74-8481

COX, Roswell David, 1944-
THE RELATIVE ROLE OF PREVIOUS EXPERIENCE ON THE RECOGNITION AND TRANSFER OF GEOMETRIC FORMS.

University of North Carolina at Greensboro, Ph.D., 1974
Home Economics

THE RELATIVE ROLE OF PREVIOUS EXPERIENCE ON THE RECOGNITION AND TRANSFER OF GEOMETRIC FORMS

by

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A Dissertation Submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Greensboro
July, 1973

Approved by

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APPROVAL PAGE

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COX, ROSWELL DAVID. The Relative Role of Previous Experience on the Recognition and Transfer of Geometric Forms. (1973) Directed by: Dr. Helen Canaday. Pp. 85.

The purpose of this study was to investigate the effects of prior tactual, prior visual, and prior tactual-visual experience on the recognition of simple shapes embedded in more complex figures, the length of time needed to recognize the shapes, the transfer to new designs following the recognition task, and the length of time needed to make the transfer. The variables were compared in relation to race and sex. Eighty, five-year-old Head Start Children were randomly selected from all the children attending Head Start in the area covered by the Kentucky River Foothills Development Council. There were forty males and forty females; forty black and forty white children randomly assigned to the four treatment groups. There were twenty children per treatment variable with an equal number of males and females, and an equal number of blacks and whites. A recognition task and a transfer of training task were administered to each child. Response latencies were recorded. Four analyses of variance were computed with subsequent t tests on significant main effects and interaction effects.

Three hypotheses were stated in this investigation. No research was readily available which would point to differences on performance due to sex or race so that no specific hypotheses were stated regarding these two variables.

The first hypothesis was that subjects under the condition of prior visual-tactual experience would score significantly better and take less time on the recognition task than would the subjects under the other three conditions.

The second hypothesis was that subjects under the condition of prior visual-tactual experience would score significantly better on the transfer task following the recognition task, and take less time to transfer to new designs than subjects under the other conditions.

The third hypothesis was that prior experience alone would result in better recognition scores, better scores on the transfer task, lower response latencies on the recognition task, and take less time to transfer to new designs than would subjects in the condition of prior tactual experience alone.

As they were stated the three hypotheses were not totally supported by the data.

The major conclusions of this investigation were as follows:

1. Previous sensory experience does tend to enhance five-year-old children's ability to recognize embedded figures.

2. The data in this investigation tended to support only partially those theorists who maintain that there is not an essential touch component in the visual recognition of geometric forms on these kinds of discrimination tasks,

in that tactual experience had some effect but this was not as powerful as visual experience.

3. Even though prior sensory experience aids in the recognition of embedded figures, there was no statistical evidence in this investigation which would support the conclusion that it also aids in the transfer of recognition to new designs in the sense of main effects across all types of subjects.

4. Girls in this investigation tended to rely on visual cues when attempting to recognize geometric forms on the transfer task.

5. Tactual experience appeared to have an inhibiting effect on girls attempting to recognize geometric shapes on the transfer task.

6. Boys in this study tended to utilize both sensory modalities separately or when combined to recognize embedded shapes on the transfer task.

7. Black children in this study appeared to benefit from the prior visual sensory experience on the transfer task but these results did not reach clear statistical significance.

8. White children in this investigation tended to rely on the visual modality in the recognition of geometric shapes on the transfer task.

9. Much additional research in the area of perceptual development is needed.

ACKNOWLEDGMENTS

I would like to express my sincere appreciation to Dr. Helen Canaday, my adviser and Professor of Home Economics, Dr. James Watson, Associate Professor and Chairman of the Department of Child Development and Family Relations, Dr. Clara Ridder, Professor of Home Economics, Dr. Robert Eason, Professor and Chairman of the Department of Psychology, Dr. Aaron Brownstein, Professor of Psychology, Dr. Eunice M. Deemer, Associate Professor of Home Economics, the members of my doctoral committee, for their patient guidance and support they gave to me during the course of this study. Dr. Carl Cochrane, Lecturer in Home Economics, is acknowledged for his helpful guidance, support, and suggestions in analyzing the data. Appreciation is expressed to the late Dr. Richard Klemer, Professor and Chairman of the Department of Child Development and Family Relations, for his support and suggestions during the initial stages of my doctoral program.

Sincere appreciation is extended to the nursery school staff at this university for their encouragement during the pursuit of my graduate degree.

A special thanks is extended to the staff of the Kentucky River Foothills Development Council for the interest and support given to the study.

To the eighty children who participated in this study I can not be grateful enough. Their cooperation and enthusiasm is acknowledged with love and appreciation for they made this investigation an enjoyable experience.

I would like to thank the Berea College administration for their genuine interest and financial assistance which helped defray the cost of this experiment. A special note of appreciation is extended to my departmental colleagues at Berea College and to the students in my classes for their understanding and support during the duration of this investigation.

To Yvonne Williams, a sophomore at Berea College, I express sincere thanks for typing all of my preliminary copies. Her contribution was invaluable.

To my wife, Fredonna, and my son, David, I give all my love and express sincere appreciation to them for their patient understanding and support.

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CHAPTER I

INTRODUCTION

Even to the most casual observer it is apparent that young children in their daily interaction with their environments are exercising the capacity to selectively attend to certain factors while at the same time ignoring others. In the process of perceptual development the young child acquires the ability to avoid distraction--to concentrate on one important aspect of the environment at a time (Gibson, 1966). Are there differences in this ability among children of differing socio-economic classes? This aspect of perceptual development aids in studying and learning about the invariant properties of the massive quantity of stimuli in the child's world.

Children appear to possess an almost insatiable curiosity about the objects in their worlds. They are constantly searching for, looking at, touching, smelling, listening to, and tasting the stimuli that confront them. There are other processes at work which appear to aid perceptual development.

Piaget (1952) discussed the concept of reciprocal coordination of schemata which takes place during the early part of the sensorimotor period. At this time instead of merely listening, looking, and grasping, the infant combines the capacities of his senses. As a result of this capacity the infant coordinates his senses so that a stimulus is the object of visual, auditory, tactual, and motor responses at the same time. Another process at work aiding perceptual development is that which White (1959) referred to as competence. If in his interaction with his environment a child feels good about the effects of his actions on the environment and the effects of the environment on him, he can acquire increased competence in dealing with his world.

Children who live in environments which provide many and varied types of stimuli bring with them to any novel situation a predisposition to attend to more stimulus information than do children raised in severely restricted, bleak environments (Hunt, 1961; CRM, 1971). Summarizing the effects of environmental conditions on the development of perception Deutsch (1968) has concluded

> . . . that life conditions including current situation, past experience, cultural and socioeconomic factors . . . influence perceptual processes through their influence on the amount and variety of stimuli to which an individual is exposed, and through which the nature and amount of practice an individual gets in learning to discriminate stimuli from each other (p. 59).

Such conclusions dealing with the effects of environmental conditions on developing perceptual processes have contributed to widespread efforts, i.e., compensatory education programs, Head Start, parent-child centers, and parent education programs to help remedy cognitive and perceptual deficiencies exhibited by young children from economically deprived environments.

For the young child many of the stimuli he confronts will be novel, but, as a result of his developing curiosity about the new and unexplained and his intrinsic drive to create clarity amidst confusion, he will actively utilize his perceptual capacities to fashion some semblance of reality.

Research Needed in the Area of Perceptual Development

In reference to the research studies on shape perception it appears that there are a variety of variables contributing to the perception of shape. It appears that some research (Kephart, 1960; Piaget and Inhelder, 1956) presents evidence to substantiate the assumption that touch may play a valuable role in the interpretation of acquired visual information. According to Gibson (1969) an important aspect of perceptual development is the ability to ignore irrelevant noncritical stimuli.

Does tactual stimulation aid in the recognition of simple shapes embedded within more complex figures?

Does tactual discrimination aid in the transfer to new designs?

Does visual and tactual experience aid economically deficient children in their recognition of forms within embedded figures?

Information on the effects of these variables would have much practical value in aiding understanding of the critical properties discovered by these children as they explore the vast array of stimuli in their environments.

Purpose of This Study

It was the purpose of this investigation to study the roles of prior visual and tactual experience on (1) the recognition of simple shapes embedded in more complex figures, (2) the length of time needed to recognize the shapes, (3) the transfer to new designs following the recognition task, and (4) the length of time needed to make the transfer. The variables were compared in relation to race and sex.

Background for This Study

Following the indications of some research on embedded figures that past experience or practice aided in the recognition of shapes as well as the transfer of the recognized forms to new designs and that tactual experience may play an important role in processing visual information (Hannawalt, 1942; Kolers and Zink, 1962; Piaget and Inhelder, 1956; Kephart, 1960). The present study attempted to establish that the above factors were critical to a child's perceptual development as he interacted with the vast array of stimuli in his daily environment.

For Gibson (1966), perception is a question of detecting information, and perceptual learning is conceived as a process of "differentiation." The "differentiation theory" of perceptual learning as proposed by Gibson and Gibson (1955) is one of learning what is attended to, both overtly and covertly. Through interaction with objects in his environment the child detects distinctive features and abstracts general properties of a vast array of stimuli. The child learns to look for the critical features, to listen for distinctive differences, to smell and taste characteristics of objects and substances, and to tactually manipulate textures of things. In addition, the child becomes "economical" in his searching, i.e., he develops selective attention. From an array of stimulus information the child selects only the information needed to identify an object. The Gibsons (1955) further suggested that the abilities to identify and to discriminate develop together as reciprocals in the child. In addition, the identifying reactions improve at the same time as discriminative reactions.

In a similar vein of thought Piaget (1950) indicated or concluded that the child's conceptualizations in the preoperational phase of cognitive development are perceptual dominant, i.e., his classification and conceptions are based largely on the salient physical characteristics of objects, as he constructs reality. But, Piaget's contention is that the child constructs reality through an inner intellectual aspect of perception rather than by detecting information. The ability to attend to higher-order characteristics of objects and events develops in successive developmental stages. The child will perceive invariants in his environment when he is ready to do so--his ability to abstract information from the environment grows as he does.

It is the assumption of Gibson and was an assumption of this study that sensory modalities, e.g. vision and touch, are important means by which critical information is detected in the environment (Gibson, 1966).

It was also the assumption of this investigation that the child in the preoperational phase of development is actively searching for those crucial invariants of objects in an attempt to construct some semblance of reality.

Clarification of Terms Used in This Study

Embedded figures referred to a modified version of Gottschaldt's embedded figures as used by Witkin (1950). The figures were modified by the present investigator since it was felt that the complex designs in their original form were too difficult for young children. The test consisted of twelve simple wooden geometric forms, designated *a* designs. Six of the geometric forms were used in the recognition task and six were used in the transfer task. The twelve *a* designs were embedded in nine complex designs designated b designs; six b designs were used for the recognition task, the other three b designs were used in the transfer tasks.

Tactual experience referred to touching and holding the wooden cut-outs of the simple geometric forms, though not being able to see them. The recognition task patterns were presented one at a time at the back of the stage. The wooden geometric forms were presented to the child in the position that they appeared in the recognition task patterns.

