CONCEPTS OF CONSERVATION AND SERIATION IN FORMAL TESTING AND FREE-PLAY SITUATIONS WITH CHILDREN UNDER SIX

By

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CHAPTER I

INTRODUCTION

Increased interest has developed concerning the need for cultivating intelligent behavior in children under six. Great changes have occurred in the curriculum of early childhood education programs reflecting this increased interest. Most teachers of young children encourage the development of language and physical skills. Appreciation of art and music is considered important. Growth in social and emotional development is also encouraged in most early childhood education programs. Many mathematical skills, such as learning colors and shapes or counting skills, are included in programs for children under six. However, there are many more important mathematical concepts which could be included in the curriculum of early childhood education programs.

The Swiss psychologist, Jean Piaget, has done much research in the area of basic mathematics and science concepts and their relation to the child's view of his world. According to Piaget, the development of the concept of conservation is the foundation for all cognitive skills. As Piaget (1952) states in *The Child's Conception of Number*,

> Our contention is merely that conservation is a necessary condition for all rational activity. This being so, arithmetical thought is no exception to the rule. A set or collection is only conceivable if it remains unchanged irrespective of the changes occuring in the relationship between the elements (p. 3).

All mathematical skills require a solid foundation in conservation if success is to be expected. The concept of seriation can also be important to other cognitive skills such as ordering and learning to think in a logical sequence. By investigating the development of the concepts of conservation and seriation in the child under six, information will be obtained which can be used by teachers in planning the mathematics curriculum for an early childhood education program.

Studies done by Piaget and many other researchers throughout the world (Lovell, Healey, & Rowland, 1962; Wohlwill & Lowe, 1962; Hood, 1962; and Elkind, 1961) point to the idea that children under the age of seven years will be unsuccessful in conservation tasks. Inhelder and Piaget (1964) also concluded that seriation skills in the young child will not be developed before the age of seven or eight. These research studies have contributed to the assumption that certain mathematical skills, such as conservation and seriation, are considered to be too advanced for the child under six. This study will investigate which is too advanced for the preschool child -- the skills themselves or the methods in which these skills have previously been presented to young children.

Children are not always able to demonstrate knowledge and skill verbally. Sometimes responses are misjudged because a child does not have the language to express what he knows. Other times, the verbal instructions given to the child are misinterpreted by him and the responses he gives are influenced by the confusing instructions (Baldwin, 1960).

In all of the Piagetian tasks, verbal instructions are given to the child and verbal responses from him are used to evaluate his knowledge. Some students of child development believe that children under six show physical evidences of thinking or reasoning before being able to express the same ideas verbally. Therefore, a task presented in a manner requiring less of the child's verbal and interpretive skills may reveal different knowledge concerning various concepts than a task scored solely on the basis of verbal response.

For teachers of young children, the literature is contradictory. Some writers imply that presenting learning experiences related to conservation and seriation to children younger than seven is useless, while other writers urge giving children experiences related to these concepts as early as age three years. The question remains whether children do make use of the concepts of conservation and seriation earlier than around the age of seven years and whether such use may be observed in the children's handling of materials sooner than it may be observed in their verbal responses in a testing situation.

Purpose of Study

The purpose of this study was to investigate the relationship between the preschool child's responses to Piagetian tests of conservation and seriation in a free-play situation and in a formal testing situation. The child's responses were examined in terms of age, sex, and program (whether the child was in the morning or afternoon group).

The specific null hypothses tested in this study were:

I. The ability of children to "conserve" or "seriate," as measured by six formal tasks and by six informal tasks does not differ among the total group, nor according to program, sex, nor age.

II. For those children whose scores change between the formal tasks and the informal tasks, the probability that the frequency of change from "conserving" or "seriating" on a formal task to "non-conserving" or "non-seriating" on the informal tasks is equal to the probability of the frequency of change in the opposite direction among the total group and according to sex or age for: the conservation of continuous liquid quantity, of continuous solid quantity, of number, of length, the seriation of Cuisenaire rods, and the seriation task using dowel rods and a set of toy stacking barrels.

III. The probability of a child's being able to conserve or seriate is the same regardless of the program in which the subject was enrolled for the six formal tasks and the six informal tasks.

IV. There is no significant difference between the number of conservers and the number of non-conservers among the total group, nor according to sex nor age for the six formal tasks and the six informal tasks.

V. There is no significant difference between the number of conservers on the formal tasks and the number of conservers on the informal tasks among the total group, nor according to sex nor age.

CHAPTER II

REVIEW OF LITERATURE

The review of literature includes information related to (1) the concept of conservation, (2) the concept of seriation, (3) the relationship between age and success in conservation and seriation tasks, (4) mathematics in early childhood education curricula, and (5) methodological problems in testing young children.

Piagetian Conservation Tasks

Conservation, as previously discussed, is considered to be necessary for all rational activity. Piaget (1968, p. 976) gave a definition of conservation as the "invariance of a characteristic despite transformations of the object or a collection of objects possessing this characteristic." He refers to this definition as "generally acceptable." In other words, the child will be able to see an object or group of objects as "the same" despite any operations performed on the objects, short of removing some of the objects. Almy (1966, p. 5) described conservation as the "ability to grasp mentally those aspects or relationships of a phenomenon that remain invariant or constant over transformations in appearance."

Specifically, the conservation tasks used in this study included the conservation of continuous liquid quantity, the conservation of continuous solid quantity, the conservation of number, and conservation of length. All of these tasks are special types of conservation as described above.

In developing the concept of conservation of liquid continuous quantity, it is necessary for children to appreciate that variations in the shape of a container of liquid do not affect the quantity of that liquid (Fogelman, 1970). When two beakers contain the same liquid quantity, the quantity of the liquid held in one beaker remains unchanged when poured into a third beaker of a different shape. Solid continuous quantity is conserved when the child recognizes that the shape of a solid does not change in the quantity of that solid (Fogelman, 1970). For instance, the quantity of a ball of clay remains unchanged whether the clay is in a spherical shape or flattened like a pancake.

Stages of conservation of continuous quantity were described in Piaget's work, The Child's Conception of Number (1952). The first stage is the absence of conservation. Children at this stage of development perceive the quantity of the liquid according to the size or number of containers. The solid quantity is perceived according to length of of the solid. In all cases, the changes seen by the child appear to him as a change in the total value of the substance. For example, an examiner might use two 14 x 6 cm glasses, each filled approximately two-thirds full of water. The child would be able to verbalize that each glass contained the "same" amount of water. However, if the liquid in one of these tall glasses was poured into two 7 x 6 cm glasses, a child in Stage One would be unable to perceive that the total quantity of the liquid in the tall glass remained unchanged after the pouring (Brainerd & Brainerd, 1972). These non-conservers tend to judge quantity according to the "relative" height rather than "absolute" height (Craig, Love & Olim, 1973). Therefore, a child in Stage One would predict that the tall glass contained more liquid than both of the smaller glasses.

Stage Two involves intermediary reactions of conservation. Two important characteristics of this stage include (1) the capability of conservation when pouring liquid from a tall glass to two smaller glasses, but the presence of non-conservation when three smaller glasses are used in place of two, and (2) the capability of conservation when the differences in the level of the liquid in two glasses are slight. Not all children go through this stage, but those children who do are still considered non-conservers (Inhelder & Piaget, 1964).

In the third stage, the child is a conserver. Immediately or almost immediately, the child recognizes that quantities of liquid are conserved, regardless of the number, height, or sizes of containers involved. This would also apply to the length of a solid mass. Children can also verbalize about this conservation when in the third stage of development. Schnall, Alter, Swanlund, and Schweitzer (1972) described some of the verbalizations given in their study. These conservation tasks were continuous solid quantity using buttons attached to a piece of elastic. Equivalent lengths of the red and blue pieces of elastic were stretched, and the child was asked if one piece of elastic had more following the stretching procedure. "S7: 'If they're the same, they're the same.' S9: 'Looks like more, but I'm pulling them...I put the blue the same as the red'" (p. 1020).

The three stages of conservation of continuous quantity are closely related to Piaget's three stages of intellectual development, the first being a perceptual stage when the child only knows what "appears" to be. He uses no formal reasoning. As he progresses toward conservation, the child develops greater ability to use reasoning. Only when the child enters the third conservation stage is he able to move from observational based thinking to formal or logical thinking.

One-to-one correspondence is another name for the type of number conservation to be used in this study. In these tests, the child is able to match, one for one, the objects in one set with the objects in another set. Conservation occurs when a child can recognize the invariance of the number of objects in each set despite a change in the arrangement of the sets (Almy, 1966).

Three stages were also found to be present in the conservation of number task (Inhelder & Piaget, 1964). Almy (1966) described the first stage, in which the child finds it nearly impossible to make any kind of correspondence between the two sets of objects.

> One child of four years and nine months, for example, when confronted with a row of seven egg cups made a row of the same length but containing only four eggs. When asked to put his eggs in the cups he seemed surprised that there were not enough to fill them (p. 27).

The difficulty of correspondence between the two sets is overcome by the child in the second stage of number conservation. The child is able to set up a one-to-one correspondence between the two sets, but when the arrangement of the sets is changed, the child is unable to recognize a one-to-one correspondence any longer (Almy, 1966). The child is consistently certain that the set that is spread out over more space has "more" than the set spread over less space, regardless of the number involved.

