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The Influence of Age, Sex, and Colors on the Number Recognition and Counting Abilities of Preschool Children

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THE INFLUENCE OF AGE, SEX, AND COLORS ON THE

NUMBER RECOGNITION AND COUNTING ABILITIES

OF PRESCHOOL CHILDREN

by

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by

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The effects of the child's chronological age, his sex, and a second concept of color were studied as they effected the counting skills and number recognition abilities in preschool children. The research was conducted at the Utah State University Child Development Laboratories with the subjects being three and four-year-old children enrolled at that time. Each child was given counting and number recognition tasks involving cubes in sets of one color and also in sets which involved two colors.

It was found that as the age of the child increased, his ability to correctly count and label sets of cubes also increased. An interesting trend was found when the sex and the age of the child were considered together. Girls and boys responded differently to the counting and number recognition tasks. At an earlier age girls showed a greater language facility with the numbers; on the other hand, boys showed an earlier development in meaning of numbers.

The smaller numbers involved were easier for the children to identify and seemed to hold much more meaning for them. The introduction of the color variable influenced the ability of the child to correctly label the number of cubes; however, many of the children did not mention the presence of cubes of two colors.

(141 pages)

INTRODUCTION

Today's children are required to learn more things in a shorter period of time than children of previous generations. The increase in man's knowledge, a nation's strivings to improve her population's intellectual level, and great advances in the field of cognitive psychology are all factors which contribute to this present situation. There is an urgency to provide children with better ways of functioning in this more demanding intellectual environment. The demands are not only on the children who are actively involved in cognitive development, but there are also quite intense demands being made on the adults who are fostering the intellectual development in our children.

There has always been concern for improving the minds and futures of our children; however, there has been a much more active interest in the last few decades. The emergence of new theories in the area of cognitive psychology has focused the attention on the process of learning as well as on the end result of the child's efforts. There has been a growing awareness of the great importance of early childhood experiences on the developing child's intellect. Facts and quantities of specific materials are still important components of the educational process, but a new dimension has been added. This involves a more general experience approach which begins early in the child's life. At least one current researcher theorizes that half of a child's intellectual development has taken place by the time he is four years of age. It is becoming evident that the preschool years cannot be discounted, but must be recognized as being vitally important in intellectual development.

The need for preschool education is becoming evident. Presently there is considerable variation in the kinds and qualities of programs available for the young child. However, there is also a limited amount of agreement among the authorities on what constitutes an effective preschool program. The search for better educational methods is real. Improvements are essential, and the programs which are intended to "increase the intellect" of preschool children should be founded on a firmer basis than now exists.

A basic area of concern in most preschool programs is that of providing firm foundations for later intellectual development through basic concept teaching. Cognitive psychologists have focused on the need for more research in this area and have pointed out new directions for researchers to go. One of the areas which needs exploration and which will benefit the preschool child is that of the child's conception of what numbers are, and what he can do with them.

Children verbally express an interest in numbers early in their lives; however, our present system does very little with formally teaching this subject until the child is nearly six years of age. Piaget (1952) supports this later introduction to number work on the basis that a child has no true understanding of numbers until he has achieved the ability to conserve, that is, to recognize that amounts remain unchanged even though shape or form is altered. This usually occurs when the child is seven or eight years of age. Piaget (Flavell, 1963) views the process of number concept development as one relying more on maturation than on experience and teaching. Piaget is considered to be one of the more knowledgable men in the area and much of the present research is based on his findings or theories. There are some current researchers who have strongly questioned the rigidity of his stages and have presented some findings which indicate that children can be taught some of the number concepts earlier than Piaget indicates. Others maintain that a child's experiences do play a role in the development of his number concepts.

Research on number concept development which is not based on Piaget's conservation principle as it relates to the preschool child is very limited. More specifically, research dealing with the child's counting ability and its significance in number concept development is particularly sparse. There is a need for some research attempting to discover what factors might contribute to the preschool child's understanding of numbers. With this knowledge more suitable and beneficial curriculums could be created for preschool children in the area of mathematics.

The child himself gives us many valuable clues indicating that he is interested in, and learning about numbers at an early age. Counting is a prevalent verbal indication that he is attempting to make number labels a part of his vocabulary. He is interested and he does have some ability to benefit from experiences involving numbers early in his life. He is born into a world of objects and verbal labels; parents often begin early to acquaint him with these kinds of things and preschool programs could also focus more in this area of subject matter.

There is interest and some ability in the preschool child to deal with numbers. There are factors within and outside of the child which could possibly play major roles in the development of this concept. Some of these factors might be age, sex, and experience. With the preschool child these stand out as the most universal influences of early development. They are definite factors, but we do not know what their full impact may be.

There is also a need to have a better understanding of how best to present and teach new concepts to preschool children. Complex situations seem to make learning of specific concepts more difficult. Simple learning situations, focused on a precise problem, seem to be more productive. Presentation of two concepts simultaneously to a child has been thought of as confusing, demanding, and less valuable than when one concept is presented singularly. With the increased demands on teachers and children in the present educational climate, it is imperative that we discover what factors influence, positively and negatively, the cognitive development of our children.

Statement of the Problem

This exploratory research will deal with the factors of the child's age and sex in an attempt to assess what role they each play in the development of number concepts in preschool children. It will also be concerned with what effect the introduction of two concepts--number and color--has on the child's perceptions of what is presented. This research is an attempt to identify factors which affect the learning and teaching of basic concepts of number to preschool children.

Objectives

The main objective of this research is to explore a selected aspect of children's conceptual development of numbers. There will be an attempt to identify factors which may be present in the beginning stages of number concept development. More specifically, the research will focus on:

1. A comparison of the number recognition abilities of three-year-old children with four-year-old children.

2. A comparison of the counting abilities of the three-year-old children with the four-year-old children.

3. A comparison of preschool children's abilities to correctly identify specified numbers of objects when presented with all objects being of one color as opposed to the same numbers of objects being presented in two colors.

4. An investigation of which numbers preschool children are best able to correctly identify and use in counting at three years of age and at four years of age.

5. An investigation of sex differences in counting ability and number recognition skill at three years of age and at four years of age.

Hypotheses

The research hypotheses for this investigation are:

1. As more objects are presented the difficulty of counting and labeling them correctly will increase.

2. Preschool children will recognize and be able to correctly label five objects better than the two larger numbers of objects

or the smaller number of objects presented.

3. Children in the four-year-old group will make fewer errors in the counting and identification of numbers than will the children in the three-year-old age group.

4. The girls of both age groups will make fewer errors in counting and number identification than will the boys of the same age groups.

5. Preschool children will make fewer errors in identifying numbers of objects all of one color as compared with numbers of objects presented in two colors.

REVIEW OF LITERATURE

The main areas which are covered in this representative review of literature are: general concept development; number concept development; conservation; perception; enumeration; and the effects of color on concept development.

Concept Development

The specific definitions of a concept are as varied as the number of persons writing them. Lyle E. Bourne, Jr. gives this definition:

> . . . a concept exists whenever two or more distinguishable objects or events have been grouped or classified together and set apart from other objects on the basis of some common feature or property characteristic of each. (Bourne, 1966, p. 22)

The above definition describes the conditions surrounding a concept which lead to the explanation of what the concept is. A very simple explanation of a concept is also given by Bourne (1966, p. 3) as he states: "A concept is a category of things."

Concept development is a rather general phase of intellectual growth; the development of specific concepts deal with a rather wide range of circumstances and processes. It is not accomplished completely through internal maturation or environmental factors. As Bruner (1964, p. 286) tells us, "Cognitive growth, then, is in a major way from the outside in as well as from the inside out." Therefore, as Piaget (Flavell, 1963) tells us, the development of logical notions is first evidenced in overt activities and later is internalized when the child is ready to effectively deal with the abstractness involved in conceptual thinking. Kohlberg (1968) describes the cognitive-developmental theory of interaction: there is an interaction between the organism and his environment from which basic mental structures develop. This view does not wholly support the idea of innate developmental patterns, nor does it completely rely on the stimulus-response patterns involving the outer or external experiences of the organism. Heredity and environment both play their part.

Concepts do exist and are constantly developing, but what is actually involved in concept development?

> First of all, concepts do not come into existence suddenly and spontaneously. Although the basis for a concept may exist in the environment, in the form of things which illustrate it, and although the organism may have the intellectual capacity to "understand" the concept, some learning process has to take place before the concept exists for the organism. Most concepts, if not all, are acquired. (Bourne, 1966, pp. 2-3)

We are constantly acquiring new concepts and striving to do so because as Bourne (1966, p. 2) indicated: "Concepts code things into a smaller number of categories and thus simplify the environment to some degree." For the young child just beginning to try to organize his world and learn to function effectively in it, concept development is a continuous process. Bourne (1966, pp. 13-15) has distinguished three important aspects in the development of a concept; the first is that of perceptual learning which involves the senses and general feelings about the world. In order to differentiate between all of these the child must then learn to label specifically and identify the attritubes of the experience or object. After labeling is accomplished and discrimination abilities increase the child is then ready to utilize the perceptual cues and the unique known attributes in identifying the concept or object.

Irving Sigel specifies the role of concepts.

> . . . concepts serve as crucial links between the environment and the individual. They are intellectual tools that man uses in organizing his environment and attacking his problems. When man employs concepts, he thinks in terms of symbols and classes. When he orders diversity into classes or categories, he begins to reduce ambiguity and imprecision. (Sigel, 1964, p. 209)

The above explanation is characteristic of the more American view of concepts. Piaget is a French cognitive psychologist and differs somewhat in his definition of a concept. Earl B. Hunt points out a difference between this type of definition and Piaget's.

> He uses the term <u>concept</u> within this system. But he appears to mean something quite different from the meaning implied by the studies of concept learning in American experimental psychology. For Piaget, a "concept" is an explanatory rule, or law, by which a relation between two or more events may be described. (Hunt, 1962, pp. 7-8)

A concept to Piaget indicates that logical thought processes are emerging within the child which allows this child to free himself from completely perceptual impressions and begin to take on more adult modes of thinking. This involves less egocentric thought and an ability to reconstruct absent objects or to use his memory. The child can experiment in his mind without manipulating concrete objects; he is further able to consider things from a point or view other than his past egocentric view. The child also begins to perceive relations which exist between objects or processes (Baldwin, 1955).

Based on his theory and experimentation Piaget has set up distinct phases of conceptual development which a child passes through during his early years of life and continues on through the middle childhood years. Sigel (1964) describes these phases as follows. The first phase is that of the sensory-motor period. This involves the first two years of life. The child is primarily a reflexive organism at birth and his task during this period is to learn to coordinate and perceive his actions with those of his environment. He begins to interact with his environment and develops the idea that he is a separate being from his surroundings and that he is capable of acting on his environment. Learning about his environment and its properties consume most of the time of the child during this first phase.

The second phase is that of preoperational thought and extends from age two through age seven. The preoperational phase involves the years from age two through age four. His capacity for symbolic activity develops during this earlier phase of the second intellectual period of his life. His thought is not mature, but rather it is still very egocentric. His perceptions are very important and his concerns with the world involve one characteristic at a time. Things are taken at face value and viewed perceptually. The second phase within the preoperational stage encompasses the years from four to seven and is labeled as the intuitive phase. This is a transitional phase from the egocentric and perceptual views of the world to a more mature form of thinking which involves some symbolic functioning. There is still egocentric thought and perceptual thinking but it is not as influential; his more mature ways of thinking involve thinking in classes, seeing relationships and an ability to begin to work with number concepts. His categorization is still based on one characteristic at a time, but the child is able to recognize more than one basis of similarity for organization.

Concrete operations extend from seven to eleven years of age in the child. Logic begins to emerge through reasoning processes. His capabilities now include an ability to reverse, classify, and seriate. An awareness of conservation is important in this phase. This is an understanding that even though order, shape, or some other characteristic of arrangement changes the amount does not change. An ability to recognize this involves a much smaller amount of perceptual concern. The organization of the child's world is now much more stable and coherent as he begins to categorize objects much more logically and to also make use of the conceptual frameworks he has acquired.

The final period is that of formal operations. The children who are involved in this phase range in age from eleven to fifteen years. This is where true logic emerges and the child begins to think abstractly and to conceptualize. His intellectual skills increase greatly and the child's thought processes now approximate those of adults. This is the culmination of Piaget's developmental phases of intellectual development.

Concept development is a long and involved process of thought. The development of specific concepts follows the same general pattern of development; however, depending upon the complexity of the concept and the theory one is studying the age and stage factors are varied. The above explanation of Piaget's stages of intellectual development is one that has gained wide acceptance on a general plane. There is criticism of the rigidity and sequence-bound stages of Piaget. However, most of the research in this area substantiates the existence of these phases.

Number Concept Development

As has been indicated there is presently a great deal of interest in and emphasis placed on cognitive growth. With this emphasis has come a considerable amount of research dealing with children's mental processes. Piaget stands out as a very prominent figure in this field. He has provided a great deal of useful information to those concerned with the intellectual processes of children.

Piaget (Flavell, 1963) considers number concept development as being far more complex than the verbal use of numbers. His theory emphasizes the child's readiness to learn about numbers--not his achievement.

Piaget (1952, p. viii) states his hypothesis as: "Our hypothesis is that the construction of number goes hand-in-hand with the development of logic, and that a pre-numerical period corresponds to the pre-logical level." This stage encompases the two to four-year-old age group. The child is egocentric and tends to judge things as they appear to him with no consideration for any other factors which might enter into the situation. At this age he is beginning to also recognize causes and effects; however, these are not yet logical interpretations. They are based very much on the child's perceptions. Previously the child has achieved a sense of object permanence and a sense of self; he realizes that he is a separate being and that he has the power to effect changes in his environment. These concepts usually develop by the second birthday and found in them are some of the beginnings of logical thought. The child must have these ideas well in mind before he can move on to the next steps of grouping objects and of being able to recognize the whole, its parts and the relationships between them.

David Elkind (1964, p. 288) tells of the importance Piaget places on the understanding of the self: "According to Piaget's psychology, conceptualizing ability derives from the internalization of the child's own actions; stages in the development of particular conceptions reveal the sequence of this internalization." He further discusses the child's experiences early in life in dealing with recognizing that there are parts to a whole. He cites the example of an infant being unable to recognize that the nipple of his bottle is still a part of the bottle when it is turned around and the bottom faces the child. Small experiences of this type face the child continually and through them he begins to recognize the relationships that exist about him. Actually one must not begin with the preconceptual stage in looking for thought patterns and experiences which are vital to the development of logic and concepts, but rather the beginning is in the sensori-motor phase.

In summary one might assert that a child must (1) discover a sense of separateness or self, (2) recognize object permanence, (3) begin to form the idea of the existence of relationships and recognize them in his environment, and (4) use his perceptions as a means of judging and recognizing the whole as being composed of parts. These are the fundamental developmental tasks of the child under about four years of age and they form the first important foundations for cognitive processes. Once these are laid the child moves on to higher and more complex processes.

Piaget (1952, p. 243) says: ". . . number seems to be the synthesis of class and asymmetrical relation." Class is interpreted as meaning classification and the asymmetrical relations involve seriation. When class and seriation begin to develop one might say that number concepts are also forming. Piaget (1952) views these developments as complementary and developing together, only in different directions. He perceives a very strong relationship to exist. Piaget (Almy, Chittenden, and Miller, 1966) recognizes their importance to number concept development on the basis that one must be able to classify or to combine objects on the basis of sameness and to also seriate or order on the basis of differences. These are basic to understanding the relationships which exist in numbers.

Elkind (1964) feels that conceptualization is derived from the child's understandings and internalization of grouping, ordering, and counting actions. Weaver (1967) agrees that classification and categorization are "highly relevant" in the development of mathematical concepts.

Dodwell (1960) further elaborates on the necessary conditions for the development of number concepts.

> Specifically, operations which are necessary conditions of an understanding of numbers are, according to Piaget, the ability to deal with the equivalence of cardinal classes in terms of one-to-one correspondence, and the ability to deal with transitive relations such as "greater than" and "less than." (Dodwell, 1960, p. 193)

He further indicates that the child needs to be able to make judgments about perceived patterns and not have them unduly influence him. The child must also be able to seriate and classify objects on the basis of a specific attribute. An understanding of relative positions in the series is required.

Elkind (1964) points out another aspect of importance in number concept development. This is the need to understand reversibility and to recognize the need for reversibility of thought when the child considers the whole and the parts as well as inclusion of elements in more than one class.

Conservation and counting ability also play important parts in the understanding of number concepts. Maier, in describing Piaget's theory of cognitive development, brings up an interesting thought:

> Although it may seem self-evident, it is important to state that a child of preschool age may know how to count, even though he has no concept of numbers. A year or so later, he usually acquires a concept of numbers regardless of his capability in counting. (Maier, 1965, p. 119)

Piaget stresses the importance of development of the nation of conservation here, and feels that once this is developed within the child, then counting will come.

Halasa (1967, p. 2607B) did a study which involved disadvantaged children and found that, "Understanding of relational quantity terms and rote counting ability were not totally sufficient for judgment of equivalence. However, Ss /Subjects/ who could judge equivalence showed a better understanding of relational quantity terms and more developed rote counting ability." This does not disagree with Piaget's statement, but it does point out that a role is played by counting abilities in judging amounts.

Wohlwill and Lowe tie counting experiences into the development of conservation in this way:

> . . . as a child obtains increasing experience in counting numeral collections of different types and in different arrangements, he gradually learns

> that alterations in the perceptual dimensions of a set do not change its <u>number</u>, i.e., that the same number is obtained from counting the set after as before such a change. Accordingly, systematic reinforced practice in counting rows of elements prior to and subsequent to changes in the length of the rows should promote conservation. (Wohlwill and Lowe, 1962, p. 32)

Kohlberg (1968, p. 1037) also acknowledged the role of counting, but he considers it as being a "prerequisite to arithmetic operations." Kohlberg (1968, p. 1036) feels that Piaget is correct in his natural development sequence and in Piaget's "stress on understanding rather than the rote learning of habits."

Verbalization and teaching of some aspects is also a factor to consider in number concept development. Mermelstein (1965) studied the number concept development of children who had not had formal schooling. His findings were that on the non-verbal tasks there was no effect from lack of formal schooling. The presence or absence of language is a relevant variable when considering the role of schooling in number concept development. The findings were that more of these children passed the non-verbal tasks than passed the verbal tasks; however, schooling did not effect the sequence of the stages or the general ages for number concept development. This would tend to support Piaget's theory of the internal development process involved.

Lovell (1961, p. 29) tells the reader, ". . . for Piaget the concept of number is not based on images or on mere ability to use symbols verbally, but on the formation and systematization in the mind of two operations: classification and seriation." The child first overtly evidences his mathematical abilities in his activities; then they later take on conceptual characteristics. They have then been internalized and definite patterns are emerging. Before this internalization can take place the child must form concrete classifications through comparisons and forming relationships. The child must be able to understand the concrete before he can move to the abstract which encompasses logical operations. Piaget feels that the eventual conception of number is built on these simple logical processes which begin early. The child goes through a great deal of trial and error behavior; however, this is very important in his eventual coordination of relations and formation of definite patterns.

Zimiles (1963, p. 695) refers to this process as one of continuous development which unfolds in a continuous manner. It is a process of culminative experiences, not specific individual ones. Piaget tends to discount the role of experiences on the development of logical thought or of specific concept development. He summarizes his views on the evolvement of the concept of numbers in the following way:

> It is a great mistake to suppose that a child acquires the notion of number and other mathematical concepts just from teaching. On the contrary, to a remarkable degree he develops them himself, independently and spontaneously. When adults try to impose mathematical concepts on the child prematurely, his learning is merely verbal; true understanding of them comes only with his mental growth. (Piaget, 1953, p. 74)

Some other experiments (Wohlwill, 1960) on the sequence of number concept development tasks has shown that the mastery of the tasks is not related to or due to learning tasks or experiences in school. Some children who could count and work with numbers were unable to pass some very low level tasks considered important to logical thinking. Success on some of the higher tasks is definitely related to age (the older children are, the better they perform). However, in the beginning stages of number concept development and until processes were established there were no sex differences found in the development of these concepts (Dodwell, 1962; Elkind, 1964).

