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The effects of meaning and labeling on four-year-old’s ability to copy triangles

Rosen Hemphill, Joyce Ann, Ph.D.

The Ohio State University, 1987
THE EFFECTS OF MEANING AND LABELING ON FOUR-YEAR-OLDS' ABILITY TO COPY TRIANGLES

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of the Ohio State University

By

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* * * * *

The Ohio State University
1987

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I would like to express my sincere appreciation and heartfelt gratitude to Dr. Gerald A. Winer, my adviser, for his never ending assistance and guidance. I would also like to thank the other members of my advisory committee, Drs. John C. Gibbs and Philip M. Clark, for their suggestions and comments. A sincere thank you goes to all the preschools and the teachers for letting me come in and be a part of the daily program while conducting this research project. In addition I would like to thank my parents for being there to help out when the need arose. And finally, I would like to thank my husband for his love, patience, and understanding.
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INTRODUCTION

One special feature of human thought is its ability to create and communicate through the use of various kinds of symbol systems. These symbol systems are the vehicles through which thought takes place and by their very nature, are creative open systems. Through the use of symbols, the human mind can create, revise, transform, and recreate wholly fresh products, systems, and even worlds of meaning (Gardner, 1982).

According to Ernst Cassirer (1969) the key to various forms of creation lies in an understanding of how humans use symbol systems. In Cassirer's view, the construction of reality is based upon the availability of a vast collection of mental conceptions or symbolic forms. The efforts of human beings to capture their experiences and to express them in forms which effectively communicate, depend upon the composition and arrangement of the symbolic conceptions.
For Cassirer (1969) symbols are not simply tools or mechanisms of thought; they are the functioning of thought itself — the vital creative forms of mental activity — the sole means by which one makes and synthesizes reality.

The use of symbolism begins to occur in humans around the age of two and, for the most part, is fully developed around seven years of age (Piaget & Inhelder, 1967; Gruber & Voneche, 1977). Although the use and integration of symbols, such as language, gestures, numbers, music, drawing and writing is used throughout the life-span, the period which witnesses the greatest amount of development and growth is early childhood.

For the purpose of this study, I shall limit my discussion to the development of symbol use in early childhood. Furthermore, because symbolism encompasses a wealth of factors and influences, I shall restrict the topic to the development of the ability to draw and copy shapes. The study of the ability to copy shapes is important because in our society geometric forms have widespread use and accurate copying is necessary for important tasks, such as writing.
This ability, like any skill, develops through maturation and practice. It would be beneficial, particularly the young child, if this process could be enhanced in such a way as to improve one's copying ability. This research explores some plausible factors which may positively affect the young child's ability to copy shapes. More specifically, in this dissertation I will examine the effects of meaning and labeling on four year olds' ability to copy triangles.
CHAPTER I
LITERATURE REVIEW

The Development of Drawing

"To confer the gift of drawing we must create an eye that sees, a hand that obeys, a soul that feels; and in this task the whole life must cooperate. In this sense life itself is the only preparation for drawing." This passage taken from The Advanced Montessori Method by Dr. Maria Montessori (1964) defines three basic conditions which must be satisfied before a child is able to express itself through a nonverbal medium. Of these three conditions, it is the development of "the eye" and "the hand" which perfects the technique of expressing the thoughts and feelings of the soul through the process of drawing.

A child's use of visual representation begins as scribbling sometime around the age of two years and develops through a series of stages until the age of six or seven years when a definite consistency emerges.
in the production of shapes. Each stage reflects an increase in the child's motor coordination and concept of proportion, order, and placement. In other words, it is a process of organizing space, developing structures, raising one's level of awareness, and increasing the representation ability of the total environment (Brittain, 1979). Kellogg (1969) argues that scribbling, which promotes the development of eye-hand coordination, has meaning for two critical operations of intelligence: reading and writing. "In learning to read, the child must perceive line formations that are like the ones he has made spontaneously...he must perceive the differences between the esthetic and the linguistic positioning of letters...as he learns to write he must put his perception to use" (Kellogg, 1969).

As mentioned, scribbling or scribble pictures are the child's first attempt at drawing. At first the lines on the paper are planless and expressionless. This random or pure scribbling is chiefly associated with movement. To produce the marks, the child tightly grips the writing instrument (i.e., between the fingers, like a hammer, etc.) and without moving the wrist, swings his/her arm back and forth. It is the pendulum path of the arm which determines the
direction and length of the lines drawn creating a wavy scribble. In this pure scribble stage, the sensorimotor child receives more pleasure from the movement involved in drawing than from the actual design created (Eng, 1959; Brittain, 1979). This wavy scribble is fundamental to the child's development of motor coordination and lays the foundation for future drawing.

As the child approaches three years of age, the scribbling becomes more controlled although it may not appear different from previous attempts. Not only does the child begin to use his/her free hand to steady the paper, but also begins to replace the arm swings with finger and wrist movements (Read, 1956; Eng, 1959; Brittain, 1979). This increase in dexterity results in a greater variety of markings on the paper, most of which are of a circular design. In addition to manual control, the child begins to use visual control over his/her lines. This control is illustrated by the child's increased attention towards filling the entire sheet of paper and by what appears to be a planful grouping together or combination of scribbles (Brittain, 1979; Gardner, 1980). From a drawing point of view, these first signs of eye-hand coordination, as seen particularly by the use of
circular forms, means that the child is acquiring a store of elementary lines and shapes to be used later on in representational drawing (Eng, 1959).

Sometime around the age of three to three and a half the child begins to name the scribbles and lines he/she has drawn. However, the meaning of these lines can change as more scribbles are added to the picture. For example, a wavy line appearing along the bottom of the paper may at one time mean water while at another moment represent a cat chasing a butterfly. Often too, the paper becomes a map upon which the child draws the path of the object but not necessarily its actual visual representation (Brittain, 1979). Note that in this case the lines and scribbles are mere haptic representations often described by the child as being fast lines, jumping lines, swinging lines, or bumpy lines.

The main point here is that the lines and squiggles and shapes represent objects to the child as words do for the adult (Eng, 1959; Golomb, 1974; Brittain, 1979). This shift from motion to the representation of motion marks a key advancement in the development of abstract thought, the use of symbolic representation. It is at this level that the child begins to see the relationship between his/her
drawings and actual objects or experiences. In other words, the child has experienced a transfer from a physical control over the lines to an understanding of what the lines represent.

At age four, eye-hand coordination increases, the grip on the writing utensil becomes more adultlike, and the drawings begin to resemble what he/she is representing. It is at this stage that the child takes a great interest in the human figure. This interest is demonstrated by the fact that the child's first representational drawing is usually a human (Eng, 1959; Piaget & Inhelder, 1967; Kellogg, 1969; Golomb, 1974; Brittain, 1979; Kellogg, 1979; Gardner, 1980). The tadpole man, also referred to as a kopffussler or tetard (Eng, 1959), is a globally used figure. It is believed that all children use this primitive ageless and sexless figure in their artistic development (Eng, 1959; Kellogg, 1969; Golomb, 1974; Brittain, 1979; Kellogg, 1979; Gardner, 1980).

Basic construction of this human includes a circle (representing the head), facial features (two circle eyes, a circle or line nose, and a curve or line mouth), and two vertical lines coming from the bottom of the head depicting the torso and legs. Of the facial features, the eyes receive the child's main
attention and are usually drawn first and are rarely forgotten (Eng, 1959). Variations upon the tadpole man include hair, arms with or without hands, feet, a naval, and a trunk. Gradually this representation of a human will increase in detail and become more complex.

Note that although the child is capable of describing a person in full detail, he/she will tend to draw the tadpole man because of its simplistic and symmetrical yet aesthetic design (Golomb, 1974). The simplicity of this figure, according to Brittain (1979), is the result of the child's view of him/her physical self as only being the important parts (i.e., head, legs, arms). Arnheim (1969) suggests that because the head is believed to be the most important part of the body - the perceived location of the self - it is usually drawn first, sometimes leaving little space for the rest of the body. Therefore, what results is the circle representing the whole body in the child's early representation of the human figure. Because the child is egocentric, he/she tends to draw all people according to this perception or schema (Arnheim, 1969; Brittain, 1979).
By the age of five years, the child has a good concept of spatial organization (Brittain, 1979). Objects tend not to "float" on the paper as they previously did and the use of base lines representing the ground and the sky begin to be incorporated into the picture. With this greater sense of order and space comes an increased understanding in the use of size. For example, the mother and father are now drawn larger than the child. However, size relativity tends to be applicable only to the human figure; buildings and other inanimate objects will tend to remain small by comparison.

As the child approaches his/her sixth year the realm of artistic expression should be well established. At this stage the child produces skillful drawings displaying a sense of confidence in his/her muscles and has formalized his/her schema of the human figure. His/her portrayal has increased substantially in complexity and realism. For example, the human figure is drawn with a thin neck, a double torso, and bent arms. Details such as clothing fashions, buttons, earrings, shoelaces, eyelashes, pupils, and fingernails appear more frequently. This attention to the differences in size, proportion,
form, sex, and direction is the result of the child's attainment of a satisfactory level of graphic representation (Golomb, 1974).

Generally after the age of six, spontaneous drawing decreases (Eng, 1959; Brittain, 1979). The pressure to succeed in school and the increased attention given to school subjects are often cited as the major contributors to the child's decline in artistic development. Edwards (1979)attributes the emphasis placed on linguistic and analytical skills by the educational system as stifling the child's artistic progress. This behavior, according to Edwards (1979), is supported by the societal view that decision making depends upon the rational ability of the individual, not his/her intuition. Other factors include the child's pre-occupation with accurate depictions (which leads to copying and tracing) and discouragement by those who do not perceive themselves as being artistically talented (Gardner, 1980). Developmentally, the only major skill yet to be attained is that of three-dimensionality which should appear around the age of nine or ten. Overall, the child of six has reached a level of consistency in the way he/she draws through focusing on proportion, order, and placement. These cognitive operations
formulate the child's method of organizing space and are vital to the child's development of abstract thought.