In the third and final stage of number conservation, the child begins to realize that no matter what change in the shape, one-to-one correspondence will remain between the two sets. As Piaget stated (1952, p. 56) about the child's discovery, "Any spatial modification in the distribution of the elements can be corrected by an inverse operation."

The final conservation task to be dealt with is the conservation of length. Tasks related to this concept of conservation examine whether a child recognizes the invariance of the length of an object regardless of any movement in the position of that object (Fogelman, 1970). One of the major tasks used in this area of conservation consists of the presentation of two straight sticks, five centimeters in length, placed parallel to each other (Piaget, 1960). One stick is then moved forward one or two centimeters and the child is asked whether one of the sticks is longer or whether they are the same length. Three distinct stages emerge after testing children with this task.

Children in Stage One conclude that the stick which was moved is the longer stick. This decision is arrived at because the children think only in terms of the "further extremities and ignore the nearer extremities" (Piaget, 1960, p. 95). This attitude is held into and through Sub-stage II-A. The major point is that younger children fail to comprehend the position of both ends simultaneously. Several reasons were given for the inability to conserve in Stage I and Sub-stage II-A. (1) Most children follow the moving stick with their eyes, looking only at the leading extremity. (2) Many children focus only on one side of a stick and, therefore, do not perceive the entire movement but only a portion of the movement. (3) Other children conclude that a change in position automatically makes the stick longer. (4) In a few cases, children follow the trailing end of the moved stick and thus judge the moved stick to be shorter (Piaget, 1960).

The intermediate stage is referred to as Sub-stage II-B. The responses in this stage include all those between non-conservation and operational conservation. At the very end of this stage, the child guesses at conservation but not operationally. Using 5 cm sticks with a displacement of 2 cm, the child concludes that the stick with the positional change is the longer. However, if two 7 cm sticks are used with 1 cm displacement, the child can conserve length following the change in position of one stick (Piaget, 1960).

In the third stage, operational conservation is present. In other words, conservation is arrived at logically instead of by guess work. Piaget (1960) cites the following examples of some common Stage III responses in <u>The Child's Conception of Geometry</u>:

> Sol (6:7): Two sticks with a stagger of 1 cm: 'It's always the same length. - How can you tell? - There's a little (empty) space there (difference between the leading extremities) and there's the same little space there (difference between the trailing extremities.'
>
> Rel (7:6): 'It's the same length but one has been moved.' Adding: 'You pushed one but they stay the same (p. 101).

Not only can the children in Stage III recognize and conclude that both sticks are still the same, but they are also able to verbalize a logical reason for the sameness of the sticks.

Piagetian Seriation Tasks

Piaget also developed tasks dealing with the child's ability to seriate. He defines seriation in <u>The Early Growth of Logic in the Child</u> (Inhelder & Piaget, 1964) as "the product of a set of asymmetrical transitive relations connected in a series" (p. 6). In other words, seriation is the process by which a child is able to order a number of objects according to their size, weight, or other physical characteristics. Very young children often encounter toys designed especially to teach seriation. These include nesting blocks, graduating rings and nesting animals and soldiers. Indeed, the basis for seriation lies in the sensori-motor stage when the child is manipulating these objects but success in ordering these toys by a very young child is finally achieved by "trial-and-error" (Inhelder & Piaget, 1964). This process is described in The Early Growth of Logic in the Child (Inhelder & Piaget, 1964).

> As for seriations, some approximation to these can be found in various constructions. One such example is a tower made up of nesting boxes. To begin with, children may choose the boxes at random but in time they manage to arrange them approximately in order of decreasing volume (p. 13).

Despite these apparent seriation attempts by the young child, Inhelder and Piaget (1964) propose that actual success in seriation can only be found when the child uses both perceptual and operational or logical skills to perform a given task. As with the previous conservation tasks, there are three stages in the child's acquisition of seriation. These stages can be studies in relation to the physical seriation of a set of objects or in relation to the child's anticipation of the order of the objects. This anticipation, according to Inhelder and Piaget (1964), is an essential element in operational or systematic seriation.

In The Child's Conception of Number (Piaget, 1952), a study of the development of seriation was reported in which the three stages showing the physical seriation of objects were discovered. The specific task was to arrange ten rods in a series according to length. The first stage in the development of seriation is one in which there is no attempt at seriation. The child was unable to arrange the ten rods according to length. However, he may be able to arrange the rods in a "sub-series" of two, three, or four. In the second stage, the child is able to order the rods through the process of "trial-and-error." If he is asked to insert additional rods into the series, he must again use trial-and-error. Many times, he may have to start his series over again from the beginning. The third stage, according to Piaget and Szeminska (cited in Inhelder & Piaget, 1964), is not arrived at until the seventh or eighth year in a child's life.

> The child proceeds systematically by looking for the smallest (or largest) element first, then for the smallest among those remaining, etc. This procedure, and this alone, may be regarded as properly operational, because it implies an awareness that any given element is both larger than the preceeding and smaller than those that succeed it. (e.g. $E > D$, C, etc. and $E < F$, G, etc.) This operational reversibility is accompanied by the ability to insert the new elements correctly, without trial-and-error (p. 250).

These same three stages were also evaluated according to the anticipation the child holds with regard to the seriation of the objects. Anticipation can be described as the subject's knowledge <u>in advance</u> "that by choosing the smallest element among those that remain, he will eventually build a series in which each term is larger than the preceeding ones, which is why he is able to avoid any errors or inconsistencies" (Inhelder & Piaget, 1964, p. 251).

To test the degree of anticipation a child has regarding the seriation of a group of objects, the following task was used: The child is first shown four dolls of varying sizes and he is asked to arrange the dolls in order. This activity is designed to show the child what will be expected of him in the anticipation task. The child is then given ten rods varying in length from 9 to 16.2 cm in random order. He is asked to arrange these rods in order like he did the dolls but first he is to "guess" what the order will be. The child displays his guess by a drawing of the predicted order of the rods. After the drawing is made, he is asked to seriate the rods physically.

Stage One is characterized by no anticipation. The children are unable to draw the predicted order as well as unable to seriate the physical objects. In both the drawing and the attempt at seriation, the child is only able to order two or three elements at once. Inhelder and Piaget (1964) cite several examples of children who were asked to perform this task.

> Fra (4:0). Given colours, Fra draws seven lines of the same length going from one edge of the paper to the other, and two small lines which are more than ten times smaller than the others. The pencil drawings are: (1) a long line and a short one; (2) five lines, three short alternating with two long. The actual seriation is a set of unco-ordinated pairs (p. 253).

> Hil (4:5) orders the dolls correctly. "And now I'd like you to draw me the sticks, but in order, starting with the smallest, then one that's a little bigger, then a little bigger, till you get to the biggest one of all. --(Pencil drawing: 2, 1, 4, 10; then 10, 2, 6, 8, 7. Actual seriation: 1, 3, 7; then 8, 7; then the two unco-ordinated series 1, 3, 7, 10 and 2, 4, 8, 9) (p. 254).

Stage Two is referred to as the "semi-anticipation" stage. During this stage, the child is approaching seriation but is not quite there yet. The child is often able to correctly seriate the rods in his drawings and may even be able to physically seriate the rods but this is accomplished by a trial-and-error. Although the anticipation of this stage is somewhat imperfect, it is true anticipation in that it has a definite effect on the actual seriation and on the details in the construction of the seriation (Inhelder & Piaget, 1964).

Stage Three is one in which the child anticipates the detail of his seriation in a drawing and is also capable of physically seriating the objects. The only mistakes that occur in drawings of children in Stage Three are due to distractions. Inhelder and Piaget (1964) describe a boy in Stage Three responding to the task:

> Ben (7:1). His drawing and actual seriation are immediately correct. The latter is disarranged, and a new element is added to be inserted in the series. Ben compares it systematically to the smallest elements, and places it between five and six, without reconstructing the series. "Why there? --(Reconstructing the series to prove his point)--There!" (p. 259).

Ages for Success in Conservation and Seriation Tasks

Volumes of work have been done on the various theories developed by Piaget and his associates. Replications of the original Piagetian studies were attempted as well as studies dealing with specific aspects of a Piagetian-type task. This section includes a brief summary of several such studies in each of the categories of tasks to be dealt with in this paper.

Conservation of Continuous Quantity (Liquid)

Beard (1963a) conducted two studies dealing with this conservation task. The first, using glasses containing equal amounts of liquid, tested the child's ability to conserve liquid when the quantity in one glass was poured into three smaller glasses. Scores ranged from 10.2 per cent conservation in the age group 4:10 to 5:9 to 63.0 per cent conservation in the 8 years to 10 years + age group. Over half of the children tested were unable to conserve in each group up to the age range of 7:10 to 8:9 years.

The second study by Beard (1963b) included more difficult items in that the children were required to show "which glass would hold more." The glasses were of various sizes and shapes. As might be expected, the number of children finding success was reduced in this study. The 4:10 to 5:9 years age range answered correctly only 4.1 per cent of the time. The oldest group tested, 8 years to 10 years +, were correct only 29.6 per cent of the time.