Lovell explains what Piaget and others feel to be the significant aspect of number concept development:

> In short, children must grasp the principle of conservation of quantity before they can develop the concept of number. Now conservation of quantity of course is not in itself a numerical notion; rather, it is a logical concept. (Lovell, 1961, pp. 305-306)

Piaget formulated the stages of conservation development which are discussed in another section of this review. Wohlwill (1960) has also formulated three major stages in the evolution of number concept development which pattern after Piaget's original stages. The first part of the stage is the "wholly perceptual approach," the second part he calls a conceptual approach to individual members, and the final part is a conceptualization of the relationships among individual members. This organization proceded from perceptions of individuals to relationships among them.

During this period which involves the child from four to seven years of age discrimination, seriation, and numeration become important. Piaget (1952) found that children could discriminate (usually between largest and smallest) when they were four years of age; seriation and numeration came later at six to seven years of age. It is interesting to note that the development was almost yearly in the sequence of the three stages. On seriation and numeration the four-year-old child was very limited in correct responses, the five-year-old was beginning to evidence some understandings under certain conditions (especially that of being able to look at the objects and to know that they were unchanged) and then the six to seven-year-old child becomes very adept at making correct responses.

Elkind (1964) reports his findings on the stages to agree very closely with Piaget's. He explains his stages in some detail:

> Stage I (age 4 years)--general impression of series; whole and parts undifferentiated; perceptual impressions; when something is destroyed he no longer believes in its existence; generally has correct individual size relations; inability to order pairs of relations; and problems in forming mental representations and coordinating relations.
>
> Stage II (age 5 years)--trial and error behavior; very important; begins coordination of relations; concept of the whole being made up parts; cannot insert a second series into one already intact.
>
> Stage III (age 6-7 years)--ordering internalized and operational; combines perception and mental attitudes; can seriate in both directions with few errors; and can add more to a series when it is "complete." He also presents his stages of numeration in the same manner.

Terada (1967) did research with the mentally retarded child's number concept development and found that they develop more slowly than those of the normal child; also it was found that the retarded child is dominated more by perceptual judgments than is the normal child.

The Japanese researcher feels that parents, early teaching of the child in the home, experiences with numbers and education are very important in the development of number concepts. There is a tendency for these researchers to criticize what they call the "overemphasis on Piaget." They also make an important point on what number concepts actually involve.

> Finally, they indicate that the essential characteristic of the number concept is not the abstraction of numerical cues, but the awareness of the correspondence between numerical operations and the operation of relationships between concrete objects. (Fujinaga, Hisataka, and Hosoya, 1964, p. 21)

Another researcher who is not so affirmative of Piaget's theory and stages is Betsy Estes. Her work of 1956 did not support the stages of Piaget; she found no stages in number concept development at all. There was a negative note in her research. Many other writers who have reviewed the literature in this area indicate that these results may be due to her methods or procedures which are questioned. Other researchers do find slight discrepancies; however, this is the only one the author encountered who was able to completely disprove Piaget's stages.

Dodwell does not feel that the stages are as rigid as Piaget reports them to be. Dodwell (1961) feels that the experiences of the child may have an effect on the rate in which the number concepts develop. This researcher as well as others have not discovered any sex differences in this area of cognitive development; it is also important to note that some age differences and some intelligence differences have been found. The older and more intelligent the child is the more rapid and complete his conservation and logical thinking development is.

Braine (1964) has found that the ages Piaget sets up for entering the developmental sequences are about two years slow for his sample.

There are indications from other research reports that the age ranges are a little high for accomplishment of these tasks.

Peters (1967) summarizes Piaget's stages as: Stage I--rough figural representations or approximations, a global approach; Stage II--the establishment of one-to-one correspondence and equality; and Stage III--understanding of equality after visual destruction of object or objects.

Deese tells the reader that:

> Numbers are difficult to attain because the instances of them are embodied in concrete objects rather than being concrete objects themselves. Thus, the concept of "two" might be exemplified by two spoons or two rabbits. (Deese, 1958, p. 293)

It is very abstract, yet it can be "embodied" in something which is very concrete, yet variable.

Ann Bravo (1965) wrote an article discussing the number experiences of early childhood which are involved in later arithmetic teaching or learning. The discussion of the many events and objects concerned with numbers which a child encounters in one hour are fascinating. She (Bravo, 1965, p. 58) then tells her reader: "Children who have been alerted to the number experiences they are having will soon be able to understand them, verbalize them, demonstrate them, enjoy them, build on them, and finally use them abstractly with ease." Teachers must plan for this.

Conservation

Lovell tells us that:

> . . . the child comes to realize, as a result of age and experience, that the amount of milk in a cup,

> the quantity of sand in a pit, the lump of plasticine that he sees on the table remains the same, at least for very short periods, if nothing is added or taken away, and if the substance is not disturbed in any way. (Lovell, 1961, p. 291)

Very early the child realizes constancy, but Piaget maintains that a child usually does not appear to understand the concept that the quantity is the same when the shape or spatial arrangement has changed until about seven or eight years of age. Before this age the child is largely influenced by his perceptions of the object and he only is able to consider one aspect or dimension at a time.

The ability to recognize that although a change has occurred on one dimension of an object it otherwise remains constant, is referred to as conservation. Almy, Chittenden and Miller (1966, p. 23) explain it: "Crucial to the child's mathematical understanding and indeed to all his rational activity, in the view of Piaget, is his grasp of the principle of conservation, an awareness of whatever remains the same when something changes." Gruen (1965, p. 963) remarks: "Conservation refers to the realization that a particular dimension of an object may remain invariant under changes in other irrelevant dimensions."

An example of this is pouring a liquid from a tall thin container to one that is short and wide or just the opposite from the first one. Although a young child may observe the activity of pouring, he may maintain that there was more in the tall thin container than now is in the short wide one. This is one of the early tasks in conservation testing. One can readily recognize the part that perception plays in this type of response. Other examples are found in making a "pancake" or a "sausage" from a ball of clay and then asking which is the largest or which is the smallest or are they the same. Having items in one-to-one correspondence and then spacing one group wider than the other also creates perceptual differences for the younger child or the one who is considered unable to conserve.

Roeper and Sigel (1966, p. 341) tell us that a child must recognize that an object may have more than one classification and keep this in mind when observing the object change forms. "In other words, the child must draw his conclusions according to certain orderly laws that he has become aware of, and he must not let visual evidence overrule his judgment."

Barbara Rothenberg (1969) has an interesting comment on conservation. She feels that in acquiring an understanding of conservation the child must consider the differences between reality and appearances. Trust in self and reasoning are important aspects in the development of conservation. In an article by Wallach, Wall, and Anderson (1967) they discuss the need for the child to recognize logical processes such as irreversibility and to also begin to distinguish between appropriate and inappropriate cues and then to respond only to the appropriate cues regardless of what he perceives.

Piaget (1952) maintains that conservation is an internal process placing things in relationship. On the other hand Wallach and Sprott (1965, p. 1057) have another point of view: "Current learning theories would suggest as the most likely possibilities that conservation is learning from direct observation or social reinforcement."

Even though Piaget maintains that conservation is an internal process it is not entirely maturational as Elkind (1961, p. 18) now indicates: "In Piaget's theory, therefore, the discovery of conservation is limited both by the maturational level of the subject and by the properties of the object and in this sense it is both a nature and nurture theory."

As Roeper and Sigel (1966, p. 341) indicate, "Piaget also notes that conservation occurs at different times in different areas." This is in agreement with what Elkind had to say when he commented on the properties of the object influencing the development of conservation.

Some current research has hypothesized that Piaget's principle of reversibility might be an important factor in the development of conservation. Wallach and Sprott (1965, p. 1058) tell us: "The recognition that changes in form or arrangement are reversible may play a critical role in the realization that they do not imply changes in amount or number." In other words, when something changes, it may be returned to its original form once again. Clay is a good example of this. As well as returning to the original shape the amount also remains unchanged. This application of the process of reversibility may not be the only one. It could also apply to a child's being able to do number tasks, that is, when he is still working in the trial-and-error stage and a mistake is made in some task he is able to return to his starting point with none of the factors changing. It is considered to be a part of the deductive process of reasoning and allows us to perform many tasks mentally. Wallach and Sprott (1965) remark that some children are observed to appear as if they still "see" the former and they have an expectation that things will return to this former state. There appears to be a recognition that the inverse operation will make the original reappear.

There has been some question as to whether this process of conservation appears or is developed and whether it applies to all situations. Piaget feels that it holds in all situations once it is attained, while Lovell (1961, p. 295) tells the reader that: "It seems rather, that the concept is applicable only in highly specific situations at first, and that it increases in depth and complexity with experience and maturation." However, regardless of whether it is an all or none thing, it must be remembered that it is an essential step in the conceptualization process and it forms the basic framework for later number reasoning.

Zimiles (1963) tells the reader that before conservation develops there is a concept of quantity which is already in existence. This concept is based on a child's perception of such things as length, density, height, or weight. In the young child there are many dimensions to this concept and as the child matures the concept becomes more clear and precise. The child's concept of quantity is definitely not adult-like in its beginning stages. He further gives an example of how adults still try to play on other adult's perceptions to create illusions of greater quantity. For instance, the glasses in restaurants sometimes are very thick, especially in the bottoms to give the illusion of a larger quantity of liquid being in the glass.

David Elkind (1967) has recently done some work on conservation to show that it has two distinct forms. They are (1) identity, and (2) equivalence. Elkind feels that Piaget fails to make a distinction between them and that he interprets one type (identity) when in his task he is assessing the other (equivalence). A more concrete example is as follows: given a standard conservation problem involving a ball of clay and then making a pancake from it, the subject never compares the ball of clay with the pancake directly. The experimenter infers that the child is making a response of identity conservation. However, given two balls of clay, one is made into a pancake while the other one remains constant and the subject then may make comparison; there is then no inference necessary from the experimenter. The response was clearly conservation of equivalence. Elkind summarizes his theory:

> To summarize, the conservation problem can be said to assess two types of conservation: equivalence and identity. The conservation of identity, however, must always be inferred from the child's response, whereas the conservation of equivalence is reflected directly in the child's judgments. Consequently, the conservation of identity would seem to be a necessary but not a sufficient condition for the attainment of equivalence conservation. The latter form of conservation would seem to require, in addition, the utilization of immediate past experience in the form of a deductive argument. (Elkind, 1967, p. 17)

Elkind feels that Piaget deals mainly with identity conservation and fails to explain how the children made equivalence judgments. He does deal with how they make identity judgments between past and present conditions. Another area he feels Piaget is weak in involving conservation is that he relies on verbal responses from the subjects for their explanation of how they arrived at their decision. He maintains that Piaget gets three types of verbal explanations, and they are as follows:

> 1. Nothing has been added or taken away so it is the same (identity);
> 2. If you make it like it was before it will be the same (reversibility);
> 3. What was lost in one way was gained in another (equation of differences or compensation). (Elkind, 1967, p. 20)

There are many forms of identity--not equivalence--conservation responses. The child is able to explain how he arrived at his solution to the problem, but he cannot explain the psychological processes involved. If the child never saw the transformation and merely saw the "before" and "after" results he would never arrive at equivalence conservation. These two forms in isolation and not shown with the process involved create illusions for the child. The child must also rely on his past experiences and deduction to attain equivalence conservation. It is felt that identity conservation precedes equivalence conservation and that they do not emerge simultaneously. In the process of acquiring these two types of conservation there appears to be a conflict between perceptions and operations. When the operational becomes stronger than the perceptual the conflict is resolved and logic becomes stronger and illusions less prominent.

Piaget has formulated three basic stages one must go through to attain conservation. There has been considerable agreement on the existence of the stages (Dodwell, 1960, 1961; Elkind, 1961; Wohlwill, 1960; Hood, 1962; Almy, Chittenden, and Miller, 1966). Recently Stommel (1966) did research with first grade children concerning conservation and number concept development; he found that there were few sex differences but big individual differences to be found. He confirmed Piaget's stages. Frances Benson (1967) found some deviant patterns but generally her results confirmed Piaget's stages. Her work was with number concept development in first grade children. Halasa (1967) considered the attainment of conservation in disadvantaged children; the findings of this research supported Piaget's general theory;

however, there was more overlapping of stages than Piaget indicated. Hans Furth in 1964 did research in the area of conservation in deaf children. His results tended to support the idea that language plays a big role in the development of conservation. He explains Piaget's view on the role of language in the development of conservation.

> While it is true that Piaget frequently uses verbal behavior as a criterion of intellectual functioning, he postulates no necessary connection between language and thinking. For Piaget, the advanced stages of logical development have their origins in non-verbal sensory-motor and imitative behavior. (Furth, 1964, p. 143)

It is his contention that Piaget does not give enough credit to the role of language in conservation development and he further sites the difference he found in the development of conservation in deaf children with that of hearing children. He found at least a one and one-half year's difference with the deaf child being this much slower in his development of this logical thinking.

Etuk (1967) did a doctoral study comparing Piaget's theory with the results that were found with children from Nigeria. The results generally upheld Piaget's theory and results. There were slight differences noted between the sexes, and between the achievement and the type of home (modern or traditional) that the child came from. In 1966 Quick did a study with mentally retarded subjects. His results indicated the same general trend of development in the sequences, but there was a slower rate of development among the retarded than among the "normal" group. There is a great deal of evidence to substantiate the stages and processes of intellectual development which Piaget has formulated.

His stages can be briefly defined as:

1. Absence of conservation
2. Intermediary reactions
3. Necessary conservation

What each stage entails is quite evident. He begins with the child of about four years of age. His performance on the conservation tasks usually place him in the first category of no conservation abilities. The children involved in the middle stage are generally from four to seven years of age and are beginning to show evidence of the process and are able to conserve in some situations. The children in the third stage are usually about seven years of age and they are placed here after they have attained conservation and logical thought processes.

Wohlwill (1960) describes the stages a little different; however, the content and pattern of the stages is the same. His first stage is the initial stage. It is a preconceptual stage and the responses of the children involved in this stage are mostly based on perceptions. The next stage he labels as the intermediary stage. Perceptions are reduced and some logic is evidencing itself. The final stage involves superordinate structures, abstract thinking and the emergence of number relations. The second stage is transitional. Sometimes it is of little importance while other times it plays a significant role and is very revealing in the process of concept development. Dodwell (1962) especially believes that while Piaget is correct in his descriptions of the stages, he is trying to make others believe that these stages exist neatly and rigidly, and in reality he is too idealistic. They just do not exist as neatly and rigidly as he proposes them. Lovell and Ogilvie (1960, p. 27) state, "But the stages are not clear cut; the borders between them are zones not lines."

Another area of concern involving conservation is that of training or inducing conservation in children. Kaplan (1967) did some research and work with disadvantaged children in trying to teach them number conservation. With this group he found that it was possible to train them, but that the effects were not lasting. He felt that a "continuous dose" of training might be more effective. Roeper and Sigel (1966) believe that in the training procedures used that some of the important prerequisites for conservation development are being left out. These they feel are multiple classification, reversibility, and seriation. They tried training these children in prerequisite operations and found results which were positive. They found that children might be able to be taught specific aspects of conservation but still be lacking in the general development which must eventually occur. Roeper and Sigel (1966, p. 345) summarize with: "The ability to conserve can be reached through the process of growth but can be facilitated by carefully planned education."

Harry Beilin attempted various types of training and concluded that:

> The training data reveal that training leads to a greater number of Ss who show improved performance, but mostly in the tasks for which they are trained. Conservation training is most likely to effect Ss who are at a transition level; those who are non-conservers or closest to "full" conservation are less likely to profit from such training. Training is not sufficient to make for extensive conservation across all tasks. The acquisition of conservation abilities appears to involve, then, a transaction in which experience in itself, although contributing considerably to improved performance, does not lead to a generalized conservation capacity. (Beilin, 1965, p. 380)

Conservation is entailed in the development of the individual and is dependent upon the emergence of logical capacities; however, there are experiences which can contribute to the development of this idea. Lovell (1961) stresses the role of play with sand, water, clay, and other such materials as well as vocabulary work on words and concepts such as "less," "same," "more," and others like these. There is something that persons involved with young children can do to help them develop this concept and be able to see its application more readily.

Enumeration

Enumeration is used in reference to counting objects, and numeration refers to the assignment of numerals to elements. Numeration requires the operations of seriation, classification, and ordering.

The majority of research in the area of counting ability has been done recently in Japan. Following are summaries from the research of some of these men. In 1953 Ikegami reported that learning of the number system is not based on intellectual development involving discrimination and generalizations, but that it is first taught to the child through traditional methods of counting. However, counting is independent of number concept development and precedes it. There is a slight relation. Shen (1962) found that an ability to count and number concept development are related but not the same. It was found that three and four-year-old children had some concepts of amounts at varying levels of understanding. Some conclusions were that number concept formation begins with oral counting. Some steps in this process were formulated as follows: (1) oral number counting, (2) counting of objects, (3) giving sums through counting, (4) selection of the same number as one shown to the child, and (5) selection of a number that the child has been prescribed to. The child first repeats the sequence of numbers then begins to understand the meaning, he discriminates then uses the numbers, and finally works with ideas of numbers which gradually evolve into conceptions.

Cheng and Lee (1960) did research with six-year-old and seven-year-old children and concluded that we should base the child's conception of numbers on his understanding of the real significance of the number. These authors strongly disagree with basing conception of numbers on the ages and stages of Piaget. They contend that education plays an important role in number concept development.

These Japanese research reports were not available to the author and English summaries of them were found in abstracted form. Iijima (1966) found through his research that: "The developmental sequence of the number concept appears to cover the following periods: (1) number operations not understood at all; (2) lower numbers are understood; (3) verbal labels understood; (4) ability to abstract numerical dimensions; and (5) understanding of the ordinal number and conservation concept" (Moore, 1965, p. 825). This researcher begins with the very basic understandings and then progresses to conservation; he does not discredit the stages which precede conservation.

Very little recent research in this country deals with counting or number recognition; the relations to this type of number understanding are marginal and only briefly mentioned in research reports. Gessell and Ilg (1943) and Ilg and Ames (1951) are about the only researchers who have presented any developmental schedules dealing with counting abilities in young children. A combination of the developmental trends which are reported in these two articles are synthesized and quoted as follows (Gesell and Ilg, 1943, p. 25; Ilg and Ames, 1951, p. 414):

6 months	"Single-minded when he plays with a block."
9 months	"Can hold and bring together two blocks and give attention to a third."
1 year	"Manipulates several cubes one-by-one in a serial manner which is the motor rudiment of counting."
18 months	Can build a tower of 3-4 cubes and uses the word "more."
2 years	"Distinguishes between one and many." Says "two balls" when handed a second ball.
2½ years	Counts rotely "1, 2," and "lots." Can give "just one" cube on request.
3 years	"Has a fair command of 'two' and is beginning to understand the simple word 'both.'" Can count two objects and can give "just two" cubes on request.
4 years	"Can count three objects, pointing correctly." Verbal counting without pointing exceeds counting of objects.
5 years	"Counts to ten, pointing correctly. He recites numbers in a series before he uses them intelligently." Most children can count 13 pennies and one-third can count to 30 or more. Most mistakes come after the number nine.

6 years	Can count to 100; can count by 10's to 100; can count by 5's to 50; can add correctly within 10; can subtract correctly within 5.
7 years	Can count by 5's and 10's to 100; can add within 20; can subtract within 10.
8 years	Can count by 2's to 20; can count by 3's to 30; can count by 4's to 50; can add within 25; can subtract within 25; can deal with simple fractions, multiplication and division.
9 years	Number concepts to 1,000 or beyond.

Another researcher who has indicated some importance in counting ability in the process of number concept development is Anita Riess. In 1943 she wrote articles and research reports on the number sense of young children. Riess (1943, p. 106) wrote that one of the functions of numbers in our lives is to serve as ". . . compensation for the shortcoming of our perceptual ability." This is in contrast to the contemporary feelings about counting and perception.

