color-Picture association task seemed to be too easy for the 11 year old Ss, (M=0.77). It appeared also to be too easy for the deaf 7 year old Ss (M=.16), but not so for the hearing 7 year old children, (M=3.0). The Color-Word association task would seem to be an area for more fruitful investigation comparing these two hearing status groups at each age level from 7 to approximately 13. These Ss would have developed to the point where mediation should be facilitative. Also, perhaps a wider choice of reversal

conditions could be explored to investigate further the interference aspect of verbal mediation.

The second hypothesis tested was that CA 7 year old Ss would have a significantly higher mean error score than the CA 11 year old Ss. This was expected after the findings of Furth and Youniss (1964). This hypothesis was confirmed. On both C-W and C-P tasks and in 22 of the total 24 conditions the younger Ss made more errors than the older Ss. The difference in performance by the CA 11 year old deaf group on the neutral and reversal conditions of the C-P task was not a statistically significant difference.

The third hypothesis being tested was: the C-W task would produce significantly higher mean error scores than the C-P task. This hypothesis was confirmed. The degree of abstraction involved in associating color to word compared with color to picture seems to account for this difference. It is interesting to note that three times as many errors were made on the C-W task compared with the C-P task. This may indicate that mediation might be more facilitative on a simple association task (when no overt verbalization is allowed) than on a more complex association task. The hearing and deaf Ss performed in no significantly different way, indicating that perhaps the mediation skills do not differ much in terms of effective performance.

The fourth hypothesis tested was: the reversal condition would be significantly more difficult than the neutral or matched condition. This hypothesis was confirmed statistically. The reversal condition showed a greater number of errors than either the matched or neutral on six of the eight groups. The two groups which did not have this finding were the hearing CA 7 C-W group and the deaf CA 7 C-W group. In these groups, the neutral condition had slightly more errors (M=4.08) than the reversal condition (M=3.67). This was not a significant difference however.

The two groups did not have any more difficulty associating the color blue with the printed word refrigerator or pink with mouse (neutral conditions). The reversal interference effect did not seem to be operating here, at least there was no evidence to say it was as strong in association strength as experienced by the other groups. As mentioned earlier these younger children may have been responding to cues (e.g. size and shape of written word) other than the task expected and experiential cues.

The three-way interaction, Age x Task x Conditions, may be interpreted as follows. Within the C-W task there is a signifigant interaction between conditions and age. At CA 7 level, the neutral condition (Mean = 3.87) was only slightly higher than the reversal

condition, (Mean = 3.58), while at the 11 year level the reversal condition (Mean = 2.5) was higher than the neutral condition (Mean = 1.8). One interpretation might be that the C-W associations at the 7 year level were not as familiar to the Ss and therefore the reversal condition interference effect was not significantly different from the neutral condition. However, at the 11 year level, the interference effect of the reversal condition was influencing performance by the Ss. Within the C-P task, there was no interaction effect between condition and age perhaps due to the small number of errors made in associations on the task, indicating that the C-P task may have been too easy, especially for the older Ss.

A concluding statement summing up the relevance of this study might be as follows. Using the cognitive development model of Bruner, it would seem that the representation of experiences, enactive, iconic or symbolic, for deaf and hearing children provides adequate feedback to mediate appropriate responses, despite differences in linguistic skills. In terms of cognitive functioning, the deaf perform not unlike their hearing counterparts. The deaf associate simple color to object and abnormal color to object as required by a task, and they reverse the normal color associations

between two pairs of objects in a way that does not seem to show a differential in cognitive performance from the hearing.

REFERENCES

1. Blair, F.X., A Study of the Visual Memory of Deaf and Hearing Children, American Annals of the Deaf, 1957, 102, 254-263.

2. Bruner, J., Courses of Cognitive Growth, American Psychologist, January 1964.

3. Furth, H.G., Research with the Deaf: Implications for Language and Cognition, Psychology Bulletin, 1964.

4. Furth, H.G. & Youniss, J., Color-Object Paired Associates in Deaf and Hearing Children With and Without Response Competition, Journal of Consulting Psychology, 1964, 28.

5. Furth, H.G., Thinking Without Language: Psychological Implications of Deafness, New York, Free Press of Glencoe, 1966.