Wallach, Wall and Anderson (1967) used water in glasses to test ability to conserve. Two tall glasses were filled with equal amounts of liquid. Liquid from one glass was poured into a low, wide glass. The children were expected to recognize that the amount of liquid remained constant following the pouring situation. Only children between the ages of 6:1 years and 7:8 years were tested. This group displayed conservation skills 55 per cent of the time.

Vinh-Bang and Inhelder (cited in Fogelman, 1970) reported results of a study dealing with conservation of continuous liquid quantity. However, they did not detail procedures or materials used in their tests. Nevertheless, these results should be included because the answers given by children were classified according to the three distinct stages in the development of this concept. According to the following results, there is an abrupt change in a child's ability to conserve between the ages of seven and eight years (Fogelman, 1970). Despite the interest provided by the results due to the three stages being used to analyze the findings, few generalizations can be drawn unless the exact test used is known.

Age	Conservation (%)	Intermediate (%)	No Conservation (%)
5	16	0	84
6	16	16	68
7	32	4	64
8	72	4	24

(Fogelman, 1970, p. 32)

Not every task of conservation of continuous liquid quantity is of equal difficulty. Just by comparing the two tasks used by Beard, great variations can be noted in the ability to conserve, depending upon the test used.

Conservation of Continuous Quantity (Solid)

Elkind (1961) used two identical balls of clay to test conservation of continuous quantity (solid). The children verified at the beginning of the session that the two balls were "the same." The child was then expected to recognize this "sameness" after one ball was transformed into a hot dog shape. The five-year-old children tested conserved 19 per cent of the time. Six-year-olds were correct 51 per cent of the time. Skill in conservation increased gradually until the final age group tested, eleven-year-olds, where 92 per cent of the subjects were conservers.

Two separate studies were again conducted by Beard (1963a & b). In the first study (Beard, 1963a), the child was asked to make two balls of equal size with plasticine. Then, one ball was rolled into a sausage. The child was expected to recognize that the amount of plasticine still remained the same. Almost half (46.9 per cent) of the children in the youngest age group, 4:10 to 5:9 years, were able to conserve. The oldest group, 8 years to 10 years +, were able to conserve 85.7 per cent of the time.

In the second task (Beard, 1963b), the same materials were used but the subject was asked to break the sausage shaped plasticine into pieces. The children were required to conserve the plasticine in the broken pieces of the sausage shape. Children scored lower on this task than on the preceeding one. The younger children, 4:10 to 5:9 years, were correct 24.5 per cent of the time. In the 8 years to 10 years + age group, 73.4 per cent of the subjects were considered to be conservers.

Older children were subjects in a study by Lovell and Ogilvie (cited by Fogelman, 1970). Six balls of plasticine, two of equal size, were the materials encorporated into this task. The two balls of equal size were to be selected and then one was transformed into a sausage shape. The subjects were to conclude that both plasticine shapes contained the "same" amount. The data obtained from this study are shown below (Fogelman, 1970, p. 35):

Average Age	Conservation (%)	Transitional (%)	Non-Conservation (%)
7:8 yrs.	36	33	31
8:10 yrs.	68	12	20
9:9 yrs.	74	15	11
10:8 yrs.	85	9	5

The ability to conserve in this solid quantity task, as with the previous one, depends greatly upon the type of task and the wording used.

Conservation of Number

The concept of conservation of number has been studied a variety of ways. Some studies deal more closely with one-to-one correspondence while others deal with the invariance of the total number of objects in a set.

Wohlwill and Lowe (1962) dealt with one-to-one correspondence using two rows of poker chips, one red and one blue. The subjects were all kindergarten children with a mean age of five years ten months. There were four situations to which the subjects responded in relation to changes made in these two rows of chips. First, the red row was lengthened to twice that of the blue row. Following this, twelve per cent of the subjects were able to conclude that both rows still contained the same number of chips. The next action involved dividing the red row into two rows of four and three, still remaining parallel to the blue row of chips. Only eight per cent of the subjects were conservers in this situation. After placing the red chips in a vertical pile in front of the blue row, the subjects were able to conserve number seven per cent of the time. In the final situation, inserting the red chips into an opaque tube, only five per cent of the subjects were able to conserve.

Beard (1963a) was also involved in a one-to-one correspondence-type study. She used six eggs (pictures) and six egg-cups. The subject put out one egg for each egg-cup and then the eggs were collected and put close together. Subjects were asked if there were still enough eggs for each egg-cup. In this study, Beard grouped her subjects together with an age range of four years ten months to seven years two months. Testing 1,224 subjects, she found 85 per cent of the subjects to be conservers.

A study almost identical to Beard's study, with the exception of using dolls and doll beds, was done by Wallach, et al. (1967). The subjects ranged in age from six years one month to seven years six months. The results of this study concluded only 43 per cent of the subjects tested were conservers.

Finally, Wallach and Sprott (1964) conducted a study in which the three distinct stages of the development of number conservation were evaluated in relation to the subjects answers. Two tasks were expected of the subjects: (1) Five large cardboard oblongs and five small circles were used to perform the one-to-one correspondence. Once again, the circles were then removed from the correspondence and placed close together. The subject was then asked if there were the same number of circles and pieces of cardboard; and (2) Six dolls and six doll beds were used in the second task. A similar situation to the one using the circles was presented to the subjects. The subjects were considered conservers if they gave correct responses in both tasks. Partial conservation was considered present if the subject was correct in answering for only one of the tasks. Non-conservation was concluded when no correct responses were given. The results of this study can be summarized as follows: The 62 subjects ranged in age from 6:5 years to 7:8 years with a mean age of 6:11 years; 45 per cent were judged to be conservers, seven per cent showed partial conservation and 48 per cent were identified (judged) to be non-conservers (Wallach & Sprott, 1964).

As with each of the preceeding conservation tasks, the ages at which conservation is expected to be achieved varies greatly. Beard's studies (1963 a & b) show greater numbers of subjects as conservers. These subjects were all English children. One reason for the great difference between Beard's studies and studies of other researchers was given by Fogelman (1970). The "superior performance" of the English children could be explained by the fact that all of those children tested, even the four-year-olds, had some time in a school situation. On the other hand, the American children tested may not have had any school experience until the age of six years.

Conservation of Length

The conservation of length reflects the child's ability to recognize the invariance of the length of objects regardless of a change in position. One study of this concept was carried out by Elkind (1966) using two different colored pencils and graph paper. Two lines were drawn on the paper by the experimenter. After the subject agreed that the lines were the same length, the experimenter drew arrowheads to create an illusion of one line being longer. The subject was again asked if the two lines were the same and he was required to give an explanation for his answer. The ability to conserve ranged from 6.7 per cent of the subjects at age four years to 76.7 per cent at the age of seven years.

Another study was conducted by Elkind (1966) which dealt with the ability to conserve length without having to contend with an illusion. In this task, two unsharpened pencils of equal length were placed parallel to one another and the subjects were to recognize the equal length of the pencils. Next, one pencil was moved forward and the subjects were to determine if the pencils were still the same. Reasons were also expected from the subjects for their responses. The subjects at age four years were able to conserve 26.8 per cent of the time. However, the seven-year-old subjects again were able to conserve 76.7 per cent of the time. This task allowed more younger children to conserve length but the seven-year-olds were not affected by the differences in the tasks.

Lovell, Healey and Rowland (1962) completed two studies dealing with conservation of length. These studies evaluated the subjects responses according to the three stages in the development of this concept. The first task was presented using a straight wooden rod and an equal length of plasticine. These materials were placed parallel to each other with the end points aligned. The subjects were asked to compare the two lengths. If the subject responded that the lengths were not the same, he was asked to run his finger along the lengths and the original question was then repeated. The results are summarized as follows (Fogelman, 1970, p. 52):

Age	N	Conservation (%)	Conservation After Touching (%)	Non-Conservation (%)
5	10	40	30	30
6	15	54	33	13
7	15	67	26	7
8	15	74	26	0
9	15	67	26	7

Lovell, et al. (1962), also required the subjects to react to lengths of two equal rods during three displacements of those rods. At the outset of the experiment, the subjects were asked if the rods, placed parallel to one another, were of equal length. Once this was established, the positioning of the rods was varied in the following ways: (1) one rod was moved forward; (2) the rods were positioned to form the letter T; and (3) an acute angle (less than ninety degrees) was formed with the two rods. The results are summarized as follows:

Age	N	Conservation (%)	Partial Conservation (%)	Non-Conservation (%)
5	10	0	10	90
6	15	13	13	74
7	15	26	7	67
8	15	53	7	40
9	15	67	13	20

(Fogelman, 1970, p. 53)

In comparing the results of these two studies, it may be noted that, although children from age five years through eight years did less well on the latter task, the nine-year-old subjects conserved 67 per cent of the time on both tasks.

Fogelman (1970), in revealing all conservation tasks developed by Piaget and his associates, concluded that the majority of investigations attempted in this area point to a sequence in the development of such skills. Length was considered as being easier to conserve than continuous quantity, volume, weight, or number.

Seriation

Seriation, the process of ordering objects in a sequence according to some physical characteristic, was studied by Beard (1963a). Materials used in this task included pictures of ten boy scouts and ten sticks in increasing size. The experimenter explained to the subject that the smallest boy was to have the smallest stick. Then, the subject was asked to find the right stick for a specific boy. The subjects were to explain their responses. Beard's subjects ranged in age from four years ten months to seven years two months. Out of the 1,224 children tested, 60 per cent were considered correct in their attempts to seriate.