Anita Riess (1943, p. 150) stresses the great extent of number experiences which, serve as learning experiences, with which young children come in contact. Pre-numerical behavior begins early in a child's life as he experiences "aggregation" when he picks up objects and makes a pile and he then experiences the opposite of this which is "isolation" in taking away objects from the group one at a time. These experiences begin as nonverbalized and then evolve into more verbal expressions. Riess further comments on the young child's ability to respond to or imitate successive numbers of physical movements when he may not yet be able to respond correctly when asked to reproduce two objects when they are simultaneously presented. Riess (1943, p. 151) concludes that on the basis of this, the ability of the child to respond to successive larger numbers of objects as compared to his response ability to simultaneous reproductions indicates ". . . that the perception of successiveness is a forerunner of conception of 'number' in the collective sense." It seems to be a "readiness for counting" step.

Adults emphasize number names early in the child's life and call attention to numbers of objects and the number names for each one. Thus the child learns to count very early, but he is not really counting but rather "naming" objects. At about this same time the child experiences a lot of verbal encouragement from adults as he is taught to name almost everything he comes in contact with. Toys have names, people have names, actions have names; number naming is an extension of this at first; the child separates and names each object. This naming of objects with number labels is done first in classes, then separately. At first all of the objects have the same name and it is generally "one"; then objects are identified separately and a name is given to each one. However, another interesting thing happens in this phase of naming, and this is that a child tends to name an object and then will continue to use that name for this object in any sequence or context. An example given by this author was that of counting marbles and the blue marble is "five" in the counting sequence. There is often a tendency for the child to maintain the label of "five" for blue marbles and repeat this when he encounters it again.

Young children between two and one-half and three years of age can give three objects to a person upon request but they cannot look at the number of objects and tell that person how many objects are in that pile; they must pick them up and count them in order to identify the amount. Riess (1943, p. 153) indicates that "the number words have, however, still only an individual naming function, and do not yet symbolize the specific structure of the group."

As adults use numbers in different ways with the children the children become familiar with a variety of ways in which to use numbers. They learn to respond to different cues and begin making more selective responses with numbers. The notion of position and sequence begin the slow transition in the child's mind which involves his ability to name and to also apply these names in the correct sequence; he begins to order, and with this comes an understanding that objects can have different names as sequence and placement change. The transition from objects to symbols begins here. Riess points out that:

> Though children continue to solve their computation problems through a counting procedure, they no longer number the different series of objects but match the items that are added or are taken away to the invariant numeral series which serves as a ready mental abacus on which to count. (Riess, 1943a, p. 156)

This is the early beginnings of adding. Subtracting follows later and is more difficult. The difficulty of subtracting causes the child to regress to counting the objects; however, he must count in the opposite direction. The grouping function of cardinal numbers follows this and Riess (1943, p. 158) feels that "the development of the grouping function is thus intimately tied up with practice in counting."

In a later article Anita Riess (1957) indicated the need for pleasurable experiences with numbers early in the child's life. There are songs, stories, nursery rhymes, and poems which stress number names. The need to manipulate numbers of objects and to become aware of words such as "many," "few," and "more," are important. Even though number words are just a part of the child's language at that time it is important that he become able to speak readily and to use them freely. He thus begins to understand numbers gradually; at first there is little understanding of the subtle implications of the words, but this comes as he manipulates objects and the language as well as grows and develops. Riess (1943, p. 53) sums up with the following statement: "Meaning of number words like meaning of all words--is established in active behavior of the child, since no one creates ideas in the child's mind, but the child himself."

More current writers commenting on the counting abilities of young children and their development include Corwin E. Bjonerud who found in a study of beginning kindergarten children that:

> These beginning kindergarten children possessed considerable understanding of number selection skills and were able to recognize a quantity of items numbering less than four immediately. Some were able to recognize more than four items, but less than nine items. All of the children were able to select quantities of three or less. The majority of the children resorted to counting the objects one at a time, but a few were able to group items for quicker and more efficient recognition. (Bjonerud, 1960, p. 349)

Therefore, these children did have an understanding of numbers in that they could find out how many through counting or grouping smaller amounts. Williams (1965) found that there was a "substantial relationship" between rote counting ability and math achievement of kindergarten subjects.

Beckwith and Restle (1966) indicate that there is more to counting than it is given credit for. They point out the need for more literature on counting in young children as they feel that the ability to enumerate sets lies at the foundation of applied arithmetic. It involves a chant of the numbers in sequence as well as pointing to each object and recognizing that it has been labeled. There is a chain of responses and the child must be able to recognize when all of the objects have been counted and then quit labeling as well as recall the number name for the last object labeled. They must be able to discriminate between the set which has been counted and the set which has not been counted. This involves what they describe as "perceptual control" (Beckwith and Restle, 1966, p. 437).

Newport (1967) feels that good early experiences with number words and objects provides a good basis for later arithmetic achievement. He suggests general experiences and vocabulary in number labels early in the child's life.

McLaughlin (1935) wrote a very informative article on the number ability of preschool children. In her research she had the children, who ranged in age from three to six years of age, count verbally, count cubes, and count verbally backwards. The author distinguished between rational and rote counting.

> Rote counting employs simple recall of verbal numerals in correct serial order, but rational counting uses this function and besides, requires the matching or tallying of the correct verbal numerals with the corresponding objects being discriminated. That is, rational counting employs a relational form of thinking which holds the two factors, number names and discriminated objects, together in a one-to-one relation. (McLaughlin, 1935, p. 350)

McLaughlin (1935) found that for the younger subjects the formation of groups was easier than the naming of the objects; they could match correctly to about three then they supplied handfuls of objects in the formation of their groups. When the author asked the question of "How many?", the younger children were quick to begin counting while the older groups of children were able to recognize one, two, or three objects in a group at sight. This was the beginning of grouping. More abstractness is involved in understanding cardinal numbers than is required for serial counting. There was also the need to be able to generalize as well as think abstractly in formation of number concepts. An increase in age increased the ability to understand numbers. In the younger groups the most common errors were in not remembering correct number terms, not being able to keep their place while counting, and confusing the terms with their correct object or not matching the number with the object. Another comment she made on rote and rational counting was:

> Rote counting has been shown to develop just slightly in advance of rational counting. It involves the memorization and accurate recall of a fixed order of numerical terms. Rational counting is a complex mental process dependent upon grasping the idea of one-to-one relation between these numeral terms and the items discriminated in an objective series. (McLaughlin, 1935, p. 352)

In the present preschool education system there is one program which originated with Carl Bereiter and Siegfried Engelmann (n.d.) that makes use of the preschool child's ability to use number labels and to count. In their program for disadvantages children they stress teaching numbers much as one would teach a second language to children. They feel that counting does have an important place in the development of numerical understandings, that it is a "difficult task" and not learned quickly. They indicate that children often can count objects or their fingers, but this does not indicate they have any idea about what counting is for, that is to group and label objects, and to answer the question of "How many objects are there?"

There are two independent skills which are necessary and which must be combined for counting. The first skill is being able to recite the number names and the second is an ability to group the objects and then realize that the number label which they apply to this group indicates how many individual objects are there. The Bereiter and Engelmann approach is one which does emphasize the use of language and which sets up specific methods for teaching counting skills to the children; these are rote skills, but they feel that there is an important function in rote counting which is the opposite of the contemporary cognitive theories of number concept development (Bereiter and Engelmann, n.d., pp. 28-29).

The cognitive theorists do not discount the meaningfulness of rote counting altogether, but they feel that its importance is minor in comparison to other more logical thought processes.

Counting serves some special function in the concept development of number. It serves to make elements alike and makes the perceptual differences among them unimportant. However, when the elements are ranked or placed in positions the differences are maintained. Counting does not create numerical relationships, but rather it creates concrete materials. Each element becomes a unit and when seriation and classification have been applied to the units, numerical operations then result (Elkind, 1964).

Elkind (1964) further explains Piaget's stages in numeration development as follows: (1) this occurs at about age 4 and during this stage the child is unable to count correctly; (2) at about age five the child was able to count and indicate the number of objects when he could see them, but not when they were absent; and (3) from six to seven years of age the child develops an ability to tell how many objects there are both when they are in view and then when he cannot see them.

Elkind (1964) feels that children under four years of age are merely imitating adult behavior when they count. Wohlwill (1960) showed in his research that rote counting abilities do precede the conceptual understanding of numbers and that they are an important factor in later development. Hood (1962, p. 281) feels much like Elkind and tells his readers that "Correspondence between numerals and objects at this level may be purely verbal--just as the child can make the glasses correspond to the bottles, so he can make the names of the first six numerals correspond to the six glasses, etc." He is referring to experiments conducted during his study which dealt with the development of number in children.

When we assign cardinal values to numbers we are disregarding object differences and classifying the objects into a set. This cardinal value is discovered by enumeration. Once they are ordered they can be counted in sequence. If we order objects on the basis of differences, they are placed in ordinal position or ranked first, second, etc. Flavell (1963, p. 313) goes on to explain that ". . . a genuine concept of cardinal number is by no means guaranteed by the ability to mouth appropriate numerical terminology in the presence of a set of objects." This is the position held by Hood which was previously explained. It is extremely necessary to understand relationships before numbers can be understood. Numbers are not independent elements; they are related elements within an ordered series and they cannot be used or understood until these relationships are evident (Piaget, 1967).

Potter and Levy (1968, p. 272) tells us that: "In order to count a set of things, one must take each item in turn and pair it with a numeral in proper sequence." This requires three skills: (1) knowing names of numerals in correct order (under 2 can do); (2) ability to point to or look at each item in an array--one at a time until all have been taken exactly once; and (3) an ability to coordinate numbers 1 and 2. Potter recognizes that Piaget considers enumeration to be of little interest because children under six tend to think that number changes when there is a spatial change. Dodwell (1960, p. 203) feels like Piaget and feels that children are able to point to and correctly label objects and use the correct counting sequence for this, but he feels that more important than an ability to do this is the need for the child to understand that he has counted the objects, assessed the quantity and given it a verbal label, and that when there is a change in the arrangement of the objects that the number of objects remains the same. The child may then be able to correctly count and label objects without the understanding of what a cardinal number is or how it applies to the concrete situation presented to him. Almy (Almy, Chittenden, and Miller, 1966, p. 27) further explains that "Piaget asserts that neither a one-to-one exchange, where the child gives the experimenter one penny for each object, nor counting aloud is sufficient to insure equivalence before the child has reached an operational level of thinking."

Wohlwill (1960) found that counting abilities did precede the conceptual ability development in children and that some of the children who counted very well did very poorly on his tests where counting or number recognition was involved.

Potter and Levy (1968) hypothesized that the child begins his enumerating skill development between the ages of two and five years of age. She measured counting ability by having children count six stickers in a row in correct sequence and by pointing to each one correctly at the same time. The youngest child to succeed on the task was three-years and two-months in age. Fifty percent of the subjects succeeded by three-years seven-months and 70 percent succeeded by four years of age. She concluded that between the ages of two and one-half years and four years of age that there is a steady and dramatic increase in the ability of the child to correctly identify the number of items in the array.

Piaget (1967, p. 53) tells us: "We know that only the first numbers are assessible to the young child because these are intuitive numbers which correspond to perceptible figures." Here he makes reference to a child's knowing some smaller numbers earlier and possibly having an understanding of them because they represent something--this could possibly be the child's fingers or a few pennies. Wohlwill (1960) indicates that a child understands numbers of five or less quite a while before he is able to understand number amounts greater than five.

Piaget (1953, p. 304) relates the importance of conservation or understanding numbers in the following way: "Although the child knows the names of the numbers, he has not yet grasped the essential idea of number: namely that the number of objects in a group remains the same, is 'conserved,' no matter how they are shuffled or arranged."

Elkind (1964) feels that when a four-year-old child counts that he is actually imitating adult behavior. This notion is based on the idea that children of this age lack the principles of class, series, and seriated classes. They may exist, but it is not in the adult form. The child must be able to coordinate class and order relations first. Only when he can understand these conditions will he be able to understand what numbers represent and how they operate.

This evidence of not understanding concepts even though the child can count was shown in Wohlwill's study (1960) when children who could count were unable to pass even the lowest levels of his sequence test. Their rote counting abilities preceded their conceptual abilities. The importance of counting in children was not completely discounted because the author felt that once perceptions were beginning to lose importance and influence that the symbolic activity of counting was needed to move on to conservation and further number concept development.

The Effect of Color on Concept Attainment

It is generally felt that an increase in the complexity of the learning situation makes the attainment of the concept embodied there more difficult. This is based on the idea that the child has other variables which serve to take away the emphasis from the specific task or which overshadow it completely.

Brian and Goodenough (1929, p. 212) did a study with children from fourteen months to fourteen years, as well as adults. Their study concerned itself with the effect of color or form on perception. They found that children under the age of three years are more concerned with the form of the object, whereas when they reach about three years of age color is what gains dominance. In other words, if the child were asked to classify a group of objects the objects would most likely be classified on the basis of the color of the objects during the period in the child's life from three years to six years of age. Then the attribute of form comes back into dominance at about six years of age and maintains this into adulthood. They found that at four to four-and-one-half years of age 75 percent of the choices made by their subjects were on the basis of color while before and after the three to six year range the percent of responses made on color were only 10 percent or 16 percent. They further go on to explain the results they obtained in this study as follows:

> The early interest in form might then be explained upon the basis of the major importance of form in the child's first attempts at organizing and classifying the objects of his environment; the later interest in color because of its importance in making finer discriminations between objects within classes whose broader features he has already mastered; while the final swing toward form is the result of the gradual organization of the various attributes of a given situation in terms of those factors which experience has shown are most frequently effective in determining appropriateness of response. (Brian and Goodenough, 1929, p. 213)

Therefore, it appears that in different phases of the development of concepts there are different points of emphasis. Kagan and Lemkin (1961) did a study concerning different perceptual attributes of objects and the role they play in children's conceptual behavior. They found that there were no sex differences but that there were age differences within the sex groups. Older girls placed much less emphasis on color than did younger girls or boys. The older boys used color more often in their selections than did the girls of the same age groups. These sex differences found in the older age group was explained as possibly being due to the development of language being gaster in girls; therefore, they had more shape and form labels to use. Kagan and Lemkin (1961, p. 28) sum it up as: "Thus, for the girls, the stimuli are more likely to derive their meaning from the label attached to them rather than through the more direct physical quality of color."

Lee (1965) did a study concerning the ease of utilizing specific concepts in preschool children. The author found that there was a significant interaction between the child's age and the concept; there was no significant difference found in the interaction of the concept and the sex of the child. Children from three years of age to six years of age were the subjects used in this research. In their categorizing the older children made more mistakes with the color and size attributes of the object than on other attributes. This was felt to be due to the fact that the child was now aware of other aspects which could be used in classification of objects and that color and size had lost their importance.

METHODS AND PROCEDURES

Setting and Procedures

This research was exploratory; therefore, the procedures employed were more of a survey in an attempt to discover possible factors and relationships which might exist between counting ability and number concept development of preschool children.

After the formulation of this research project the data were gathered at the Utah State University Child Development Laboratories. From the total nursery school population 48 children were selected by the researcher on the basis of age only. Eight of the originally selected 48 subjects were not involved in the data reported here due to absences and/or refusals to participate. Three girls from the original selection did not participate for the following reasons: absences during testing sessions; refusal to leave the nursery school room with the researcher; no verbal response to the tasks or questions. There were also 5 boys not included in these data. The reasons for their not participating were: moved from the city and no longer attending the nursery school; Spanish-speaking and understood little English responding with "block" to each question or task; and three refusals to leave their play in the room. The other 40 children were eager to participate.

Each child who was presently three-years-four-months to three-years-eight-months or four-years-four-months to four-years-eight-months of age was selected to participate. There was no attempt to obtain a random sample because the age factor was a critical variable in the study. At the time of the selection there was first preference given to the age and then the sex of the child was considered, as an equal sex ratio was also desired. For the research reported here 40 subjects were involved; there were 20 in the three-year-old age group and 20 in the four-year-old age group. A reasonable sex distribution was achieved with 12 girls and 8 boys in the younger group and with 11 girls and 9 boys in the older age group. This distribution allowed for an analysis of possible sex differences and the age interval of one year provided for an analysis of the age factor in this area of concept development.

The subjects for this research were all attending the Utah State University Child Development Laboratories during the Winter Quarter of 1969. The total group was representative of the 6 separate laboratory groups which met for two and one-half hours daily, Monday through Thursday, in the Family Life Building. There were 3 laboratories with one morning and one afternoon group which met in each one. In each laboratory there were 1 head teacher, 4 student teachers, and 20 children ranging from three to five years of age. There were 10 boys and 10 girls of a representative age distribution in each laboratory. These children came from Logan city and nearby rural communities. They came from homes with the parental occupations ranging from professionals to students; however, there was a common parental interest in preschool education evidenced by the enrollment of the children from such diverse backgrounds.

As was previously indicated, children from each of the 6 laboratories were included in the research. Each laboratory was run individually under the direction of a head teacher, who is a member of the faculty in the Department of Family and Child Development. Different approaches to teaching were utilized within each laboratory providing a varied yet very similar background of experiences for the subjects within the laboratories. The philosophy of the Utah State University Child Development Laboratories is such that the researcher did not anticipate any formal teaching in the area of number recognition in any specific laboratory.

Development of the Test

To facilitate the task of looking at the preschool child's ability and methods of counting as well as what effect two colors of objects have on his perceptions of the amounts presented, the author devised a test which was used in the collection of the data presented here.

The word "number" will be used often in this research report. It should be pointed out that it does not refer to the written or printed symbol which denotes a certain value or amount, but rather it refers to providing a verbal label for a specified group of objects. Only objects were presented; symbols for numbers were never used. The interest of the researcher was in the ability of the preschool child to correctly enumerate the objects and then to provide them with their proper verbal label.

For the number recognition tasks 4 numbers were selected. The numbers were 4, 5, 7, and 8. Numbers 1, 2, and 3 were omitted because the author felt these would be the most familiar numbers to the preschool child, and that they would be easily and readily recognized. It was also felt that the researcher could assess the child's understanding and command of these 3 numbers by using the number 4. This number was selected also because it is a component part of all of the larger numbers used and it was felt that it might play a role in the identification of the tasks involving 2 colors of objects. Four is a number which begins to seem large to the child, yet it remains small enough to be easily handled and counted on the fingers of one hand. The number 5 was the first number selected for the tasks because of the researchers interest in it and the fact that it was hypothesized as being a meaningful number to the preschool child. The meaningfulness of the number 5 was felt to lie in its being a terminal number, that is, the child has 5 fingers and 5 toes per hand and foot. Also many of the nursery school songs and fingerplays deal with repetition of objects counted on the fingers. Some begin with 1 and count up to 5 while others begin on 5 and each time the rhyme is repeated 1 is eliminated, thus the child counts backwards from 5 to 1. It was felt by the researcher that this might possibly be the basis for an interesting and important hypothesis. It is a familiar number or number label which might be comparable in importance or use to the child's age number.

The number 7 was selected as being a large number and more than the next consecutive one to 5. The author also desired an odd-even combination of colored blocks on the second set of tasks; 5 served this purpose for the smaller numbers and 7 filled the position for the larger numbers. The last number was 8. It was the large number with even component parts for use in the 2 color test serving the same purpose as 4 in the smaller group. The number 8 was felt to be the most difficult of the 4 numbers selected for preschool children to handle.

The researcher constructed 8 separate objects to be used as tasks. All were uniform in size and general appearance. Each consisted of a wooden base that measured 14 inches by 3 inches. The color of each base was medium brown. Glued to each wooden base were specified numbers of 1 inch cubes. On the first 4 tasks all of the cubes were of natural wood color and arranged in a centrally located straight line on a wooden base. The cubes were each equally spaced depending on the specified number of cubes required for each task. All cubes were uniformly spaced: 1 inch from each end, 1 inch from each side of the base, and at equal distances from each other, depending on the number of cubes presented in the task. External measurements were uniform, but internal spacing differed due to the difference in the number of cubes being used per task. The placement and spacing was the same on both sets of tasks; the only difference was found in the placement of red cubes with the natural color ones on the second series of tests.