In summary, the child's drawing gives witness to the development of his/her power of attention. At first, the child isn't able to hold fast to the mental images or to control and direct the line's movement. But after a while the markings become firmer, more comprehensive, and more intentional. They are a reflection of the child's development in the use of observation and analysis as well as the child's increased ability in synthesis, judgement, and expansion of thought (Eng, 1959).

The Development of the Ability to Copy

Because geometric shapes are used in representing one's environment pictorially in drawings and descriptively via the means of the alphabet and words, their place in the child's repertoire of symbol usage is an extremely important one to study. The ability to use and copy shapes, like any skill, develops through maturation and practice. However, it has been written by numerous researchers and theorists that this ability - the ability to copy geometric shapes and designs - develops through a series of stages
subsequent to the development of drawing. (See Eng, 1959; Piaget & Inhelder, 1967; Arnheim, 1969; Brittain, 1979; Gardner, 1980 & 1982.) Eng (1959), for example, writes that in her experiences in working with children she found that almost all three year olds are able to draw a rectangle during "free play drawing", but when asked to draw one, could not.

There have been a number of theoretical pieces addressing this lag in the development of copy to that of drawing. One researcher looking into this was Arnold Gesell. He and his colleagues at the Yale Clinic of Child Development conducted extensive and detailed studies of the neuromotor development of infants and children. From these studies Gesell derived chronological norms and timetables for the appearance of various behaviors. In terms of copying shapes, Gesell (1940) found that the child can copy a circle at three years, a square at 4 years six months, a triangle at five years three months, and a diamond at seven years. Subsequent research by Brittain (1979) found a similar timetable in relation to copying development.

Gesell (1940) believed that "there are laws of growth and mechanisms of development which apply to body and mind" (Gesell, 1940, p. 10). His
maturational theory is based on the idea that the child's development is directed from within, by the action of the genes, and therefore, always unfolds in fixed sequences. Although environmental factors are important in that they support normal growth, they play no role in the sequential unfolding of structures and action pattern (Crain, 1985). Therefore, since the "laws and growth mechanisms of development" determine the timetable of a behavior's appearance, it can be deducted that the lag between drawing and copying can be attributed to these same biological and maturational mechanisms.

Piaget, however, suggests that the ability to copy develops from the child's increasing cognitive understanding or conceptualization of space and spatial relationships. In his theory, Piaget differentiates between two types of space: perceptual and representational (Piaget & Inhelder, 1967). Perceptual develops first and refers to an understanding of space through contact with objects which are present in the child's environment. Representational space, on the other hand, refers to the mental image or representation of space and spatial relationships when objects are not present.
Beginning in the period of sensorimotor development the child gains a primitive perceptual understanding of space as a result of his/her direct interaction with the environment. With increased contact with objects a system of spatial relationships develop and become internalized, thus providing a basis for the later developing representational space. According to Piaget this internalized system is comprised of five topological relationships which includes: proximity (nearness); separation (differentiation between objects); enclosure (surrounding); order (following a proper succession), and continuity (well defined integration between elements) (Piaget & Inhelder, 1967).

Following the sensorimotor period, around the age of two, the pre-operational child develops an ability to use and manipulate symbols to represent the environment. This ability is seen in the child's attainment of a language. With advancements made in the child's use of symbols his/her understanding of topological relationships transfer from a perceptual one to that of a representational one. The tadpole man, which is the child's first representational drawing, is an excellent illustration of the child's representational understanding of topological
relationships. First, the head, represented by a circle, demonstrates enclosure in that the child has surrounded an area for the housing of facial features irrespective of whether or not such features are included. Proximity, reflected by the side-by-side placement of the eyes, is an elementary relationship which plays an important part in every drawing that goes beyond mere scribbling (Piaget & Inhelder, 1967). Since the eyes are drawn in the top half of the circle and the mouth along the bottom half, order is preserved. Limbs drawn from a trunk or trunk area reflect the integration of elements, in other words, continuity. And finally as the child's artistic ability matures, the addition of fingers demonstrates a separation between the elements (Piaget & Inhelder, 1967; Windmiller, 1976).

At approximately age four topological space gradually assumes the properties of projective and Euclidean space as is seen by the increasing complexity of the tadpole man. This process is generally completed between the ages of six and seven years. Projective space is the perceived relationship between an observer and some objects based on the observer's position. It provides the child with cues as to an object's distance and dimensionality. For
example, depending upon where a child is standing, two objects may appear side-by-side or in a straight line. Axis dimensions, such as right-left, front-back, and above-below, form the structure of the system and develops in a horizontal to vertical to oblique order (Arnheim, 1969; Olson, 1970; Goodnow, 1977).

This developmental pattern is evidenced by the research conducted by Hanfmann (1934). In this study, 22 preschool and Kindergarten aged children were presented three sets of equilateral triangles to copy: the first set had one side of the triangle based in a horizontal position; the second set had one side of the triangle based in a vertical position; and the third set had neither a horizontally nor vertically based side. Hanfmann (1934) found that the triangles with one horizontal side were copied correctly, in terms of perspective, by most of the children; the triangles with a vertical side were copied correctly by a smaller number of children; and greatest number of failures involved the triangles in the "crooked" position.

The coordination of the axis dimensions mentioned above also form an overall reference system which are important in Euclidean space. This system gives rise
to important features such as angles, planes, and parallel lines. Once operating under these concepts of Euclidean space, the child has the ability to execute the drawing or construction of the angles of a diamond, for example. These skills are now possible because under Euclidean space the child uses the object, a point, or a line in relation to its location in the axis dimensions, thus establishing a reference or focal point. Using this reference point, the child is able to connect lines in such a way as to create angles (Piaget & Inhelder, 1967; Windmiller, 1976). These new skills are important in the child's learning to print and in the child's representation of his/her expanding view of the environment which includes buildings, machines, playgrounds, and other geometrically constructed objects.

To test his hypothesis that topological spatial concepts and operations are understood and differentiated prior to projective and Euclidean features, Piaget administered a variety of tasks to children two to seven years of age. One such task required the child to reproduce or copy a series of forms (see Figure 1) ranging from topological shapes (e.g., #1, 2, 3) to simple geometric shapes (e.g., #4, 4, 6, 7, 8) to more complex shapes
Figure 1
(e.g., #9, 10, 11, 13). The purpose was to discover the extent to which a child at different levels of development could correctly copy the shapes in terms of topological, projective, and Euclidean properties. The copying of the shapes would provide insight to the development of the child's use of geometrical relationships together with "abstraction of shape"; in other words, to better understand the development of representational space (Piaget & Inhelder, 1967).

Upon completing the study Piaget concluded that topological relations took priority over Euclidean properties (Piaget & Inhelder, 1967). When comparing the degree of accuracy among the shapes drawn, basic topological relations, particularly closure, tended to be mastered before Euclidean properties, such as straight lines and right angles. Also, in terms of accuracy, the simple geometric shapes (e.g., #1 through 8) were reproduced correctly before the more complex ones. Piaget's explanation:

In particular . . . pictorial representation expresses in essence the basic requirements for the composition of figures; the active rather than the perceptual aspect of their construction. Similarly, ... the 'abstraction of shapes' is not carried out solely on the basis of objects perceived as such, but is based to a far greater extent on the actions which enables
objects to be built up in terms of their spatial structure. This is why the first shapes to be abstracted are topological rather than euclidean [sic] in character, since topological relationships express the simplest possible co-ordination of the dissociated elements of the basic motor rhythms, as against the more complex regulatory processes required for co-ordination of euclidean [sic] figures." (Piaget & Inhelder, 1967, p. 68)

Overall, Piaget's theory of the development of spatial operations and concepts suggests that the first spatial operations the child understands involve the elementary notions of proximity, enclosure, and other topological relations. These notions form the basis of the child's schema. Thus, in the process of perceiving a shape for the purpose of copying it, for example, the child works from his/her view of the object (which at first is topological in nature) rather than from the actual external stimulus of the form (Maccoby & Bee, 1965; VanSommers, 1984). In other words, the child does not draw what he/she sees, but what he/she knows (Eng, 1959; Kellogg, 1979; Edwards, 1979). For example, at a certain age, children are able to distinguish between people but, they don't draw the differences. The reason,
according to Arnheim (1969) is that children tend to operate in "generalities". Case in point: a circle is used to represent a head but, a head is not perfectly spherical.

Golomb (1974), however, argues that the "generalities" or schemata under which children operate are not necessarily as rigidly applied as often believed. In comparing children's drawn and sculpted humans and snowmen, both body formations, she found "an absence of uniform representational schema, model, or procedure" across body type (Golomb, 1974, p. 175). For example, snowmen were always constructed as having an abdomen while humans were not. Also, in sculpting, humans were always sculpted flat and horizontally while snowmen were sculpted vertically and three-dimensionally. Nevertheless, the lack of correctness in children's drawings lies in the process of representation as children definitely see more than what they draw. As the child develops, his/her schema incorporates the concepts and principles of projective and Euclidean space taking into account proportions, perspectives, and distance (Piaget & Inhelder, 1967), thus increasing the accuracy of the reproduction of a shape. "The drawing, like the mental image, is not
simply an extension of ordinary perception, but is rather the combination of the movements, anticipations, reconstructions, comparisons, and so on, that accompany perception and which we have called perceptual activity" (Piaget & Inhelder, 1967, p. 33).