Seriation according to weight was also tested by Beard (1963b). Three weighted matchboxes of different colors and a balance were needed for this task. The experimenter instructed the subject to use the balance to find out which box was the heaviest and which was the lightest. The results were examined according to age and sex of the subject. In the youngest group, four years ten months to five years nine months, boys were successful 50 per cent of the time while 36.4 per cent of the girls were successful. In the eight- to ten-year-old age group, 93 per cent of the boys were correct and 60.8 per cent of the girls were correct.

Lovell, et al. (1962) used ten Cuisenaire rods of different lengths. In this task, the children were asked to anticipate the series by touching the rods in order. After the anticipation, the subjects physically seriated the objects. Results were presented only for those children in Stage Three, where anticipation and construction of the series were both correct. Of the five-year-old subjects, 33 per cent were in Stage

Three while 100 per cent of the nine-year-olds were in that stage. Only 80 per cent of the ten-year-old subjects were found to be in Stage Three.

Seriation was one of the few tasks in which Piaget detailed his experiments enough to enable reporting of procedures. Piaget and Szeminska (cited by Inhelder & Piaget, 1964) conducted a seriation task using ten small rods, ranging in length from 9 to 16.2 centimeters. Children were asked to put the rods in order. The three stages in the development of this skill are delineated in the results summarized below (Inhelder & Piaget, 1964, p. 250):

Ages (Number of Subjects)	4 (15)	5 (34)	6 (32)	7 (32)	8 (21)
Stage IA. No attempt at seriation	53	18	7	0	0
Stage IB. Small uncoordinated series	47	61	34	22	0
Stage II. Success by trial-and-error	0	12	25	15	5
Stage III. Success with operational method	0	9	34	63	95

As with the conservation tasks, there appears to be some difference in the ability to seriate depending upon the task required of the subject and the instructions given by the experimenter. Once again, Beard's subjects were more successful at younger ages which may point to the idea that experience has some effect upon the ability to conserve and seriate.

Need for Mathematics in Early Childhood Education Curricula

Despite the results of most Piagetian-type experiments, inferring that children are not ready for basic mathematics concepts until the age of seven or eight years, many researchers argue that young children are ready for experiences in this area. Wann, Dorn, and Liddle (1962) emphasize the underestimation of the intellectual capacity of the child under six.

> It is important to see and accept the fact that young children are not "unready" for the many challenges involved in intellectual experience. Unreadiness is a concept as fruitless as it is difficult to determine. The notion of unreadiness arises from overgeneralizations about a given period or age in the development of children. It is more helpful to think, rather, of individual children as being ready at all times for some kind of learning, ready perhaps for different kinds of experiences, a different approach, another level of concept development. This way of looking at the problem leads to action wheras dismissing children of a given age as "not ready" leads to stagnating inactivity (p. 99).

Bruner (cited by Wann, et al., 1962) reiterated this basic idea in a report of the Woods Hole Conference on Education:

> Experience over the past decade points to the fact that our schools may be wasting precious years by postponing the teaching of many important subjects on the grounds that they are too difficult...The foundations of any subject may be taught to anybody at any age in some form (p. 101).

Mathematics is one content area that has for too long been slighted or ignored in early childhood education curricula. This is due, in part, to the fact that the majority of Americans greatly underestimate the maturity of the three-, four-, and five-year-olds. As James Hymes (1968) related in <u>Teaching the Child Under Six</u>: "Too many people persist in thinking: 'What could threes, fours, and fives possibly learn?'" (p. 8).

Another reason for the absence of mathematics in programs for children under six is that teachers of these children are not well prepared in teacher training programs to deal with this content area on the young child's level (Almy, 1966). Too many day care centers or preschools emphasize rote learning of the names of colors and the counting numbers from one to ten. These activities are supposed to satisfy any questions about whether mathematics is encorporated into the program. However, children under six are ready for many other mathematics activities. Fehr (cited by Spodek, 1972) proposes that much of the mathematics content in the elementary school can be put to use at appropriate levels in early childhood education programs.

> Such a program would include the study of "sets," or collections of objects, the learning of cardinal and ordinal numbers, one-to-one correspondence, the operations of addition, subtraction, multiplication, and division, as well as the concept of fractions, simple geometry, and developing concepts of measurement of two-dimensional space, volume, and weight (p. 138).

Some may question the feasibility of providing such experiences in the programs for children under six. However, appropriate experiences in all of the previously mentioned areas can be planned for young children. A list of the skills a child must have before he is considered ready for formal written work in mathematics is shown below. Since most written work in mathematics is introduced at the beginning of first grade, the following skills must be developed in preschool and kindergarten programs.

1. Be able to sort, according to similarities, a collection of miscellaneous objects.

2. Develop, through active participation and discussion, the vocabulary of order-the use, that is, of number in its ordinal aspect and of comparatives that arise in ordering, such as 'larger,' 'heavier,' and so on. He must distinguish between different uses of the word 'big' and between 'more' in number and 'more' in some other quantity.

3. Be able to recognize collections of objects and patterns in collections implying the concept of a set as an abstract identity.

4. Be able to match sets in one-to-one correspondence.

5. Learn number names and their order in the counting sequences at least up to ten and preferably up to twenty.

6. Be able to match the words in the counting sequence to objects in a one-to-one correspondence.

7. Understand the conservation of cardinal number as applied to a discrete group of permanent objects, recognizing collections as equivalent or distinct if counted.

8. Learn to read and write the number symbols and words, matching them with collections.

(Gardner, Glenn, & Renton, 1966, p. 55)

Leeper, Dales, Skipper and Witherspoon, in Good Schools For Young Children (1974), also emphasize the importance of mathematics as a part of the curriculum of early childhood education programs. Not only are children more capable to deal with mathematics concepts at an earlier age, but they can be successful if appropriate experiences are provided. In making learning experiences appropriate, the teacher must remember how young children learn. When a child learns to count, it does not mean he has an understanding of numbers. He only develops that understanding through many and varied first-hand experiences with numbers of things.

Almy (1966) suggests how understanding is developed by children in relation to conservation and seriation. Those children who have experienced many opportunities in classifying objects or in ordering objects according to certain physical characteristics will arrive at a level of operational thought needed for conservation sooner than children not provided with such activities.

Piaget's work has important implications for early childhood education program planners. His experiments can be used to evaluate a child's level of thinking. When used with the very young child, the teacher may gain greater understanding of the child's ability if tasks are presented in more familiar settings and with his peers participating (Almy, 1966). Once the child's level is determined, these tasks can be great aids in evaluating a child's progress. Not only will mathematics progress be seen in these tasks, but also progress in learning to think logically in all areas will be displayed.

> A well-constructed Piaget interview provides the teacher with something more than he customarily gets from standardized test results. This is a picture of the ways the child organizes (or fails to organize) information. His errors and his misconceptions are revealed *as they occur*. From this direct observation of his functioning in a problem-solving situation, the teacher can derive many clues as to either his readiness for more complex learning or the kinds of experiences he may need before he can move ahead (Almy, 1966, p. 135).

As James Hymes (1968) summarized, "It is so easy to lump children. We tend to put them in a pile, put a label on the pile, and think we never again have to look at the people in the pile" (p. 39). If teachers continue to operate in this manner when studying the results of Piagetian tests, mathematics will continue to be ignored with children under six. However, if all children will be recognized as unique and will be provided with experiences in *all* areas of the curriculum, according to their own level of development, the child's intellectual capacities in the years before six will be truly cultivated.

Methodological Problems in Testing Young Children

Responses given by any person are influenced by the characteristics of the person himself and by the characteristics of the situation in which he is asked to respond (Baldwin, 1960). In the case of the preschool child, verbal responses are dependent upon the development of the language skills of the child. When confronted with a situation requiring verbal responses, the young child's reaction may not indicate what he actually means. Baldwin (1960) pointed out that research situations can be structured with language for adults. Responses can be expected to reflect an understanding of the stimuli.

> The trouble is that children do not understand instructions very well, and verbal structuring of the situation does not always produce the same results that it does with adults. We cannot count upon the effectiveness of these verbal procedures with children (p. 23).

When using the formal testing situations of the Piagetian tasks, verbal responses are the only means of evaluating the child's knowledge. Especially when testing children under six, the characteristics of language development and the verbal structure of the test must be taken into account in evaluating the results.

Summary

1. Conservation skills are the foundations for mathematics concepts as well as all rational activity.
2. Seriation skills aid in the development of logical thought and sequencing of ideas.
3. The three stages in the development of conservation and seriation skills relate to the three stages of intellectual development discussed by Piaget.
4. A majority of the research dealing with the various tasks developed by Piaget in the area of conservation and seriation indicate that, before the age of seven or eight years, few children are successful at the specific tasks.

5. The ability to conserve and seriate in Piagetian-type tasks is affected by the type test and the wording used by the experimenter.
6. For too long, the intellectual capacities of the child under six have been underestimated.
7. Mathematics in early childhood education programs has not been developed to its full potential.
8. Young children, under the age of six years, are ready for and can find success in mathematics experiences <u>if</u> such experiences are appropriate for the child's level of development and are presented in a way the child can comprehend.
9. Reliance upon verbal instructions and verbal responses in the evaluation of a child's knowledge of conservation and seriation may disguise a child's actual ability.