Two bases held 4 cubes each. One held only natural color cubes while the other one held 2 red cubes followed by 2 natural color cubes. Two bases held 5 cubes each. One held only natural color cubes while the other one held 3 red cubes followed by 2 natural color cubes. Two bases held 7 cubes. One held only natural color cubes while the other one held 4 red cubes followed by 3 natural color cubes. Two bases held 8 cubes each. One held only natural color cubes while the other one held 4 red cubes followed by 4 natural color cubes.

The sequence of presentation of tasks to the subjects was as follows: 4 cubes--natural color, 7 cubes--natural color, 5 cubes--natural color, 8 cubes--natural color, 4 cubes--combined colors, 7 cubes--combined colors, 5 cubes--combined colors, and 8 cubes--combined colors. The tasks were not presented to the subject in the sequential order of counting, but slightly altered to eliminate the possibility of the child's relying on the natural counting sequence of the numbers which he may have rotely mastered. That is, the task involving 5 cubes did not follow the one involving 4 cubes, and 7 cubes did not precede 8 cubes. The order was consistent throughout the testing of the complete number of subjects. The tasks were presented separately to the child in the sequence listed above. As the child completed the first task the cubes were removed and the next task was presented until he had completed the 8 tasks.

The author was interested in discovering the different methods employed by the children in arriving at the response they gave for each task. The data collection sheet provided a means for the researcher to indicate the child's response and how she observed the child arrive at the answer given.

A second area of interest was that of the preschool child's counting ability. To investigate this area, each child was asked to verbally count after he had completed the 8 tasks. The researcher said: "Let me hear you count as far as you can." As the child counted the researcher recorded the beginning and ending points of correct counting and recorded the entire response if the counting sequence was incorrect. A subjective appraisal of the child's counting skill and confidence shown were recorded on the data sheet. The author felt that questions concerning the child's feelings about counting and applications of counting in the child's life might also yield some valuable information on the importance of counting to the child.

Individual comments on the task or the introduction of the colored cubes were also recorded. The author felt that these were the pertinent aspects for this particular research study. The only personal information required concerning the child were his age and his sex.

Administration and Collection of Data

The data were gathered during Winter Quarter 1969. During the free play periods the individual children selected for the study were asked by the researcher if they would like to go with her and play a game in another room. They were assured that it would not take long and that the researcher would bring them right back to their room and they could continue their play. The researcher was familiar with the majority of the children through working with them during the previous quarter in the Child Development Laboratories. The children were taken to a nearby room where they arrived each day with their parents. The room was familiar to them, yet it lacked distracting stimuli.

The child was then asked to be seated at a small table across from the researcher. There was nothing on the table when the child arrived. After they were seated the researcher placed the data collection sheet on the table. The child was told that this paper was going to be used for "keeping score" on the game. The first task of 1 color blocks was then placed on the table in front of the child. The researcher told the child that she needed the child to help her find out how many cubes were on the board. The child was then asked: "How many blocks do you see?" The child was allowed any method he chose to find out how many blocks were presented to him. His first response was recorded on the data collection sheet by the researcher; this was the procedure for recording each response for the 8 tasks.

As soon as the child had responded to the task it was removed from the table and the next one was presented until the child had completed the entire series. There was no positive or negative reinforcement given for any response; each time when the child completed his response the tasks were changed and he was asked if he was ready for another one, or if he thought he could tell the researcher how many there were on the next task, or some question similar to these. The 8 separate tasks were kept in a box behind the table out of the view of the child, but they were easily accessible to the researcher.

The data collection sheet provided for the verbal number responses to be indicated as well as space for brief comments on the child's methods of arriving at the answer given, and his confidence level as it appeared to the researcher.

At the completion of the first section, that is, the recognition and correct labeling phase of the test, the child then entered the second phase. He was asked to count as far as he could for the researcher. The researcher then noted the initial number he began counting on and then listened for the first error in the sequence of the child's counting. The first error was noted and the remainder of the sequence was recorded. If the child was unable to count correctly at all, his entire response was recorded until he quit counting. Subjective appraisals of the counting ability and confidence level were made and recorded by the researcher. Observable counting methods were also indicated. When the child had completed counting he was asked: "Do you like to count?", "What do you count?", and "How did you learn to count?" The responses were recorded on the data sheet. If the child had made any comments regarding the tasks or the colors when they were introduced on the second series of tasks, the researcher recorded these. At the completion of the testing session the child was thanked and returned to his classroom by the researcher.

DATA COLLECTION SHEET

CHILD'S NAME________________________ SEX________________________

CHILD'S AGE________________________ TEST DATE________________________

NUMBER RECOGNITION

TEST A (No color)		TEST B (Color)	
#4 Response	________	#4 Response	________
#7 Response	________	#7 Response	________
#5 Response	________	#5 Response	________
#8 Response	________	#8 Response	________

COMMENTS:

How did he arrive at his answer?

Did he count?

Was he confident in answering?

Did he hesitate? ________ When?

Did he use diversion tactics? ________ What?

COUNTING SKILL

Counted from ________ to ________ correctly. Then:

Counting methods:

Confidence:

Do you like to count?

What do you count?

How did you learn to count?

COMMENTS:

Child's comments on color:

Child's comments on task:

PRESENTATION OF FINDINGS

In this study 40 preschool children were given a number identification and counting test. The test was developed by the researcher and administered to the subjects who were all enrolled in the Utah State University Child Development Laboratory during the Winter Quarter of 1969. Four groups of children were compared on number identification skill and counting ability; there was one each of the following groups: three-year-old girls, three-year-old boys, four-year-old girls, and four-year-old boys. These groups allowed for a comparison of one year age differences and sex differences. The test involved identification of 4 specific numbers when they were presented involving only the concept of number using wooden cubes of one color and then once again when there were 2 colors of wooden cubes. This aspect of the study was aimed at seeing if the introduction of a second concept of color would have any effect on the preschool child's ability to focus on the specific task at hand of identifying how many cubes were presented to him.

The presentation of the findings will be presented under two main headings: number identification skills of preschool children and the counting ability of preschool children. Each section will then deal more specifically with the hypotheses and the variables of the study pertaining to that area. Following the presentation of the findings a discussion of the specific factors will be accompanied by tables which have been included to clarify specific points and to allow for comparisons of the data. After an analysis of the data gathered in this study the author has found evidence to conclude with the following findings.

Number Identification Skills

Hypothesis 1 states: as more objects are presented the difficulty of counting and labeling them correctly will increase. This indicates that of the 4 numbers of objects presented in this test, the most difficult task was predicted to be the one involving 8 cubes. The results indicated that the most difficult number of objects for the subjects to correctly identify was 7. Only 28 percent of the total group of subjects responded correctly to the tasks involving 7 cubes. There was a slightly higher percentage of correct responses for the 8 cubes; it was 31 percent. The difference is not significant and it indicates that both of the larger numbers were more difficult for the preschool children to identify and correctly label than were the tasks involving fewer numbers of objects. There was a correct response rate of 57 percent for the tasks involving 4 cubes, and a 45 percent correct response rate for the tasks with 5 cubes presented. The results then confirmed the hypothesis regarding the increase in difficulty of identification and correct labeling of larger numbers of cubes.

The second hypotheses refers to the number 5. It reads: Preschool children will recognize and be able to correctly label 5 objects better than the two larger numbers of objects or the smaller number of objects presented. The results do not confirm this hypothesis completely as 4 objects were the task receiving the highest number of correct responses. The 45 percent total correct response rate for the 5 cube tasks was lower than the 57 percent rate for tasks involving 4 cubes. It was higher than the correct response rates for 7 or 8 cube tasks. This could be due to the increase in the number of objects more than to any other reason. It was interesting to the author to note that there were more responses of "5" given than of any other response on the entire test. There were 62 responses of "5" given by the preschool children during the entire testing session. This was the highest number of responses of a single verbal label in the test. There were 61 responses of "4" given during the entire test and the trend was for the responses of "4" to be correct more often than the responses of "5" were. There were 46 correct responses of "4" given and 15 incorrect ones. Of the 62 responses of "5" only 36 were correct and 26 of the total were incorrect. The hypothesis, as it was stated, was not supported by the data obtained in this research in respect to the number 4. In relation to the numbers 7 and 8 more support is found.

The age of the child was predicted to be a factor in the total number of correct responses he was able to give. Hypothesis 3 states: children in the four-year-old age group will make fewer errors in the counting and identification of numbers than will the children in the three-year-old age group. The total correct response rate for the three-year-old group of this sample was 36 percent. This is lower than the response rate for correct identification of the four-year-old group who maintained 45 percent correct responses for the entire group of four-year-olds. These figures support the hypothesis that older children do make fewer errors in number identification tasks than do the three-year-olds.

Hypothesis 4 indicates that: the girls of both age groups will make fewer errors in counting and number identification than will the boys of the same age groups. On the correct response percentage scores the researcher found no difference in the rates of correct responses for the girls and boys. A correct response percentage of 40 percent was obtained when both age groups were combined and the total group of boys was compared with the total group of girls from this sample. Individual group percentages of correct responses indicate that there were some slight differences between the sexes within the age-sex groups. Thirty-eight percent was the correct response rate for the three-year-old girls; the same rate for the boys in this younger age group was 32 percent. Therefore the hypothesis was supported for the group of three-year-olds. The differences in percent of each group responding correctly to the tasks was slight but present. In the four-year-old group the boys had a higher percentage of correct responses than did the girls of this group. The percentage of correct responses for the boys in the four-year-old group was 48 percent while this same response rate for the girls of this group was 42 percent. It was interesting to note that the differences in the percentage scores for the two sex groups within the age groups is identical with the exception of the sex of the group scoring the highest at each age. The hypothesis was not confirmed in the four-year-old age group, but it was supported in the three-year-old age group. No over-all sex difference was noted.

The final hypothesis deals with the assumption that: preschool children will make fewer errors in identifying numbers of objects all of one color as compared with numbers of objects presented in two colors. There were 66 correct responses on the tasks involving only blocks of 1 color from the total group of children. On the tasks involving the blocks of 2 colors there were 64 correct responses. The percents of correct responses for these two sets of tasks were 41 percent and 40 percent respectively. The difference is not a significant one and in regards of the total group there appeared to be no difference in the correct response rate for blocks all of 1 color and for blocks of 2 colors. In considering the groups separately the author found that in the three-year-old girl group there were a considerable number of comments on the 2 colored block tasks. The three-year-old boys commented less and were affected less by the color concept than were the three-year-old girls. The four-year-old boys commented less but showed more effects from the introduction of the colored blocks than did the three-year-old boys. There were no comments or effects in the group of four-year-old girls. The three-year-old girls were much more affected by the color concept than were any of the other three groups; the four-year-old girls were totally unaffected by the colored cubes, and the two groups of boys showed slight effects from this second concept introduction. Therefore, if the researcher considers the total group response to the introduction of color there is no support for the hypothesis; considering the groups separately the most support from the study would come from the three-year-old girls.

Counting Skill

Two of the hypotheses previously mentioned deal with counting as well as number identification skill. Hypothesis 3 refers to the assumption that as the age of the child increases so do his counting skills. There was a definite trend for the older group of children to be able to count further without error than was found in the younger group. Half of the three-year-old children could count in correct sequence from 1 to 5; whereas, with the older group all of the girls and 77 percent of the boys counted this interval without error. The same trend was found in the other intervals of 1 to 10, 1 to 15, and beyond 15. Four-year-old children consistently counted with fewer errors and to higher numbers than did the three-year-old subjects. This hypothesis would be supported.

Hypothesis 4 concerned itself with the sex differences which were predicted to exist, that is, girls will make fewer errors in counting than will the boys of their respective age groups. This was not supported in the three-year-old group because the boys consistently counted further and with fewer errors than did the girls of the three-year-old age group. The girls from the four-year-old age group did perform better on the counting test than did the boys of the four-year-old group in all intervals but total counting length. The boys of this group were percentagewise a little higher than were the girls of this older group, but it should be noted that both sex groups of the four-year-old group had three members each correctly counting beyond 15. The percentage difference is not significant. It appears that the hypothesis did gain some support from the four-year-old group but not from the three-year-old group. There is a possibility that the higher scores of the three-year-old boys is due to the fact that all of them were three-years-eight-months in age and are being compared to girls who range in age from three-years-four-months to three-years-eight-months.

DISCUSSION OF FINDINGS

Hypothesis 3 and Hypothesis 4, respectively, deal with the age and sex factors as they might apply to the number identification skills of preschool children. This section will discuss the findings from this research regarding the number identification ability of each of the four age-sex groups. Each group will be discussed separately beginning with the younger groups; following the four group discussions there will be a brief summary of the findings concerning the age and sex of the preschool child as it applies to his ability to recognize and correctly label specified numbers of objects. Two tables will appear with each age-sex group discussion. The first table deals with an individual analysis of the correct responses of that particular group. The total number of correct responses per child are listed; this is also broken down into two separate scores. These scores are: the total number of correct responses made on the first set of tasks which were of one color, and total number of correct responses on tasks involving blocks of two colors. The response scores of the children in the younger age group (three-years-four-months) are presented first and they then procede down the column to the scores of the older children (three-years-eight-months) of the group. This allows for a comparison of any developmental sequence within the age range if any existed. The second table presents the total number of subjects responding correctly to all four of the tasks, to three of the tasks, to two of the tasks, one of the tasks, or to none of the tasks presented in each set. It will also list the percent of the group who made the specified number of correct responses per set.

Number Identification Skills of Three-Year-Old Girls

Considering the two hypotheses mentioned previously the researcher anticipated that the group of three-year-old girls would perform better than the three-year-old boys, but not as well as the girls or boys of the four-year-old age group. There were 12 subjects in this group. In this group not one of them responded correctly in identifying and correctly labeling all of the 8 tasks. There was one child, whose age was three-years-four-months, who made only one incorrect response and it was made on the second set of tasks which involved blocks of 2 colors for the number 7. Her response was "8" (Table 1).

Another child, age three-years-six-months, made only two incorrect responses and they were both in labeling 7 as "6." One child made 5 correct responses, 3 children followed with 4 correct responses which was a score indicating correct responses for one-half of the tasks. The other half of the total group of three-year-old girls did not respond correctly to one-half or more of the total number of tasks presented to them. Two subjects made 2 correct responses, 3 children made only 1 correct response and 1 child did not make any correct responses. These figures in Table 1 involve individual subject responses.

In comparing the total number of correct responses made on the first set of tasks involving only blocks of 1 color, the researcher found 19 correct responses, and on the second set of tasks which involved the

Table 1. Individual analysis of correct responses of three-year-old girls on one color and two color block tasks (N = 12)

Sex-Age	One color tasks correct number of responses	Two color tasks correct number of responses	Total number of correct responses for both tasks
G 3-4	3	2	5
G 3-4	4	3	7
G 3-5	0	2	2
G 3-5	1	1	2
G 3-5	0	1	1
G 3-6	3	3	6
G 3-6	0	0	0
G 3-7	3	1	4
G 3-7	3	1	4
G 3-8	2	2	4
G 3-8	0	1	1
G 3-8	0	1	1

blocks of 2 colors there were 18 correct responses. Considering the three-year-old girls all together the researcher found the combined percentage of correct responses on the entire test to be 38 percent.

There were four subjects who improved their number of correct responses on the second set of tasks. It was interesting to note that their total number of correct responses on the first set of tasks was zero, and then on the second set of tasks which did involve blocks of two colors they did give one or two correct responses. It did not appear to the author that there was evidence of a practice effect because of the pattern of responses obtained from each of the subjects involved. Their responses had been quite random ones; two of the subjects only verbally responded while the other two counted. However, their counting was not sequential. There was a tendency in this group of four subjects to repeat number labels rather than to have a purposeful correct labeling goal in mind. These four children ranged in age from three-years-five-months to three-years-eight-months.

The fewer the number of correct responses made by the child the farther their response deviated from the correct one, and the less logical the verbal label was for that specific task. The child responding incorrectly in most cases did not usually respond with a label that was only one numeral more or less than the label required to be correct. It was interesting to note that the child who made no correct responses to any of the tasks used only the number labels 2 through 10. As a total group the subjects responded with labels 1 through 10, 14, and 19. This did not appear to the researcher to be an extremely wide range of responses for the numbers 4, 5, 7, and 8. There was only one response of "14" given for the number 8 and one response of "19" given for the number 7.

The responses of this same group to being asked to count as far as they could indicated that most of them were only familiar with numbers of one decade or less; there were a few exceptions when the children had ended the correct counting sequence and then added a few larger numbers out of sequence. It appeared that they were familiar with the verbal labels for the larger numbers but did not use them as often.

There was one child who did not respond to the first task (4 blocks of one color) and one child who responded with an, "I don't know," to the task involving 7 blocks of one color. This child responded most of the time with "5"; she also gave the response of 19 mentioned above. On one of her responses of "5" she counted in the following way: "1, 2, 3, 23, 28, 29, 5." Her answer to the task involving 8 blocks of two colors was then "5" even though her counting was very non-sequential in one section.

One child whose age was three-years-four-months made a total of 4 correct responses on the first set of tasks which involved only blocks of one color; there were no children in this age-sex group who made 4 correct responses on the second set of tasks involving blocks of two colors (Table 2).

There were 4 children responding correctly to all but one of the tasks on the first set, but on the second set of tasks there were only 2 subjects responding correctly to 3 of the 4 tasks presented them. On the one-color block set there was 1 child who responded correctly to half of the tasks and 1 child who labeled only 1 of the tasks correctly. On the second set of tasks 3 children responded correctly to half of the tasks and 6 children responded correctly to 1 task. Five children made no correct responses on the first set of 1 color blocks while only 1 child did not respond correctly to any of the tasks on the second set.

Table 2. Total number and percent of correct responses of three-year-old girls on number identification tasks (N = 12)

	One color block tasks		Two color block tasks	
Possible number of correct responses per child	Number responding correctly	Percent responding correctly	Number responding correctly	Percent responding correctly
4 correct responses	1	8	0	0
3 correct responses	4	33	2	16
2 correct responses	1	8	3	25
1 correct response	1	8	6	50
0 correct responses	5	41	1	8
Total	12		12	

As was mentioned previously there did not appear to be a practice effect in this age group even though the subjects were presented with the same number of objects on the second set of tasks involving two colors as they encountered on the first one color block tasks. The effect of blocks of two colors on the subject's responses is discussed in another section as is their response rate to specific numbers of blocks. A comparison of this particular group with the other three age-sex groupings follows the individual discussions of each group.

Number Identification Skills of Three-Year-Old Boys

In consideration of Hypothesis 3 (age) and Hypothesis 4 (sex) this particular group was the one the author felt would score the lowest of the four groups. It should be noted that all of the 8 subjects in this group were three-years-eight-months in age. There were no younger three-year-old boys (three-years-four-months to three-years-seven-months) who would participate or who were enrolled at that particular time in the Child Development Laboratories. For this reason there were only 8 three-year-old boys included in this research project.

One child responded with 8 correct responses out of the possible total of 8. The trend did not carry through this group, and the next in line was 1 child who made 5 correct responses. Following there was 1 boy with 3 correct responses, 2 boys making 2 correct responses each, 1 boy with 1 correct response, and 2 boys who made no correct responses on any of the 8 tasks (Table 3).

Table 3. Individual analysis of correct responses of three-year-old boys on one color and two color block tasks (N = 8)

Sex-Age	One color tasks correct number of responses	Two color tasks correct number of responses	Total number of correct responses for both tasks
B 3-8	4	4	8
B 3-8	1	0	1
B 3-8	0	0	0
B 3-8	2	3	5
B 3-8	1	1	2
B 3-8	1	1	2
B 3-8	0	0	0
B 3-8	1	2	3

The author compared the total number of correct responses for the tasks involving blocks of only 1 color and found that the individual children in this group made 10 correct responses. This is a correct response rate for this group of 31 percent on the 1 color block tasks. There is an increase of 1 correct response for the total group on the second set of tasks. The increase in 1 correct response did not alter the percentage score a great deal as it only raised to 34 percent. The total correct response rate for the three-year-old boys was 32 percent.