Visual experience referred to merely looking at the wooden cut-outs one at a time as they were presented on the stage, without being allowed to finger them. The recognition task patterns were presented one at a time at the back of the stage. The child was presented the wooden geometric forms in the position that they appeared in the recognition task patterns.

Visual-tactual experience referred to looking-touching behavior. The child was allowed to manipulate a set of a form cut-outs in addition to viewing an identical set placed on the stage. The recognition task patterns were presented one at a time at the back of the stage. The geometric forms were presented to the child in the position that they appeared in the recognition task patterns.

Control group referred to those subjects who were not given any prior visual or tactual experience with the a designs.

<u>Recognition task</u> referred to the experience of locating the simple design in a more complex pattern by outlining it with a finger.

<u>Transfer of training task</u> referred to the experience of finding the simple designs in more complex designs which were not used in the recognition task (after Hannawalt, 1942). The child outlined the embedded figure with a finger.

<u>Attend</u> referred to concentrating or focusing on certain properties of an object or form while ignoring others.

The Sample

The subjects for this study were randomly selected from all of the children who attended Head Start in the area served by the Kentucky River Foothills Development Project. The area includes Madison, Clark, Estill, and Powell counties. Children who were enrolled in the fall of 1972 were eligible for the study provided they had already had their fifth birthday and would not be six years old before the study was completed.

Eighty subjects were randomly selected with proportional numbers of Negro and white subjects and an equal number of boys and girls.

Permission for the children to participate in this research study was obtained from the Kentucky River Foothills Development Council, the parents of the children, and the individual teachers. These permissions were obtained before this study was started.

Hypotheses

For this study, three hypotheses were stated. Hypotheses I and II were derived from the work of Gibson (1966). Hypothesis III was derived from the work of Pick, Pick, and Klein (1967) and DeLeon, Raskin, and Gruen (1970).

Hypothesis I

Subjects under the condition of prior visual-tactual experience will score significantly better and take less time on the recognition task than will subjects under the other conditions.

Hypothesis II

Subjects under the condition of prior visual-tactual experience will score significantly better on the transfer task following recognition, and take less time to transfer to new designs than subjects under the other conditions.

Hypothesis III

Prior visual experience alone will result in better recognition scores, better scores on the transfer task, lower response latencies on the recognition task, and take less time to transfer to new designs than will subjects in the condition of prior tactual experience alone.

No research was readily available which would point to differences on performance due to sex or race so that no specific hypotheses are stated.

CHAPTER II

REVIEW OF RELATED LITERATURE

Much research has been directed toward an attempt to clarify the factors involved in a child's selective perception of stimuli in his environment. What variables are involved when a child perceives a single stimulus from an array of added stimuli? What is the role of sensory modality in perceiving a stimulus hidden in an embedded figure, or more specifically, do sensory modalities functioning together facilitate perception in children from low income families?

Investigators studying embedded stimuli have tended to focus their efforts on the effects of prior experience, filtering, observing responses, and punishment. Research on the effects of deprivation on perceptual discrimination have also been attempted.

Traditionally, the problem of determining the effect of past experience on the perception of embedded figures has been one of controversy. Gestalt psychologists stated that practice was not very crucial in the detection of figures and often alluded to the Gottschaldt experiment (Gottschaldt, 1926, in Ellis, 1938) for evidence. Gottschaldt's experiment was designed to test the effect of practice on figure detection. In his experiment simple a patterns were embedded in more complex b patterns and exposed to one group of subjects 520 times and another group of subjects three times. No significant differences were found between the two groups in their ability to recognize the a patterns in the b patterns. However, certain experiments performed after Gottschaldt's research (Henle, 1942; Hannawalt, 1942) have hinted at the possible positive effects of past experience. Hannawalt (1942) concluded that practice was an important factor in recognition as well as transferring the recognized form to new designs. A more recent experiment has also tended to support the assumption that practice does affect performance on form recognition (Kolers and Zink, 1962, in Gibson, 1969).

Gibson (1969) concluded that the research on the effects of past experience on form recognition is beset with problems of definition of past experience, performance set, and instructions given to the subject.

Filtering, or ignoring irrelevant stimuli, also appears to be a factor in embedded forms. Frances (Frances, 1963, in Gibson, 1969) researched perceptual segregation, testing the hypothesis that perception of hidden forms depended on filtering out noncritical stimuli and that this result is affected by certain types of practice. He concluded that the subjects in the experiment searched for relevant features of the patterns to be filtered and at the same time profited from practice in ignoring irrelevant stimuli from the total field of stimulation. Gibson (1969) stated that the process of perceptual segregation in a child's perceptual development is suggested by Frances' experiment. The ability to ignore irrelevant stimuli may be an important aspect of perceptual development and needs further attention.

In embedded figures experiments, the subjects see the camouflaging stimuli and they are selective in their responses. Observing activity has a selective function--exposing receptors to chosen aspects of potential stimulation. Gibson (1966) stated that practice in exploring the vast array of stimulation in the world will facilitate the discovery of the critical properties of objects.

Experiments have also been attempted to demonstrate the effect of punishment on subjects' ability to perceive embedded figures. In an investigation by Hochberg and Brooks (1958) subjects were presented with four polygonal figures, displayed three times each, for 10 seconds. Two of the polygonal figures were accompanied by an unpleasant sound coming over earphones. In testing, 16 test patterns were presented, in each pattern one of the four polygonal figures was embedded. The subject's task was to find the embedded figure. Back lighting was progressively increased until the subject recognized the figure. A majority of the subjects had higher recognition thresholds for the punished stimuli. This experiment and others like it (Smith and Hochberg, 1954; Mangan, 1959) in the field of perceptual learning tend to support Gibson's (1969) contention that even though punishment does influence behavior, it is very doubtful that it plays as important role in perceptual learning.

In addition to studies emphasizing visual perception of shape and form, there are studies which emphasize the relative role of tactual perception. Kephart (1960) and Piaget and Inhelder (1956) contend that there is an essential touch component in visual perception, with actual tactual contact with a stimulus contributing to the interpretation of visual information. This position has been refuted by Fantz (1966) who believes that prior tactual perception is not an essential prerequisite for visual perception, in fact, visual perception precedes action, i.e., a primitive form of visual perception is present at birth. Further, in a review of the literature, Pick, Pick, and Klein (1967) have noted that experiments in the area of visual and tactual discrimination show that visual discrimination in children is superior to tactual discrimination (Lipsitt and Spiker, 1967). A recent study DeLeon, Raskin, and Gruen, (1970) corroborates this study.

DeLeon, Raskin, and Gruen (1970) investigated the relative roles of vision and touch in the shape perception of three and four year old children. The study used 48 white mostly upper-middle class children from suburban residences who were divided into two groups of 24 subjects each. The investigators presented the children with 16 5 x 5 inch random shapes presented on a 21 x 12 x 13 inch yellow wooden stage. For each random shape there was a standard and a comparison shape.

The experimental task consisted of visual exploration of the standard and comparison forms, tactual exploration of the standard and comparison forms, both tactual and visual exploration of the standard and comparison forms, and both tactual and visual exploration of the standard form but only tactual exploration of the test forms. All children underwent a pretraining experience to determine whether they understood the concept of "same." If a child correctly answered questions regarding the concept of "sameness" they were rewarded with M & M's.

During the testing procedure each subject performed discrimination tasks under the three experimental procedures (visual, tactual, tactual and visual) by placing the standard and comparison forms on the platform of the stage. For the tactual tasks a curtain was placed over the front of the stage so that the child could not see the comparison of standard forms. In all of the experimental procedures the subjects were to find among the comparison shapes the one which was the "same" as the standard.

The results of the DeLeon, Raskin and Gruen (1970) study showed that visual discrimination in young children is superior to tactual discrimination. The subjects performed poorest on the tactual procedure and the children in the visual procedure performed as well as children in the tactual plus visual procedure. Overall, the four-year-olds performed better than the three-year-olds.

The investigators concluded that their results appear to be inconsistent with theorists who propose that tactual cues are an important component of visual discrimination in young children, but that the results are consistent with studies which have demonstrated that young children were better able to make visual than tactual discriminations.

In addition to the foregoing studies there is research which has emphasized the effects of deprivation on performance of discrimination tasks. Some deprivation research has dealt with animal studies, handicapped human beings, and deprivation due to living in economically deprived areas.

In the area of animal studies Riesen (1958) examined research reports on chimpanzees reared in darkness from birth and then placed them in a normal environment. Riesen reported that the animals were unable to learn visual tasks and could not differentiate patterns. According to Deutsch (1968) there is some evidence that for pattern vision to develop there must be pattern stimulation introduced early to the developing organism. In addition to animal studies emphasizing the effects of deprivation on discrimination tasks Deutsch (1968) reported on a study by Von Senden (1932) on human beings of varying ages who had undergone surgery for cataracts, which they had from birth or had developed shortly after.

In the Von Senden experiment all the subjects underwent successful operations to remove the cataracts. There appeared to be three major findings in this research study. Pattern discrimination was very difficult for all subjects. The subjects reportedly resorted to ancillary aids to solve problems of recognition; and even though pattern vision improved over time, some of the subjects never acquired normal pattern discrimination. These findings have been corroborated by Gregory and Wallace's (1963) study using blind persons who through surgery were able to see.

Studies emphasizing the effects of cultural deprivation on the developing child often have been controversial (Havighurst, 1970).

The subjects in the DeLeon, Raskin, and Gruen (1970) study previously mentioned were middle class, urban children. There are some research studies, however, which demonstrate the performance of children from lower socioeconomic groups on tasks.

Boger (1952) studied the effects of perceptual training on group I.Q. scores of elementary pupils in rural ungraded schools. It was the purpose of this study to determine whether training with stimulating visual materials involving reasoning ability of a perceptual nature would enhance performance on intelligence tests. The subjects for this experiment were 25 white and 29 Negro children in grades one through four. The control group consisted of 22 Negro and 28 white children. All children were given the Otis Quick-Scoring Mental Ability Test and the California Test of Mental Maturity. This testing was done prior to the experimental group being given training in perceiving spatial relationships, geometric designs, working puzzles, distinguishing likenesses and differences in pictorial designs, and increased development of eye-hand coordination. The results seem to indicate that previous training in perceptual skills did influence positively performance on the subsequent tests. Both Negroes and whites showed significant gains in I.Q. on both the Otis and California tests. In his conclusions Boger suggests that visual perceptual training for rural Negro and white children may effectively facilitate overall performance on both the verbal and non-verbal parts of intelligence tests. In addition, prior visual experience should facilitate performance especially in situations requiring perceptual discrimination (Boger, 1952).

In a similar study Covington (1962; unpublished doctoral dissertation reported in Bloom, Davis, Hess, 1965) studied the differences in visual perceptual ability in children entering kindergarten and the effects of training on this ability. The subjects for his study were 72 kindergarten age children from upper-status families (both parents had some college training) and lower-status families (parents had no training beyond high school). The experimental groups in this study were exposed to abstract forms and standard forms via projection on a screen for 13 consecutive school days. The control groups received the same treatments except they viewed pictures rather than abstract forms. The results showed that both the upper and lower status experimental groups improved on the visual discrimination tasks after training. In addition, the lower status group improved significantly more than the upper status group which might suggest that the lower status group profited more from the prior familiarity with the stimulus objects. Covington (1962) concluded by stating that this study showed that differences in perceptual ability were likely to exist between children coming from varying social classes.