Note, however, at no time does Piaget mention that the inability to use projective and Euclidean space is due to a lack in motor skills. In fact, Piaget and Inhelder (1967) report that when a child was asked to reproduce a shape using matchsticks, the child did no better than when he/she was asked to draw it even though the first task was motorically easier. Golomb (1974) and Brittain (1979) found similar results in the child's use of clay. When asked to create a three-dimensional representation or sculpture of a human, the child tended to roll the clay into ropes and use them as lines, so to speak, to create a flat or horizontal figure which did not differ from the drawn tadpole man. The lag in production according to Piaget and Inhelder (1967) is due to the level of understanding of a form is based on the child's own actions that topological relations, such as proximity and enclosure, are developed before Euclidean relations.
Since Piaget's initial study concerning the development of representational space, other researchers have looked into the same question. Although their explanations may differ as to why representational space increases in complexity with age, the same basic observation is made: an understanding of topological spatial relationships occurs prior to that of Euclidean space. It has been suggested that the above order of development is due to the fact that a straight line is harder to draw than a curved line (Ninio, 1979) or that a square cannot be made more closed, but can be simplified by making it a circle (Graham, Berman, & Ernhart, 1960). The point is not that all drawings or shapes will be topologically correct, but rather they will be more correct in terms of topological properties more often than in terms of projective or Euclidean properties (Dodwell, 1963). Irrespective, the development of representational space reflects a simple to more complex progression.

Eleanor Maccoby and Helen Bee (1965) introduced the "number of attributes" hypothesis to explain why the young child has difficulty in copying geometric shapes. In order to perceptually differentiate
between two shapes, the child draws his/her attention to a number of characteristics or attributes which distinguishes the one shape from the other. However, in order to copy the shape, more attributes are required. For example, in discriminating between a square and a triangle, the child can perceptually make the distinction on the basis of the number of sides or the number of corners the shape has. If, however, the child is asked to copy a triangle, and sets out to do so based on that information alone, he/she will have probably produce a three-sided, three-angled open figure which closely resembles an incomplete square. In order to make a correct copy of a triangle, the child must not only notice that the shape has three sides and three angles, but also must notice the size of the angles (Maccoby, 1968). Therefore, the more attributes the child can discriminate, the more accurate the copy. According to Maccoby and Bee (1965) this ability to extract more information increases with age.

Maccoby, however, in 1968 modified the number of attributes hypothesis. She proposed that for the discrimination of the object alone, the child needs a holistic perception - that is, the ability to
discriminate shapes on the basis of their whole shape rather than on the basis of selected characteristics. This notion is based on research by Zaporozhets (1965) as well as others (including Maccoby, 1968) which found that infants and young children tend to fixate on one aspect of the figure, whereas older children and adults survey the entire contour of the shape with their eyes. According to the revised hypothesis, the child's inability to reproduce shapes is due to his/her perceptual inability to see the entire shape and the inability to break the shape down into its parts and understand the relationship of those parts to the whole.

The approach Olson (1968 & 1970) takes is one which emphasizes qualitative differences in perception as opposed to quantitative differences as suggested by Maccoby and Bee (1965). His approach, which is eclectic in nature, states that the perceptual information needed to discriminate an object from among a set of alternatives is qualitatively different from the perceptual information needed to recreate or reproduce its likeness. For example, "one requires different information to catch a ball . . . than to discriminate it from a cup, or to draw it, or to name it" (Olson, 1970, p. 185).
Olson derived his theory mainly from principles addressed in the works of three theorists. As a basis, he borrowed from E.J. Gibson (1969) her "feature" theory which suggests that objects are perceived by means of certain features or cues which distinguish that object from all other objects. However, according to Olson (1970), Gibson's theory is inadequate in explaining why opposing diagonal lines (e.g., / and \) are more difficult for the young child to differentiate between than are horizontal and vertical lines. Therefore, Piaget's notion about the developmental progression of perception from topological to Euclidean features and relationships was added. This developmental theory provides a hierarchical rationale or basis as to why production occurs after recognition and discrimination. And finally, Olson incorporated Garner's (1966) idea of a contrast set which states that the process of perception is completely meaningless without a context of alternatives. In theory, the contextual nature of the object enhances its distinguishing features from others being perceived. In summary, Olson states that "one of the primary changes that occurs with development is that the child comes to perceive an
event in terms of a much larger set of alternatives, that is, on the basis of many more, or different, features including such subtle ones as direction of line, size and number of angles, and so on" (Olson, 1970, p. 176).

The question, however, arises as to whether the measurement in correctness or accuracy in copying geometric shapes is an index of the acquisition of spatial concepts. Ninio (1979) argues that although the acquisition of spatial relations is necessary for correctly copying a shape, it is not a sufficient condition. Differences in motor difficulty in executing the drawing may be a factor. For example, due to the physical design of the arm, the hand naturally makes an arc as it moves across the page resulting in a curved line being easier to draw than a straight one (Eng, 1959). In the replication of Piaget and Inhelder's work, Lovell (1959) found that children could construct geometric figures with matchsticks at least six months earlier, on the average, than they could draw them.

One factor may be that of perceptual distinctions. It has long been recognized that a young child can make perceptual discriminations before
he/she can match the perceived distinctions in his/her own copying behavior (Nelson & Bartley, 1962; Maccoby & Bee, 1965; Brittain, 1979). For example, a child can recognize a square before he/she is able to draw one. Visual representations or drawings do not demand all aspects of an object to replicated; representation implies simplification and abstraction. Duplication or copying, on the other hand, demands precision and attention to details. The amount of "detailing" is based on the child's perception of what is important, thus setting the standards of likeness or discrimination. When a child copies a shape he/she may be only concerned with reproducing certain features as opposed to the whole shape (Arnheim, 1969; DiLeo, 1970). If this is the case, one cannot say the topological or Euclidean features of the object are the basis for discrimination necessary for copying. But rather, it may be the perceptual activities of the child in exploring and viewing the shape (Laurendeau & Pinard, 1970; Cousins & Abravanel, 1971; Golomb, 1974). Note, however, that at this point Piaget would argue that the child's perceptual abilities would be based on his/her level of understanding representational
space. "The fact that at least two years work is required ... in order to pass from copying the square to copying the rhombus ... shows pretty clearly that to construct a euclidean [sic] shape, something more than a correct visual impression is required" (Piaget & Inhelder, 1967, p. 74). The child must slowly acquire the representational schemata primarily through his/her own activity before he/she can construct the rhombus even if his/her perception of it is well developed (Olson, 1970).

Both of the factors mentioned above, motor ability and perception, should be considered in the formation of a psychological theory concerning the development of representational space. In an attempt to study these effects on the ability to copy geometric shapes, Collett (1971) had children perform a variety of tasks ranging from the recognition to the tracing and the copying of shapes. Each child was asked to pick out a designated shape from a series of shapes (recognition or perception task), trace that shape (motor ability task), and then copy it (combination of the previous two tasks). The results showed that although the child recognized the shape,
the ability to trace it did not necessarily precede the ability to copy it. Therefore, copying requires other abilities than just perceptual and motoric.

Note, all the studies concerning the development of topological, projective, and Euclidean space have the child copying the geometric figure on square or rectangular paper. Although it is not unusual for a four year old to be able to copy a square onto rectangular paper, perhaps the same child may not be able to copy a square onto triangular paper. Thus the question is raised: Does the child use the edges of the paper as references or guides instead of using his/her spatial abilities? To answer this question Brittain (1976) studied the effects of various shaped paper (e.g., square, round, triangular, kidney shaped) on the child's drawings. The results showed that a child could copy a triangle onto triangular paper just as easy as copying a circle onto triangular paper. The hardest task for the child was copying a square onto triangular paper; the square was usually drawn as having three sides. These results suggest that the copying ability may be a reflection of the type of paper normally used (four sided) and therefore, prior findings may not be an accurate picture of the child's level of development or the developmental sequence as well.
As stated in the beginning of this paper, one assumes the eyes, the hand, and the soul as being necessary and responsible for the child's ability to draw. In looking at two of these, the eyes (perception) and the hand (motor ability) do not appear to be sufficient in and of themselves for correctly or accurately reproducing a shape. Perhaps then it is the child's "soul" (Montessori, 1964) which holds the key to this developmental process.

James J. Gibson (1929) states that an individual uses one of two means in organizing the information concerning the features of an object or figure. One is the perception of a figure as a composition of various geometric shapes. For example, a mountain range would be viewed as a series of triangles. The other way an individual might perceive and organize a figure would be by associating the shape or object with something familiar. Using the mountain range example again such a perception would liken to the rooftops of houses in a neighborhood. According to Gibson (1929) a difference does not exist as to whether one method gives more information than the other. In both types, a name is assigned to the form and the form is related to objects. The difference
lies in the kind of form or object seen or perceived; one is geometrically based and the other involves familiarity.

Carmichael, Hogan, and Walter (1932) expanded Gibson's (1929) work to suggest that the way an individual conceptualizes a form would affect the product or reproduction of that form. To demonstrate this they briefly presented 125 male and female college students and instructors with a series of twelve forms which they were asked to draw. However, immediately preceding each form's presentation, the subjects were told what they should expect to see. Some were told to expect shapes of a geometric nature while others were told to expect shapes resembling a familiar object. For example, when presented with the figure of a rectangle with a same sized concentric diamond, some were told to expect to see a window with curtains while others were told to expect a diamond within a rectangle. As was hypothesized, the product or drawings of the two groups differed even though both were presented the same figure. Carmichael, et al.'s (1932) study substantiates the view that the visual form along with the individual's conceptualization determines, at least in certain cases, the nature of a figure's reproduction.
Herman, Lawless, and Marshall (1957) replicated and expanded upon the 1932 Carmichael, Hogan, and Walters study. In addition to using the same twelve figures and two word lists Herman, et al. (1957) also presented the figures without a label. The purpose of this particular aspect of their study was to investigate the effects of no labeling on the reproduction of the ambiguous figures. As did Carmichael, et al. (1932), this study found that the verbal labels presented with the figures influenced the subjects' reproductions of the visually perceived forms. However, they also found that in the cases in which the figure alone was presented, that is without a label, the subjects often provided a label themselves; these self-imposed labels were also found to influence the reproduction of the figures.