Two of the boys in this group improved their correct response scores on the second set of tasks by 1 correct response. One child labeled the 7 blocks on the first set of tasks as "5" in a verbal response only. He did count some of the blocks and on the second set of tasks he did label the task involving 7 blocks correctly. His other responses were all correct with the exception of number 8 on both sets; these he labeled as "7" on both tasks. This may have been due to the child's counting and touching the blocks the second time. This seems more feasible or probable to the author. The other child who increased the number of correct responses he made on the second set from the first set correctly labeled the tasks involving 5 and 8 blocks. His only correct response on the first set of tasks was on the task involving 7 blocks. This child had a tendency to move his fingers quickly over the blocks in a crawling motion; he verbally counted but often labeled the task with the number which was 1 more than the actual number of cubes present. He talked quickly and left out some of the verbal labels as he counted; he then ended up with the verbal label 2 higher than the one required for the task. His correct responses on the second set of tasks were the last two responses for the entire test; the author felt that it was possible that this child was just beginning to coordinate his counting and finger movements. Both of these boys gave answers which were very near the correct ones on each task and the author feels that there may have been some familiarity with the numbers of cubes on each task the second time these boys encountered them.

In this age-sex group the researcher did not ever have the response of "1" given; there were also no verbal labels of "11" or "12" and only 1 response of "10" was given. They did respond with a number of teen responses, particulary, "16," "17," and "19." Most of these responses came from one child who began his counting on "3" and counted correctly in sequence to "6" then began naming teen numbers in any order. His individual counting followed this same pattern, but this will be discussed in the counting section.

The verbal responses of this group of subjects ranged from "2" to "19." One child responded with the verbal labels of "2," "3," and "4."

Still another mentioned only "2," and "6." There were 2 boys responding with only the verbal labels required for this test: 4, 5, 7, and 8. Two boys used various numbers from "3" through "10" and the one child mentioned previously gave all high teen responses and a "6." The tendency for these boys was to remain in the first decade of number names with the exception of one child. Only 2 children used number names from a range of more than 3 numbers. There were 2 boys in this group who did not use any of the required verbal labels for these tasks, namely, 4, 5, 7, or 8.

Table 4 compares the numbers and percentages of correct responses of subjects responding with a specified number of correct responses. There was 1 subject who responded correctly to 4 of the possible 4 responses on the first set of tasks and to 4 of the tasks on the second set correctly. This was the same child in both instances. He was able to respond correctly to each task (Table 4).

Table 4. Total number and percent of correct responses of three-year-old boys on number identification tasks (N = 8)

	One color block tasks		Two color block tasks	
Possible number of correct responses per child	Number responding correctly	Percent responding correctly	Number responding correctly	Percent responding correctly
4 correct responses	1	12	1	12
3 correct responses	0	0	1	12
2 correct responses	1	12	1	12
1 correct response	4	50	2	25
0 correct responses	2	25	3	37
Total	8		8	

There was 1 child who responded correctly to 2 of the tasks on the first set and 1 who responded correctly to 2 tasks on the second set. This response did not come from the same child; they were individual children responding in this way.

The majority of three-year-old boys responded to 1 task correctly on both sets or they made no correct responses on the test. Seventy-five percent of the subjects on the first set of tasks made only 1 or no correct responses. There was a slight increase in the number of correct responses made on the second set of tasks by the three-year-old boys.

Number Identification Skills of Four-Year-Old Girls

This group was the one predicted to do the best on the number identification tasks on the basis of Hypothesis 3 (age) and Hypothesis 4 (sex). In the individual analysis of the performance of the subjects of this group (Table 5), we note that only 1 of the 11 girls was able to respond correctly to all of the 8 tasks. She was four-years-eight-months of age.

Of the 3 girls responding with only 2 incorrect responses on the total test, there was 1 girl who responded correctly to all 4 of the tasks on the second set and then made 2 incorrect responses on the first set of tasks. Her incorrect responses were made when she did not verbally count the blocks. One of the other girls who did count each block still labeled 2 of the tasks 1 number higher than they actually were. The third subject who made 6 correct responses skipped 1 block in counting the 7 cubes in the first set of tasks and labeled it as "6."

Table 5. Individual analysis of correct responses of four-year-old girls on one color and two color block tasks (N = 11)

Sex-Age	One color tasks correct number of responses	Two color tasks correct number of responses	Total number of correct responses for both tasks
G 4-4	0	0	0
G 4-4	3	3	6
G 4-4	4	2	6
G 4-4	1	0	1
G 4-5	0	0	0
G 4-6	1	1	2
G 4-6	2	1	3
G 4-6	2	4	6
G 4-6	2	2	4
G 4-8	1	0	1
G 4-8	4	4	8

Her other incorrect response was in labeling the 8 blocks of 2 colors as "5." This may have been influenced by the blocks of 2 colors as she correctly labeled the number of blocks the first time she encountered the task involving 8 cubes. One subject responded correctly to 2 of the tasks on each set. It was interesting to note that she gave only verbal responses on the first set of tasks and confused 4 and 5 labeling them just the opposite of what they were; she did label 7 and 8 correctly. On the second set of tasks she again labeled 5 incorrectly, but 4 was labeled accurately. Five was labeled as "8" and 8 was labeled as "9."

There was 1 child who responded correctly 3 times; her responses were correct on the 4 and 7 tasks of the first set and the 8 task of the second set. Her responses were interesting to note: 4, 5, 6, 7, 8, 9, 10, 11. They did not appear in this sequence, but no verbal label for a number was repeated more than once. One child gave 2 correct responses and both were on the task involving 4 blocks. Her responses were as follows and in the sequence quoted: "4, 5, 6, 7, 4, 5, 6, 7." These were the only verbal labels she gave and there was no observable evidence of counting. There was no hesitation and the child appeared confident in giving these answers. Two subjects responded with 1 correct response on the first set of tasks; their correct response was on the task involving 4 blocks of 1 color. There were 2 girls who responded incorrectly to each of the tasks presented to them. The responses they gave were individual ones. One child who was four-years-five-months of age responded very uniquely. Her response to the first task involving the 4 cubes of 1 color was, "5." After she responded she kept mouthing this number name then she began to mouth the name of the following number in the counting sequence. When she was presented with the second task her immediate reply was, "6." This method of mouthing the next number name in the counting sequence prevailed throughout the testing and her responses in the succeeding tasks were: "5, 6, 7, 10, 11, 12, 13, 14."

The other subject who gave no correct answers to any of the tasks responded to 5 of the 8 tasks with, "5." However, on the task with 5 cubes of 1 color she responded with, "3," and on the task involving 5 cubes of 2 colors her response was, "7." She also responded to the task requiring a response of 8 on the second set as "3." This child did not ever count or touch the blocks, but looked at the task briefly and then stared at the researcher and responded. At times she was very hesitant to give an answer, but this did not continue throughout the testing.

There were 20 correct responses from this group on the first set of tasks; this represents 45 percent of the group who responded correctly. On the second set of tasks where color was a new variable or stimuli there were 17 correct responses. The percent of correct responses dropped to 38 percent. The total correct response rate for four-year-old girls was 42 percent.

The range of verbal labels given by the four-year-old girls was from 3 through 15. The teen number labels were all used by subjects who did not observably count the blocks, but who appeared to be giving verbal responses only. It was interesting to note that no responses of 1, 2, or 3 with the exception of 1 child responding with "3." Every one of the subjects responded with at least 2 of the verbal labels which were required to be correct for these tasks. Seven of the 11 children mentioned all 4 of these number labels. Over half of the subjects mentioned "6" in their verbal labeling of the number identification tasks of the entire test. Five of the subjects responded with only 1 alien verbal label on any of the 8 tasks.

There was quite an even spread of the group on the number of correct responses which were made on the 8 tasks (Table 6).

Table 6. Total number and percent of correct responses of four-year-old girls on number identification tasks (N = 11)

	One color block tasks		Two color block tasks	
Possible number of correct responses per child	Number responding correctly	Percent responding correctly	Number responding correctly	Percent responding correctly
4 correct responses	2	18	2	18
3 correct responses	1	9	1	9
2 correct responses	3	27	2	18
1 correct response	3	27	2	18
0 correct responses	2	18	4	36
Total	11		11	

There were 2 subjects responding correctly to all of the tasks on the first set and 2 subjects responding correctly to all of the tasks on the second set. One child responded correctly to all of the tasks on both sets, while 1 child responded correctly to all of the tasks on the first set and made 2 errors on the second set, and the other subject made 2 errors on the first set but none on the second set. There was 1 individual who made an error on the first set by labeling 7 as "6" and also 1 error on the second set of tasks when she labeled 8 as "5." There were 5 subjects who made 1 or 2 correct responses on the 1 color block tasks and also the same number who responded correctly to 1 or 2 of the tasks on the 2 color sets. Two children made no correct responses on the 1 color block tasks and 4 subjects made no correct responses on the 2 color block tasks. The children responding incorrectly to all of the tasks were: the child who responded with a predominance of "5" responses, the child who mouthed the following sequential number in the counting sequence and responded with that number as soon as the task was placed before her.

Two other children responded incorrectly to all of the tasks involving blocks of 2 colors. The responses of these girls were verbal and no observable counting took place. One of the girls did respond with the correct verbal labels of 7 and 8 but she labeled the tasks involving 4 and 5 cubes with these; the responses for 7 and 8 respectively were "12 and 15." The other girl responded with number names which were 1 or 2 numerals higher than the ones required to be correct on the task.

Number Identification Skills of Four-Year-Old Boys

The author's predictions for this group was that the subjects of this group would do better than the three-year-old girls, but not as well as the four-year-old girls. It was also anticipated that the year's increase in age would cause the four-year-old boys to perform better than the three-year-old boys.

The oldest subject of this group was four-years-eight-months of age and was the only child who responded correctly to all of the 8 number identification tasks of this age group. Two of the subjects made only 1 error on the 8 tasks (Table 7).

One of the boys responded with "3" to the first task involved 4 blocks; he began counting on the second block and omitted the first one in touching and counting both. The other child labeled 7 as "8" on the second set of tasks which did involve the blocks of 2 colors.

Table 7. Individual analysis of correct responses of four-year-old boys on one color and two color block tasks (N = 9)

Sex-Age	One color tasks correct number of responses	Two color tasks correct number of responses	Total number of correct responses for both tasks
B 4-4	2	2	4
B 4-4	0	0	0
B 4-5	2	2	4
B 4-5	3	4	7
B 4-6	0	1	1
B 4-6	4	3	7
B 4-6	2	2	4
B 4-7	0	0	0
B 4-8	4	4	8

Three of the subjects responded correctly to one-half or 4 of the tasks. There were also 2 who responded incorrectly to all 8 of the tasks. Of the subjects responding incorrectly to one-half of the tasks, all of them made correct responses on "4" and "5," but there was only 1 correct response of "7" and no correct responses of "8." The types of responses given by the 3 subjects who made no correct responses were more random and often the verbal labels were larger than the ones required to be correct on the tasks. Some of the incorrect large answers were just 1 or 2 larger, but other times they were much larger and teen numbers. One child labeled the second set of tasks according to the groups of colored blocks. For instance 4 was "2 and 2;" this was the only correct grouped response but this same type of response was made for all of the 2 color block tasks. One other child responded very randomly with verbal labels and matched only 1 of the number of blocks presented on the task correctly. For example, he labeled 8 as "4" and 4 as "5;" these were both on the first set of tasks and indicate the way some of his answers were much too large while others were only 1 larger. All of his responses were made after he had wiggled his fingers over the blocks sometimes verbalizing a number lable and sometimes never verbalizing at all. He was quite confident in answering and did not hesitate at all before his response. One of these subjects also responded with "eleventeen" and "19" on tasks with 7 and 8 blocks. He also gave some very small answers of "2" and "3" for 5 blocks, but his answers for 4 blocks were "5" and "6." His responses were made after he had counted the blocks; however, he began with "1" and then went to "4" then on from there sometimes in sequence and sometimes not. The first subject described of this group as making no correct responses gave verbal labels only and did not observably count on any of the tasks.

The range of verbal labels for this group was from 2 to 19 and included "eleventeen." The teen responses were usually "18" and "19" with the smaller ones omitted. The most frequent incorrect responses were "5," "6," "8," and "9." They did respond with "8" many times, but on tasks which required another label; many of the 8 blocks tasks were incorrectly labeled also. One child correctly labeled the tasks involving 4 and 5 blocks but when the ones with 7 and 8 were presented he either put up 10 fingers or said, "10."

This group answered 47 percent of the tasks in the first set correctly and 50 percent of the tasks involving blocks of 2 colors. The total response rate of the four-year-old boys was 48 percent.

There were 2 of the individuals in this age-sex group who improved their number of responses on the second set of tasks; both of them made 1 more correct response on the second set of tasks than on the first. One child who made only 1 correct response correctly labeled the 5 blocks on the second set. Another child correctly labeled all of the tasks on the second set after making 1 error on the first set of the tasks on; his error was in naming the 4 blocks "3" after beginning to count on the second block of the 4 presented.

In considering the number of subjects responding correctly to 4 of the 4 tasks presented in each group (Table 8) there appears to be approximately the same percentage of correct number of responses in each group. There were 2 subjects who responded correctly to all 4 of the first set of tasks and also 2 subjects responding correctly to

Table 8. Total number and percent of correct responses for four-year-old boys on number identification tasks (N = 9)

Possible number of correct responses per child	One color block tasks: Number responding correctly	One color block tasks: Percent responding correctly	Two color block tasks: Number responding correctly	Two color block tasks: Percent responding correctly
4 correct responses	2	22	2	22
3 correct responses	1	11	1	11
2 correct responses	3	33	3	33
1 correct response	0	0	1	11
0 correct responses	3	33	2	22
Total	9		9	

the 4 tasks on the second set. One child responded correctly to the 4 tasks on both sets while 2 individual subjects responded correctly to an individual set correctly. There was 1 subject responding to all but 1 of the tasks correctly on each set. The largest percentage of correct responses was 2 per set. Thirty-three percent of the subjects responded correctly to half of the tasks on each set. There was 1 child who made only 1 correct response and this was on the second set of tasks. There were no correct responses made by 3 subjects on the first set of tasks and on the second set of tasks there were 2 boys making no correct responses.

Comparison of Three-Year-Olds and Four-Year-Olds

One of the hypotheses for this research project specifically was concerned with the factor of the age of the child and the role it played in their ability to count, identify, and correctly label a specified number of objects. The total correct response rate for the three-year-old subjects was 36 percent. The girls responded correctly more often than the boys; the response rate with correct verbal labels for the girls was 38 percent and for the boys of this age group it was 32 percent. For the older group the correct response rate was higher than it was for the younger age group. It stood at 45 percent. The opposite trend occurred here as the boys had the higher response rate for this age group with 48 percent correct responses and the girls followed with a correct response rate of 42 percent.

In comparing the percent of each age group who responded to 8 tasks, 7 tasks, 6 tasks, or 5 tasks correctly the author found that the three-year-old group had 25 percent of its group members correctly responding to at least half of the tasks. The four-year-old age group was once again about 10 percent higher in their response rate than the three-year-old children were; their percent of correct response for at least half of the tasks was 35 percent. This means that there were fewer members of the four-year-old group who made less than half of the responses correctly.

The author did not find any significant differences in the performance ability of the subjects within their own groups due to their developmental age. There was a tendency for the younger three-year-old girls to do somewhat better than the older three-year-old girls in this particular group. It was the author's feelings that this was due more to individual differences than possible developmental differences during the 4-month period. This trend did not occur as noticeably in any of the other groups as it did in the three-year-old girl group.

Some interesting things that appeared to be connected with the age of the child was preoccupation with specific numbers and the range of the incorrect responses. In the three-year-old age group there was a much greater tendency for the subjects to respond 3 or more times with the same verbal label to the various tasks presented him. It is often a repetition of the verbal label in succession rather than the child's repeating the number randomly during the testing session. The number labels of 5, 4, 3, and 6 were popular for this repetition. When the children responded to 3 or 4 tasks in succession with the same verbal label they did not appear hesitant or puzzled by their responses. There was 1 four-year-four-month-old girl who had a preoccupation with "5" and responded the majority of the time with this verbal label. The general incorrect response range for the three-year-olds was from 1 or 2 to 10 with a few children responding with teen numbers.

In the four-year-old group the beginning and ending numbers of the incorrect range increased. The older children did not begin with 1 and usually not 2; most of their responses were 3, 4, or higher. They went more into the lower teen responses rather than the higher ones; however, there were some responses of 18 and 19, but these came more from the subjects whose counting and number identification methods were more deviant than most. There was an interesting number of responses of "6" in this age group. This number was the one omitted from the counting sequence in the author's choice of numbers to be used in this test. One of the four-year-old boys also responded with "eleventeen" on 1 of the tasks. The older subjects appeared to have better command of the larger numbers such as 12 and the early teen numbers because they were used more often in sequence than randomly as they were used by the three-year-olds. The more difficult parts such as the transition from 10 into the teens was handled much better by the older group and there was a tendency for them to use it more often.

There did seem to be a slight difference in the ability of the children to identify specified numbers of cubes and to then label them correctly. The younger subjects lagged behind the ones 1 year older by about 10 percentage points on their correct response rates. The author is inclined to indicate a slight improvement in these abilities with an increase in the subject's age. Therefore, it would appear that this hypothesis concerned with age would be supported in this area of number identification ability of preschool children.

Comparison of Sex Differences on Number Identification Skill

Hypothesis 4 stated: The girls of both age groups will make fewer errors in counting and number identification than will the boys of the same age groups. On the correct response percentage scores there was no difference in the rates between the boys and the girls. The researcher combined the 2 age groups for a total sex group comparison and found that both had a correct response percentage score of 40 percent. In comparisons of the age groups, the three-year-old boys and the three-year-old girls had exactly the same percent of subjects responding correctly (25 percent) to at least half of the tasks on the entire test. There was a very slight difference found in the four-year-old age group; there were 36 percent of the four-year-old girls responding to 5 or more of the tasks correctly as compared with 33 percent of the boys of this same age group.

Individual group percentages of correct responses indicate that there were some slight differences between the sexes within the age-sex groups. Thirty-eight percent was the correct response rate for the three-year-old girls; the same rate for the boys of this age group was 32 percent. In the four-year-old group the boys had a higher percentage of correct responses with 48 percent which is the highest for the entire group, and a 42 percent correct response rate for the girls who were four-years-old. A slight difference was noted within the age groups which may be due to sex differences in counting and number identification ability or they may be due to characteristics of the subjects of the group.

The responses of the entire group were analyzed and the author found no unusual techniques or methods which appeared to be due to the sex of the child. There were no noticeable differences on their incorrect verbal labels for the tasks. One unique situation which was only connected with the three-year-old boys was that of the total group of 8, 3 of them began counting with "3" and never began counting on "1." In the three-year-old group there was one set of identical twin boys; the author found it very interesting to note the similarities and differences in the skills of these 2 boys. They both began counting on "3." The author felt that this might possibly be due to their age being 3 or some immaturity in verbalizing as well as counting and number recognition skills. They did count some in sequence once they began on 3.

In light of the findings indicated in this research the author feels that there are no real significant sex differences when one considers the over-all preschool group. There may exist some small differences due to the child's sex, but from this research it would be impossible to assert an influence from the factor of sex. If a slight difference in boys and girls' responses was noted the author could still not predict earlier or better skill development in number identification for either of them because the results of the present research indicate that the three-year-old girls out-performed the boys of their group, but the boys in the four-year-old age group did better than the girls of their corresponding ages. Therefore, one sex group did not appear superior to the other. Hypothesis 4 was not proven and therefore, the notion of sex differences playing a big part in number identification skill would have to be rejected. There is a possibility that there may be some sex influence which would be involved in an interaction of sex and another factor or factors.