Deutsch (1963, in A. H. Passow [Ed.], Education in depressed areas) presented the thesis that the lower-class child enters the first grade so ill prepared that his experience becomes negatively uninforcing rather than being a positive educational experience. Deutsch maintained that one of the major factors contributing to the child's lack of readiness for school is his lack of variety of visual, tactual, and auditory stimulation in the home. However, he did state that class differences in perceptual abilities and general environmental orientation decreased with age, while language differences tend to increase.

Of particular importance to this discussion of adverse environmental conditions on perceptual development are the attempts of Looff (1971) and his consulting staff working with poverty parents and children in Eastern Kentucky.

Based on empirical observations conducted by educational administrators, his consulting staff, and teachers, Looff maintains that there are severe cognitive-perceptual deficiencies evident among the young children of Eastern Kentucky. He attributed these deficiencies to lack of vital sensory stimulation in the home, poor nutrition, improper discipline, and a lack of parental awareness of techniques to guide or aid their children's intellectual development. He stressed the need for home tutoring and programs for children which utilize teaching materials which would foster cognitive and perceptual development. Looff cited examples of some regional community day-care programs which provide a variety of auditory, visual, and tactual experiences for children, coupled with an emphasis on developing a positive self-image, and establishing sound social relationships which he maintains should prove to be effective in helping to alleviate many of the deficiencies with which the rural Eastern Kentucky child begins school (Looff, 1971).

CHAPTER III

METHOD AND EXPERIMENTAL PROCEDURES

The experimental design for this research study was a 4 x 2 x 2 factorial design which was tested to investigate the effects of the following variables on the recognition of simple designs embedded in more complex patterns, the length of time needed to recognize the simple designs, the transfer of training to new designs, and the length of time needed to make the transfer.

1. Conditions of:
    a. Prior visual experience
    b. Prior tactual experience
    c. Prior visual-tactual experience
    d. Control
2. Sex
    a. Male
    b. Female
3. Race
    a. White
    b. Black

Stimuli

The set of stimuli used in this research study was a modified version of Gottschaldt's (1926 in Ellis, 1938) embedded figures. It was felt by this investigator that a modification was needed since many of the embedded figures in their original forms appeared to be too difficult for Head Start children.

The modified version of embedded figures consisted of twelve simple wooden geometric forms, designated a designs and nine more complex drawn and colored designs, designated b designs. Each of the a forms was embedded in one of six b designs. The other six recognition task a forms, used in the transfer of training task, were embedded in the remaining three b designs.

Wooden cut-outs were made for each a design. Each b design was drawn in black ink on 12 x 12 white cardboard. The size of each a cut-out corresponded to its drawn size in the b design. The a designs were camouflaged by lines and the b designs were colored with red, blue, and green magic markers.

The stimulus forms were presented via a wooden stage so constructed as to allow the subject to view a visual stimulus and to manipulate a tactual stimulus simultaneously.

The order of presentation of stimuli was random for each subject.

Subjects

The subjects for this research project were randomly placed in one of the four treatment groups--three experimental groups and one control group. There were twenty subjects in each group with an equal number of blacks and whites and males and females. The age range for the subjects in this experiment was between 61.4 months and 70.9 months, with the average age being 65.8 months.

The control group was used to determine the effects of performance of unrelated tasks on the same recognition task and transfer of training task that were given to the experimental groups.

The length of time required to transfer to new designs was correlated between the control group and the experimental groups, in order to determine the differences in transfer time due to exposure to completely different stimuli. In addition, correlations were made on the scores on the recognition task and transfer task of the control group and the experimental groups.

Of interest to this investigator was the fact that of the eighty subjects randomly selected for this study only two refused to be tested and only two were absent when the testing was administered. These four children were replaced randomly, using a table of random numbers in the same fashion as the original eighty subjects had been selected.

Procedures

Before the beginning of the investigation a pilot study was conducted using a different group of children.

The pilot study was conducted to evaluate the subjects' ability to recognize the a designs embedded in the b designs. After the pilot study, the investigator in consultation with the committee made the necessary changes.

Training

Subjects were trained individually. Each subject was randomly assigned to one of the four different treatment groups. The investigator said to each child, "I want you to help me with this stage. I have some pictures I want you to look at while I do some work behind the stage."

Prior Tactual Experience

The subject was seated in front of the wooden stage. The investigator said to each child in this group, "Look at the stage. Look inside it; look under it. Take as long as you want to examine the stage." After each subject had concluded his examination of the stage the investigator said, "Place your arms in the large hole in front of the stage." (At this point the investigator began presenting the wooden cut-outs one at a time, through a slot in the back of the stage in the position it appeared in the b design). "I am giving you a wooden block. Touch the block, rub it, and feel the shape in your hands. While you are touching the wooden block, watch the picture I have placed on the back of the stage. The shape of the block is hidden in the picture. I will show it to you." While the subject was manipulating each wooden a design the corresponding drawn recognition task b design was presented at the back of the stage. After the subject had been exposed to each a design and each recognition task b design two times for ten seconds duration each the investigator said to the subject, "Now, let's move over to this table and play with the wooden blocks and pictures some more."

Prior Visual Experience

The subject was seated in front of the wooden stage. The investigator said to each child in this group, "Look at the stage. Look inside it; look under it. Take as long as you want to examine the stage." After each subject had concluded his examination of the stage the investigator said, "Now I am going to show you some blocks." (At this point the investigator began presenting the wooden cut-outs, one at a time, through a slot in the side of the stage in the position it appeared in the b design). "I am putting a wooden block on the stage. Look at it. I have placed a picture on the back of the stage. The shape of the block you are watching is hidden in the picture. I will show it to you." While the subject was watching the wooden a design on the stage the corresponding drawn recognition b design was presented on the back of the stage. After each subject had been exposed to each a cut-out and each drawn recognition task b design two times for ten seconds duration each, the investigator said to each subject, "Now, let's move over to the table and play with the wooden blocks and pictures some more."

Prior Visual-Tactual Experience

The subject was seated in front of the wooden stage. The investigator said to each child in this group, "Look at the stage. Look inside it; look under it. Take as long as you want to examine the stage." After each subject had concluded his examination of the stage the investigator said, "Place your arms in the large hole in front of the stage." (At this point the investigator began presenting the wooden cut-outs, one at a time, through a slot in the back of the stage in the position it appeared in the b design). "I am giving you a wooden block. Touch the block, rub it, and feel the shape in your hands. While you are touching the block look at the block I have placed on the stage floor." (The block was placed on the stage in the position it appeared in the b design). "It is just like the one you are touching. I have placed a picture on the back of the stage. The shape of the block that you are touching and the one that you are watching is hidden in the picture. I will show it to you." While the subject was watching the wooden a design and touching a similar wooden a design with his hands, the corresponding drawn recognition b design was presented on the back of the stage. After each subject had been exposed to each _a_ cut-out and each drawn recognition task _b_ design two times for ten seconds duration each, the investigator said to each subject, "Now, let's move over to the table and play with the wooden blocks and pictures some more."

Control Group

The subject was seated in front of the wooden stage. The investigator said to each child in this group, "Look at the stage. Look inside it; look under it. Take as long as you want to examine the stage." After each subject had concluded his examination of the stage the investigator said to each child, "There are some crayons and a sheet of paper on the stage. I want you to draw a picture of your house for me." After the subject had spent two minutes drawing a picture of a house the investigator said to him, "Now let's move over to this table and pley with some wooden blocks and pictures."

Test

The test for this experiment consisted of two parts--a recognition task and a transfer of training task.

Recognition Task

The subjects were tested individually. The subject sat with the investigator at the table. A sample _a_ wooden cut-out and its corresponding sample _b_ design was placed before each child and the child was asked to point to the a shape embedded in the b design and to "go around the shape with your finger." If the child could not do this or appeared not to understand the instructions the investigator helped him until he felt the child did understand the instructions. The investigator then placed the drawn recognition task b design and its corresponding a cut-out before the child in the position it appeared in the b design and said: "I want you to see if you can find that shape (investigator points to the wooden a design) in this picture. Point to it and go around the shape with your finger." Two minutes were allowed for each subject to recognize each embedded figure. A stop watch was used to record the response latencies. The subjects' scores on the recognition task were the total number of correct responses and the length of time taken to recognize each embedded figure. The six b designs with their corresponding a designs were presented randomly one at a time. If the child gave up in his efforts to recognize the embedded figure, as was exhibited by stating that he could not find it or by engaging in non-test related behavior, such as looking around the room, the investigator recorded a two minute score for that stimulus.

Transfer of Training Task

The subjects were tested individually immediately after the recognition task. The three drawn transfer of training task b designs were presented one at a time with their two corresponding a wooden cut-outs presented one at a time. The investigator placed the drawn b design before the child; then placed before him, one at a time, the two a wooden cut-outs in the position they appeared in the b design and said, "Here are some new pictures, and I want to see if you can find that new shape (investigator pointed to wooden design) in these pictures. Point to it and go around the shape with your finger." Two minutes were allowed for each subject to recognize each new a design embedded in each of the new b designs. The subjects' scores on the transfer of training task were the number of correct recognitions and the length of time taken to recognize the new a designs in the new b designs. If the child gave up the same procedure was followed as in the recognition task.

Analysis of the Data

An analysis of variance was used to compute the main effects of the four treatments and the interaction among them.

As the technique for analyzing the data, an analysis of variance was chosen for these three reasons:

1. By using the analysis of variance, it was possible to assess interaction effects in the data (i.e., sex x treatment). No satisfactory non-parametric technique was available for assessing such interactions.

2. Given small sub-group sizes such as a sex x race x treatment group the analysis of variance allowed for summating across such sub-groups and thus increasing the N and the power of the test in testing many of the effects.

3. If separate t tests have been computed, using various combinations of treatments, sex, and racial groups, the large number of possible t's would have maximized the probability of accepting results, which were actually chance occurrences appearing among a great number of significant tests. It is preferable to use the analysis of variance as a first step and to perform t tests only where the overall effect or interaction justifies individual t testing.

The dependent variables analyzed were number of correct responses in a series of repeated tests or response latencies in these tests. It was realized that these measures probably do not represent the interval scales which are the techniques necessary for parametric statistical techniques. However, it was felt that in view of the fact that scales used in behavioral studies rarely meet this criterion that parametric techniques have been consistently and successfully used with such data with sufficient justification for the present kind of analysis.

The t tests computed following the analysis of variance were calculated using Tukey's formula (Guilford, 1965, p. 277). The formula and example are shown in the appendix (see Appendix G). Where treatment effects were significant, each treatment mean was compared with each other mean. Where significant interactions were found involving treatments each treatment mean was compared with every other separately and within the sub-classifications with which the interaction was obtained.

CHAPTER IV

RESULTS

Four 4 x 2 x 2 analyses of variance were computed to determine whether main effects or interaction effects were present in the recognition task, the transfer task, the recognition task response latencies and the transfer of training task response latencies.