6. Hiskey, J., Nebraska Test for Learning Aptitude for Young Deaf Children, American Annals of the Deaf, 1956.

7. Hughes, W., A Comparison of Verbal Conceptualization in Deaf and Hearing Children, University of Illinois, 1959.

8. Kendler, T.S. & Kendler, H.H., Reversal and Non-reversal Shifts in Kindergarten Children, Journal of Experimental Psychology, 1959, 58, 56-60.

9. Kendler, H.H. & Kendler, T.S., Vertical and Horizontal Processes in Problem Solving, Psychology Review, 1962, 69, 1-16.

10. Kendler, T.S., Development of Mediating Responses, Wright, J.C. & Kagan, J. (eds.), Basic Cognitive Processes in Children, Monogr., Social Research in Child Development, 1962, 28, No. 2, 33-52.

11. Kendler, T.S. & Kendler, H.H., Experimental Analysis of Inferential Behavior in Children, In Lipsitt, L. & Spiker, C. (eds), Advances in Child Development and Behavior, Vol. 3, New York, Academic Press, 1967, 157-190.

12. Kendler, T.S. & Kendler, H.H. & Wells, D., Reversal and Non-reversal Shifts in Nursery School Children, Journal of Comparative Physiological Psychology, 1960, 53, 83-88.

13. Larr, A.L., Perceptual and Conceptual Ability of Residential School Deaf Children, Exceptional Children, 1956, 23, 63-66.

14. Luria, A.R., The Role of Language in the Formation of Temporary Connections, In B.Simon (ed.) Psychology in the Soviet Union, Stanford, Stanford University Press, 1957.

15. McKay, E.B., An Exploratory Study of the Psychological Effects of Severe Hearing Impairment, Unpublished doctoral dissertation, Syracuse University, 1952.

16. Myklebust, H., The Psychology of Deafness, Grune & Stratton, New York, 1960.

17. Myklebust, H. & Brutten, M., A Study of the Visual Perception of Deaf Children, Acta Otolaryngology, Suppl. 195, 1953.

18. Oleron, P., Conceptual Thinking of the Deaf, American Annals of the Deaf, 1953, 98, 304-310.

19. Oleron, P., A Study of the Intelligence of the Deaf, American Annals of the Deaf, 1950, 95, 179-195.

20. Reese, H.W., Verbal Mediation as a Function of Age Level, Psychological Bulletin, 1962,59, 502-509.

21. Vygotsky, L.S., Thought and Language,M.I.T. Press & John Wiley and Sons, 1962.

22. Weir & Stevenson, S., The Effect of Verbalization in Children's Learning as a Function of Chronological Age, Child Development, 1959, 30, 143-149.

23. Youniss, J. & Furth, H.G., Reaction to a Placebo: The Mediational Deficiency Hypothesis, Psychological Bulletin, 1963, 60, 499-502.

APPENDIX

TABLE IV

Total Number of Errors for Color-Word and Color-Picture Tasks and Matched (M), Neutral (N) and Reversal (R) Conditions for Two Age Levels of Hearing and Deaf Subjects.

COLOR-WORD

	Hearing				Deaf			
	M	N	R	TOTAL	M	N	R	TOTAL
CA 7	33	52	41	126	23	46	41	110
CA 11	4	4	18	26	9	14	35	58
	37	56	59	156	32	60	76	168

COLOR-PICTURE

	Hearing				Deaf			
	M	N	R	TOTAL	M	N	R	TOTAL
CA 7	8	19	39	66	3	7	18	28
CA 11	1	7	9	17	1	1	4	6
	9	26	48	83	4	8	22	34

TABLE V

Percentage of Errors for Color-Word and Color-Picture Tasks and Matched (M), Neutral (N) and Reversal (R) Conditions for Two Age Levels of Hearing and Deaf Subjects.

COLOR-WORD

	Hearing			Deaf		
	M	N	R	M	N	R
CA 7	26	41	33	21	42	37
CA 11	15	15	70	16	24	60

COLOR-PICTURE

	Hearing			Deaf		
	M	N	R	M	N	R
CA 7	12	29	59	11	25	64
CA 11	6	41	53	17	17	66