Patterns and Content of Responses for Four Cubes

For this research it was hypothesized that as more blocks were presented to preschool children, the difficulty of counting and of correctly labeling them would increase (Hypothesis 1). Four was the fewest blocks presented in the test, and based on the above hypothesis the author anticipated more correct responses on the tasks involving 4 blocks than on any of the other tasks which involved larger numbers of blocks of 2 colors on the subject's perceptions of the task. It was anticipated that more subjects would respond correctly to the task involving 4 blocks all of 1 color than would respond correctly to the task involving 4 blocks of 2 colors.

The results of the number and percent of correct responses on the tasks involving 4 blocks are indicated in Table 9. The total correct response rate for tasks involving 4 blocks for the entire group of subjects was 57 percent. The percent of correct responses on the first set of tasks which involve only blocks of 1 color was 60 percent. This dropped a little on the second set of tasks where 2 colors of blocks were presented to the subjects and it stood at 55 percent.

Forty percent of the responses were incorrect ones. Included in this group of incorrect responses were the following verbal labels: 2, 3, 5, 6, 7, 8, 19, and one subject gave no response at all. Most of the children responding with "3" were three-year-olds, and they gave verbal responses very quickly without observably counting or touching the blocks. On the tasks involving only blocks of 1 color there were 5 incorrect responses of "3;" 3 of them were given by three-year-old girls, 1 by a three-year-old boy, and the other 1 by the four-year-old boy.

Table 9. Total number and percent of subjects responding with correct verbal label to four blocks all being one color and four blocks that are of two colors (N = 40)

	Four one color blocks		Four two color blocks	
Age-Sex	Number responding correctly	Percent responding correctly	Number responding correctly	Percent responding correctly
Three-year-olds				
Girls (N 12)	6	50	7	58
Boys (N 8)	5	62	3	37
Four-year-olds				
Girls (N 11)	8	72	6	54
Boys (N 9)	5	55	6	66
Total	24	60	22	55

The only incorrect responses for the four-year-old group were 3 and 5. These are numbers just 1 larger or 1 smaller than the one required to be correct. The three-year-olds gave more incorrect responses in a wider range of number labels.

Of the 4 groups the four-year-old girls responded with the highest percent of correct responses (72 percent). The three-year-old boys followed with 62 percent, the four-year-old boys were next with 55 percent, and the group with the lowest percent of correct responses was the three-year-old girls with 50 percent for correct responses.

When the blocks were presented in 2 colors rather than all in 1 color, the results were a little lower. There were 22 correct responses from a possible 40; this was a total of 55 percent for correct responses. As Table 9 indicates the four-year-old boys responded with the highest number of correct verbal labels (66 percent) for tasks involving 4 blocks. This was an increase of 11 percent over their response rate on the first set involving only blocks of 1 color. The three-year-old girls also increased their rate of correct responses from 50 percent to 58 percent while the three-year-old boys and the four-year-old girls decreased their numbers of correct responses. It is possible that there may have been some type of practice effect when the tasks were presented all in one test session; the subjects did encounter the same number of blocks twice going through task 1 and task 2 for each number of blocks. The results of the research show that there were some individual children who responded incorrectly the first time they encountered the specified number of blocks and then were able to respond correctly on the second task. There were also some children who responded correctly the first time and incorrectly the second time they had the number. It was felt by the author that the introduction of blocks of 2 colors did have an effect on the number recognition of some individual children.

Patterns and Content of Responses for Five Cubes

Hypothesis 2 was based more on observation of preschool children and working in the Child Development Laboratory than on research. There was no research found which stated that preschool children would be able to recognize and correctly label 5 objects better than other numbers of objects. The author felt that there was a possibility of "5" being a number that these preschool children might be very familiar with through repetition of songs and fingerplays involving the numbers 1 through 5 and beginning or ending on this number. There was also the possibility of their being familiar with 5 because they do have 5 fingers and 5 toes per hand and foot. Based on this reasoning the hypothesis was developed and 5 blocks were included in the test in hopes of discovering if 5 did have particular meaning for these preschool children.

The third task on each set contained 5 wooden cubes; on the first set there were blocks all of 1 color (natural wood). Based on the hypothesis mentioned above the author felt that there would be more responses of "5" than of any other number. It was also hypothesized that there would be more correct responses on 5 blocks than on others. Table 10 indicates that on the first set of tasks involving only the blocks of 1 color that there were 15 correct responses to the 5 blocks. This represented 37 percent of the total group of 40 children who responded correctly to this task. On the second set of tasks in which

Table 10. Total number and percent of subjects responding with correct verbal label to five blocks all being one color and five blocks that are of two colors (N = 40)

Age-Sex Group	Five one color blocks		Five two color blocks	
	Number responding correctly	Percent responding correctly	Number responding correctly	Percent responding correctly
Three-year-olds				
Girls (N = 12)	5	41	6	50
Boys (N = 8)	2	25	4	50
Four-year-olds				
Girls (N = 11)	3	27	4	36
Boys (N = 9)	5	55	7	77
Total	15	37	21	52

there were 3 red blocks and 2 natural color ones, the percent of correct responses increased to 52 percent. There were 21 correct responses from the total group. The total correct response rate was 45 percent. This response pattern was not expected as it was hypothesized that the tasks involving the blocks of 2 colors would be more difficult for the preschool child to identify due to the presence of the 2 distinct concepts presented the child. There was the aspect of repetition to be considered here; however, on the other 3 numbers used there was a slight decrease in the percentage of correct responses on the tasks involving the blocks of 2 colors as compared with the correct responses for tasks involving blocks of 1 color. It does not appear that seeing the same number of blocks a second time was the reason for this increase in correct responses. The color variable did not appear to have an adverse effect on the number recognition of 5 cubes.

On the first set of tasks which involved blocks of 1 color only the three-year-old girls responded correctly 41 percent of the time. Their incorrect responses were: 2, 4, 7, 10, and 3 responded with 6. Four of the 7 incorrect responses were just 1 larger or 1 smaller than the response required for the task. The child responding with "10" gave only verbal responses and labeled 8 as 10 also; she made no correct responses on the entire test. The three-year-old boys had a correct response rate of 25 percent. The incorrect responses from this group ranged from 2 through 16. Four-year-old girls responded correctly to 27 percent of the tasks; their incorrect responses were: 3, 4, 6, 7, and 8. The four-year-old boys had the highest correct response rate and it was 55 percent. There were 4 incorrect responses with 1 each of 3, 6, 8, and 9.

On the tasks involving the blocks of 2 colors the four-year-old girls made the lowest percent of correct responses (36 percent). The incorrect responses were large numbers: 7, 8, 10, 13, and 6. There was no breaking the cubes up according to color and then supplying a smaller number label indicating part of the group; the children named them all much larger than they were. The three-year-old boys and the four-year-old boys both responded with 50 percent correct responses. Their incorrect responses showed an influence of the colored blocks as they counted each color group separately and responded with "2" or "3" as a final response. There were also 3 high responses of "8," "10," and "16." The group with the highest number and percentage of correct responses was the four-year-old boys group. Their correct response rate was 77 percent. The only incorrect response given by this group was "2." There were 2 natural color blocks on this task.

There were 62 responses of "5" given by the subjects during the entire testing of number identification skills. This was the highest number of responses of a single verbal label in the test. It was just 1 more than the number of responses of "4" of which there were 61. It was anticipated that 4 might be a very familiar number to these preschool children because half of them were four-years-old and it is also a number which they quite easily recognize and it is also mentioned just as often as "5" is in the songs and fingerplays. Its placement is also very near the beginning or the end and this has an effect on the remembering of the number. Of the responses of "4" more were correct ones than incorrect ones; there were 46 correct responses and 15 incorrect ones. This is quite different from the breakdown of correct and incorrect responses of "5" on approximately the same total number of responses. Of the responses of "5" 36 were correct and 26 were not correct. There was a higher correct response rate on "4" than on "5."

Table 11. Total number of verbal responses of "five" on number identification tasks of one color blocks and two color blocks of any number sequence (N = 40)

	Correct responses		Incorrect responses	
Age-Sex group	One color block tasks	Two color block tasks	One color block tasks	Two color block tasks
Three-year-old				
Girls (N=12)	5	6	4	3
Boys (N= 8)	2	4	3	2
Four-year-old				
Girls (N=11)	3	4	6	5
Boys (N= 9)	5	7	3	0
Total	15	21	16	10

In order of the frequency of their occurrence the following number names were given during the entire test: "6," there were 30 responses; "3," there were 20 responses; "2," there were 17 responses; and "9," there were 15 responses. Even though half of the subjects were three-years-odl there were only one-third as many responses of "3" as there were of "4."

Four and 5 were by far the most frequent responses of this group of preschool children. This would lend support to the hypothesis that preschool children do recognize and respond correctly to 5 more than they do to other smaller numbers; however, if the hypothesis were to state the number "4" the evidence gathered in this research project would support it very well.

Patterns and Content of Responses for Seven Cubes

Seven and 8 were selected for the study because of their increasing amount and complexity. It was hypothesized that as the number of blocks increased the difficulty in correctly identifying and labeling them would also increase. It was felt that 7 would be more difficult to identify but that 8 would be still more difficult for the preschool children to correctly label. As on the other number tasks previously discussed the first set, which involved 7 blocks of 1 color, was predicted to be the easier of the 2 tasks involving 7 blocks to identify and correctly label. The second set had some blocks of red and some of natural color and Hypothesis 5 indicated that the introduction of the second color of blocks would increase the complexity of the task.

Twenty-eight percent of the subjects responded correctly to the 7 blocks on the entire test. As was predicted in the hypothesis there was a higher correct response rate for the first set of tasks involving only 1 color; there were 15 correct responses or 37 percent of the subjects responded correctly to the 1 colored block task. On the task involving the 7 blocks presented in red blocks and natural color blocks there was a correct response rate of 20 percent. On this number of blocks there were no age groups which improved their number of correct responses on the second set of tasks involving 7. Eighty percent of the responses given on the task involving 7 blocks of 2 colors were incorrect. Table 12 portrays the 4 separate group responses in percent and total numbers of correct responses of "7."

There was a high percentage of incorrect responses for the task involving 7 one color blocks. The range of these responses was from 1 to 13. There was 1 response of, "I don't know," but the rest responded

Table 12. Total number and percent of subjects responding with correct verbal label to seven blocks all being one color and seven blocks that are of two colors (N = 40)

	Seven one color blocks		Seven two color blocks	
Age-Sex group	Number responding correctly	Percent responding correctly	Number responding correctly	Percent responding correctly
Three-year-olds				
Girls (N = 12)	4	33	0	0
Boys (N = 8)	2	25	2	25
Four-year-olds				
Girls (N = 11)	5	45	4	36
Boys (N = 9)	4	44	2	22
Total	15	37	8	20

to each task involving 7 blocks. The most frequent incorrect response for 7 was "6." There were 7 responses of "6" and this was followed by 5 responses of "5." There were 3 responses of "8" and 4 responses of "4." Eleven of the incorrect responses were numbers of 5 or less. There were also 3 responses above 10, and they were 11, 12, and 13. The three-year-old girl group was the only one not responding with a number above 10; their highest incorrect response for 7 was a "9."

On the second set which involved 7 blocks of 2 colors the most frequent incorrect response was "8." There were 6 responses of this number. Other incorrect responses which were made repeatedly were: 6, 3, 9, 2, 4, 5, and 12. There was one response of "eleventeen" by a four-year-old boy.

The three-year-old girls had the lowest response rate on the tasks involving 7 blocks. They responded 4 times correctly from a total of 24 responses. They responded with "6" 5 times and "8" 3 times. These responses are just 1 larger or 1 smaller than the number required to be correct. There were 4 responses of "3" and 1 response of "4" which indicated that there may have been an effect from the blocks of 2 colors. These incorrect responses of "3" and "4" were all made on the tasks which involved blocks of 2 colors; there were 3 natural color blocks and 4 red blocks presented on this task. There was also 1 response each of 1, 2, 9 and 19. These responses were given by subjects who incorrectly labeled many of the other tasks.

The three-year-old boys had 4 correct responses but due to their smaller number of subjects this made up 25 percent of their group responding correctly to 7 blocks. They responded with "6" 3 times, but made no response of "8." They had 2 incorrect responses of "2," 2 incorrect responses of "4," 2 incorrect responses of "5," and 1 incorrect response each of "9," "13," and "19." Even on the task involving 2 colors of blocks there were no responses of "3" from this group; there was only 1 incorrect response of "4" which indicated a possible effect of color on this age group. Most of the incorrect responses came from subjects who verbalized an answer with few coming from those who actually touched and counted.

The four-year-old girls had the highest correct response rate for the 7 block tasks. On the blocks of 1 color they had a correct response rate of 45 percent and it was 36 percent on the tasks involving the blocks of 2 colors. Their most frequent incorrect response was "5"; there were 2 incorrect responses of this on each set. There were 2 responses of "6" and 1 response of "8"; their incorrect responses were usually incorrect by more than 1 more or less than the number. Their incorrect responses ranged from 4 through 12. There were no incorrect responses of "3" or "4" on the second set of tasks, thus there appeared to be no effect on counting or identification due to the blocks of 2 colors.

Thirty-five percent of the responses made by the four-year-old boys were correct on tasks involving 7 blocks. They had twice as many correct responses on the task with blocks all of 1 color as they did on the task involving blocks of 2 colors. On this second set of tasks there appeared to be a color effect on only 1 child who labeled that task and 3 times on the second task. Other incorrect responses made by this group were: "6," "4," "12," "eleventeen" and "18."

It appeared to the author that 7 was a very difficult number for the subjects to correctly label and identify compared to smaller numbers.

Patterns and Content of Responses for Eight Cubes

According to the hypothesis about the increase in the number of objects increasing the difficulty or complexity of the task, this was predicted as being the most difficult of the 4 numbers to correctly label and identify. Thirty-one percent of the subjects responded correctly to the tasks involving 8 blocks. Comparing this with the correct response rate for each of the other numbers we find that on 4 blocks the correct response rate was 57 percent, it was 45 percent for 5 blocks, and 28 percent on tasks with 7 blocks. According to these figures 7 was the most difficult of the 4 numbers for the subjects to correctly identify and label. Eight was a difficult number for the subjects to handle. There was a high percent of incorrect responses and they included numbers 2 through 17. The most frequent incorrect response was "9" and there were 9 responses of this. All of the groups responded with "9." The next most frequent response was "7" and there were 7 responses made. This means that 16 of the incorrect responses were 1 larger or 1 smaller than the number involved in the task. Other frequent incorrect responses were: 5, 6, 10, 4, and 2. There were individual responses of 14, 19, 18, 17, and 15. These responses came from subjects in each age group and they were often the subjects who made other high teen number responses. They employed carious methods of arriving at their answers; some counted, some gave only verbal responses, and some touched the blocks and assigned random verbal labels to them.

Table 13 indicated the number and percent of each age group responding correctly to each of the tasks involving 8 blocks.

The three-year-old girls had the highest correct response rate of the 4 groups. Nine of their 24 responses were correct; 37 percent of their responses were correct. The group responding with the next highest percent of correct responses on tasks involving 8 blocks were the four-year-old boys with 33 percent correct responses. The four-year-old girls followed and the three-year-old boys had the lowest number of correct responses (18 percent).

The range of incorrect responses for the three-year-old boys was from 2 to 17. They responded frequently with "2," "3," "5," "6," and "7." One subject responded with "3 red and 2 white"; his response was the only one of this group which appeared to have been affected by the colored blocks. The three-year-old girls had the fewest incorrect

Table 13. Total number and percent of subjects responding with correct verbal label to eight block all being one color and eight blocks that are of two colors (N = 40)

Age-Sex group	Eight one color blocks: Number responding correctly	Eight one color blocks: Percent responding correctly	Eight two color blocks: Number responding correctly	Eight two color blocks: Percent responding correctly
Three-year-olds				
Girls (N = 12)	4	33	5	41
Boys (N = 8)	1	12	2	25
Four-year-olds				
Girls (N = 11)	4	36	3	27
Boys (N = 9)	3	33	3	33
Total	12	30	13	32

responses; however, they ranged from 2 to 14. Their most frequent incorrect responses were: "5," "7," and "9."

The other incorrect responses did not appear to be affected visibly much by the colored blocks in 2 groups. The four-year-old girls responded with numbers from 3 to 15 with "9" being their most frequent response. There appeared to be no major effect of the introduction of the second color of blocks on these subjects. There was 1 four-year-old boy who responded by verbally grouping the colors and then giving a response of "3 and 3" as he did for this task involving the 8 blocks of 2 colors. It would appear that the colored groups of blocks had distracted him because he had correctly identified 4 and 5 blocks on this same test and responded with his fingers on the task involving 7 blocks. The range of incorrect responses for the four-year-old boys was from 4 to 19. There were 2 responses of 4, 2 responses of 9 and 10 and 1 response each for 3, 11, 18, and 19. These very large and very small responses were given by subjects who consistently responded with this type of verbal label. The percentage of correct responses for tasks involving 8 blocks both with 1 and 2 colors of blocks was 33 percent. All 3 of these subjects making up this percent responded correctly to both tasks. In this case if they responded correctly to 8 blocks the first time they responded correctly on the second set also. This occurred once with the three-year-old boys, once with the four-year-old girls, and 4 times with the three-year-old girls. With the three-year-old girls the same pattern held up: if they responded correctly to the 8 blocks on the first task they also responded correctly on the second task.

As was hypothesized 8 was a difficult number for the preschool child to correctly identify and label; however, 7 was slightly more difficult than was 8. The effect of the introduction of blocks of 2 colors on the second set of tasks involving 8 blocks was not a negative one as had been hypothesized. There was an increase in correct responses of 1.

Number Identification Methods

As the subjects each responsed to the number identification test the author indicated on the data sheet the method of arriving at the solution used by each subject. There appeared 4 categories or 4 different methods employed by the preschool children of this study in arriving at the answer which they gave to the researcher. The 4 types of responses are variations of 3 general types of response: verbal counting, physical touching of the blocks, and verbal response only. The 4 combinations of these were: physical touching and verbal counting, no physical touching and verbal counting, some physical touching and verbal response only, and no physical touching and verbal response only. There were other possible combinations but none were used by the subjects of this sample.

Table 14 indicates the numbers and percentages of subjects from each age-sex group employing these methods. Physical touching was evidenced when the subject touched, with his fingers or hand, the blocks used in the test. Most generally the child touched each block with his finger if he did touch the blocks. Verbal counting was any verbalization of numbers between the time the child was presented with

Table 14. Methods of arriving at solution responses for number identification tasks as observed and interpreted by researcher

	Three-year-olds				Four-year-olds			
	Girls		Boys		Girls		Boys	
Method	No.	%	No.	%	No.	%	No.	%
Physical touching, verbal counting	8	66	3	37	3	27	2	22
No physical touching, verbal counting	0	0	1	12	2	18	0	0
Some physical touching, verbal response	1	8	1	12	2	18	5	55
No physical touching, verbal response	3	25	3	37	4	36	2	22

the task and when he gave his final response to the researcher. It did not have to be sequential counting to be classified as verbal counting. Verbal response only refers to the child who did not count aloud during the time the task was before him, but rather he gave only 1 verbal response to the researcher when he was ready to answer the question of "How many blocks are here?" The child may have been counting silently but there was no observable evidence of this to the researcher when it was classified here.

In comparing the total numbers of subjects employing each of the 4 methods listed above the author found that 16 of the 40 subjects (40 percent) both physically touched the blocks and counted them verbally before giving a final response. Thirty percent or 12 individuals employed the fourth method and did not touch any of the blocks or count verbally, they gave a verbal response only. Nine individual subjects (22 percent) did touch some of the blocks but did not verbally count before they responded. The least used method employed by these preschool children was that of verbally counting but not touching the blocks. Three subjects did this and accounted for 7 percent of the total group.