Recognition Task

A 4 x 2 x 2 analysis of variance was performed on the number of correct responses on the recognition task (see Table 1). This analysis revealed a significant main effect for treatment variation (F = 12.44, df = 3/64 $p < .01$). The data further indicated that the subjects under the condition of prior tactual-visual experience made more correct responses than did the subjects under the conditions of prior tactual experience and no previous experience (see Table 2).

Multiple t tests were performed (using Tukey's method as previously described between all pairs of treatment means. The results are shown in Table 3. Inspection of this table revealed that all conditions involving tactual or visual experience were superior to the no prior experience group. The results also clearly indicate that though the

TABLE 1

Analysis of Variance for Correct Responses on the Recognition Task

Source	df	SS	MS	F
A (Treatments)	3	42.19	14.06	12.44*
B (Sex)	1	2.82	2.82	2.49
C (Race)	1	2.82	2.82	2.49
AB	3	1.53	.51	.045
AC	3	3.13	1.04	.92
BC	1	.75	.75	.066
ABC	3	.98	.33	.029
S/ABC	64	72.14	1.13	
Total	79	126.35		

* $p < .01$

TABLE 2

Mean Number of Correct Responses on the Recognition Task Under Each Treatment Level

Treatment Level	Total Correct Responses	Number of Subjects per Treatment	M
Prior Tactual Experience	53	20	2.65
Prior Visual Experience	70	20	3.50
Prior T + V Experience	73	20	3.65
No Prior Training	37	20	1.85

TABLE 3

t Test Results for Mean Number of Correct Responses on the Recognition Task

Comparison	
Visual-Tactual vs. Visual	+ .15
Visual-Tactual vs. Tactual	+ 1.00*
Visual-Tactual vs. No Experience	+ 1.80*
Visual vs. Tactual	+ .85*
Visual vs. No Experience	+ 1.65*
Tactual vs. No Experience	+ .80*

(Critical value for difference in means to exceed .05 p level = .67)
N = 20
+ = First treatment of pair is greater
- = Second treatment is greater
* = $p < .05$

tactual condition had a significant effect, the visual training effect was more potent, visual being greater than tactual, and although the visual-tactual yielded a slightly higher mean, it was not significantly different from the visual condition alone.

Transfer of Training Task

A 4 x 2 x 2 analysis of variance was performed on the number of correct responses on the transfer of training task (see Table 4). This analysis revealed two significant interaction effects; a treatment x sex variation ($F = 6.96$, $df = 3/64$, $p < .01$) and a treatment x race variation ($F = 9.40$, $df = 3/64$, $p < .01$).

TABLE 4

Analysis of Variance for Correct Responses on the Transfer of Training Task

Source	*df*	SS	MS	*F*
A (Treatments)	3	.93	.31	.36
B (Sex)	1	1.25	1.25	1.47
C (Race)	1	.05	.05	.06
AB	3	17.77	5.92	6.96*
AC	3	23.97	7.99	9.40*
BC	1	.99	.99	1.16
ABC	3	.99	.33	.39
S/ABC	64	54.59	.85	
Total	79	100.54		

* $p < .01$

Means reflecting the two significant interactions and the *t* tests which were performed are shown in Table 5. The analysis in regard to the treatment *x* sex interaction revealed that:

1. For girls the prior tactual condition was not superior and indeed was almost identical to the no prior experience condition. Prior visual experience was greater than tactual experience, subjects under the condition of prior visual-tactual experience performed better than subjects under the condition of prior tactual experience and

TABLE 5

$\underline{t}$ Test Results for Mean Number of Correct Responses on the Transfer of Training Task

Treatment x Sex

Treatment	Means Boys	Means Girls
Visual-Tactual Experience	2.9	3.5
Visual Experience	2.7	3.0
Tactual Experience	2.8	2.9
No Experience	1.4	2.3

Comparison	Boys	Girls
Visual-Tactual vs. Visual	+ .20	+ .50
Visual-Tactual vs. Tactual	+ .10	+ 1.50*
Visual-Tactual vs. No Experience	+ 1.50*	+ 1.20*
Visual vs. Tactual	- .10	+ 1.00*
Visual vs. No Experience	+ 1.30*	+ .70*
Tactual vs. No Experience	+ 1.40*	- .30

Treatment x Race

Treatment	Means Blacks	Means Whites
Visual-Tactual Experience	2.8	3.6
Visual Experience	2.9	2.8
Tactual Experience	2.4	2.4
No Experience	2.1	1.6

TABLE 5 (continued)

t Test Results for Mean Number of Correct Responses on the Transfer of Training Task

Treatment *x* Race

Comparisons	Blacks	Whites
Visual-Tactual vs. Visual	- .10	+ .80[a]
Visual-Tactual vs. Tactual	+ .40	+ 1.20*
Visual-Tactual vs. No Experience	+ .70[a]	+ 2.00*
Visual vs. Tactual	+ .50	+ .40
Visual vs. No Experience	+ .80[a]	+ 1.20*
Tactual vs. No Experience	+ .30	+ .80[a]

(Critical value for differences in means to exceed .05 *p* level = .82)
(Critical value for differences in means to exceed .10 *p* level = .70)
N = 10 a = $p < .10$

the visual-tactual group did not perform better than the visual group. Though the difference between the prior visual group and the no prior experience group, in favor of the prior visual experience group, was not quite significant ($p < .10; > .05$) the overall pattern of results seemed to indicate that on the transfer of training task, prior visual experience was helpful while prior tactual experience was not.

For boys all three previous conditions--prior visual experience, prior tactual experience, and prior visual-tactual experience were superior to no prior experience. Prior tactual experience was superior to prior visual, but was not significant. Prior visual-tactual was superior to both prior visual and prior tactual experience, but was not statistically significant from either. Overall, it appeared that on the transfer of training task tactual experience was helpful, but combining prior tactual with visual was not beneficial.

The analysis in regard to the treatment x race interaction revealed that:

1. No significant differences were found among the comparisons made within the blacks. The only two suggestive findings ($p < .10, > .05$) favor the view that the black subjects benefited from visual experience since prior visual-tactual and prior visual experience were suggestively higher than no prior experience. With the lack of clearly significant results; however, it was most safely concluded that prior training did not enhance performance with this measure on the transfer of training task.

2. In the case of the white subjects the clearest trend was that prior visual experience was beneficial to the subjects. The prior visual condition was superior to no prior experience as was the prior visual-tactual experience with the visual-tactual being clearly superior to prior tactual alone and marginally superior to prior visual experience alone ($p < .10, > .05$). However, the rsults were suggestive that prior tactual experience may also have been beneficial. The difference between the prior tactual experience and no prior experience means was a 80 where .82

was needed for significance at the .05 level. Equally the difference in favor of the prior visual-tactual experience over prior visual alone was only .02 short of the critical value needed for significance at the .05 level of confidence. In addition, the prior visual and prior tactual modes did not differ significantly.

To summarize, the data for white subjects was best interpreted that prior visual experience enhanced transfer on this task. Evidence favoring tactual enhancement was suggestive, but judgment is best withheld for further research evidence.

Recognition Response Latencies

In addition to computing analyses of variance on the number of correct responses on the recognition and transfer tasks, a 4 x 2 x 2 analysis of variance was performed on the recognition response latencies (see Table 6). This analysis revealed a significant main effect for treatment variation (F = 15.060, df = 3/64, $p < .001$).

The data further indicated that the subjects under the condition of prior tactual-visual experience took less time to recognize the embedded figures than did the subjects under the other three treatment variables (see Table 7).

The differences between the mean scores for the significant treatment effect and the t tests are shown in Table 8. The results are virtually identical to those

TABLE 6

Analysis of Variance for the Recognition Task Response Latencies

Source	*df*	SS	MS	*F*
A (Treatments	3	16359.338	5453.112	15.060*
B (Sex)	1	475.313	475.313	1.312
C (Race)	1	973.013	973.013	2.687
AB	3	1187.437	395.812	1.093
AC	3	1126.937	375.645	1.037
BC	1	40.612	40.612	.112
ABC	3	414.738	138.246	.381
S/ABC	64	23174.000	362.090	
Total	79	43751.390		

TABLE 7

Average Number of Seconds Required to Make the Correct Responses in the Recognition Task

Treatment Level	Total Seconds	Number of Subjects	M
Prior Tactual Experience	33100	20	1655
Prior Visual Experience	25360	20	1268
Prior T + V Experience	25220	20	1261
No Prior Experience	38860	20	1943

TABLE 8

t Test Results for Means of Recognition Task Response Latencies

Comparison	Differences Between the Means	
Visual-Tactual vs. Visual	7	- .35
Visual-Tactual vs. Tactual	394	- 19.70*
Visuel-Tactual vs. No Experience	682	- 34.10*
Visual vs. Tactual	387	- 19.35*
Visual vs. No Experience	675	- 33.25*
Tactual vs. No Experience	288	- 14.40*

(Critical value for differences in means to exceed for .05 p level = 12.06)
N = 20

obtained from the measurements of correct recognition responses, i.e., experience with both sensory modalities enhanced performance with the visual mode having the greatest effect. Thus, as before, scores on all conditions were superior to no prior experience, both conditions involving visual experience were superior to tactual, and adding tactual to visual did not significantly surpass visual alone.

Transfer Response Latencies

The analysis of variance for the transfer task response latencies is shown in Table 9. The analysis revealed a significant treatment effect ($F = 5.843$, $df = 3/64$, $p < .005$) and a significant treatment x sex interaction effect ($F = 3.435$, $df = 3/64$, $p < .05$). It must be remembered

TABLE 9

Analysis of Varience for the Transfer Task Response Latencies

Source	df	SS	MS	F
A (Treatments)	3	3876.150	1292.050	5.843*
B (Sex)	1	31.250	31.250	.141
C (Race)	1	328.050	328.050	1.483
AB	3	2290.550	763.516	3.435+
AC	3	524.950	174.983	.791
BC	1	451.250	451.250	2.040
ABC	3	1536.950	512.316	2.317
S/ABC	63	14150.400	221.100	
Total	79	23189.550		

* $p < .005$;   + $p < .05$

that the interpretation of a main effect must be accepted with caution in the presence of an interaction involving this main effect. Thus, the significant treatment x sex interaction means that the patterns of treatment results vary according to the sex of the subject.

The data further indicated that the subjects under the condition of prior tactual-visual experience took less time to transfer to new design than did the subjects under the other three treatment variables (see Table 10).

TABLE 10

Average Number of Seconds Required to Make the Correct Responses in the Transfer Task

Treatment Level	Total Seconds	Number of Subjects per Treatment	M
Prior Tactual Experience	35280	20	1764
Prior Visual Experience	32920	20	1646
Prior T + V Experience	31120	20	1556
No Prior Experience	38560	20	1928

1. The Treatment Effect. The _t_ test results for the significant treatment effect in Table 11 revealed that prior visual-tactual experience resulted in lower response latencies than either prior tactual experience or no prior experience, but was not significantly different from prior visual experience alone. Prior visual experience resulted in lower response latencies than no prior experience, but was not significantly different from prior tactual experience. Prior tactual experience was not significantly superior to no prior experience.