VanSommers (1984) took the Carmichael, et al. (1932) study an additional step further. He argued that the actual mechanical production—the drawing process—would differ depending on the meaning assigned to the shape. Similar to the Carmichael, et al. study (1932), VanSommers (1984) presented two groups of adults with the same design, but varied the labels attached for each group. For example, the
design was labeled "Two Mice Sniffing" for one group and "Two Swords Crossed" for the other. While the final product or drawing did not differ significantly in appearance, the actual drawing process or steps taken to achieve the finished design varied by group depending upon the attached label. The group which was presented "Two Mice Sniffing" tended to reproduce the design by first drawing two opposing angles with the apexes meeting while the other group, which was presented "Two Swords Crossed", usually began their design by drawing two complete straight lines intersecting at their midpoints. Again, the final design was similar across both groups; the process of achieving that design was different. VanSommers (1984) concluded that the drawer's action or process may result from either a cooperation or competition between two forces: geometry and semantics. "Drawings, therefore, are produced by actions in which meaning and pragmatics may be actively involved in determining the form, direction, and sequence of strokes" (VanSommers, 1984).

An example in which the geometrical and semantical aspects of a figure compete is demonstrated in a study conducted by Phillips, Hobbs, and Pratt.
Children were presented nonsense cubical shapes as well familiar and unfamiliar views of cubes. The results showed that the children were better able to copy the unfamiliar patterns with greater accuracy than the patterns of familiar objects and perspectives. The authors suggest that perhaps at times a knowledge of an object may interfere with the copying task at hand. In other words, the more one is familiar with an object or is more knowledgeable about the identity of that object, the more likely one is to rely on his/her own schema rather than on the object's actual "retinal properties". Conversely, the more unfamiliar one is with the subject matter, the more attentive one will tend to be in copying its shape, thus producing a more accurate rendition of that object.

VanSommers (1984) found similar results with adults. Presented with familiar and unfamiliar designs, one of which was a knot, adult subjects were asked to draw or reproduce the design. Although the knot figure was very familiar to the adults, it posed a great difficulty for them to reproduce. It seems that the subjects did not draw all of the crossings of the thread which would accurately depict a knot.
VanSommers (1984) concluded that if a person is familiar with an object he/she usually will not extract the essential features of the presented design. Instead, he/she relies on his/her memory or schema of it and, therefore, is incapable of correctly reconstructing it. Drawers tend to "launch themselves into a production routine hoping that it can be relied on to achieve the desired effects" (VanSommers, 1984, p. 155).

These studies are somewhat in agreement with M.D. Vernon's (1962) theory on the psychology of perception. According to Vernon (1955), the individual perceives and reacts to objects and the environment in accordance with the schemata which have been built up from infancy. The schemata which operate in perception perform two functions: to produce a condition of expectation and to provide a means of classifying, understanding, naming, and interpreting the percepts. As a result, an individual perceives an object "in accordance with the schematic category of events to which at the moment they seem to appertain" (Vernon, 1955, p. 185). In other words, there is a certain degree of familiarity which affects an individual's perception. When experiencing a new
object or situation the individual will extract any familiar characteristics and based on those percepts, will respond.

Vernon extends this notion of familiarity to copying behavior. The very young child's inability to accurately copy geometric shapes could be because he/she has little interest in and experience with geometric shapes. Therefore, a schema for perceiving such shapes is not available to the child. However, as the child matures and has increasingly more interactions with the environment, the child develops a schema based on real and familiar objects. Therefore, when a child is presented with a geometric symbol or shape, such as a triangle, the child will perceive it on the basis of its familiar components (such as closure or straight lines) and copy or reproduce the shape based on that perception. What results is a connection between the object and a visual symbol. This connection based on familiarity is why "it seems that with figures which can be taken to represent real objects the observer perceives something in the shape which suggests this object to him, and does not trouble to notice all the details of the shape, as he must do in perceiving 'meaningless' shapes" (Vernon, 1952, p. 64).
With Vernon's notion of familiarity as a basis, Trisdorfer (1972) designed a study in hopes of demonstrating that the interaction between the geometrical and semantical aspects of a figure would positively affect the reproduction of that figure. Because children tend to have difficulty in copying geometric shapes, Trisdorfer (1972) hypothesized that copying ability would improve if the shape was meaningful to the child. The shape chosen to copy was the triangle since three- to five-year-olds show varying degrees of skill in reproducing it. The children were first asked to copy a triangle. Then, they were shown a grouping of four hats (e.g., a lady's hat, a "Peter Pan" hat, a "stove top" hat, and a witch's hat) and asked to point to the witch's hat. Thereupon, the children were asked to draw the witch's hat; a recognizable object to most children and triangular in shape.

The outcome of the study showed no significant difference in the copy of the triangle versus the copy of the witch's hat. Of 48 children tested, 21 scored equally well on both copies. The fact that the triangle, a geometric shape, was presented as a concrete object did not provide the child with an
advantage in the reproduction of it. Therefore, according to Trisdorfer the reference made to a geometric shape in terms of a familiar object does not necessarily increase the child's graphic ability.
CHAPTER II
PROBLEM STATEMENT

A review of the research seems to indicate there is no consensus as to whether meaning plays a role in the reproduction of shapes. The Carmichael, et al. (1932) study, the Herman, et al. (1957) study, and the VanSommers (1984) study found meaning to significantly alter the process and the outcome. The Trisdorfer (1972) study, on the other hand, found meaning to have no effect at all on reproduction.

A review of the research also seems to suggest, however, that the effect of meaning on a person's ability to reproduce shapes was never truly addressed. In most of the studies reviewed, the researcher imposed a "meaning" on the shape prior to presenting it to the subject - in essence, a label. For example, in the Trisdorfer study the "meaning" (a witch's hat) which was applied to the figure was from the researcher's perspective, not necessarily that of
the child. As a result, the researcher was measuring the effects of labeling, not meaning per se. Note that the point is not that the researcher's label did not match the child's own unprecedented perception of the shape; rather, that this information is not available. Therefore, it cannot be claimed that meaning had no effect when it isn't known what the shape meant to the subject.

Trisdorfer's study, however, was not the only one to use labels instead of meaning. The classic study by Carmichael, Hogan, and Walters (1932) also imposed a predetermined label onto the figure, as did VanSommers (1984). In both cases, the researcher told the subjects in advance what they were going to see; and in both cases the subjects responded to that label. Nonetheless, these studies provide valuable information on the effects of labeling on reproduction. But, as in the Trisdorfer study, the researchers do not know whether the labels matched the subject's own meaning.

The Herman, et al. (1957) study, on the other hand in retrospect, did measure the effects of meaning on the reproduction of ambiguous shapes, although this
was not the intent of the study. As was presented earlier, the purpose of the study was to replicate the Carmichael, et al. (1932) study and to study the effects of the label's omission on the reproduction of the figure. To test the latter, the subjects were not told in advance as to what they were about to see. However, like the experimental group, the subjects were required to reproduce the figure they had been presented. Upon completion of the task, the subjects were asked to write down a word or phrase which would describe the particular shape they had just seen and drawn. The results from this section of the study found that the self-imposed meaning affected the subjects' reproduction of the shape in a similar manner as what had occurred in the experimental condition.

Another point concerning the current status of the literature available is that not all of the studies used children as subjects. In many of the studies adult subjects were used (e.g., Carmichael, et al., 1932; Herman, et al., 1957; VanSommers, 1984), and as a result, the researchers were not concerned with the geometrical correctness of the figure drawn.
Because adults can already accurately copy geometric shapes, the researchers were more interested in the depiction of what was perceived and not whether a triangle had the correct number of sides. Although Phillips, Hobbs, and Pratt (1978) used children as subjects, the study concentrated on a child's ability to copy a three dimensional perspective drawing of a cubic shape; the researchers did not directly impose a label or meaning onto the shape. Instead, their study looked at whether a child's familiarity of the object influences his/her ability to reproduce a correct three dimensional perspective of the object. Unfortunately, the researchers were concerned with "the kind of structure drawn rather than the precision with which it was executed" (Phillips, et al., 1978, p. 22).

The purpose of this study, therefore, was to determine whether the meaning a child attaches to a figure directly affects the child's ability to copy a geometric shape in comparison to the effects of labeling. Because the copying of geometric forms has such widespread use and because accurate copying is necessary for important tasks such as writing, it is
imperative that all possible ways of understanding copying behavior should be investigated. If it is determined that the presentation of a geometric shape in a meaningful context improves the child's copying ability, then perhaps such a technique should be included in preschool curricula in an effort to enhance the child's perceptual development.

The notion of meaningfulness and its relationship to copying is not a new one. For example, Vernon (1962) theorized that not only can children more readily perceive and reproduce objects which are familiar or useful to them, but also argued that such objects were more meaningful in a representational sense than as pure geometric shapes. Similarly, Werner (Werner & Kaplan, 1963) suggests that because children operate under physiognomic perception and see objects as possessing dynamic, emotional, and expressive qualities, they react to geometrical and impersonal forms as being real and full of life and emotion. Thus, the young child often sees geometric figures as familiar objects and reproduces such shapes as if they were real objects. Hence, it seems appropriate to hypothesize that copying ability would
be maximized if the subject matter being copied by the child has a certain amount of perceived meaning or importance attached to it.

The key element to the design of this study, therefore, is the shape or figure chosen to be replicated. The targeted figure to be used in this study is the triangle. The triangle was chosen because first of all, as presented earlier, the age norm for copying a triangle is five years and three months (Gesell, 1944); preschoolers, therefore, should demonstrate varying degrees of copying competence. Secondly, the triangle is a geometric shape which can be easily incorporated into a meaningful context for the child. For example, by combining the triangle with a square, the context changes from a purely geometrical one to one which can be perceived as a real object: a rocketship, a crayon, mother's lipstick, or a bullet.