The three-year-old girls preferred the physical touching and verbal counting as a means for arriving at their response. There were 8 of them who did this; this was the largest number of subjects from an individual group employing one method. There were no three-year-old girls who did not touch the blocks as they counted. There were 3 of the girls in this group who gave verbal responses only. The four-year-old girls employed this verbal response only method more than any other one as 36 percent of them did not observably count or touch the blocks. They did not seem to employ one particular method a great deal more than another one; they were spread out among all 4 methods much more than any other group. The three-year-old boys were equally divided between the physical touching and counting verbally and the verbal response only. There were 3 individuals in each group (37 percent). In the other method categories there was 1 in each. The four-year-old boys were mainly in the category of some physical contact and some verbal response only. Fifty-five percent of these boys arrived at their answers this way. There were 2 in each of the following categories; physical touching and verbal counting, and verbal response only. None of the four-year-old boys counted aloud without touching the blocks.

Color Comments and Effects

Hypothesis 5 is concerned with the effect that the introduction of the concept of color will have on a task involving the concept of number. It states that: Preschool children will make fewer errors in identifying numbers of objects all of 1 color as compared with numbers of objects in 2 colors. On the first set of tasks the 4 specified numbers were presented to the child all being of 1 color (natural wood). On the second set of tasks the tasks were presented partly with blocks of red and the rest were of natural wood color. They were uniform in all respects but their color. The author hypothesized that having the blocks presented in 2 colors would have an adverse effect on the number identification responses of the preschool subjects.

In an attempt to analyze this the author wrote down any comments made by the subjects which concerned the color of the blocks during the testing session. From the 40 subjects there were only 11 who commented on the color of the blocks; this was 27 percent of the group. The author also studied the responses of the children in relation to the color groupings of the blocks on the second set of tasks. Any responses which were observed as being affected by the color groupings of the blocks were tabulated. The results of the findings in these 2 areas were then categorized as to whether or not the color had appeared to have a significant effect on their response. Four categories were devised, they were: (1) comments on colors, observable effects; (2) no color comments, but observable effects; (3) comments on colors, but no observable effects; and (4) no comments on colors and no observable effects. Table 15 indicates the total numbers and percentages of subjects from each age sex group as they fit into these categories.

The significant finding from this area of the research is that the colored blocks apparently had no effect at all on the four-year-old girls. They made no comments on the colored blocks and there was no observable effect noted in their responses to the second set of tasks. The group commenting the most on the colored blocks was the three-year-old girls; they also evidenced the greatest number of effects from the 2 distinct color groupings of the blocks. Some of the comments made by three-year-old girls were: "There's a red one!," "Some are red and some are white," "One red, one red, one white, one white," and " That's a red one again." Some of these subjects went down the line of blocks labeling them by color first, then they counted them on the second time. In counting the blocks some only counted one of the color

Table 15. Total numbers and percents of subjects commenting on the colored blocks and showing possible effects of the color groupings in their responses to number identification tasks

Age-Sex group	Comments--Effects		No comments--Effects		Comments--No effects		No comments-No effects	
	No.	%	No.	%	No.	%	No.	%
Three-year-olds								
Girls (N = 12)	3	25	3	25	4	33	2	16
Boys (N = 8)	2	25	0	0	1	12	5	62
Four-year-olds								
Girls (N = 11)	0	0	0	0	0	0	11	100
Boys (N = 9)	1	11	2	22	0	0	6	66
Total	6	15	5	12	5	12	24	60

groups and then quit before going onto the next group. One four-year-old boy and 3 three-year-old boys commented on the colored blocks. The four-year-old commented that there were "2 of each" on the task involving 4 blocks; he then went on to group all of the other tasks which followed, but most were incorrect. The three-year-old boys comments were: "Here's a red!," "Two red and 2 white," and "I want to do the green ones."

Twelve percent of the subjects commented on the colored blocks but there were no observable effects on their number identification. There was another 12 percent who did not comment on the colors but evidenced effects of the color groups in their responses. These were the subjects who would respond with "3" for 7 or 5, "4" for 7 or 8, "2" for 4 or 5.

There were 11 subjects who showed observable evidence of effects of the presence of blocks of 2 colors; this was 27 percent of the subjects. The percentage of subjects commenting on color was the same as this one; however, it should be remembered that not all of the subjects who commented on the colored blocks were effected by them, and not all of the subjects who were effected by the 2 colors of blocks commented on the 2 colors. There appears to be individual response factors involved.

It was interesting to note the total percents of correct responses on the 4 numbers used in this research. It was hypothesized that the percent of correct responses would decrease on the second set of tasks which involved the blocks in 2 colors. This trend seemed to be seen on the tasks involving 4 blocks as the percent of correct responses decreased from 60 percent on the 1 color block tasks to 55 percent on the tasks involving both colors of blocks. The opposite happened on tasks involving 5 blocks as the percent of correct responses increased from 37 percent to 52 percent. On 7 the trend was much the same as on 4 and the percent of correct responses for the 1 color block task was higher than that involving the red and natural color blocks. The percentage decrease from the first to the second task was from 37 percent to 20 percent. The tasks involving 8 blocks were more consistent in the results of each set of tasks. There was a slight increase of 2 percent as the correct response rate on the 1 color blocks was 30 percent and it raised to 32 percent on the second set of tasks.

When the tasks were presented to the subjects the order of presentation was: 4, 7, 4, 8. The author noted that there was a slight negative effect, possibly from the color on the 4 block tasks and also on the 7 block tasks. These were the first 2 tasks presented and the decrease in correct responses was greater for 7 than for 4. There was an increase in the number of correct responses on the second task involving 5 blocks and when the task involving 8 blocks was presented there was only a very slight increase noted. The author feels that the effect might have decreased as the familiarity with the 2 colors of blocks increased.

Patterns and Content of Responses on Counting Skill

Three-year-old girls

The purpose of the counting section was to analyze the verbal counting of the preschool child and compare the counting ability with the number recognition ability of individuals and groups of children. Table 16 presents an individual analysis of the counting skill of the

Table 16. Individual analysis of counting ability of three-year-old girls (N = 12)

Sex-Age	Recorded counting to termination
G 3-4	1, 2, 5, 4, 5
G 3-4	1 to 14 then 16
G 3-5	1 to 5 then 7, 8
G 3-5	1 to 4, then 8, 9, 17
G 3-5	13, 16, fiveteen
G 3-6	1 to 8
G 3-6	4, 5, 7,
G 3-7	1 to 12 then 20
G 3-7	1 to 14
G 3-8	1 to 7 then 4
G 3-8	1, 2, 4
G 3-8	1, 2, 3, 8

subjects. It indicates the beginning, termination, and incorrect points.

There were 2 subjects who did not begin counting on 1, rather one randomly verbalized 3 numbers: "13, 16, fiveteen," and the other child repeated, "4, 5, 7," and then quit. The rest of the subjects in this group correctly began on 1 and followed it with 2. This was where the individual differences came into focus. Two of the children were able to count correctly to 14 while some others counted to 2. There was a wide range of counting abilities as there was of number identification skills. Table 17 indicates the intervals of 5 to which the three-year-old girls responded correctly.

Six, or one-half, of the subjects were unable to count in correct sequence to 5. There were 3 who counted correctly to between 10 and 15, but none of them were able to correctly count the interval of 1 through 15.

Table 17. Counting length and correctness of sequence of three-year-old girls (N = 12)

Interval	Number correctly completing interval	Percent correctly completing interval
1 to 5 correct sequence	6	50
1 to 10 correct sequence	3	25
1 to 15 correct sequence	0	0
Beyond 15 correct sequence	0	0

The range of verbal labels provided by these children on the number identification tasks was from 1 to 10 plus 14 and 19. In the counting exercise the subjects responded with approximately this same range. There were the 2 children who counted correctly to and including 14; there were also a few random larger numbers which the subjects repeat. It appears that the counting sequence involves the numbers each subject will use in number identification. The numbers in the first decade are the most often and most correctly used ones by this age group. The familiarity with the smaller numbers and their correct use in counting make them more meaningful and more useful to this group than teen numbers.

Three-year-old boys

The three-year-old boys as a group counted from 1 to 28. There was 1 individual child who counted correctly from 1 to 28 and then quit; he also was able to correctly label each of the tasks on the number identification test. As Table 18 indicates there were 4 subjects who were able to count in correct sequence from 1 to 5. In the second interval of 5 one of these 4 subjects counted only to 9 and was eliminated from the other 3 who counted to at least 10. One child

Table 18. Individual analysis of counting ability of three-year-old boys (N = 8)

Sex-Age	Recorded counting to termination
B 3-8	1 to 28
B 3-8	3, 1, 2, 3, 4, 4, 3
B 3-8	3, 4, 6, 7, 8, 9, 10
B 3-8	Refused
B 3-8	1 to 10
B 3-8	1 to 13
B 3-8	3, 4, 5, 6, 17, 13, 18
B 3-8	1 to 9

continued on the 13 and 1 to 28. In this group there was 1 subject who refused to count; in response to the question: Do you like to count? he replied, "No." The remaining 3 subjects of this group all began counting with "3" and did not begin with the usual "1." One of these did mention "1" and "2" later in his counting but the other 2 never mentioned them at all. Two of these subjects who began counting on "3" were twins. They very randomly said some numbers and other times they were able to place them in correct counting sequence. The one twin correctly counted "1, 2, 3, 4," after beginning with 3, and the other twin correctly counted, "6, 7, 8, 9, 10," after beginning with "3, 4." Between the 2 of them they correctly counted from 1 to 10 with the exception of never including "5." The other subject who began counting on "3" counted correctly to 6 (3, 4, 5, 6) then began his assignment of large teen numbers. He used these a great deal in his number identification tasks.

Table 19 indicates the number and percent of subjects who correctly counted the indicated interval. If the child counted from 1 through

Table 19. Counting length and correctness of sequence of three-year-old boys (N = 8)

Interval	Number correctly completing interval	Percent correctly completing interval
1 to 5 correct sequence	4	50
1 to 10 correct sequence	3	37
1 to 15 correct sequence	1	12
Beyond 15 correct sequence	1	12

and including 5 he was counted as correctly completing the interval. There were 4 of the subjects (50 percent) who counted correctly to 5. One subject counted correctly beyond 15 to 28. The subject counting to 13 correctly was the only other child who counted correctly beyond 10.

In their responses to the number identification tasks this group responded with the numbers 1 through 10 plus 13, 16, 17, and 19. These teen responses came from a few individual children, especially 1.

Four-year-old girls

This group had a wide range of counting abilities. One child who was four-years four-months in age counted correctly to 31 and then stopped while another child (four-years six-months) counted from 1 to 7 and stopped. In comparing the numbers correctly used in counting and the numbers which this group used in their number identification responses the author found that there seemed to be a good understanding of the first 3 counting numbers both in their placement in counting and their assignment to correct numbers of objects. As Table 20 indicates this group all began counting correctly at 1 and continued to 5 in correct sequence. In their number identification tasks they did not incorrectly label any of the tasks with "1"

Table 20. Individual analysis of counting ability of four-year-old girls (N = 11)

Sex-Age	Recorded counting to termination
G 4-4	1 to 12 then 14
G 4-4	1 to 10
G 4-4	1 to 31
G 4-4	1 to 11 then 13 to 22
G 4-5	1 to 14 then 21, 22, 23
G 4-6	1 to 7
G 4-6	1 to 14 then 8, 20, 26
G 4-6	1 to 10 then 19
G 4-6	1 to 20
G 4-8	1 to 15
G 4-8	1 to 16 then 20 to 29

or "2" and 1 child did incorrectly label 2 of the tasks with "3." The subject who stopped counting at 7 was a child who used only 4, 5, 6, and 7 in her number identification tasks. She did not count to 8 and she was not able to correctly identify the 8 blocks; she labeled them as "7." Ninety percent of the group then went on to count correctly to at least 10 as Table 21 indicates. Two of the subjects in this group were able to count in correct sequence in the 20's; 1 counted to 31, another to 29, and there were also 2 who counted 3 correct numbers in sequence in the beginning of the 20's. As was anticipated the most difficult area, or the area where more quit or made errors, was in the second decade or the teens. There were 4 subjects who counted correctly to 15 and only 3 of them were able to continue on correctly beyond this number.

The range of numbers used in the number identification tasks was from 3 to 15. The incorrect use of the teen numbers in the tasks were from 1 child in particular who used the numbers 10 through 14 and another

Table 21. Counting length and correctness of sequence of four-year-old girls (N = 11)

Interval	Number correctly completing interval	Percent correctly completing interval
1 to 5 correct sequence	11	100
1 to 10 correct sequence	10	90
1 to 15 correct sequence	4	36
Beyond 15 correct sequence	3	27

child who labeled the blocks randomly using 11, 12, and 15. The majority of the group counted and labeled with first decade numbers.

Four-year-old boys

There were no four-year-old boys who were unable to count correctly the first 4 numbers of the counting sequence. However, as a group these subjects did not count too far. As Table 22 indicates there were 5 of them who did not count correctly to 10, but there were also 3 who counted beyond 15 in correct sequence. One of the boys refused to count. This was the only child who held up fingers in response to some of the number identification tasks. When asked if he liked to count he replied, "Yes, but I can't. I haven't learned yet, but I'm starting to learn 6." His response when asked to count was, "I can't." He did respond correctly to 4 of the number identification tasks.

Three of the subjects eliminated 1 or 2 numbers as they counted; these were in one spot but the child did not stop but rather he went on counting as if that were the way it went. They were able to count much farther than the interval of correct counting for which they are given credit in Table 23. One went on to count to 10 while the other 2 went beyond 15 after their omissions. There were 77 percent of the

Table 22. Individual analysis of counting ability of four-year-old boys (N = 9)

Sex-Age	Recorded counting to termination
B 4-4	1 to 20
B 4-4	1 to 16 then 18 to 20
B 4-5	Refused
B 4-5	1 to 9
B 4-6	1 to 5
B 4-6	1 to 4 then 7, 8, 9, 10
B 4-6	1 to 6 then 9 to 16
B 4-7	1 to 6 then 11
B 4-8	1 to 36

Table 23. Counting length and correctness of sequence of four-year-old boys (N = 9)

Interval	Number correctly completing interval	Percent correctly completing interval
1 to 5 correct sequence	7	77
1 to 10 correct sequence	3	33
1 to 15 correct sequence	3	33
Beyond 15 correct sequence	3	33

subjects in this group who were able to count correctly to 5. Included in those who were not able to do this was the subject who refused to count and 1 child who eliminated 5 and 6 in his counting to 10. There were 3 or one-third of the group who were able to count in correct sequence beyond 5 all the way to 10. These same subjects were all able to count beyond 15 correctly; 1 of them counted to 36 and then stopped while the other 2 counted to 16 and 20.

In comparing the responses made by this group on the number identification tasks and their counting length the author found them having some understanding of the amount of teen numbers. This was concluded from the fact that there were 2 teen numbers used in the number identification tasks, 18 and 19, and both were used by boys on tasks involving 7 and 8 blocks. These boys had a tendency to use larger numbers in their responses. Large counting numbers were used in counting most of the time and the smaller more correct numbers were used on the tasks.

Responses to: Do You Like to Count?

The counting exercise and questions regarding counting were near the end of the testing session for the purpose of not alerting the subjects to counting to discover how many. One of the objectives was to see how many of the preschool children of this sample would count to find out the number of blocks on each task. These questions were then asked after many of them had been involved in counting. This may have influenced their answers when asked: Do you like to count?

As Table 24 indicates there were 6 subjects who stated that they did not like to count. This was 15 percent of the sample. Of these 6 negative responses 4 of them came from the four-year-old girls. Most of these same girls had high scores on number identification tasks and their response to this question was, "No, not very much." When asked the question concerned with what they counted, these same girls usually responded with, "Nothing." There was 1 three-year-old boy who was negative toward counting. He said that he did not like to count, he refused to count when asked to count for the researcher, and he correctly labeled 6 of the 8 number identification tasks. He did not count verbally and his responses were usually only verbal; sometimes

Table 24. Total number of responses to the question: Do you like to count? (N = 40)

Age-Sex group	Yes	No
Three-year-olds		
Girls (N = 12)	11	1
Boys (N = 8)	7	1
Four-year-olds		
Girls (N = 11)	7	4
Boys (N = 9)	9	0
Total	34	6

he would touch the blocks before he responded. The three-year-old girl who did not like to count sang the numbers when she was asked to count for the researcher; she sang the numbers correctly to 7 then she responded with "4." She said that she did not count anything at home or school, but she was able to correctly respond to half of the number identification tasks. There were no four-year-old boys responding negatively to this question.

Responses to: How Did You Learn to Count?

It is always fascinating to ask children to explain how things happened to be or how they came about. Very often their responses are matter-of-factly stated as to have just come about. The most frequent response that was given by these children when asked: How did you learn to count? was: "I just knowed," or "I just started," or even, "I teached myself." When they did give credit to someone else for helping them the response was usually, "I just learned from Mom (or whoever it might be)." The child appears to feel that he has a very active role in this learning which is taking place so rapidly. Table 25 indicates the breakdown and number of responses to the above question.

The next most frequent response following the self is "my mommy" or "Mom" or "Mother." One-fourth of the responses gave credit to the female parent. Six boys responded with this answer as did 4 three-year-old girls, but no four-year-old girls responded with this answer. Five of the four-year-old girls took the credit themselves and the remaining 6 each had different individual responses. Three-year-old girls responded this way: one-third felt they taught themselves or just learned, one-third said their mother's taught them, and the other third had individual responses. Thirty-nine percent of the girls felt that they just knew or learned by themselves but only 17 percent of the boys responded this way. Thirty-five percent of the boys felt that they had learned to count from their mother's help, but only 17 percent of the girls responded this way. The responses of these 2 sex groups are almost

Table 25. Responses to the question: How did you learn to count?

	Girls		Boys		
Response	Three years	Four years	Three years	Four years	Total number of responses
Self (taught self, just started)	4	5	1	2	12
Mother	4	0	1	5	10
Father	0	1	0	0	1
Mother and Father	1	1	0	1	3
Siblings	1	1	1	0	3
Other relatives	0	0	3	0	3
Name (no explanation)	1	0	0	0	1
Teacher	0	1	1	0	2
Record	0	1	0	0	1
I don't know	1	1	1	1	4

exactly opposite. There was only 1 four-year-old girl who responded with "from my daddy;" no other subject indicated that their father had taught them. Three children felt that both of their parents had taught them; there were also 6 who considered their siblings or other relatives to have taught them. One four-year-old girl and 1 three-year-old boy said that a teacher had helped them learn to count. Another child provided an individual response when she indicated that she had learned to count from a record. Four children, 1 from each age-sex group, responded with, "I don't know."

It was very meaningful to look at the sex differences which appeared in the types of responses most frequently given by these preschool children. Opposite situations or attitudes seem to be present in the minds of the boys and the girls as to the origin of their number learning.

Responses to: What Can You Count at Home or School?

The author was interested in discovering what meaning or use the verbal labels of numbers had to preschool children. They were asked this question: What can you count at home or school? The responses they gave are listed in Table 26 in the order of their frequency of occurrence.

It was not surprising to the author to have a number of responses of "blocks" because this is what they had just previously been counting on the number identification part of the test session. Many of the children hesitated and thought before they responded to this question.

Table 26. Total number of responses to question: What can you count at home or school?

Response	Girls' responses Three years	Girls' responses Four years	Boys' responses Three years	Boys' responses Four years	Total number of responses
Blocks	2	2	1	2	7
People	2	1	0	1	4
Toys	1	0	2	0	3
Numbers	0	0	2	1	3
Books, paper	0	1	0	2	3
Games	0	1	1	0	2
Animals	1	0	0	0	1
Money	1	0	0	0	1
Clothing	0	1	0	0	1
Miscellaneous	1	2	1	2	6
Nothing	5	5	1	4	15

Actually the highest number of responses was "nothing;" there were 15 respondents with this reply (37 percent). This was not listed at the top because this told little of what they count; it was a negative response in that they did not indicate that they counted things. The group labeled as miscellaneous had one response for each of the following: puzzles, chairs, building logs, cans, wheat (this was in the trough in the room where this subject had been playing), and valentines (the test date for this child was February 19). These miscellaneous responses were very interesting and provided a more insightful look into what a preschool child finds to count. The wheat that the child had been previously playing with, the valentines from the recent holiday, chairs for everyone, and building logs were probably mentioned because the child had had a recent experience of counting them. These responses came more from four-year-olds than three-year-olds.