2. The Treatment _x_ Sex Effect. The analysis of the means for the treatment _x_ sex effect in Table 12 revealed that for boys, prior visual-tactual experience, prior visual experience, and prior tactual experience were all superior to no prior experience, but were not significantly different

TABLE 11

t Test Results for Means of the Significant Treatment Effect in the Transfer Task Response Latencies

Treatment Effect

Comparison	Differences Between the Means	
Visual-Tactual vs. Visual	90	+ 4.50
Visual-Tactual vs. Tactual	208	+ 10.40*
Visual-Tactual vs. No Experience	372	+ 18.60*
Visual vs. Tactual	118	+ 5.90
Visual vs. No Experience	282	+ 14.10*
Tactual vs. No Experience	164	+ 8.20

(Critical value for differences in means to exceed .05 p level = 9.40)
N = 20

TABLE 12

t Test Results for Means of the Significant Interaction Effect in the Transfer Task Response Latencies

Treatment x Sex

Treatment	Means: Boys	Means: Girls
Visual-Tactual Experience	83.20	72.40
Visual Experience	78.10	86.50
Tactual Experience	83.00	93.40
No Experience	102.90	89.90

TABLE 12 (continued)

t Test Results for Means of the Significant Interaction Effect in the Transfer Task Response Latencies

Treatment x Sex

Comparison	Boys	Girls
Visual-Tactual vs. Visual	+ 5.10	- 14.10*
Visual-Tactual vs. Tactual	+ .20	- 21.00*
Visual-Tactual vs. No Experience	- 19.70*	- 17.50*
Visual vs. Tactual	- 4.90	- 6.90
Visual vs. No Experience	- 24.80*	- 3.40
Tactual vs. No Experience	- 19.90*	+ 3.50

(Critical value for differences in means to exceed .05 p level = 13.28)
N = 10

from each other. Thus, it appeared that boys tended to benefit from both sensory modalities when presented alone and also when they were combined.

The results for girls tended to reveal that girls benefited only from a combination of the two sensory modalities, visual and tactual, since prior visual-tactual experience was superior to prior visual, prior tactual, and no prior experience. No other combination revealed any significant differences.

CHAPTER V

DISCUSSION

The discussion chapter was divided into three parts: hypotheses, sex, and race.

Hypotheses

Regarding the first hypothesis that subjects under the condition of prior visual-tactual experience would score significantly better and take less time on the recognition task than would the subjects under the other three conditions, the data revealed that subjects who had prior visual-tactual experience did have more correct responses on the recognition task than the subjects under the other three conditions. The $\underline{t}$ tests performed on all combinations of means in the main treatment effect revealed that the prior visual-tactual group scored significantly better on the recognition task than did the prior tactual and no prior experience groups; however, there was no significant difference between the performance of the prior visual-tactual group and the group receiving prior visual experience alone.

In reference to the second part of the first hypothesis, i.e., that subjects receiving prior tactual-visual experience would have lower response latencies than the other three groups, the data revealed the prior visual-tactual group did indeed take less time to recognize the embedded figures on the recognition task than did the subjects under the other three conditions. The *t* test results for the significant treatment effect were similar to those for the number of correct responses on the recognition task. The prior tactual-visual group scored significantly better than the prior tactual and no experience groups but was not significantly superior to the prior visual experience group.

Nevertheless, even though most of the means compared within the groups mentioned in the hypothesis were significant at the .05 level, the hypothesis was not supported totally by the data which would tend to support Gottschaldt (1926) that previous training on the detection of embedded figures did not significantly improve the subjects' ability to detect simple forms imbedded in more complex designs. However, the significant treatment effect on the recognition task and the *t* test comparisons did reveal that prior training did have positive effects on the subjects who received prior tactual-visual experience, prior tactual experience, and prior visual experience as opposed to those subjects who received no prior training. These findings are consistent with previous investigations (Henle, 1942; Hannawalt, 1942; Kolers and Zink, 1962) which have found that prior training significantly improved the detection of embedded figures.

According to Kephart (1960) and Piaget and Inhelder (1956) there is an essential touch component in visual perception, with actual touch contact with a stimulus contributing to the interpretation of visual information. The data on the recognition task did reveal that those subjects who had had prior visual-tactual experience had more correct responses on that task; however, the results were not statistically significant from the data on those subjects who had received only prior visual experience. This finding is consistent with the investigations of Fantz (1966) and DeLeon, Raskin and Gruen (1970) who stated that prior tactual experience is not an essential prerequisite for visual perception.

The response latency data suggest that when five-year-old children are allowed prior tactual, prior visual, and prior visual-tactual experience with geometric forms they tend to take less time to recognize those forms embedded in more complex designs under the conditions of prior visual-tactual and prior visual experience. It is possible that had the children in the prior tactual-visual group relied more on the tactual component of the training then their response latency scores would probably have been higher than the group who received only prior visual experience. A plausible reason for this is that tactual exploration takes more time than does visual exploration of geometric forms (Gibson, 1969; DeLeon, Raskin and Gruen, 1970).

For hypothesis two, that subjects under the condition of prior visual-tactual experience would score significantly better on the transfer task following recognition, and take less time to transfer to new designs than subjects under the other conditions the results for the first part of the hypothesis did not reveal any significant treatment effect, but did produce two significant interaction effects, which will be discussed later. However, an analysis of the raw score data (see Appendix E) on the number of correct responses on the transfer of training task disclosed that the prior tactual-visual experience group did recognize more embedded figures on the transfer task than did any of the other three groups.

Concerning the second part of this hypothesis, that subjects who had received prior visual-tactual experience would take less time to transfer to new designs, the data confirmed that the prior visual-tactual group did have significantly lower response latencies on the transfer of training task. This group of subjects performed better than the prior tactual and no prior experience groups, but did no better statistically than the prior visual experience group.

The analysis of variance for the transfer task response latencies also revealed a significant treatment x sex interaction effect at the .05 level, which will be discussed later.

In reference to the second hypothesis, the results did not tend to support the entire hypothesis as stated.

As was previously mentioned there was not a significant treatment effect for the transfer task. A further examination of the raw score data (see Appendix E) revealed that the scores were fairly evenly spread ranging from 37 to 64, with a score in the 40's and one in the 50's. This finding does not support Hannawalt (1942) who stated that prior experience enhanced the transfer of learning to new designs. It was possible; however, had the sample in this investigation been larger and more stringent controls placed on the procedures, that the results may have been different.

Regarding the significant treatment effect in the response latencies on the transfer task, the results were similar to the data on the response latencies of the recognition task. The statements made by Gibson (1969) and DeLeon, Raskin, and Gruen would appear to apply here also.

It was further hypothesized that prior visual experiences alone would result in better recognition scores, better transfer task scores, and lower recognition task and transfer task response latencies than the subjects under prior tactual experience alone. In regard to the recognition task the _t_ test results did reveal that the subjects receiving prior visual experience made significantly more correct responses than did those subjects receiving prior tactual experience, and, in addition, had significantly lower response latencies than did the prior tactual group.

The transfer of training results were not so positive. There was not a significant treatment effect on the transfer task; thus, multiple *t* tests were not computed on the combinations of means among the treatments. However, an analysis of the raw score data (see Appendix E) disclosed that the subjects in the prior visual experience group did indeed make more correct responses on the transfer task than did the subjects in the prior tactual group.

There was a significant treatment effect at the .005 level on the transfer task response latencies; however, the *t* tests computed on all combinations of means did not reveal any significant difference between the response latencies of the prior visual experience group and the prior tactual experience group.

Overall, the data tended to confirm the parts of the hypothesis which referred to the recognition task but did not confirm the sections which referred to the transfer task. Thus, the results did not support the hypothesis as stated, but the results of the recognition task are consistent with the studies of Pick, Pick and Klein (1967), Lipsitt and Spiker (1967) and DeLeon, Raskin and Gruen (1970) who state that visual discrimination in young children is superior to tactual discrimination.

It should be mentioned, however, that consistent with the DeLeon, Raskin and Gruen (1970) study the children in the present investigation may have been too old for tactual cues to manifest a major influence on the recognition of the embedded figures and that five-year-old children, whether they be middle class or economically deprived, may have been too old to test this hypothesis. A similar study on young children, preferably infants, might result in entirely different findings.

Even though no specific hypotheses were stated regarding sex or race the data revealed some interesting results concerning these two variables.

Sex

The results of the analysis of variance for correct responses on the transfer of training task revealed a significant treatment x sex interaction effect, at the .01 level.

An examination of the mean number of correct responses on the transfer task disclosed that boys who received prior visual-tactual experience made the most correct responses, followed by the prior tactual experience group, the prior visual experience group, and making the least number of correct responses on the transfer task was the no prior experience group.

The pattern for girls was different in some respects. The group who received prior visual-tactual experience made more correct responses, followed by the prior visual experience group. Interesting to this investigator was the fact that girls who received no prior experience made more correct responses than did the group who received prior tactual experience. Thus, it would seem from this finding that prior tactual experience had no inhibiting effect on performance. Is it possible that on discrimination tasks of this nature that girls do not rely on tactual cues for recognition?

The girls in this study made more correct responses on the transfer task than did the boys, but the difference was not significant.

An examination of the *t* test comparisons on the transfer of training task revealed that boys appeared to benefit from all three types of prior training when compared with the no prior experience group; but, when the three prior training groups were compared with each other, no significant differences were found. However, for the girls the overall pattern of results seemed to indicate that on the transfer of training task, prior visual experience was helpful while prior tactual experience was not.

In addition to the significant treatment *x* sex interaction on the transfer of training task, there was also a significant treatment x sex interaction effect at the .05 level on the transfer task response latencies.

An examination of the mean number of seconds required to recognize the embedded figures on the transfer of training task revealed that for boys the group who received prior visual experience had the lowest response latencies, followed by the prior tactual group, the prior visual-tactual group and the group who had received no prior experience. For the girls the group who received prior visual-tactual experience had the lowest response latencies, followed by the prior visual group, the no prior experience group and the tactual group. This pattern of results was identical to the pattern of results for girls on the transfer task.

Reviewing the t test comparisons for the treatment x sex interaction on the transfer task response latencies the pattern of results for boys was identical to their pattern of results on the transfer task. All three prior training groups had lower response latencies than the no prior experience group, but when the three types of prior sensory training groups were compared with each other, no significant differences were found. It appeared that on the transfer task, both sensory modalities separately and when combined tended to lower the response latencies. For girls, however, it appeared that only the combination of the two sensory modalities resulted in lower response latencies.

Except for the two discussed significant treatment x sex interactions, there were no significant main effects due to sex or any other interaction effects regarding sex in this investigation.

Race

There was no significant finding regarding race in this experiment. In the analysis of variance for correct responses on the transfer of training task a significant treatment x race interaction effect, at the .01 level, was revealed.

An inspection of the mean number of correct responses on the transfer task disclosed that the black subjects who had received prior visual experience made the most correct responses, followed by the prior visual-tactual group, the tactual group, and the no prior experience group. The white subjects, however, exhibited a different pattern. The subjects who had received prior visual-tactual experience made the most correct responses, followed by the prior visual group, the prior tactual group, and the no prior experience group.