Most importantly, however, this figure resembles the basic universal composition of a house which most children employ (Kellogg, 1969). The house-like figure is central to this study because it resembles an object which plays a significant role in the
child's life. Eng. (1959) states that based on her observations the house in which a child lives is his/her second favorite artistic subject; human beings are the first. The reason for this high interest level, she speculates, is that the child associates it with his/her family. From this perspective, the figure is a source of great meaning to the child.

In reviewing children's drawings reproduced in Rhoda Kellogg's book, *Analyzing Children's Art* (1969), (see Figure 2) it is apparent that children as early as three years of age can and do draw these geometrically based houses; an age which is prior to when the literature cites the development and use of these individual shapes. So although the young child can draw the shapes freehand, he/she has great difficulty in demonstrating the ability to copy the same shapes until a later age. The reason, as discussed, is because copying takes greater eye-hand coordination and perceptual skills than drawing. Therefore, the goal of the researcher is to determine whether these skills can be enhanced in such a way as to accelerate this developmental process if possible.
Buildings (4 years)

Buildings (5 years)

Figure 2
The study I conducted used the child's frame of reference and natural abilities. By focussing on both the external assigned label and the child's internal meaning this study attempts to determine whether or not these factors singularly or combined influence the child's reproduction of geometric shapes. More specifically the following hypotheses will be tested.

Hypotheses.

1. The children whose internal meaning matches the external label will copy the shape with greater accuracy than the children whose internal meaning does not match the external label.

2. More male subjects will copy the triangle with greater accuracy than will female subjects when the label "rocketship" is used.

In addition to the above hypotheses, the following questions will be researched:

- Is there a sex difference in the child's perception or meaning of an object? For example, do more boys see rocketships than girls?
- Does the child elaborate on the figure? For example, are windows and doors added to a house, or wings and writing to a rocketship. If elaboration occurs, is there a sex difference? Do girls elaborate more than boys?

- Is age a variable?

In summary, the application of a meaningful context to the geometric shape should result with the child producing a more accurate copy of the shape. Furthermore, the introduction of a matching label to the same figure should result in increased geometric accuracy.
Pilot Study.

The purpose of the pilot study was to determine whether a four year old child's schema of an object remains constant over a period of a week. The basic design of the study involved the copying three triangles by four-year-old male and female children over a period of three weeks. In addition, the effects of meaning and labeling on the child's reproduction of triangles were measured. To test the effects of meaning and labeling, each child was asked whether the shape looked like anything, and if so what. One week later the same figure was presented, however a label was attached. In some cases the label matched the child's meaning and in others it did not. However, because this aspect of the study involved the establishment of a contrast set over a period of a week, it was necessary to determine whether the
meaning that the child placed on the figure remained the same over this interval. In other words, did the child's schema of that figure remain stable over a period of time.

A total of 28 four-year-olds, both male ($n = 14$) and female ($n = 14$), were tested over a two week period. The children were randomly selected from the morning and afternoon preschool program at Joliet Junior College, Joliet, Illinois. The children were from middle income homes with at least one parent having had some college education. These children were used as subjects in the pilot study only.

The pilot study involved two testings over a two week period. The procedure was identical for both testings. Because the children were used to the college's faculty and students visiting the classroom, observing their play, and interacting with them in testing situations, a period to get acquainted was not necessary. At each testing the subject was taken individually to a small low table in the corner of the classroom; the child was told that he/she would be playing a game with the experimenter. Each child was presented with the house-like figure (equilateral triangle on top of a rectangular base) which was described in the preceding section. After the child
had a few moments to study the shape, the experimenter asked the child whether the shape looked liked anything to him/her. If the child answered yes, he/she was asked what it was. After the child replied, he/she was thanked and dismissed; his/her response was then recorded. One week later, the procedure was repeated with the same subjects. In this study the child was not asked to reproduce the shape at either testing.

The results of the pilot study indicate that of the 28 children who participated, 23 or 82% retained the same schema over the two week interval. Interestingly, of those 23 children, 20 or 87% said the figure was a house both times. In conclusion, the pilot study was successful in establishing that most children at four years of age retain their schema of an object over a period of time.

Subject Sample.

Subjects consisted of 221 four-year-old male (n = 110) and female (n = 111) children living in the Will and DuPage County area in northeastern Illinois. The subjects were selected from various preschools within the two county area. The preschool programs ranged from a very structured classroom type setting to a very relaxed, open and unstructured environment.
Student-to-teacher ratio in all the preschools used was 10-to-1. All subjects were from middle-class homes in which at least one parent having had some college education.

The subjects were divided into three age groups:

Early-4 - 4 years 0 months to 4 years 4 months
Middle-4 - 4 years 5 months to 4 years 8 months
Late-4 - 4 years 9 months to 4 years 12 months

Each age group had approximately the same number of boys and girls.

The average age within each age group by sex was:

Early-4 (n = 61):
Male: 4 years 2.1 months
Female: 4 years 2.8 months
Total: 4 years 2.5 months

Middle-4 (n = 66)
Male: 4 years 6.7 months
Female: 4 years 6.9 months
Total: 4 years 6.8 months

Late-4 (n = 94):
Male: 4 years 10.9 months
Female: 4 years 10.8 months
Total: 4 years 10.8 months

In addition, subjects were randomly assigned to one of four experimental groups or conditions. The random placement of the children was to avoid any possible preschool effects between conditions. Within each condition there were early-, middle-, and late-four-year-old males and females (see Table 1).
Table 1

Mean Age Within Condition Group by Sex and Age

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<th>EARLY</th>
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<th>LATE</th>
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<tr>
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<td>4 yrs 2.2 mo</td>
<td>4 yrs 6.9 mo</td>
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<td>4 yrs 6.4 mo</td>
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<td>Condition 4</td>
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Stimuli.

The stimuli for the study were presented on sheets of 8 1/2" x 11" white paper.

1) Triangle Task - The figure to be copied was a four inch equilateral triangle drawn in heavy lined black ink on the upper half of an 8 1/2" x 11" sheet of white paper (see Figure 3a).

2) Contextual Task - The figure used in this task consists of two parts: a 4 1/2" x 5" upright or vertical rectangular base with a 4 1/2" equilateral triangle adjacently positioned on top. As with the figure used in the triangle task, the figure was drawn in heavy black lines (see Figure 3b).

Procedure.

All subjects were tested three times with an interval of one week separating testings. One week prior to testing the experimenter assisted in the classroom for at least three days so that the children would become acquainted with her. At the end of this "get acquainted" period, the children were given the triangle task.

On the day of testing the children in the class were told that the experimenter would be playing some games with them. For the testing, each subject was taken to a small low table in a corner of the
Figure 3
preschool classroom where he/she was tested individually. In the middle of the table were two containers containing red, orange, yellow, green, blue, purple, brown, and black large crayons and large markers. The child was free to choose the color(s) and medium to work with. Directly in front of the child was a blank 8 1/2" x 11" sheet of white paper which was to be used for the copying tasks. The child was presented the figure and asked to copy it - to make one just like it on the paper in front of him/her. In the event that the child claimed that he/she could not perform the task at hand because he/she "didn't know how to draw a triangle", the child was asked and encouraged to try. If the child continued to refuse to try, the experimenter kindly thanked the child and the child was deleted from the subject sample. If the child completed the task, he/she was also thanked for his/her efforts. No reinforcement or prizes were given to the subjects.

In all, there were four initial conditions in which the subjects were divided. Each subject participated in only one condition. All subjects completed three drawings/copies.
Condition 1 - Control:

This group was the control group for verbal factors, such as labeling. In the first week of testing the children performed the triangle task, that is, copied the equilateral triangle. For both the second week of testing and the third week of testing, the children copied the contextual figure. In this condition, the children were not asked whether they thought the figure looked like anything; in other words, the child's meaning for the shape was not obtained. Similarly, no labeling was used in conjunction with the presentation of the contextual figure in the third trial. During the copying process if the child did not clearly identify the line between the triangular top and the rectangular bottom of the contextual figure task, the experimenter would point to the triangle on the stimulus figure and comment to the child not to forget "this". Subjects in this group were not asked what they thought the figure was nor was the figure presented given a label.

Condition 2 - Meaning and Labeling the Same:

In the first week of testing the children in this condition performed the triangle task. At the second week testing, the child was given the contextual task. Upon the child's completion of the task, the
The experimenter pointed to the stimulus figure and asked the child whether he/she thought the figure looked like anything. If the child said yes, he/she was asked what it was. Out of the 45 children in this condition, 37 or 82% said the figure was a house. The remaining 8 children said the figure was something other than a house, for example: a star, a tent, an arrow, or a crayon. The purpose of this question was to tap into the meaning which the child may have placed on the figure. One week later (the third week of testing) the same contextual figure was again presented to the child. However, with its presentation, the figure was given a label which matched the child's meaning. For example, if the child had said that the figure was a house, then for the third presentation the experimenter would ask the child to copy this house ... "to make a house like this one". During the copying process if the child did not clearly identify the line between the triangular top and rectangular bottom, the experimenter would point to the triangle on the stimulus figure and comment to the child not to forget "this". Therefore, in this condition the child's meaning attached to the figure was the same as the label used in the third testing.
Condition 3 - Meaning and Label are Different; the label "Crayon" was used:

In the first week of testing, the children in this condition performed the triangle task. As in Condition 2, at the second week testing the child was given the contextual task. Upon the child's completion of the task, the experimenter pointed to the stimulus figure and asked the child whether he/she thought the figure looked like anything. If the child said yes, he/she was asked what it was. Of the 50 children in this condition 30 or 60% said it was a house, 4 referred to it in terms of the geometric shapes, and 2 said it was a garage. The remaining 14 said it was something else, for example: a barn, a corn crib, a church, a tent, a rocketship, a tree, and a flag on a mountain. One week later (the third week of testing) the same contextual figure was presented to the child again. However, with its presentation, the figure was given the label "crayon", regardless of what the child's meaning was (as long as it was not crayon). For example, if the child said the shape was a house, then for the third testing the child would be asked to copy this crayon ... "to make a crayon like this one". During the copying process if the child did not clearly identify the line between the
triangular top and the rectangular bottom, the experimenter would point to the triangle on the stimulus figure and comment to the child not to forget "this". In this condition none of the subjects had a meaning of crayon for this figure. Therefore, in this condition the child's meaning attached to the figure was not the same as the label used in the third testing.