CHAPTER III

PROCEDURES

Subjects

The subjects for this study were 32 preschool children, 16 boys and 16 girls, ranging in age from three years ten months to five years six months. These children were in attendance at the Oklahoma State University Child Development Laboratory in Stillwater, Oklahoma. These were children of university professors, local businessmen, and university students. The majority of the subjects were judged to be of upper-middle socio-economic status.

Collection of Data

The data were collected during March and April of 1975. By choosing this time, all subjects tested had at least one semester in attendance at the preschool laboratory. Each subject was given all formal tasks before any of the informal tasks were presented. The testing time for each of the tasks ranged from approximately two minutes to no longer than five minutes.

All data for the formal and informal tasks were collected during the free-play period of the regular preschool program. Children were allowed to decline from participating in the procedures if they became inattentive, appeared restless or refused to answer the questions.

However, the children who declined on one day were asked to participate again at a later time so that all children completed all of the tasks. Two days were needed to present each formal and informal task to all of the subjects.

TABLE I

AGE DISTRIBUTION OF CHILDREN BY GROUP

Group	Boys	Girls	Total	Age Range
Total Group	16	16	32	3:10 - 5:6
Male Subjects	16	0	16	4:8 - 5:6
Female Subjects	0	16	16	3:10 - 5:3
Five-Year-Old Subjects	8	8	16	5:1 - 5:6
Four-Year-Old Subjects	8	8	16	3:10 - 4:11
Five-Year-Old Male Subjects	12	0	12	5:1 - 5:6
Four-Year-Old Male Subjects	4	0	4	4:8 - 4:9
Five-Year-Old Female Subjects	0	4	4	5:1 - 5:3
Four-Year-Old Female Subjects	0	12	12	3:10 - 4:11
Morning Group	8	8	16	3:10 - 5:6
Afternoon Group	8	8	16	4:4 - 5:4

The experimenter observed the subjects and chose materials for the informal testing situations which appeared to be most widely used by the subjects. All of the children had used the playdough, the barrels, the flannelboard and had participated in some form of water play.

A form of time sampling was incorporated in this study to allow for a more accurate estimate of the behavior of young children in relation to conservation and seriation tasks. Two morning and two afternoon free-play periods were scheduled for the formal testing of each of the six Piagetian tasks in this study. Two morning and two afternoon free-play periods were also needed for the informal testing of each of the six Piagetian tasks in this study. Each child was observed in a task no longer than five minutes. He could remain at the center and manipulate the materials after five minutes but the observation and collection of data for the study ended after that period of time. As mentioned previously, additional days were needed at the end of formal testing and informal testing to give all children in the group an opportunity to make-up any tasks not attempted.

The formal testing situation was carried out by one experimenter using a cassette tape recorder to describe what was taking place during the testing. The child's ability to accomplish a given task was described as well as important behavior displayed or explanations given by the subject. The explanations given by the subject were later evaluated according to the evaluation guide for logical explanations (see Appendix A). This was developed from examples reported in the literature concerning acceptable explanations for answers given in conservation and seriation tasks.

In the informal testing situation, the experimenter recorded observations using a cassette tape recorder. The basis for this observational method was taken from Caldwell, Honig, and Tannenbaum (1969). The method used by these researchers was amended to include only the basic procedure in which the experimenter whispered key phrases into the microphone of the recorder, describing the subject's behavior during the testing situation. In many cases, such as when the subject gave responses and explanations for those responses, his voice was picked up by the recorder located near the child.

Selection of Instruments

The purpose of this study was to investigate whether, for the preschool child, Piagetian-type tests of conservation and seriation elicit the same responses as may be observed in a free-play situation. Therefore, two types of situations were developed to test a subject's knowledge of conservation and seriation, formal and informal. The instruments used in both situations were similar, the informal situation being changed from the formal one only to make it less structured for the subject.

Most Piagetian tasks selected for the formal testing situation were replications of the tasks used in studies done by researchers other than Piaget and his associates. The reason for this was that the majority of the original tasks developed by Piaget were not described in the available literature in enough detail to allow replication of the procedures. The informal tasks used in the free-play situations were adaptations of the formal tasks, amended to allow for use in self-selected activities.

Instead of the one-to-one relationship between the experimenter and the subject in the formal tasks, the informal tasks were developed to allow for up to three children participating at one time. However, the children in the actual study participated only one at a time. In a few instances, two children would come to the table together. If one started a task, the other child would always move to another activity. The materials used in the experiments were those the subjects had contact with previously in their preschool program.

Conservation of Continuous Quantity Task
(Liquid)

Formal. The task was a replication of the task used by Beard (1963a). Materials included two 9-ounce transparent glasses, three 4-ounce transparent glasses, and a large pitcher of water. The two 9-ounce glasses were filled with equal amounts of water. The subject was asked if both glasses contained equal or the same amount of water. Once this fact had been established, the experimenter poured the water from one of the 9-ounce glasses into the three 4-ounce glasses in equal amounts. The experimenter then asked: "Now I have this one to drink (the remaining 9-ounce glass) and you have all three glasses of water to drink. Will you have more to drink, or shall we still both have the same, or shall I have more to drink?" After the subject responded, he was asked to tell how he knew.

Informal. Materials used for this task included two 2-cup plastic containers, two 1-cup measuring cups, and a large pitcher of water. During the free-play experience, the investigator was located at an empty table and developed rapport with the child through informal conversation. After the child had begun to play with the materials, he was asked casually if the two large containers of water contained the same amount. Once the sameness had been determined, the experimenter poured the water from one of the 2-cup containers into the two 1-cup measuring cups. The subject was asked: "Do the two smaller cups still have the same amount of water in them as the large cup has? How do you know?"

Conservation of Continuous Quantity Task

(Solid)

Formal. Beard's task (1963a) in this area of conservation was selected. The material used by Beard was plasticine but playdough was substituted. The subject was asked to make two balls of equal size with the playdough. Once the equality is determined, the subject was asked to roll one of the balls into a sausage shape. Considering the experiences of the children tested, "hot dog" was used instead of "sausage shape." The experimenter then asked the subject, "Is there still as much playdough in the hot dog as there is in the ball? How do you know?"

Informal. Playdough and wooden mallets were used as materials in this free-play task. During the free-play experience, the investigator was located at the playdough table and developed rapport with the child through informal conversation. After the child had begun to play with the materials, the experimenter casually asked, "Do you suppose we could make two balls that were the same size?" Both the experimenter and the subject proceeded to make the balls. When equality had been determined, the experimenter asked the child to pound one of the balls made by the experimenter into a pancake. Then the experimenter asked, "Do the pancake and the ball still contain the same amount of playdough? How do you know?"

Conservation of Number

Formal. A replication of the experiment completed by Wohlwill and

Lowe (1962) was used for this task. The materials used included seven red poker chips and seven black poker chips. Only the first situation used by Wohlwill and Lowe was used in this study. The child was asked to place the red row of poker chips in a row and then to "give one black poker chip to every red poker chip." After one-to-one correspondence had been established, the subject was asked if there were the same number of red and black poker chips. The experimenter then extended the row of red poker chips in both directions to a length of about twice that of the black row. The subject was told that the row of red chips were his and the row of black chips were the experimenter's. After the spreading of the red row, the subject was then asked, "Who has more chips, you or I?" The subject was then asked for an explanation of his response.

Informal. Materials used in this task included a flannelboard, five red circles and five blue circles. This number was chosen because most of the children in the study were familiar with the concept of the numbers one through five. By eliminating two of the objects from the previous tests the subject was still tested concerning his concept of the conservation of number. The subject was still required to demonstrate his ability to recognize the invariability of number regardless of changes in the position of the number of objects. The experimenter was located at the mathematics center and developed rapport with the children who chose to work at the center by informally talking with the children. During the free-play experience, children chose freely to come into the center to manipulate the materials. Once the child had begun to work with the materials, the experimenter asked the subject if he would give each blue circle a red circle. After the one-to-one correspondence was completed, the subject was asked if there were the same number of blue and red circles. The experimenter spread out the row of red circles after equality of the red and blue circles had been determined. Then the experimenter asked, "Are there still the same number of red circles as there are blue circles? Can you show me or tell me how you know?"

Conservation of Length

Formal. The test used by Lovell, et al. (1962) was replicated for this task. Two dowel rods, one foot in length, were used. The rods were placed with their extremities coinciding so that the child could easily recognize and agree that the rods were the same length. Three situations were presented to the subjects: (1) one rod was pushed slightly ahead of the other, (2) the rods were placed so as to form the letter T, and (3) the rods were placed so that the end points were touching at an acute angle. After each change in position of the rods, the experimenter asked the child if the two rods were still the same length or if one rod was longer than the other. He was also asked for an explanation of his response.

Informal. A flannelboard and two pipe cleaners of the same color and length (approximately one foot) were used to complete this free-play task. During the free-play period, the experimenter was located at the mathematics center and developed rapport with the children who came to this center. Once a child had begun to play with the materials, the experimenter asked the child if the two pipe cleaners were the same length. When equality had been determined, the experimenter instructed the subject to move the pipe cleaners in the following ways: (1) move one pipe cleaner slightly ahead of the other, (2) move the pipe cleaners so that they look like the letter T, and (3) move the pipe cleaners so that they look like the letter V. After each movement, the subject was asked if the two pipe cleaners were still the same length. Explanations were also asked for the responses given.