The white subjects made more correct responses on the transfer task, but the difference was not significant.

A survey of the t test comparisons of the mean number of correct responses on the transfer task revealed that there were no significant comparisons, at the .05 level, among the black subjects. There was a marginal finding, however, at the .10 level, suggesting that black subjects did benefit from prior visual experiences. For whites, however, the most prominent pattern appeared to be that the white subjects benefited more from the visual modality than the tactual modality on the transfer task.

CHAPTER VI

SUMMARY AND CONCLUSIONS

It was the purpose of this investigation to study the relative effects of prior tactual, prior visual and prior visual-tactual experience on the recognition of simple shapes embedded in more complex figures, the length of time needed to recognize the shapes, the transfer to new designs following the recognition task and the length of time needed to make the transfer. The variables were compared in relation to sex and race.

There were eighty, five-year-old subjects in this study; forty blacks and forty whites, forty males and forty females, drawn randomly from all the children attending Head Start in the area covered by the Kentucky River Foothills Development Council. Each subject was randomly assigned to one of four treatment groups: prior tactual experience, prior visual experience, prior tactual-visual experience, and no prior experience. Each treatment group consisted of twenty subjects: five white males; five black males; five white females; and five black females.

A stage, wooden cut-outs of geometric forms, and drawn and colored cardboard embedded designs were used to test the three hypotheses, and to determine whether any sex or race differences were present. A recognition task and a transfer of training task were administered to each child.

The first hypothesis was that subjects under the condition of prior visual-tactual experience would score significantly better and take less time on the recognition task than would the subjects under the other three conditions.

The second hypothesis was that subjects under the condition of prior visual-tactual experience would score significantly better on the transfer task following the recognition task, and take less time to transfer to new designs than subjects under the other conditions.

The third hypothesis was that prior experience alone would result in better recognition scores, better scores on the transfer task, lower response latencies on the recognition task, and take less time to transfer to new designs than would subjects in the condition of prior tactual experience alone.

No research was readily available which would point to differences on performance due to sex or race so that no specific hypotheses were stated.

As they are stated, hypotheses I, II, and III were not totally supported by the data.

The major conclusions of this investigation were as follows:

1. Previous sensory experience does tend to enhance five-year-old children's ability to recognize embedded figures.

2. The data in this investigation tends to only partially support those theorists who maintain that there is not an essential touch component in the visual recognition of geometric forms on these kinds of discrimination tasks, in that tactual experience had some effect but this was not as powerful as visual experience.

3. Even though prior sensory experience aids in the recognition of embedded figures, there is no statistical evidence in this investigation which would support the conclusion that it also aids in the transfer of recognition to new designs in the sense of main effects across all types of subjects.

4. Girls in this investigation tended to rely on visual cues when attempting to recognize geometric forms on the transfer task.

5. Tactual experience appeared to have an inhibiting effect on girls attempting to recognize geometric shapes on the transfer task.

6. Boys in this study tended to utilize both sensory modalities separately or combined to recognize embedded shapes on the transfer task.

7. Black children in this study appeared to benefit from the prior visual sensory experiences on the transfer task but these results did not reach clear statistical significance.

8. White children in this investigation tended to rely on the visual modality in the recognition of geometric shapes on the transfer task.

9. Much additional research is needed. Research is needed to clarify the problems of definitions of past experience, performance set, and instructions given to subjects. Much research on the actual relationship between vision and touch needs to be done. Such research specifically on how infants manipulate the objects in their environments would aid investigators in their understanding of how the senses act as perceptual systems. Further research needs to be done on economically deprived children and children from minority groups of all ages to determine how the various senses, especially vision and touch, affect their perceptions of the affordances and the invariant properties of the objects in their environments. In close association to this suggestion is that controlled experiments need to be carried out on how the child's particular environment affects his interpretation of sensory input from the objects he manipulates in his environment. In addition, research on rural-urban differences and similarities in perceptual development would increase the understanding of educators faced with the problems of implementing educational programs to alleviate much of the misunderstanding and self-fulfilling prophesies encountered by rural youth who migrate to urban industrial complexes.

BIBLIOGRAPHY

BIBLIOGRAPHY

Bloom, B., Davis, A., & Hess, R. Compensatory education for cultural deprivation. New York: Holt, Rinehart, and Winston, 1965. Pp. 95-96.

Boger, J. H. An experimental study of the effects of perceptual training on group IQ scores of elementary pupils in rural ungraded schools. Journal of Educational Research, 1952, 46, 43-53.

C. R. M. Developmental psychology today. Del Mar, California: CRM Books, 1971.

DeLeon, J. L., Raskin, L. M., & Gruen, C. E. Sensory-modality effects on shape perception in preschool children. Developmental Psychology, 1970, 3, (3), 358-362.

Deutsch, C. "Environment and perception." In Deutsch, Katz, & Jenson (Eds.), Social Class, race and psychological development. New York: Holt, Rinehart, and Winston, 1968. P. 59.

Deutsch, M. "The disadvantaged child and the learning process." In A. H. Passow (Ed.), Education in depressed areas. New York: Teachers College Columbia University, 1963. Pp. 163-180.

Deutsch, M., Katz, I., & Jensen, A. R. (Eds.), Social class, race, and psychological development. New York: Holt, Rinehart, and Winston, 1968.

Ellis, W. D. A sourcebook in Gestalt psychology. New York: Harcourt, Brace, 1938.

Fantz, R. L. Pattern discrimination and selective attention as determinants of perceptual development from birth. In A. H. Kidd & J. L. Rivoire (Eds.), Perceptual development in children. New York: International Universities Press, 1966. Pp. 143-173.

Francis, R. L'apprentissage de la segregation perceptive. 1963. In Eleanor Gibson, Principles of perceptual learning and development. New York: Appleton-Century-Crofts, 1969. Pp. 111-113.

Gibson, E. J. Principles of perceptual learning and development. New York: Appleton-Century-Crofts, 1969.

Gibson, J. J., & Gibson, E. J. Perceptual learning: Differentiation or enrichment? Psychological Review, 1955, 62, 32-41.

Gibson, J. J. The senses considered as perceptual systems. New York: Houghton-Mifflin Co., 1966. Pp. 266-287.

Gottschaldt, K. Gestalt factors in repetition. In W. D. Ellis (Ed.), A sourcebook in Gestalt psychology. New York: Harcourt, Brace, 1938. Pp. 109-135.

Gregory, R. L. & Wallace, J. G. Recovery from early blindness. Experimental Psychology Monograph 1963, whole No. 2. Cambridge, England.

Guilford, J. P. Fundamental statistics in psychology and education. New York: McGraw Hill, 1965. Pp. 276-277.

Hannawalt, N. G. The effect of practice upon the perception of simple designs masked by more complex designs. Journal of Experimental Psychology, 1943, 31, 134-148.

Havighurst, R. Minority subcultures and the laws of effect. The American Psychologist, 1970, 25, 313-322.

Henle, M. An experimental investigation of past experience as a determinant of visual form perception. Journal of Experimental Psychology, 1943, 30, 1-22.

Hochberg, J. E., & Brooks, V. Effects of previously annoying stimuli (auditory) on visual recognition thresholds. Journal of Experimental Psychology, 1958, 55, 490-591.

Hunt, J. McV. Intelligence and experience. New York: Ronald Press, 1961.

Kephart, N. C. The slow learner in the classroom. Columbus, Ohio: Merrill, 1960.

Kidd, A. H., & Rivoire, J. L. (Eds.). Perceptual development in children. New York: International Universities Press, 1966.

Kolers, P. A., & Zink, D. L. Some aspects of problem solving: Sequential analysis of the detection of embedded figures, 1962. In Eleanor Gibson, Principles of perceptual learning and development. New York: Appleton-Century-Crofts, 1969. Pp. 171-174.

Lipsitt, L. P., & Spiker, C. C. (Eds.). Advances in child development and behavior. Vol. 3. New York: Academic Press, 1967. Pp. 191-223.

Looff, D. Appalachia's children: The challenge of mental health. Lexington, Ky.: The University Press of Kentucky, 1971. Pp. 140-152.

Mangan, G. L. The role of punishment in figure-ground reorganization. Journal of Experimental Psychology, 1959, 50, 369-375.

Piaget, J. The origins of intelligence in children. Trans. by Margaret Cook. New York: International University Press, 1952.

Piaget, J. The psychology of intelligence. London: Routledge, 1950.

Piaget, J., & Inhelder, B. The child's conception of space. Trans. by F. J. Langdon & J. L. Lunzer. London: Routledge & Kegan Paul, 1956.

Pick, H. L., Pick, A. D., & Klein, R. E. Perceptual integration in children. In L. P. Lipsitt & C. C. Spiker (Eds.), Advances in child development and behavior. Vol. 3. New York: Academic Press, 1967. Pp. 191-223.

Riesen, A. H. "Plasticity of behavior: Psychological aspects." In H. F. Harlow and C. N. Woosey (Ed.), Biological and biochemical bases of behavior. Madison, Wisc.: University of Wisconsin Press, 1958.

Smith, D. E. P., & Hochberg, J. E. The effect of "punishment" (electric shock) on figure-ground perception. Journal of Psychology, 1954, 38, 83-87.

White, R. W. Motivation reconsidered: The concept of competence. Psychological Review, 1959, 66, 297-333.

Witkin, H. A. Individual differences in the ease of perception of embedded figures. Journal of Personality, 1950, 19, 1-15.

APPENDIX A

LETTER TO HEAD START CENTER

January 8, 1973

MEMO TO: Specific Center

FROM: Roswell David Cox--Berea College, Assistant Professor of Child Development.

RE: Ph.D. Dissertation Research Project.

I have been consulting with Loretta Lundsford and Linda Stillwagon about the possibility of using the five-year-old Head Start children enrolled in the Kentucky River Foothill Agency Head Start Program as subjects for my Ph.D. dissertation experiment during the month of January. Both Loretta and Linda have given me permission to do the study, but I feel I need to meet you personally and get your individual permission and answer any questions you may have about my experiment; therefore, I would like to visit your center briefly, Thursday or Friday of this week; i.e., January 11 or 12, 1973.

As an introduction, let me give you some information about my study. The investigation is designed to study the effects of previous visual, tactual, and visual-tactual experiences on the recognition and transfer of geometric forms embedded in complex designs and the time needed to recognize and transfer to new designs. There will be a random sample of 80 children chosen from all the children in the KRF program, thus, it is probable that some children will be selected from all centers. If you have questions, please feel free to ask me when I see you about the possibility of using the children in your classrooms in the study.

In addition, I would like to have your permission to allow some of my students who are currently taking my course, <u>Education of the Preschool Child</u>, to work in your classroom at least one day each during the month of January.

Further, Loretta and I discussed an "in-kind consultation-training" arrangement during the duration of the study. I will be available to you to answer any questions you may have regarding curriculum, behavior problems, scheduling, etc. while I am in your center.

I am sure that both you and I will find the learning experience in the next few weeks very rewarding.