Condition 4 - Meaning and Label are Different; the label "Rocketship" was used:

In the first week of testing, the children in this condition performed the triangle task. As in Condition 2 and 3, at the second week of testing the child was given the contextual task. Upon the child's completion of the task, the experimenter pointed to the stimulus figure and asked the child whether he/she thought the figure looked like anything. If the child said yes, he/she was asked what it was. Of the 38 children in Condition 4, 32 or 84% said the contextual figure was a house, 2 referred to it in terms of the geometric shapes, and the remainder said it was something else, for example: a barn, a hotel, a light tower, or a "piece of junk". One week later (the third week of testing) the same contextual figure was presented to the child again. However, with its
presentation, the figure was given the label "rocketship", regardless of what the child's meaning was (as long as it was not rocketship). For example, if the child said the shape was a house, then for the third testing the child would be asked to copy this rocketship ... "make a rocketship like this one". If the child did not clearly identify the line between the triangular top and rectangular bottom the experimenter would point to the triangle on the stimulus figure and comment to the child not to forget "this". In this condition none of the subjects had a meaning of rocketship for this figure. Therefore, in this condition the child's meaning attached to the figure was not the same as the label used in the third testing.

Condition 5 - Control:

After the data had been collected and analyzed, this fifth condition was added to the study. The purpose of Condition 5 was to provide further insight into the results already obtained, in particular, to control and test for the possible occurrence of a practice effect. The procedures used for Condition 5 were identical to those followed for the first four conditions. Similarly, this group copied the triangle task for the first week of testing. For the second
and third week of testing, however, the group repeated the triangle task. In other words, the subjects in Condition 5 were simply asked to copy only the equilateral triangle for each of the three trials; the subjects in Condition 5 did not perform the contextual task. In addition, no meanings were obtained and no labels were used in the triangle's presentation. Therefore, effects of meaning and labeling were not potential experimental factors for this condition. Thus, this condition group also served as a control group for the visual factors as well. Because this group was added "after the fact", so to speak, the original analyses excluded this condition.

Criteria for Judging Triangles

The quality of the triangle produced (dependent variable) was judged independently by two judges on a point scale ranging from zero points (least resembling a triangle; a scribble) to five points (an accurate triangle). This rating scale was based on a format used by Williams (1970) to rate squares and was modified by Collett (1971) and Trisdorfer (1972) to evaluate triangles (see Figure 4). The rating scale did not require that the base line be parallel to the bottom of the page.
Rating Scale for Copied Triangles

0 Points:
- scribble, random line or lines, spiral, any open shape

1 Point:
- closed rounded form having no distinct sides

2 Points:
- closed shape with one distinct side
  "or"
- squarelike shape (any quadrilateral)
  "or"
- 3 distinct sides but left "open at top"

3 Points:
- 2 distinct, relatively straight sides with wavy lines joining them at top (1 distinct angle)
  "or"
- 3 distinct, relatively straight sides with wavy lines joining them at top (2 distinct angles)

4 Points:
- 3 distinct relatively straight sides; a fair approximation of a triangle, but with 1 or 2 types of minor mistakes. (Each type of mistake may occur more than once, but will count as only one minor mistake -- for example, a triangle with an accentuated ear at an angle and an extra line for closure will be counted as having 2 mistakes, while a triangle with 2 ears at angles will be counted as having only 1 mistake.) Types of minor mistakes are as follows:

Figure 4
Figure 4 (continued)

"jog" at an angle

accentuated "ear" at an angle

extra line for closure at an angle

space at closure point

overlapping lines at angles

an extension of 1 side past angle

2 relatively straight sides with 1 wavy or jagged side and no other mistakes

5 Points:

A good approximation of a triangle having 3 distinct, relatively straight sides (sides may be slightly wavy) and 3 distinct angles. The baseline does not have to be parallel to the bottom of the page.
The sequence of the point values of the rating scale is based on Piaget's (Piaget & Inhelder, 1967) theory concerning the general development of a child's conception of space. As described earlier, Piaget found a progression from topological features (for example, proximity and enclosure) to Euclidean ones in both children's spontaneous drawings and reproductions of geometric shapes. Also according to Piaget, this sequence is true of the development of perception.

In order to establish interrater reliability, the two judges were given a pilot session in rating or scoring the triangles prior to judging the copies produced by the subjects. The judges were allowed one week to study the rating scale. Sample triangles and contextual figures representing each value on the scale were evaluated and discussed by the judges and the experimenter. Then each judge independently scored two sets of 20 triangles each which were obtained from various four year olds who were not included in the subject sample. A comparison of the scoring on the two sets of triangles resulted with the judges agreeing on 18 out of 20 for the first set and 19 out of 20 on the second set. In the three cases total that the judges disagreed on the score, the difference was only one point.
After the pilot session, the judges independently rated the 221 sets of three triangles (one being the reproduction of the simple triangle and the other two being the copies of the contextual figure). The judges were permitted as much time as needed to complete the task. The judges were given one triangle task as a time to prevent the judges from comparing the subject's performance on more than one task. To further prevent comparison of scores, each task was recorded on separate sheets as well as each judges' scorings. Once completed, the judges scores were averaged together to arrive at one score per task per subject. No subject had a perfect score for the triangle drawn; therefore, a ceiling effect was not a factor in the analysis.
CHAPTER IV
RESULTS

In order to test the hypotheses for the effects of labeling, meaning, and contextual presentation a system of analyses of variance (ANOVAs) was used. The model was of an age x sex x conditions x trials factorial design (3 x 2 x 4 x (3)) with subjects repeated across trials. Therefore, the statistics used included a repeated measures ANOVA.

Verbal Effects. A four-way ANOVA with an age x sex x conditions x trials format (3 x 2 x 4 x (3)) with subjects repeated across trials was used to analyze the effects of meaning and labeling in relation to the verbal contextual presentation of triangles on four-year-olds' ability to copy such shapes. This analysis yielded four significant effects: a significant main effect for age ($F = 9.93, (2, 156), p < .05$); a significant interaction between age and condition ($F = 2.56, (6, 156), p < .05$); a
significant main effect for sex ($F = 6.88, (1, 156), p < .05$); and a significant effect across trials ($F = 15.51, (2, 312), p < .05$). There was not, however, a significant main effect for condition ($F = .13, (3, 156), p > .05$) nor for a condition by trial interaction ($F = 1.00, (6, 312), p > .05$) as hypothesized.

For a more detailed examination of age effects, group means for age were calculated by collapsing over sex, conditions, and trials. This analysis found that the late-four-year-olds copied the triangle with greater accuracy ($\bar{X} = 3.39$) than did the middle-four-year-olds ($\bar{X} = 3.04$) whose performance on the tasks was better than the early-four-year-olds' ($\bar{X} = 2.54$). Although this effect was not hypothesized, it was expected as the literature clearly indicated this age trend effect (see Gesell, 1944; Piaget & Inhelder, 1967; Brittain, 1979).

Another significant effect found was an age by condition interaction. By collapsing across sex and trials, the age means for the four conditions were obtained (see Table 2 and Figure 5). This interaction indicates that the effects of the conditions were
Table 2

Mean Scores According to Age
Collapsed Acrossed Sex and Trials

<table>
<thead>
<tr>
<th>AGE</th>
<th>EARLY</th>
<th>MIDDLE</th>
<th>LATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition 1</td>
<td>1.97</td>
<td>3.03</td>
<td>3.87</td>
</tr>
<tr>
<td>Condition 2</td>
<td>2.53</td>
<td>3.17</td>
<td>3.05</td>
</tr>
<tr>
<td>Condition 3</td>
<td>2.63</td>
<td>2.98</td>
<td>3.49</td>
</tr>
<tr>
<td>Condition 4</td>
<td>3.08</td>
<td>2.82</td>
<td>3.14</td>
</tr>
</tbody>
</table>
Figure 5
different for children of the different age levels.

Inspection of Figure 5 suggests that there is an
interesting pattern of performance for the youngest
subjects. For children in this age group, there
seemed to be an increase in performance across
Conditions 1 through 4. In fact, Newman-Keuls
analyses revealed that the difference between
Conditions 1 and Condition 4 were statistically
significant ($p < .05$). Thus, there were more correct
drawings of triangles in Condition 4 ($\bar{X} = 3.08$) where
the figure was labeled a rocketship, than in Condition 1, where the figures went unlabeled ($\bar{X} = 1.97$).

No other differences between conditions were
significant for children in this age group or for
children in any of the other age groups. Thus, there
was some evidence that labeling might affect the
performance of children. But the labeling effect only
occurred among the youngest children, and it was only
evident when comparing one labeling condition against
the control.

Although there were no other significant
differences among the conditions for the children in
other age groups, the means were nonetheless examined
to determine if any other interesting trends occurred. Children who were in the middle-four-year-old age group did not seem to respond significantly in either direction in terms of effects of labeling and meaning on copying performance. The overall difference in performance between the two most extreme conditions (i.e., Conditions 2 and 4) was 0.35. From this it can be concluded that middle-four-year-olds do not seem to be affected by either the visual or verbal context in which a triangle is presented.