Responses, categorized as people, included parents, siblings, babies, friends, and just names which were not explained. Toys included dolls, and "toys"; all of the responses of toys came from three-year-olds. Three boys responded with "numbers" to this question and 1 began to count for the researcher; there were no girls responding with this. Girls responded with: "animals," "money," and "clothes" and there were none of these responses from the boys. On the response of "nothing" there were twice as many girls as boys responding with this. Five three-year-old girls, 5 four-year-old girls, 1 three-year-old boy and 4 three-year-old boys responded with "nothing." Ten of the 23 girls in the sample responded with this same answer.

The responses to this question varied a great deal and pointed up the individual differences of these subjects.

SUMMARY

The current emphasis where children are concerned is on intellectual or cognitive development. There is a push for more preschool programs both for the disadvantaged and for the more affluent children of America. Parents and teachers have been made aware of the great potential which lies within the mind of the preschool child. However, this potential has been there all along, but not until recently has there been much concern for developing it. A few cognitive psychologists brought it to the attention of the adults and now there is a desire to do something about the preschool years.

There are preschool programs of every kind presently in operation and the future points to more and more of them. This is all well and good because preschool education can serve the nation in a very unique and meaningful way; however, all of the preschool programs are not designed with the child's intellectual well-being in mind. If there is going to be an increase in the number of preschools and also an increase in the percent of the under-five populations who attend them, we need to be sure that they are worthwhile and educationally sound. At the present time there is quite a bit of information regarding intellectual development in the young child, but much of this is of one type. It has happened, just as it often does when the population learns of a new or different idea which points toward improvement, that it decides to abandon the older more traditional ways of doing things.

A specific example of what has just been indicated is in regards to counting. The cognitive psychologists have let themselves be heard regarding the small amount of value they place in the rote counting abilities of preschoolers. With the new theories and research has come the term of "conservation" which refers to a logical ability that does not develop in the mind of the child until he is about seven or eight years of age. This ability to conserve is to realize that when the form of some object or objects is changed that the amounts or physical properties of the objects remain unchanged. This new idea is replacing the old-fashioned notion of counting as being the indicator of number understanding.

It is important that we do have researchers who constantly strive to discover new facts about human functioning, but it is the author's belief that these time-tested practices still have a place of importance and value in the life of the young child.

The purpose of this research was to explore number identification and counting abilities of preschool children. It was hoped that there may be indications from some of the applications and questions which the children answered that would give some insight into what they think or know about counting and working with numbers. Forty children were involved in the research project which was carried out at Utah State University in the Child Development Laboratories. The researcher looked at the ability to rote count and the ability to apply these counting or number names to objects in the process of enumeration. The researcher was interested in trying to discover if they were merely verbal labels that children used unknowingly, or if there was some spark of understanding in the children who used them. Therefore one of the objectives of this research was to look at what rote counting and labeling meant to these young children. The second objective was geared more to discovering something about how best to teach number concepts. This was through the use of cubes in two different colors in an attempt to see if the introduction of a second concept increased the complexity of the task to a point where one concept interferred with focusing on the other. This was felt to be important as many preschool programs are not simplified enough or focused on one concept at a time. It is not enough to talk "down" or in a very simplified manner to these children in order to communicate, nor is it desired. The simplification is felt to be most effective if the child is presented with one idea at a time and then given time to discuss this with another person so as to clear up misconcepts and to strengthen others. However, some concepts are not so influential as to distract or interfer with normal learning.

The author discovered that the ability of the preschool child to use numbers increased with the child's age. Three-year-olds can benefit from work with verbal number labels and identification or matching tasks; the four-year-old child has an increased ability to deal with these operations and thus his benefits can be greater in his own way. There are still large benefits in store for the younger child, but they are of a different type. Children usually like to count at this age as they are rapidly increasing their vocabularies and speaking abilities. If the adults working with these children will stop and take the clues that children are giving them they will possibly reconsider overshadowing counting with conservation. They both have a role and the researcher feels that the children of this sample did show an interest in and an ability to use numbers in a meaningful way for their present stage of development. Conservation was not considered in this research as the project focused on counting and numerating ability.

In comparing the three-year-old and the four-year-old age groups, the author found that the older group did perform better on the number identification tasks as was expected. There was an unexpected finding which involved a combination of age and sex differences. It was found in this study that the girls of the three-year-old age group did respond better or more correctly to number identification tasks than did the boys of the same age group. However, in the four-year-old age group the opposite trend occurred, and the boys did better in identifying correctly the number of cubes than did the girls of the same age. There was a much greater increase in the percent of correct responses for the boys than was found for the girls. The increase found in the group of girls from age three years to age four years was from a correct response rate of 38 percent to 42 percent. The three-year-old boys had a correct response rate of 32 percent and the four-year-old boys had a much higher rate at 48 percent. It is the author's feelings that the girls have a greater verbal facility with numbers earlier than do the boys. Their interest in and skills with numbers may also emerge earlier; however, the skills boys show seem to be greater even though they emerge slightly later than they do in girls. The skills of the boys also appeared to be much more oriented to finding meaning in number which contrasted with the more adept facility of the girls to count and verbalize number names. Therefore, the author feels that in preschool children the boys find greater meaning in numbers, and the girls have greater language facility but not as much meaning of numbers.

The author found that the introduction of the second concept of colors produced very few comments from the group; however, it did have a subtle effect on the ability of these children to label the larger numbers correctly when the blocks of two colors were present. It was very beneficial to become aware of the fact that color has peaks of influence in the lives of the child. There were some of the older children who probably recognized that the blocks were different colors, but they were able to keep in mind the fact that they were not concerned at the time with naming the colors, but rather their concerns were with naming the numbers of objects. However, in dealing with the younger age children of three years there was a tendency for them to be distracted by the new variable of color; their concentration on number was lessened as they were unable to focus as directly on one variable at age three as compared to children at age four years. Therefore, it is the author's feeling that children learn concepts best when there is only one presented at a time, especially when they are younger. The findings of this particular study indicate that more learning is able to occur when teaching or experiences are focused on one specific aspect of an object.

Conclusions

It is not feasible nor is it logical to draw a great number of conclusions from research done with a small sample such as this. There has been research indicating that colors are influential and there is research indicating that at other times it has little bearing on the subject's performance. The tentative conclusions which the author drew from this study tend to support those of Brian and Goodenough (1929) in that colors influence different ages of children in different ways, and that the effects of the color concept may be very subtle and often go unnoticed if the child does not verbalize concerning them. Color tends to be a distraction for the younger child, as it add complexity for which the child is not yet prepared.

There was a vast difference found in the counting and number identification abilities of these children; although there was a slight trend for the older children to perform better there were many individuals in all four groups who could correctly label all or not any of the tasks presented. This seemed to the author to be an indication of past experience differences with counting and labeling of objects rather than a developmental factor. The sex of the child had an effect which depended on the age of the child. Boys and girls responded differently to number recognition and counting. Boys seem to find meaning in number at an earlier age than do the girls; however, the girls can count, by rote, more accurately than do boys. Age did have a slight influence, but it was no greater than one would expect to find involving any specific concept development involving an age difference of one year or more.

The basic responses of the subjects on number identification tasks were "4" and "5." These responses involve numbers which appear to have more meaning to the children of the age group involved in this study. There is a need to explore these types of learning experiences more because if preschool programs are set up extensively in the future, they will be dealing with this type of concept teaching as these are the basic foundational concepts for later intellectual growth.

Suggestions for Further Research and Study

Some of the suggestions for further research that the author can make are:

1. A comparison of the counting and number identification skills of this group or a similar one to children labeled as disadvantaged. It would be interesting to note if there was or was not a difference in the counting abilities of these two groups on the numbers from one through ten as well as those higher ones. The uses made of counting and their feelings about counting would be most interesting to compare.

2. A study involving blocks that were not fastened to the base but rather loose blocks which the children could manipulate as they were placed on the table before them. It would be fascinating to note how they counted when they were able to manipulate the blocks and if they were able to then establish one-to-one correspondence relationships if the blocks were not placed in a straight line. What would be the different counting strategies of the various age-sex groups? Would there be small class groupings done by some of the older children?

3. A comparison of the abilities of the children in being requested to give a specified number of objects to the experimenter as opposed to being given a number of objects and then being asked, "How many?"

4. A comparison of a random arrangement of the colored blocks on the color variable. That is, provide more than one new color on the second task and place the colored blocks randomly rather than by grouping the two colors of blocks together.

5. Comparisons involving form, size, or some other variable with the number being predominant to assess what role these attributes play in comparison to that played by color.

6. A comparison of the differences in boys and girls appraisals of the relative influence of each of their parents as sources of knowledge or learning.

These types of studies plus many more would bring to mind the most relevant variables which interfere with teaching the concept of number. They would help prospective and present teachers focus on what things they are doing to confuse their pupils or to provide the best possible learning environments for them in the preschool's of tomorrow.

LITERATURE CITED

Almy, M., E. Chittenden, and P. Miller. 1966. Young Children's Thinking. Teachers College Press, Teachers College, Columbia University, New York. 153 p.

Baldwin, A. L. 1955. Cognition in Childhood, p. 276-285. In Morris L. Haimowitz and N. R. Haimowitz (Eds.). Human Development: Selected Readings, Second Edition. 1966. Thomas Y. Crowell Company, New York.

Beckwith, M., and F. Restle. 1966. Process of enumeration. Psychological Review 73:432-444.

Beilin, H. 1965. Learning and operational convergence in logical thought development. Journal of Experimental Child Psychology 2:317-339.

Benson, F. A. 1967. An examination over an eight month period of Piaget's concept of number development and the presence or absence of certain interrelated tasks in a group of first grade children. Unpublished dissertation. University of Oregon. (Original not seen; abstracted in Dissertation Abstracts 27(10-A):3300.)

Bereiter, C. and S. Engelmann. n.d. Language learning activities for the disadvantaged child. Anti-Defamation League of B'nai B'rith, New York. 34 p.

Bjonerud, C. E. 1960. Arithmetic concepts possessed by the preschool child. The Arithmetic Teacher 7:347-350.

Bourne, L. E. Jr. 1966. Human conceptual behavior. Allyn & Bacon, Inc., Boston, Massachusetts. 139 p.

Braine, M. D. S. 1964. Development of a grasp of transitivity of length: A reply to Smedslund. Child Development 35:799-810.

Bravo, A. R. 1965. Formal preparation for early childhood arithmetic. The Arithmetic Teacher 12:56-58.

Brian, C. R., and F. L. Goodenough. 1929. The relative potency of color and form perception at various ages. Journal Experimental Psychology 12:197-213.

Bruner, Jerome. 1964. The course of cognitive growth, p. 285-300. In Morris L. Haimowitz and N. R. Naimowitz (Eds.). Human Development: Selected Readings, Second Edition. 1966. Thomas Y. Crowell Company, New York.

Cheng, T., and M. Lee. 1960. An investigation into the scope of the conservation of numbers among 6-7 year old children. Acta Psychologica Sinica 28(1):35-84. (Original not seen; abstracted in Psychology Abstracts 35:473.)

Deese, J. 1958. The psychology of learning, Second Edition. McGraw-Hill Book Company, Inc., New York. pp. 291-300.

Dodwell, P. C. 1960. Children's understanding of number and related concepts. Canadian Journal of Psychology 14:191-205.

Dodwell, P. C. 1961. Children's understanding of number concepts: Characteristics of an individual and of a group test. Canadian Journal of Psychology 15:29-36.

Dodwell, P. C. 1962. Relation between the understanding of the logic of classes and of cardinal number in children. pp. 104-113. In Sigel, I. E., and F. H. Hooper, (Eds.). Logical thinking in children, 1968. Holt, Rinehart and Winston, Inc., New York.

Elkind, D. 1961. Children's discovery of the conservation of mass, weight, and volume: Piaget replication study II, pp. 11-19. In Sigel, I. E., and F. H. Hooper, (Eds.). Logical thinking in children, 1968. Holt, Rinehart and Winston, Inc., New York.

Elkind, D. 1964. Discrimination, seriation, and numeration of size and dimensional differences in young children: Piaget replication study VI, pp. 56-75. In Sigel, I. E., and F. H. Hooper, (Eds.). Logical thinking in chilren, 1968. Holt, Rinehart and Winston, Inc., New York.

Elkind, D. 1967. Piaget's conservation problems. Child Development 38(1):15-27.

Estes, B. W. 1956. Some mathematical and logical concepts in children. Journal of Genetic Psychology 88:219-222.

Etuk, E. 1967. The development of number concepts: An examination of Piaget's theory with Yorba-speaking Nigerian children. Unpublished dissertation. Columbia University. (Original not seen; abstracted in Dissertation Abstracts 28(4):1295-A.)

Flavell, J. H. 1963. The developmental psychology of Jean Piaget. D. Von Nostrand Company, Inc., Princeton, New Jersey. 472 p.

Fujinaga, T., Hisataka, S., and Hosoya, J. 1963. The developmental study of the children's number concepts by the method of experimental education. Japanese Journal of Educational Psychology 11:18-26. (Original not seen; abstracted in Child Development Abstracts 38:21.)

Fujinaga, T., Hisataka, S., and Hosoya, J. 1964. The developmental study of the number concept by the method of experimental education. Japanese Journal of Educational Psychology 12:44-53. (Original not seen; abstracted in Child Development Abstracts 38:46-47.)

Furth, H. G. 1964. Conservation of weight in deaf and hearing chileren. Child Development 35:143-150.

Gessell, A., and Ilg, F. L. 1943. Infant and child in culture of today. Harper and Brothers Publishers, New York. 403 p.

Gruen, G. E. 1965. Experiences affecting the development of number conservation in children. Child Development 36:963-979.

Halasa, O. 1967. A developmental study of the attainment of number conservation among economically and culturally disadvantaged children. Unpublished dissertation. Western Reserve University. (Original not seen; abstracted in Dissertation Abstracts 28(6):2606-2607-B.)

Hood, H. B. 1962. An experimental study of Piaget's theory of the development of number in children. British Journal of Psychology 53:273-286.

Hunt, Earl B. 1962. Concept learning: An information processing problem. John Wiley and Sons, Inc., New York. 286 p.

Iijima, F. 1966. Abstract of the developmental sequences of the child's conception of number. Japanese Journal of Educational Psychology 14(1):25-36. (Original not seen; abstracted in Psychology Abstracts 40(8):825.)

Ikegami, K. 1953. Problems of the development of children's number idea. Kyoiku Kagaku 3:49-60. (Original not seen; abstracted in Psychology Abstracts 28:529.)

Ilg, F. L., and L. B. Ames. 1951. Developmental trends in arithmetic. Journal of Genetic Psychology 79:3-28. In Hurlock, E. B. (Ed.). Child Development, Fourth Edition. McGraw-Hill Book Company, New York. 776 p.

Kagan, J., and J. Lemkin. 1961. Form, color, size in children's conceptual behavior. Child Development 32:25-28.

Kaplan, J. D. 1967. Teaching number conservation to disadvantaged children. Unpublished dissertation. Columbia University. (Original not seen; abstracted in Dissertation Abstracts 28(8):3492-B.)

Kohlberg, L. 1968. Early education: A cognitive developmental view. Child Development 39(4):1013-1063.

Lee, L. C. 1965. Concept utilization in preschool children. Child Development 36:221-227.

Lovell, K. 1961. The concept of substance. pp. 290-296. In Mussen, P. H., J. J. Conger, and J. Kagan (Eds.). Readings in Child Development and Personality. Harper and Row, Publishers, New York.

Lovell, K., and E. Ogilvie. 1960. A study of the conservation of substance in the junior school child, pp. 19-30. In Sigel, I. E., and F. H. Hooper (Eds.). Logaical thinking in children. 1968. Holt, Rinehart and Winston, Inc., New York.

Maier, H. W. 1965. Three theories of child development. Harper and Row, Publishers, New York. 314 p.

McLaughlin, K. L. 1935. Number ability of preschool children. Childhood education 11:348-353.

Mermelstein, E. 1965. The effect of lack of formal schooling on number development. Unpublished dissertation. Michigan State University. (Original not seen; abstracted in Dissertation Abstracts 26(8): 874-875.)

Newport, J. F. 1967. Are almost all children disadvantaged in mathematics? Arithmetic Teacher 14:21-23.

Peters, D. L. 1967. Task variations and individual differences in Piaget's conservation of number. Merrill-Palmer Quarterly 13(4):295-308.

Piaget, Jean. 1952. The child's conception of number. Routledge and Kegan Paul Ltd., London. 248 p.

Piaget, Jean. 1953. How children form mathematical concepts. Scientific American 189(5):74-79.

Piaget, Jean. 1967. Six psychological studies. Random House, New York. 169 p.

Potter, M. C., and E. I. Levey. 1968. Spatial enumeration without counting. Child Development 39:265-272.

Quick, A. D. 1966. Number and related concepts for arithmetic for the educable mentally retarded. Unpublished disseratation. University of Alabama. (Original not seen; abstracted in Dissertation Abstracts 27(9):2953A.)

Riess, A. 1943a. An analysis of children's number responses. Harvard Educational Review 13:149-162.

Riess, A. 1943b. Quantification vs. number sense. Journal of Psychology 15:99-108.

Riess, A. 1957. Pre-first grade arithmetic. The Arithmetic Teacher 4:50-54.

Roeper, A., and I. Sigel. 1966. Finding the clue to children's thought processes. Young Children 21:335-349.

Rothenberg, B. B. 1969. Conservation of number among four-and-five-year-old children: Some methodological considerations. Child Development 40(2):383-406.

Shen, C. H. 1962. Some problems on the formation of number conception in 3-4 year old children. Acta Psychologica Sinica 3:210-218. (Original not seen; abstracted in Psychology Abstracts 38(2):254.)

Sigel, Irving E. 1964. The attainment of concepts, p. 209-248. In Hoffman, Martin L. and L. W. Hoffman (Eds.). Review of Child Development Research, Vol. 1. 1965. Russell Sage Foundation, New York.

Stommel, L. J. 1966. The prediction of first grade achievement by an instrument based on Piaget's theory of the formation of number concept. Unpublished dissertation. University of California Berkeley. (Original not seen; abstracted in Dissertation Abstracts 27(8):2457A.)

Terada, A. 1967. An experimental study on the development of number concept of mentally retarded children: A comparison with normal children of the same MA. Japanese Journal of Educational Psychology 15(1):11-20. (Original not seen; abstracted in Psychology Abstracts 41(8):1100.)

Wallach, L., and R. L. Sprott. 1965. Inducing number conservation in children. Child Development 34:1057-1071.

Wallach, L., A. J. Wall, and L. Anderson. 1967. Number conservation: The roles of reversibility, addition-subtraction, and misleading cues. Child Development 38:425-442.

Weaver, J. F. 1967. Classification and mathematical learning. Arithmetic Teacher 14:398-409.

Williams, Alfred H. 1965. Mathematical concepts, skills, and abilities of kindergarten entrants. The Arithmetic Teacher 12:261-268.

Wohlwill, J. F. 1960. A study of the development of the number concept by scalogram analysis. The Journal of Genetic Psychology 97:345-377.

Wohlwill, J. F., and R. C. Lowe. 1962. Experimental analysis of the development of the conservation of number. Child Development 33:153-167.

Zimiles, H. 1963. A note on Piaget's concept of conservation. Child Development 34:691-695.

Zimiles, H. 1966. The development of conservation and differentiation of numbers. Monograph for the Society for Research in Child Development, 31(6):1-46.

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