Sincerely,

Ros Cox

APPENDIX B

DATA FORM

DATA SHEET

No.__________ Male__________ C__________

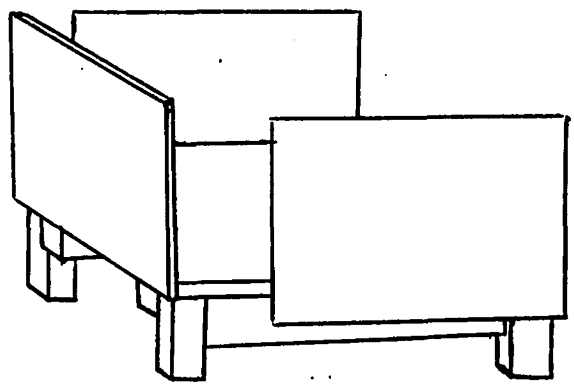
Group__________ Female__________ N__________

RECOGNITION TASK	TIME (SEC)	TRANSFER TASK	TIME (SEC)
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
TOTAL		TOTAL	
	MEAN_____		MEAN_____

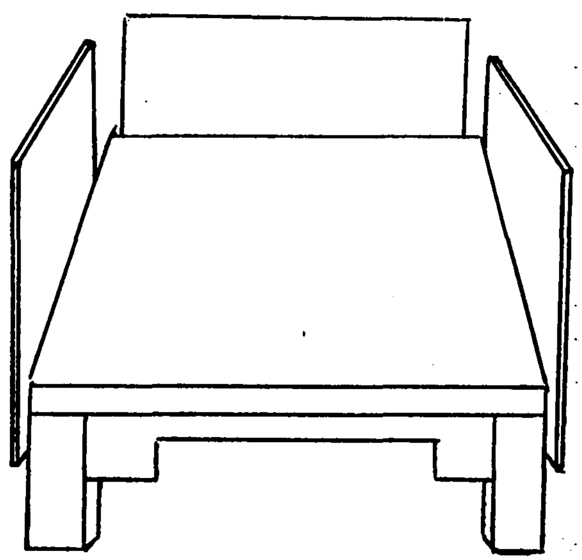
APPENDIX C

DRAWING OF STAGE USED IN THE EXPERIMENT

Drawing of Stage Used in the Experiment



Side View

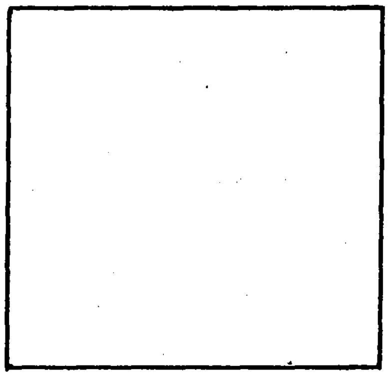


Front View

APPENDIX D

DRAWINGS OF GEOMETRIC FORMS USED IN THE RECOGNITITON AND TRANSFER TASKS

Geometric Forms Used in the Recognition Task



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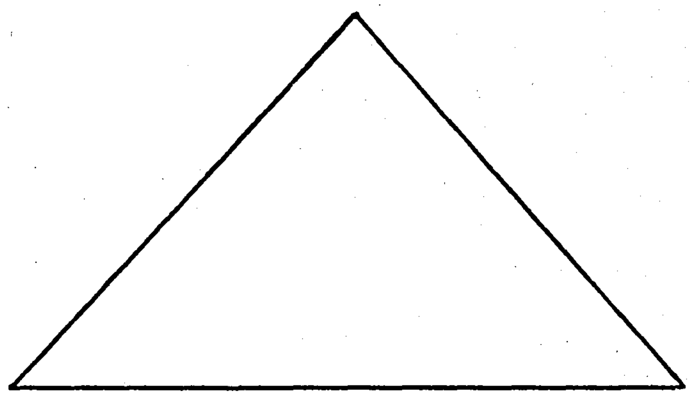

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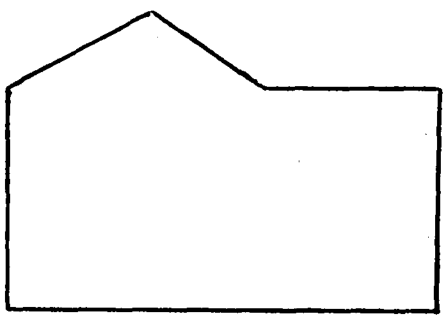

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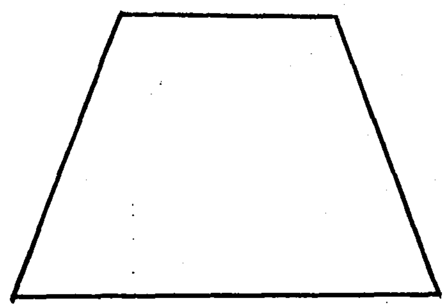

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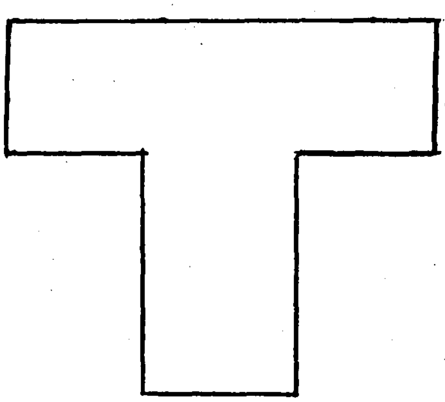

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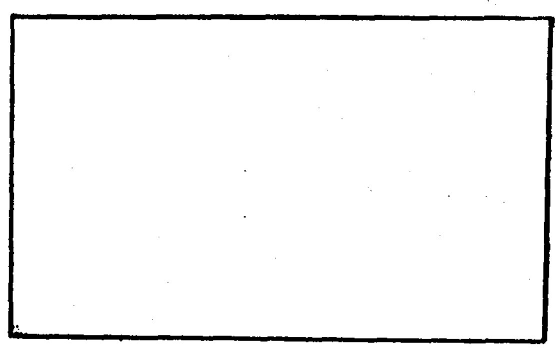
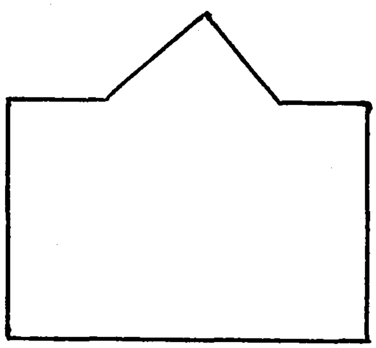


6

Geometric Forms Used in the Transfer Task



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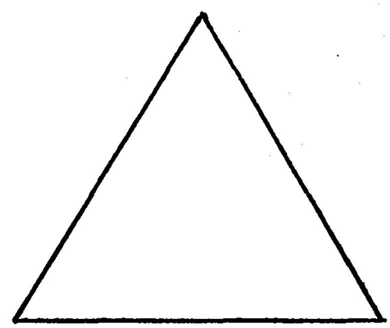

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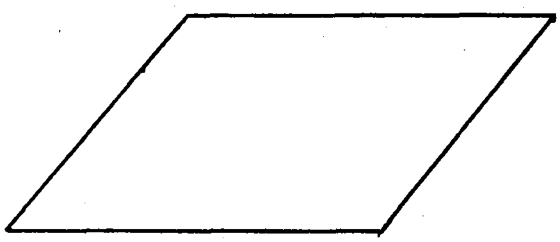

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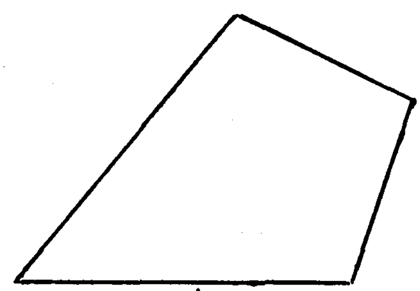

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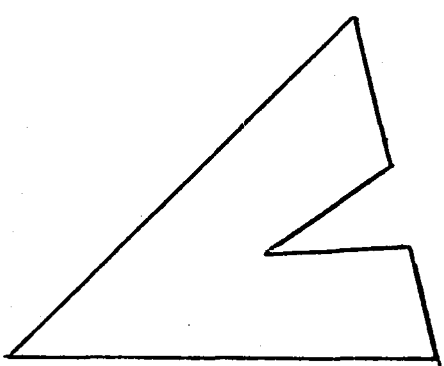

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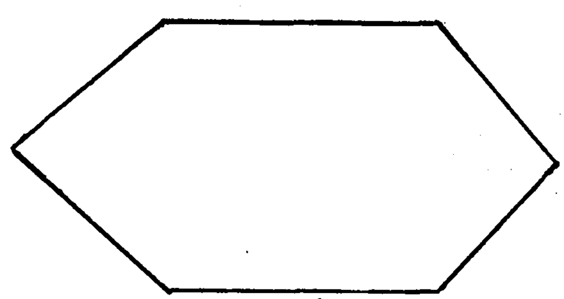


6

APPENDIX E

RAW SCORE DATA

Raw Score Data--Recognition Task

	C_1		C_2		
	B_1	B_2	B_1	B_2	
	5	3	4	3	
	4	2	2	3	
A_1	1	3	1	3	
	3	5	3	2	
	2	2	1	1	53
	2	5	1	4	
	5	4	5	5	
A_2	2	4	4	3	
	4	3	3	4	
	5	4	1	2	70
	3	5	5	4	
	4	4	4	3	
A_3	2	4	3	4	
	4	3	4	4	
	4	2	3	4	73
	0	4	2	2	
	1	3	2	0	
A_4	2	3	2	3	
	2	2	1	2	
	2	2	1	1	37
	57	67	52	57	233

A_1 - prior tactual experience

A_2 - prior visual experience

A_3 - prior tactual-visual experience

A_4 - no prior experience

B_1 - Male

B_2 - Female

C_1 - White

C_2 - Black

Raw Score Data--Transfer Task

	C_1		C_2		
	B_1	B_2	B_1	B_2	
A_1	3 4 0 3 2	3 2 2 3 2	4 4 1 4 3	2 2 1 2 1	48
A_2	2 4 3 4 3	2 3 3 2 3	2 3 1 4 1	3 4 4 4 2	57
A_3	2 3 3 4 2	4 3 3 3 1	4 4 2 2 3	4 4 5 4 4	64
A_4	2 0 2 1 2	3 4 2 2 3	1 2 2 1 1	2 1 2 1 3	37
	49	53	49	55	206

Raw Score Data--Recognition Task Response Latencies (in seconds)

	C_1		C_2		
	B_1	B_2	B_1	B_2	
	31	80	55	84	
	70	83	96	94	
A_1	106	85	107	74	
	66	68	73	88	
	91	98	101	105	
					1655
	100	32	102	50	
	29	55	39	35	
A_2	87	49	59	78	
	56	66	83	67	
	36	49	112	84	
					1268
	90	52	53	52	
	46	47	57	73	
A_3	87	51	70	48	
	79	78	49	66	
	44	83	66	70	
					1261
	120	55	96	94	
	106	75	107	120	
A_4	97	88	92	89	
	98	108	117	92	
	86	97	102	104	
					1943
	1525	1399	1636	1567	6127