Seriation Using Cuisenaire Rods

Formal. The task for seriation using Cuisenaire rods was developed along the same lines of those used by Inhelder and Piaget. Ten Cuisenaire rods of different colors and lengths were used. Each of the subjects was asked to arrange the rods in order, starting with the smallest and continuing until the largest rod was found. Following the seriation, the subject was asked to insert one rod (held out by the experimenter) into the series.

Informal. The materials used for this task were the same as those used in the formal task. During the free-play period, the experimenter was located at the mathematics center and worked to develop rapport with the children who chose to play in the center through informal conversation. Once the child had begun to manipulate the rods, the experimenter asked if the child could find the "smallest and the biggest" rods. Then the subject was asked to put all the rest of the rods in an order between the smallest and largest rod he had chosen. Following the seriation, the additional rod (held out by the experimenter) was given to the subject and he was instructed to "put the rod in the order where it fits."

Second Seriation Task

Formal. The formal section of the second task for seriation was the only replication of an original Piagetian task reported by Inhelder and Piaget (1964). Two formal tasks and two informal tasks were used to investigate the influence that differences of materials had on success in seriation. The materials used for the second formal seriation task were ten small dowel rods, graded in length from 9 to 16.2 centimeters. Each of the subjects was asked to arrange the ten rods in order, starting with the smallest and continuing until the largest rod was last in the ordering. Following the seriation, the subject was asked to insert one additional rod into the series.

Informal. The materials used for the informal task were five small toy plastic barrels of different sizes and colors. During the free-play experience, the experimenter was at the center for manipulative materials and developed rapport through informal conversation with those children who chose to play at that center. Once the child had begun to play with the barrels, the experimenter asked the subject to put the five barrels in order from smallest to largest. Again, the number five was chosen because the children in the study were familiar with the numbers one through five. The subject was still required to put the objects in a sequence according to specific physical characteristics (height).

Reliability and Validity

Validity

Validity of the Test Items. All test items were replications of tasks used in studies reported in the literature. Only the informal tasks were adapted to allow for self-selection. Since the tasks were ones found frequently in the literature by several researchers, it was assumed that the items had construct or face validity.

Reliability

Reliability of Children's Responses. In observational studies of young children, problems can be encountered as a result of the effect the observer has upon the children. Many times, a new or strange person in a preschool situation can cause changes in the normal behavior of the children in the preschool. These problems are recognized. However, the experimenter had worked and interacted with the subjects in the preschool situation for one semester. The experimenter was also well acquainted with the type of program, having studied it for five years. Therefore, no great deviation in the behavior of the subjects was expected.

Observer Reliability. Observer reliability was established prior to the collection of the data for this investigation, using some of the formal tasks used in the actual study. The children used to establish observer reliability were in the age range of three to five years, the same age range of the actual subjects in the study. None of the actual subjects were used. Rather, subjects from the University Children's Center, another laboratory school on the campus of Oklahoma State University in Stillwater, Oklahoma, were used. The experimenter and another observer were located in an isolated room in the center and the subject was asked to come to the room, just as the subjects did when participating in the actual formal testing situations for the study. The experimenter and the observer each had a cassette tape recorder to record the happenings during the task. The same method was used for establishing observer reliability as was previously discussed. Each task was scored independently by the experimenter and the observer, each using her respective tape recording. Each subject was assigned a stage according to his responses. A compilation of behavioral characteristics reported in the literature (Appendix B) served as a basis for the experimenter and the observer to use in scoring the responses. The stages assigned by the experimenter and the observer to each subject were compared to determine the number of agreements between the experimenter and the observer.

Reliability was determined using the following formula described by Compton and Hall in Foundations of Home Economics Research (1972, p. 216):

$$\frac{2 \text{ x number of agreements}}{\text{total of observer A + total of observer B}}$$

This formula was used to determine the per cent of agreement between the experimenter and the observer on the explanations given by the subjects in the tasks presented. It was also used to determine observer agreement on the behaviors judged to show understanding of conservation and seriation.

The first trial for observer reliability was not used for calculating agreement due to mechanical failure of the tape recorder of the experimenter. On the second trial, nine tasks were presented. The agreement between the experimenter and the observer was 100 per cent.

The stages described by Piaget and later confirmed by other researchers (Piaget, 1952; Inhelder & Piaget, 1964; Craig, et al., 1973; and Schnall, et al., 1972) were used in the assignment of stages to the subjects according to their responses. These stages and the specific methods are described in the following sections and in Appendix B. Because of the multitude of studies reported which list exact behavior of subjects in each of the stages, it was felt that validity of the scoring procedures could be assumed.

Administration and Scoring

Conservation Tasks

Formal. The subjects were individually invited by the experimenter to accompany her into a quiet room across the hall from the preschool laboratory playroom. One task was presented each day. On some days when several children were absent, two tasks were presented to make use of the extra time. The experimenter was seated at a table with the subject, and the materials were placed before them. The same experimenter administered all tests. The three stages of development in each of the conservation tasks were used as the basis for scoring. These stages are detailed in Chapter II, Review of Literature. One point was given for a child in Stage One, an additional point was given for a child in Stage Two, and a third additional point was given for those who were able to display behavior classified as Stage Three. Explanations considered appropriate are listed in Appendix A. Subjects were able to score a total of three points on any one task.

Informal. These tasks were all carried out during the free-play period. One task was presented each day. On days when several subjects were absent, two tasks were administered to make use of the extra time. The materials were set up as another one of the interest centers in the arrangement of the equipment for the days the testing took place. The materials were placed in positions where a majority of the children usually played so as to encourage the subjects to choose the activity.

In all tasks, one point was given for the child's ability to display Stage One behavior, an additional point was given for those in Stage Two, and a third additional point was assigned for subjects displaying behavior classified as Stage Three.

Seriation Tasks

Formal. The subject was again individually invited by the experimenter to accompany her into a quiet room across the hall from the preschool laboratory playroom. The seriation tasks were presented on separate days. The subject and the experimenter were seated at the table on which the materials had been placed. As with the conservation tasks, the same experimenter administered all tasks. The stages described by Piaget were used to score these tasks. Details of the stages are given in Chapter II, Review of Literature. There was no point given for a child judged to be in Stage IA, with no attempt at seriation. One point was given for each of the other stages, IB, II, and III. Anticipation was not required as this study was only testing the child's ability to seriate the objects and not the child's ability to predict seriation. Three points were the maximum any subject could score for either of the tasks.

Informal. This task was also presented in the form of one of the interest centers normally set up in the preschool laboratory. The tasks measuring skill in seriation were presented on separate days. The materials were placed in a popular place in the school so as to encourage the majority of subjects to make the task a self-selected activity. The subject was given one point for attempting a small series (choosing the smallest and largest or ordering two barrels or two rods). An additional point was given for a sequence of three or more barrels or rods. A final point was given for the correct sequencing of all five barrels or all of the Cuisenaire rods. Again, three points was the maximum score any subject could obtain from either of the two seriation tasks.

For the purposes of statistical analysis, each subject was classified as a conserver or non-conserver (seriator or non-seriator) on each test. All those subjects responding with Stage One or Two behavior were judged to be "non-conservers" or "non-seriators", as those stages were referred to previously. Those subjects who showed Stage Three behavior were judged to be true "conservers" or "seriators." In some instances, due to the requirements of the specific statistical test, subjects were given one point for being a conserver or seriator and were given no point for being a non-conserver or non-seriator. This was done in cases where the statistical test required two categories of responses.

Analysis of Data

The Wilcoxon matched-pairs signed-ranks test was used to test Hypothesis I. The McNemar test for the significance of changes was used to test Hypothesis II. Hypothesis III was tested using the Cochran Q test for significance of differences of proportions. The Binomial test for significant differences was used to test Hypotheses IV and V.

The following null hypotheses were examined:

I. The ability of children to "conserve" or "seriate," as measured by six formal tasks and by six informal tasks does not differ among the total group, nor according to program (whether the child was in the morning or afternoon session), sex, nor age.

II. For those children whose scores change between the formal tasks and the informal tasks, the probability that the frequency of change from "conserving" or "seriating" on a formal task to "non-conserving" or "non-seriating" on the informal tasks is equal to the probability of the frequency of change in the opposite direction among the total group and according to sex or age for: the conservation of continuous liquid quantity, of continuous solid quantity, of number, of length, the seriation of Cuisenaire rods, and the seriation task using dowel rods and a set of toy stacking barrels.

III. The probability of a child's being able to conserve or seriate is the same regardless of the program in which the subject was enrolled for the six formal tasks and the six informal tasks.

IV. There is no significant difference between the number of conservers and the number of non-conservers among the total group, nor according to sex nor age for the six formal tasks and the six informal tasks.

V. There is no significant difference between the number of conservers on the formal tasks and the number of conservers on the informal tasks among the total group, nor according to sex nor age.

CHAPTER IV

RESULTS

The purpose of this study was to investigate the relationship between the preschool child's responses to Piagetian tests of conservation and seriation in a free-play and a formal testing situation. The child's responses were classified to allow for comparisons between the number of conservers and non-conservers (seriators and non-seriators). The child's age, sex, and program (whether he was in the morning or the afternoon session) were tested in relation to his responses on the tasks of conservation and seriation.