Children in the late-four-year-old-age group, however, did seem to be affected by the contextual presentation of the triangle, but in the opposite direction of that of the early-four-year-olds. Again by examining age group means across conditions, the performance on the task was lower for subjects in Condition 2 where the label matched the child's meaning ($\bar{X} = 3.05$), Condition 3 where the label "crayon" was used ($\bar{X} = 3.48$), and Condition 4 where the label "rocketship" was used ($\bar{X} = 3.14$) than for Condition 1, the control ($\bar{X} = 3.87$). The largest difference between means occurred between the control
group (Condition 1) and the group in which the meaning and labeling were the same (Condition 2). It should be noted, though, that this age trend was not significant.

Finally, the means in the conditions by age group interaction were analyzed in yet another way. Differences between each age group were analyzed separately for each condition. For example, comparisons were made between the three age groups in Condition 1 only; similar comparisons were conducted separately for each condition. This type of analysis revealed two significant effects, both of which occurred in Condition 1 only. One significant difference occurred between children in the early and middle age groups and the other occurred between the children in the early and late age groups. In both cases the older children outscored (copied the triangle with greater accuracy) those in the early age group. Perhaps this difference suggests that age effects can be sensitive when the drawings occur in the absence of verbal contextual cues.
With respect to the main effect of sex, group means for males and females were obtained (collapsing over age, conditions, and trials). The results indicate that females ($\bar{X} = 3.25$) performed with greater accuracy than did males ($\bar{X} = 2.85$).

The last significant effect found as a result of this ANOVA was a trial effect. To further analyze where the changes occurred across trials, group means for trials, collapsed across age, sex, and conditions were calculated. Upon review of these group means, it is apparent that the greatest amount of increase in accuracy occurred between Trial 1, the triangle task, ($\bar{X} = 2.77$) and Trial 2, the contextual task, that is the task in which the triangle appeared located on top of a rectangle ($\bar{X} = 3.18$). There was almost a 0.50 point improvement as compared to the .03 negligible amount of improvement between Trial 2 ($\bar{X} = 3.18$) and Trial 3, the contextual task with a label, ($\bar{X} = 3.21$). Furthermore, in a more detailed examination using age x sex group means (24 total groups: early-, middle-, and late-four-year-old males and females) compared between trials, it was found that 19 out of the 24 or approximately 80% of the groups showed an
improvement between Trial 1 and Trial 2 while only 12 out of the 24 or 50% of the groups showed improvement between Trial 2 and Trial 3.

Results from a Newman-Keuls test support the above observations. Two significant differences were found: one between the triangle task (Trial 1) and the contextual task (Trial 2), and the other between the triangle task and the contextual task with a label (Trial 3). There was not a significant difference between Trials 2 and 3. This information seems to suggest that the visual context may be positively affecting the child's performance. That is, the difference between Trial 1 and Trials 2 and 3 was the presence or absence of what has been labeled the contextual cues, namely the rectangular base. On Trial 1 there was no such base, while on Trials 2 and 3 the triangle was presented on the base. In other words, the last two trials seemed to provide what has been termed a visual context, and this visual context might have improved performance.

However, there is another possibility. It is conceivable that the improvement across trials was due to practice and not to the addition of visual
context. Recall that to test out this possibility a fifth group was added to the study. Children in this group received three trials just like the children in the preceding four groups or conditions. For their three trials, however, the children were merely asked to copy a triangle. No label or visual contextual cues were provided. If the previously noted trials effects were due to the conditions and not to practice or repetition of trials there should be no improvement in this control group of children across trials. Moreover, if labeling and context affects the child's copying ability, a difference should exist between the children in this group, for whom no change was expected, and the children in the other groups for whom an improvement across trials was obtained. That is, there should be a trials by conditions interaction when comparing the new control (Condition 5) to the other conditions.

As was noted this fifth group was added after the main study was completed. Therefore, in a sense the children from this group must be considered independently from children in the other groups. In the analyses that follow the results of this condition
(Condition 5) will first be analyzed independently of the other groups. Then, the results of this group will be analyzed in comparison to the other four groups.

**Practice Effect.** The first analysis was conducted on the responses of only the subjects in this new, fifth condition. The analysis was designed to determine if practice improved performance. To test for practice effect a three-way ANOVA (age x sex x trials) of Condition 5 was used. No significant effect of trials was found ($F = 1.29$, $(2, 72)$, $p > .05$). That is, the subjects' performance on the triangle task did not significantly improve over trials alone. Further analysis also indicated that there were no significant interactions with respect to trials for Condition 5. Therefore, based on these results, it appears that there were no effects due to practice.

The analysis of Condition 5 separately also yielded a significant main effect for age ($F = 3.28$, $(2, 36)$, $p < .05$). Examination of age group means (means from data collapsed across sex and trial) showed that late-four-year-olds copied the triangle
with greater accuracy ($\bar{X} = 2.61$) than did middle-four-year-olds ($\bar{X} = 3.01$) who copied the triangle better than did the early-four-year-olds ($\bar{X} = 2.61$). Again, although this effect was not hypothesized, it was expected.

**Contextual Effect.** In the next analyses Condition 5 was specifically compared with the other four conditions using an ANOVA. That is, to determine whether the visual context of the stimulus affected the child's ability to copy the triangle, a four-way ANOVA was performed comparing the differences between conditions and trials; more specifically an age x sex x conditions x trials (3 x 2 x 5 x (3)) factorial with subjects repeated across trials.

The most important effect expected in this analysis was the predicted trials by conditions interaction. If this interaction was found to be significant in the expected direction, it would signify that the trials effect of the main study was due to the visual context. Unfortunately, this interaction was not significant ($F = 1.49$, (8, 384), $p > .90$). Because there is no evidence that the effect of trials in the main study was due to the
visual context, it must therefore be concluded that practice effects were responsible for the improvement.

The analyses of these data, however, did produce two significant results: a significant main effect for age ($F = 13.12, (2, 192), p < .001$) and a significant effect for trials ($F = 14.9, (2, 384), p < .001$). These effects essentially paralleled the main effects obtained in the original analysis when Condition 5 was not used.

Several other analyses were employed to determine if the differences between Condition 5 and the other conditions were significant, that is, whether there was the predicted trials by conditions interaction. For example, Condition 5 was individually compared with each of the four other conditions in a series of separate ANOVAs. The predicted relation failed to occur.

Finally, analyses were performed using the scores of the second two trials only. It was hoped that a conditions effect would be obtained for these latter trials, thus suggesting the presence of a conditions by trials interaction (although in this analysis trials as such was not entered as a variable). Again,
these analyses yielded insignificant conditions effects. In addition, analyses of differences scores were conducted. For this analysis scores on the first trial were subtracted from the sum of scores on the last trials (Trials 2 and 3). This analysis also proved fruitless.

Other. A general review of all the children's reproductions resulted in some interesting findings in terms of what the child thought the contextual figure was and whether or not the child elaborated beyond the simple task at hand. Overall, 94% of the children said the figure was a concrete object. Of those children, 74% said that the contextual figure was a house; an additional 5% of the children said that the figure was something closely resembling a house, such as a church, a garage, a barn or a hotel; while another 5% referred to the figure in terms of the geometric shapes which made up the figure. There were no differences between the sexes as to what the children called it; 74% of both the number of males and the number of females said that the figure was a house. Similarly, both males and females equally referred to the figure as a garage, a barn, a hotel,
and a tent. Therefore, there appears to be no sex differences in how the children perceived the shape.

Another interesting observation was the type of elaborations the children used. Elaborations refer to the decorations and detailing the child voluntarily added to the basic geometric figure, such as: doors, windows, or rocket boosters (see Figures 6 & 7). Overall, 36 females and 25 males elaborated on the contextual figure. No child elaborated on the solitary triangle (the triangle task). Most of the elaborations occurred over the three conditions in which a label was used, although the label did not necessarily dictate the type of elaboration. For example, one girl, after having completed the task on Trial 2 said that the model figure was a house, but stated that she had drawn a "house person" (see Figure 8). In some cases, however, the label did affect the type of elaboration. For example, when asked to copy a rocketship in Trial 3 one boy added wings, rocket boosters, and round windows (see Figure 9b), whereas in Trial 2 in which the same model figure was copied but without a preceding label, the same boy had added a chimney, a rectangular window, and a door.
Figure 7
(see Figure 9a). Later when asked whether he thought the model figure was anything, he said it was a house. Therefore as can be seen in this last example, the child's perception of the figure had directly determined the type of elaborations used. However, as seen in the first example, this effect was not always the case.

Another interesting finding was that the children who elaborated did not do so consistently, that is, just because a child elaborated on one task was not an indication that he/she would do so on the other. For example, some children elaborated on the second contextual task (Trial 3) but not the first (Trial 2) and vice versa. No child, however, elaborated on the basic triangle, although such elaboration was not discouraged.

Overall, elaboration seemed to be dependent upon the visual context of the figure moreso than the verbal. Whether the figure was called a house, a rocketship, or a crayon did not necessarily dictate what types of elaboration the child used. However, elaboration only occurred when the contextual task was presented. Both males and females voluntarily engaged
in elaboration. Although more females elaborated than males, there were no major differences in the types of their elaborations; for example, both sexes would add windows and chimneys to "houses" and boosters to "rocketships".

Summary. In summary, there was evidence for improvement across trials. This improvement, however, was most likely due to a practice effect. There were consistent age effects with the copies or reproductions of older children being more accurate than those of the younger children. There was an effect for gender with females outscoring males. And lastly, there was an interaction between age and conditions. This interaction revealed that conditions were effective for only those in the youngest age group. Further analysis of this interaction revealed that the youngest age group of children who received the figure described as a rocketship had more accurate copies of triangles than children who had no labels provided.
CHAPTER V
DISCUSSION

The purpose of this study was to explore the effects of meaning and labeling on four-year-olds' ability to copy triangles. Through a combination of visual and verbal presentations early-, middle-, and late-four-year-olds were tested on their ability to copy triangles. The four-year-old age group was chosen because four-year-olds demonstrate a wide range of ability in the production of triangles (Gesell, 1944; Brittain, 1979).