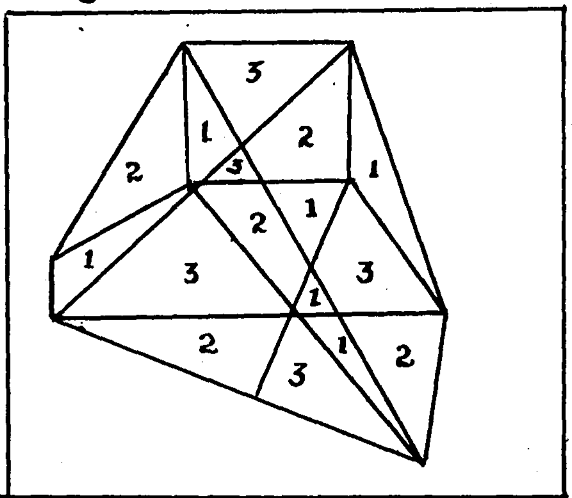
Raw Score Data--Transfer Task Response Latencies (in seconds)

	C_1		C_2		
	B_1	B_2	B_1	B_2	
A_1	84 72 120 82 95	83 88 88 86 82	79 66 106 59 67	104 99 105 95 104	1764
A_2	111 64 76 75 70	89 78 66 84 85	75 67 75 68 100	99 81 108 73 102	1646
A_3	111 67 69 65 85	48 70 81 84 104	75 74 102 116 68	65 76 55 70 71	1556
A_4	88 120 88 107 94	96 52 86 96 77	117 95 110 107 103	101 106 97 108 80	1928
	1743	1623	1729	1799	6894

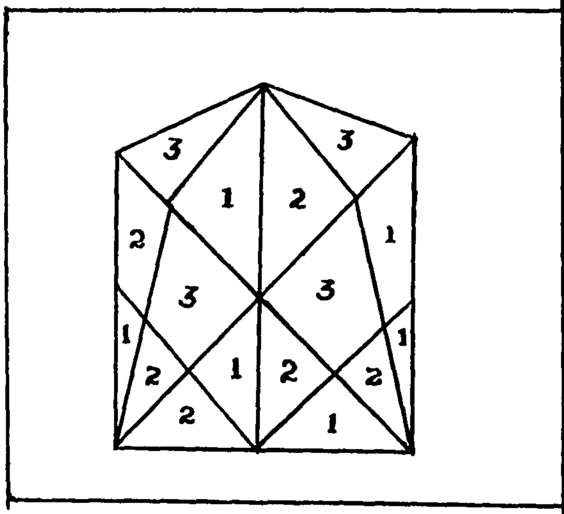
APPENDIX F

DRAWINGS OF EMBEDDED FIGURES USED IN RECOGNITION TASK AND TRANSFER TASK

Embedded Figures--Recognition Task

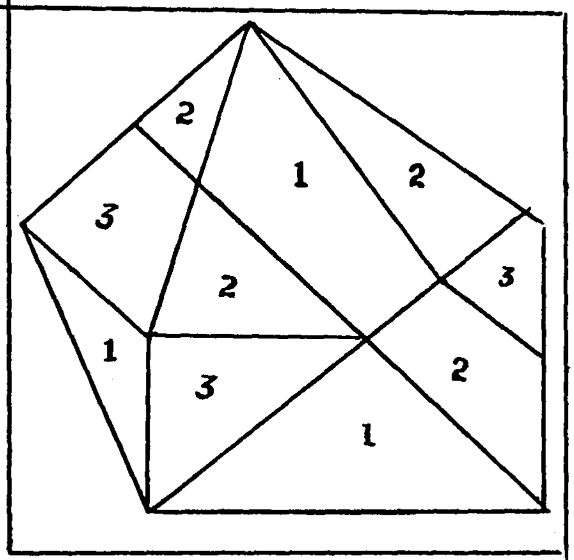


1



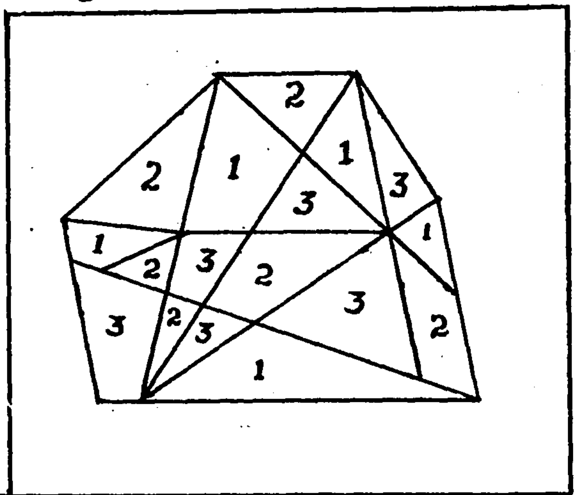
2

Blue----1
Green---2
Red-----3



3

Embedded Figures--Recognition Task



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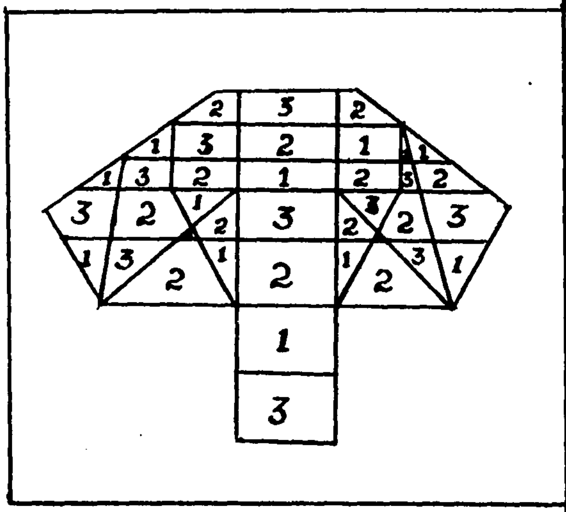

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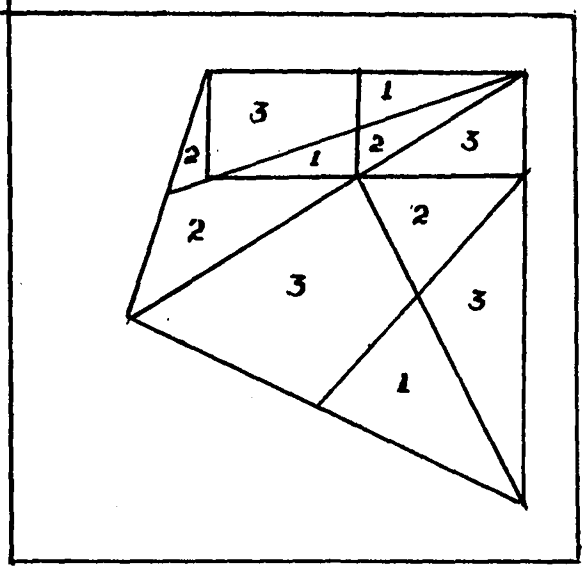
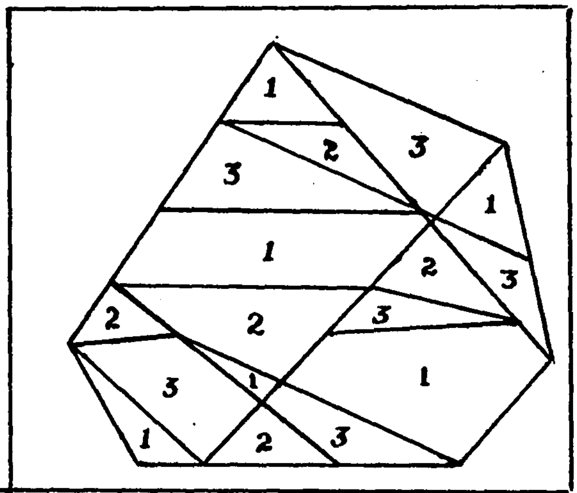


6

Embedded Figures--Transfer Task



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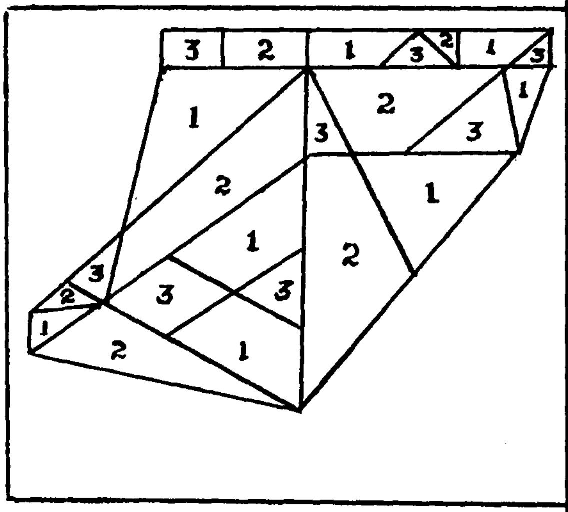
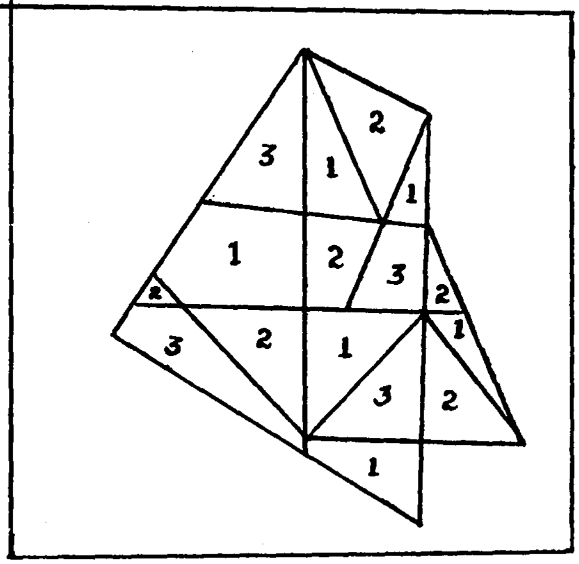


1,5



3,4

APPENDIX G

TUKEY'S t TEST AND AN EXAMPLE

Example: Tukey t Test Analysis for the Significant Treatment Effect in Table 1

1. S/ABC = 1.13 (is an estimate of s^2)

2. $$\sigma_{dm} = \sqrt{2\ \sigma \frac{2}{n}} = \sqrt{\frac{2(MS)_w}{n}} = \sigma_{dm}\sqrt{\frac{2x1.13}{20}} = .336$$

   Where n = number of subjects per group to be compared

3. .05 confidence level t for 64 df is 2.00

4. σ_{dm} x t value at .05 confidence level = critical difference

5. Critical difference is 2.00 x .336 = .67

6. Visual-Tactual vs. Visual. . . . . + .15

   Visual-Tactual vs. Tactual . . . . + 1.00*

   Visual-Tactual vs. No Prior Experience . . . . . . + 1.80*

   Visual vs. Tactual . . . . + .85*

   Visual vs. No Experience . . . . + 1.65*

   Tactual vs. No Experience. . . . . + .80*

   + = First treatment of the pair compared is greater

   - = Second treatment of the pair compared is greater

   * = Significant at .05 level of confidence