The results of each of the individual hypotheses are reported on the following pages.

Hypothesis I: The ability of children to "conserve" or "seriate," as measured by six formal tasks and by six informal tasks, does not differ among the total group nor according to program, sex, nor age. Significant differences ($p < .001$) were found for the total group between the child's ability to conserve or seriate on the six formal tasks and the child's ability to conserve or seriate on the six informal tasks when examined by the Wilcoxon matched-pairs signed-ranks test. The groups, morning and afternoon, boys and girls, and four-year-olds and five-year-olds, all showed significant differences ($p < .01$). The direction of significance in all cases indicated that the subjects were able to conserve or seriate more often on the six informal tasks than on the six formal tasks. The results are presented in Table II.

TABLE II

DIFFERENCES IN ABILITIES TO CONSERVE ON FORMAL AND INFORMAL TASKS

Group	N	Wilcoxon T-Value	Level of Significance
Total	32	4.45 (z-score)	.001
Morning	16	7.5	.01
Afternoon	16	0.0	.01
Male S's	16	3.5	.01
Female S's	16	0.0	.01
Four-Year-Old S's	16	8.0	.01
Five-Year-Old S's	16	0.0	.01

Hypothesis II-A: For those children whose scores change between the formal and the informal tasks, the probability that the frequency of change from conserving or seriating on a formal task to non-conserving or non-seriating on the informal tasks is equal to the probability of the frequency of change in the opposite direction among the total group and according to sex or age for the conservation of a continuous liquid quantity. The McNemar test for the significance of changes was applied to these data. Significant changes were shown for the total group, the female subjects and the five-year-old subjects. Changes determined as statistically non-significant were recorded for the male subjects and the four-year-old subjects. For those significant changes recorded, the direction was, in all cases, that the subjects who were non-conservers on the formal task changed to conservers on the informal tasks more often than subjects changed in the opposite direction. The results are shown in Table III.

TABLE III

CHANGES IN ABILITY TO CONSERVE WITH A CONTINUOUS QUANTITY OF LIQUID ON A FORMAL AND INFORMAL TASK

Group	N	X^2 Value df=1	Level of Significance
Total	32	6.67	.01
Male S's	16	1.125	n.s.
Female S's	16	5.14	.05
Four-Year-Old S's	16	0.167	n.s.
Five-Year-Old S's	16	7.11	.01

<u>Hypothesis II-B: For those children whose scores change between the formal and the informal tasks, the probability that the frequency of change from conserving or seriating on a formal task to non-conserving or non-seriating on the informal tasks is equal to the probability of the frequency of change in the opposite direction among the total group and according to sex or age for the conservation of a continuous</u>

solid quantity. The McNemar test for the significance of changes was applied to these data. The total group, the female subjects and the five-year-old subjects showed significant changes, indicating that more than six times as many subjects changed from non-conserving on the formal tasks to conserving on the informal tasks. Again, the male subjects and the four-year-old subjects did not significantly change in any one direction. The results are shown in Table IV.

TABLE IV

CHANGES IN ABILITY TO CONSERVE WITH A CONTINUOUS QUANTITY OF SOLID ON A FORMAL AND INFORMAL TASK

Group	N	X^2 Value df=1	Level of Significance
Total	32	5.818	.02
Male S's	16	0.25	n.s.
Female S's	16	5.14	.05
Four-Year-Old S's	16	0.80	n.s.
Five-Year-Old S's	16	4.167	.05

Hypothesis II-C: For those children whose scores change between the formal and the informal tasks, the probability that the frequency of change from conserving or seriating on a formal task to non-conserving or non-seriating on the informal tasks is equal to the probability of of the frequency of change in the opposite direction among the total group and according to sex or age for the conservation of number. Significant changes were recorded for the total group, indicating that a greater number of subjects changed from non-conservers on the formal tasks to conservers on the informal tasks. The McNemar test for the significance of changes was applied to the data. Although no significant changes were recorded for the male, female, four-year-old, or five-year-old subjects, there were more subjects who changed from non-conservers on the formal tasks to conservers on the informal tasks than there were subjects who changed in the opposite direction. Table V shows the results of this test.

TABLE V

CHANGES IN ABILITY TO CONSERVE WITH NUMBER ON A FORMAL AND INFORMAL TASK

Group	N	X^2 Value df=1	Level of Significance
Total	32	4.9	.05
Male S's	16	2.29	n.s.
Female S's	16	1.33	n.s.
Four-Year-Old S's	16	2.25	n.s.
Five-Year-Old S's	16	1.5	n.s.

Hypothesis II-D: For those children whose scores change between the formal and the informal tasks, the probability that the frequency of change from conserving or seriating on a formal task to non-conserving or non-seriating on the informal tasks is equal to the probability of the frequency of change in the opposite direction among the total group and according to sex or age for the conservation of length task. The McNemar test for the significance of changes was applied to these data. The total group revealed significant changes from non-conserving on the formal tasks to conserving on the informal tasks. For the other groups, no changes were judged to be significant. However, in all cases, there were more subjects who changed from non-conservers on the formal tasks to conservers on the informal tasks than there were subjects who changed in the opposite direction. Table VI shows the results of this test.

TABLE VI

CHANGES IN ABILITY TO CONSERVE WITH LENGTH ON A FORMAL AND INFORMAL TASK

Group	N	χ^2 Value df=1	Level of Significance
Total	32	4.9	.05
Male S's	16	1.5	n.s.
Female S's	16	2.25	n.s.
Four-Year-Old S's	16	0.50	n.s.
Five-Year-Old S's	16	3.125	n.s.

Hypothesis II-E: For those children whose scores change between the formal and the informal tasks, the probability that the frequency of change from conserving or seriating on a formal task to non-conserving or non-seriating on the informal tasks is equal to the probability of the frequency of change in the opposite direction among the total group and according to sex or age for the seriation task using Cuisenaire rods. When the McNemar test for the significance of changes was applied to these data, no changes were judged to be significant. In all cases, there were more subjects who changed from non-seriating on the formal task to seriating on the informal task than there were subjects who changed in the opposite direction. The results are shown in Table VII.

TABLE VII

CHANGES IN ABILITY TO SERIATE USING CUISENAIRE RODS ON A FORMAL AND INFORMAL TASK

Group	N	χ^2 Value df=1	Level of Significance
Total	32	2.5	n.s.
Male S's	16	1.5	n.s.
Female S's	16	0.25	n.s.
Four-Year-Old S's	16	0.25	n.s.
Five-Year-Old S's	16	1.5	n.s.

Hypothesis II-F: For those children whose scores change between the formal and the informal tasks, the probability that the frequency of

<u>change from conserving or seriating on a formal task to non-conserving or non-seriating on the informal tasks is equal to the probability of the frequency of change in the opposite direction among the total group and according to sex or age for the seriation task using dowel rods and toy barrels</u>. The McNemar test for the significance of changes was applied to the data. In all cases, the McNemar test revealed significant changes at the .01 level. For the total group, the level of significance of change was .001. More subjects changed from non-seriators on the formal tasks to seriators on the informal tasks than did subjects change in the opposite direction. Table VIII shows the results of this test.

TABLE VIII

CHANGES IN ABILITY TO SERIATE ON A FORMAL TASK USING DOWEL RODS AND AN INFORMAL TASK USING STACKING TOYS

Group	N	χ^2 Value df=1	Level of Significance
Total	32	21.04	.001
Male S's	16	8.1	.01
Female S's	16	10.08	.01
Four-Year-Old S's	16	10.08	.01
Five-Year-Old S's	16	9.09	.01

<u>Hypothesis III-A: The probability of a child's being able to</u>

conserve or seriate is the same for all six formal tasks, regardless of program. The Cochran Q test for significance of differences of proportions was applied to the data. For the total group, the morning group, and the afternoon group, no significant differences were revealed between the number of subjects who were able to conserve or seriate on any of the six formal tasks. Table IX shows the results of this test.

TABLE IX

DIFFERENCES IN PROPORTIONS BETWEEN THE TOTAL NUMBER OF CONSERVERS OR SERIATORS ON THE SIX FORMAL TASKS

	Number of Conservers		
	Total Group N=32	Morning Group N=16	Afternoon Group N=16
Liquid Task	7	2	5
Solid Task	12	4	8
Number Task	13	6	7
Length Task	7	3	4
Cuisenaire Task	13	6	7
Second Seriation Task (Dowels and Barrels)	4	1	3
Total	56	22	34
Cochran Q-score	5.3125	10.32	5.92
Level of Significance	n.s.	n.s.	n.s.

Hypothesis III-B: The probability of a child's being able to conserve or seriate is the same for all six informal tasks, regardless of program. The Cochran Q test for significance of differences of proportions was used to determine the results shown in Table X. The afternoon group's responses were not significantly different on any of the six informal tasks. For the morning group, the conservation of length task proved to be the task with the least number of conservers. The second seriation task, using dowel rods and toy barrels, was revealed as the task children succeeded at most often. Significant differences in the probability of a child's being able to conserve or seriate were found ($p < .001$) for the morning group. As a result, the level of significance of different proportions for the total group was .01. The differences for the total group showed the same direction as the morning group revealed. However, the total number of conservers and seriators on the six formal tasks more than doubled for the six informal tasks for the total group, the morning group, and the afternoon group.