To test the effects of meaning and labeling the children were presented with a task in which they had to copy triangles. For the first trial, the children were asked to simply copy an unlabeled triangle. For the second and third trials, however, the children were asked to copy a triangle which was presented in a visual context, that is, on a rectangular base. The total configuration the child was examining on the latter two trials resembled the figure which most children use to depict a house.
For the control subjects, the figure on the last two trials was unlabeled. That is, the children were asked to copy three forms without any labels. The critical feature of this group, then was that the contextual figure was not named. Subjects in the other three main groups received the same drawing task, but in these groups or conditions labels were attached to the figure to be copied immediately prior to the last trial. Thus, before the third trial the child was shown the figure to be copied and was told "Copy this ____".

In the first of these experimental conditions (Condition 2) the label used for the third trial was essentially similar to the meaning which the child was asked to provide after the second trial. Thus, there was a congruence between the label the child spontaneously provided and the label the experimenter provided. In the remaining two experimental groups the label the experimenter provided immediately prior to the third trial differed from the meaning the child offered on Trial 2. In Condition 3 the label provided was one of a common object that most children frequently see in school and at home, namely that of a crayon. In the last condition, (Condition 4) the configuration to be copied was termed a rocketship.
It was assumed that this object would be more familiar to boys than girls. Thus, any positive effect of labeling should occur more frequently with boys than girls in this condition.

**Conditions Effect.** For the main hypothesis it was predicted that children whose internal meaning matched the external label would copy the shape with greater accuracy than the children whose internal meaning did not match the external label. Thus, it was assumed that there would be an effect of conditions and, moreover, a trials by conditions interaction. That is, it was predicted that the greatest amount of improvement would occur among subjects in the second condition in which there was a congruence between the label the experimenter used and the meaning the child provided. In addition, since the label was provided on the last trial, the effect of the experimental condition should only have occurred on the last trial. Hence there should have been a trials by groups interaction. The results disconfirmed the hypothesis.

In fact the only significant results of relevance to this hypothesis was the age by conditions interaction. For the youngest subjects, the condition which yielded the highest score was the one in which
the label "rocketship" was used, while the lowest score occurred among the subjects in the control condition (Condition 1).

It is difficult to explain this effect as there was not a trials by conditions interaction. Because the experimental manipulation was introduced on the third trial, any effect due to conditions should have occurred only on the last trial. Therefore, if the label "rocketship" had been effective in improving the child's ability to copy triangles, the interaction between trials and conditions should have materialized. Unfortunately, this interaction was nonsignificant.

Why then were there higher scores in the rocketship condition than the control condition for the younger subjects? In order to explore this difference more thoroughly a separate analysis was conducted with the scores of the youngest subjects only. In this analysis a comparison was made between Condition 1 (the control) and Condition 4 (the label "rocketship") across trials. Again, there was no trials effect. Moreover, examination of the means revealed that the difference between the conditions existed only on the first trial! As there was no
difference between the experimental treatments at this phase of the testing, i.e., Trial 1, it must be assumed that the age by conditions interaction was due to chance.

The overall lack of significant statistical findings could be due to a variety of factors other than chance, however. For example, the task chosen for the children to perform could have been motorically too advanced or complex for the four-year-olds' level of ability. That is, the child may have understood the task perceptually, but because of his/her inability to use a writing utensil may not have been capable of motorically demonstrating it. There are different reasons to discount this explanation, though. First of all, none of the children in study was uncomfortable with using a pencil or marker. In fact, writing and drawing exercises were part of the daily preschool program. Therefore, all of the children were experienced in performing pencil-paper tasks. Secondly, studies which used similar perceptual tasks as those in this study but which were motorically easier, did not yield significant improvement across tasks. That is, those studies which used the copying of geometric shapes but had the child manipulate matchsticks or modeling clay
instead of a pencil and paper, demonstrated that the child's performance does not differ significantly between the two methods of testing (see Piaget & Inhelder, 1967; Golomb, 1974; Brittain, 1979). Therefore, the motoric aspects of this task were not necessarily factors responsible for the insignificant results.

Another possibility could be that the contextual configuration (the triangle with the rectangular base) was not one which invoked feelings of familiarity and emotional and expressive qualities. Such feelings, according to Vernon (1962) and Werner (Werner & Kaplan, 1963), enable the child to more readily perceive and reproduce objects which previously were perceived as being merely unfamiliar and impersonal shapes. The contextual figure used in this study was perceived as a concrete object by 100% of the subjects, with over 80% referring to the figure as a house. As Eng (1959) stated based on her observations, the house is the young child's second favorite artistic subject; the reason, she speculates, is that the child associates it with his/her family. Therefore, the figure chosen to be copied was one in which children could and, essentially did identify with. Note, however, that the above is not saying
that the tasks used in this research to study the young child's copying ability were the only ones or the best ones; other methods exist (see Olson, 1970; Freeman, 1980; Freeman & Core, 1985). By the same token, the tasks used were not necessarily inferior to the methods the other studies used.

What could have happened, however, was that the child's familiarity with the object more-or-less resulted with the child relying on his/her own schema of the object rather than on the figure's "retinal properties". A study in which children copied familiar, unfamiliar, and nonsensical cubical shapes resulted in the children being better able to copy the unfamiliar patterns with greater accuracy than patterns of familiar objects and perspectives (Phillips et al., 1978). As the authors suggested, perhaps at times a knowledge of an object interferes with the copying task at hand. This study, conducted by Phillips, Hobbs, and Pratt (1978), may lend a possible explanation as to why the older-four-year-olds' accuracy on the tasks tended to be lower on the experimental conditions and, by the same token, explain why the early-four-year-olds performed better in the condition in which the term
"rocketship" was used. However, the lack of consistent significant results does not fully support this view.

In sum, the purpose of this study was to determine whether a familiar shape, one which would invoke a sense of meaning, could enhance the perceptual process in such a way as to allow the child to more readily identify the key features or attributes of a shape thus, increasing his/her perceptual understanding and resulting in a more accurate copy. Because the experimental manipulations of this study did not produce significant results, the usage of labeling was not found to enhance the process of perceptual development. As a result, the random significant findings with respect to a conditions effect can be attributed to chance or to irregularities in the data.

Trials Effect. The overall analysis of Conditions 1 - 4 also indicated that there was a significant main effect for trials. In addition, there was not a significant trials by conditions interaction for these four conditions. These results indicate the use of labels was not effective in improving the child's accuracy in copying triangles, although the accuracy increased across trials.
Further analyses indicated that the differences between the first and second trials, and the differences between the first and the third trials were significant. These trials varied in terms of visual presentation; that is, the second and third trials involved a meaningful contextual figure whereas the first trial did not. The differences between the second and third trials, however, were not significant; these trials varied in terms of verbal presentation or labeling only. Therefore, when a contextual presentation was varied, such as the triangle versus the triangle being presented in conjunction with a rectangle, significant differences in group means occurred; when a verbal context was applied, such as the label "rocketship", significant differences between the group did not occur. While these results suggest that there might have been an improvement due to the visual context a second control group (Condition 5) was added in which the children were asked to copy a series of three triangles, that is, figures without a visual context. This last condition was then combined with the first four and an ANOVA was performed. There was no significant trials by conditions interaction. Thus, it cannot be assumed that the improvement across trials from the original
four conditions of this study were due to what was a common factor to those conditions, namely, the presence of a visual context. Instead, the most likely conclusion is that the improvement across trials was due to practice effects.

At first glance, the lack of the significant effect of trials on performance appears to contradict the lack of a significant conditions effect. However, one must keep in mind that the purpose of this study was to determine whether the experimental conditions (those that used meaning and labeling) could enhance the young child's perceptual process above and beyond normal development such that copying ability would greatly improve. In general, what the trials effect shows is that with repeated exposure or practice, the child's ability to copy improves. Whether this improvement due to practice is greater than what would result with normal development cannot be determined by this study.

Age Effect. In all the analyses, the only consistent significant result was for an age main effect. This effect, when analyzed by group means according to age and collapsed across sex, conditions, and trials found that performance improved with age; that is, the older children tended to copy the
triangle with greater accuracy than the younger children. Although this age effect was not specifically hypothesized, it was expected. As discussed previously, the literature indicates that the age norm for correctly reproducing or copying a triangle is 5 years 3 months (Gesell, 1944; Brittain, 1979). Therefore, it was naturally assumed that the older-four-year-olds would copy the triangle with greater accuracy than the younger-four-year-olds.

It was hypothesized that more male subjects would copy the triangle with greater accuracy than would female subjects when the label "rocketship" was used. The analysis of the data did not produce a significant sex by conditions interaction which could have lent support for a sex difference in response to verbal presentation. As a result, this hypothesis was rejected.

**Conclusion.** The purpose of this study was to determine whether meaning and/or labeling had an effect on four-year-olds' ability to copy triangles. The results of this study were mixed and yielded few significant findings. The hypotheses studied were not supported by the results. However, some of the information obtained in this research strongly suggests that some trends are occurring. For example,
the early-four-year-olds tend to copy the triangle better, with greater accuracy, when it is presented in a meaningful contextual figure and when a label is applied to that figure, whereas the older-four-year-old children appear to be negatively affected by such a presentation. Perhaps another study which concentrated on the early-four-year-old age range may be in order since this age group responded the most to the contextual presentation; these children would be best served by an enhancement mechanism if one could be found. In conclusion, this study determined that overall, labeling had little effect on the child's ability to copy a triangle. This study also found, however, that more research into the visual contextual presentation of geometric figures is needed. Therefore, at this point the data is inconclusive as to whether meaning affects the copying ability of young children.


Cousins, Donald and Eugene Abravanel. "Some findings relevant the hypothesis that topological spatial features are differentiated prior to Euclidean features during growth." British Journal of Psychology, 62(4), 1971, 475-479.