Hypothesis IV-A: There is no significant difference between the probability of conservers and the probability of non-conservers among the total group, nor according to sex nor age, for the six formal tasks. The Binomial test for significant differences in proportions was applied to these data. Significant differences in the proportion of conservers and non-conservers were found for the total group on the conservation of continuous liquid quantity task, the conservation of length task, and the second seriation task. The group of male subjects showed significant differences on the conservation of length and the second seriation task. Significant differences in the proportions of conservers and non-conservers were found with the responses from the female subjects on the conservation of liquid task and the second seriation task. Four-year-old subjects' responses were significantly different for the second seriation task, while five-year-old subjects showed significant differences on the conservation of length task. Four-year-old female subjects were significantly different in their responses on the conservation of continuous liquid quantity and the second seriation task. Significant differences were noted for the five-year-old male subjects on the conservation of length and the second seriation tasks. No significant differences were found for the four-year-old male or the five-year-old female subjects. Results are shown in Table XI.

TABLE X

DIFFERENCES IN PROPORTIONS BETWEEN THE TOTAL NUMBER OF CONSERVERS OR SERIATORS ON THE SIX INFORMAL TASKS

	Number of Conservers		
	Total Group N=32	Morning Group N=16	Afternoon Group N=16
Liquid Task	18	5	13
Solid Task	21	8	13
Number Task	21	9	12
Length Task	15	3	12
Cuisenaire Task	19	8	11
Second Seriation Task (Dowels and Barrels)	27	13	14
Total	121	46	75
Cochran Q-score	16.06	20.70	2.54
Level of Significance	.01	.01	n.s.

TABLE XI

DIFFERENCES BY GROUPS BETWEEN THE PROPORTION OF CONSERVERS AND NON-CONSERVERS ON THE SIX FORMAL TASKS

Group	Liquid Task	Solid Task	Number Task	Length Task	Cuisenaire Task	Second Seriation Task
Total	7/25 **	12/20	13/19	7/25 **	13/19	4/28 ***
Four-Year-Old S's	5/11	6/10	4/12	4/12	5/11	0/16 **
Five-Year-Old S's	2/14 **	6/10	9/7	3/13 *	8/8	4/12
Male S's	5/11	6/10	7/9	2/14 *	6/10	3/13 *
Female S's	2/14 **	6/10	6/10	5/11	7/9	2/14 **
Four-Year-Old Male S's	3/1	1/3	0/4	0/4	1/3	0/4
Five-Year-Old Male S's	2/10 *	5/7	7/5	2/10 *	5/7	2/10 *
Four-Year-Old Female S's	2/10 *	5/7	4/8	4/8	4/8	0/12 **
Five-Year-Old Female S's	0/4	1/3	2/2	1/3	3/1	2/2

Note: a/b = total number of conservers/total number of non-conservers

* = $p < .05$ ** = $p < .01$ *** = $p < .001$

Hypothesis IV-B: There is no significant difference between the probability of conservers and the probability of non-conservers among the total group, nor according to sex nor age for the six informal tasks. The Binomial test was applied to this data and the results are shown in Table XII. No significant differences were found with the four-year-old subjects, the four-year-old males, or the five-year-old girls. The female subjects showed significant differences between the number of conservers and the number of non-conservers on the conservation of continuous solid quantity task and the second seriation task. The five-year-old subjects revealed significant differences on the conservation of number and the second seriation task. For the total group, the male subjects, the five-year-old male subjects and the four-year-old female subjects showed significant differences only on the second seriation task.

Hypothesis V: There is no significant difference between the probability of conservers on the formal tasks and the probability of conservers on the informal tasks among the total group, nor according to sex nor age. Table XIII shows the results obtained from applying the Binomial test to these data. No significant differences were found for the four-year-old male or the five-year-old female subjects. The total group and the five-year-old subjects revealed significant differences on the conservation of continuous liquid quantity and the second seriation task. For the four-year-old, the male, the female, the five-year-old male, and the four-year-old female subjects, significant differences were noted on the second seriation task. However, of the 54 binomial tests run for this hypothesis, 50 revealed greater numbers of conservers on the informal tasks than the number of conservers on the formal tasks.

TABLE XII

DIFFERENCES BY GROUPS BETWEEN THE PROPORTION OF CONSERVERS AND NON-CONSERVERS ON THE SIX INFORMAL TASKS

Group	Liquid Task	Solid Task	Number Task	Length Task	Cuisenaire Task	Second Seriation Task
Total	18/14	21/11	21/11	15/17	19/13	27/5 ***
Four-Year-Old S's	7/9	9/7	8/8	6/10	7/9	12/4
Five-Year-Old S's	11/5	12/4	13/3 *	9/7	12/4	15/1 **
Male S's	9/7	8/8	12/4	6/10	10/6	13/3 *
Female S's	9/7	13/3 *	9/7	9/7	9/7	14/2 **
Four-Year-Old Male S's	2/2	0/4	2/2	1/3	1/3	2/2
Five-Year-Old Male S's	7/5	8/4	10/2 *	5/7	9/3	11/1
Four-Year-Old Female S's	5/7	9/3	6/6	5/7	6/6	10/2 *
Five-Year-Old Female S's	4/0	4/0	2/2	4/0	3/1	4/0

Note: a/b = total number of conservers/total number of non-conservers

* = $p < .05$ ** = $p < .01$ *** = $p < .001$

TABLE XIII

DIFFERENCES BY GROUPS BETWEEN THE PROPORTION
OF CONSERVERS ON THE SIX FORMAL AND
THE SIX INFORMAL TASKS

Group	Liquid Task	Solid Task	Number Task	Length Task	Cuisenaire Task	Second Seriation Task
Total	7/18 *	12/21	13/21	7/15	13/19	4/27 ***
Four-Year-Old S's	5/7	6/9	4/8	4/6	5/7	0/12 **
Five-Year-Old S's	2/11 *	6/12	9/13	3/9	8/12	4/15 **
Male S's	5/9	6/8	7/12	2/6	6/10	3/13 *
Female S's	2/9	6/13	6/9	5/9	7/9	2/14 **
Four-Year-Old Male S's	3/2	1/0	0/2	0/1	1/1	0/2
Five-Year-Old Male S's	2/7	5/8	7/10	2/5	5/9	2/11 *
Four-Year-Old Female S's	2/5	5/9	4/6	4/5	4/6	0/10 **
Five-Year-Old Female S's	0/4	1/4	2/2	1/4	3/3	2/4

Note: a/b = total number of conservers on formal tasks/total number of conservers on informal tasks

$* = p < .05$ $** = p < .01$ $*** = p < .001$

CHAPTER V

DISCUSSION AND SUMMARY

Discussion of Findings

The results from the tests of Hypothesis I, shown in Table II, demonstrate the great differences in children's abilities to conserve on the formal tasks and their abilities to conserve on the informal tasks. In all cases, the subjects showed greater ability to conserve or seriate on the informal tasks than on the formal tasks. The level of significance for any one group did not greatly vary. The total group differences showed a level of significance of .001 while the subgroups, according to age and sex of the subject, showed levels of significance of .01. This difference in level of significance was due, in part, to the fact that the available statistical tables used for the T-scores only went as far as the .01 level for the two-tailed test. The data from the total group required the calculation of a z-score because of the number of subjects involved. The tables for the z-score went as far as the .001 level of significance for the two-tailed test.

The results from the analysis of these data seem to indicate that the differences in a child's ability to conserve or seriate on the formal tasks and his ability to conserve or seriate on the informal tasks are not due to age or sex but, rather, to the situation in which the tasks are presented. Significantly more children succeeded at the conservation and seriation tasks when presented in informal settings.

Investigation of the responses of the subjects who changed from one classification on the formal tasks to a different classification on the informal tasks revealed the results shown in Tables III-VIII. In all cases where significant changes were recorded, the change was from a non-conserver or non-seriator on the formal tasks to a conserver or seriator on the informal tasks. This direction of change was also found with those groups not showing statistically significant changes. On all six tasks and with all groups analyzed, more subjects changed from a non-conserver or non-seriator on the formal tasks to a conserver or a seriator on the informal tasks than did subjects change in the opposite direction.

The male subjects and the four-year-old subjects consistently revealed changes which were not significant, except on the second seriation task, using dowel rods and toy barrels. This seems to indicate the possibility of a relationship between the significance of changes and the sex and age of the subject. However, with such small numbers of subjects (16) in these groups, further studies would be needed to determine what relationships do exist.

The second seriation task revealed such high levels of significance, .001 and .01, that the degree of difficulty of the formal task and the informal task may not be the same. So many more children were able to seriate on the informal tasks than on the formal tasks that the two tasks used, formal and informal, may not measure the same type of seriation. This would not be in question had all of the other tasks shown similar increases on the informal tasks. Since it was only with the second seriation task, some questions must be answered.

Seriation has been described as the process of ordering objects in a sequence according to some physical characteristic (Beard, 1963a). The second formal task measuring seriation utilized ten dowel rods, ranging in length from 9 to 16.2 centimeters. The subjects were presented with the ten rods and were asked to put them "in order." The differences in length were very difficult to recognize, as demonstrated by only 4 of the 32 subjects being able to seriate on the formal tasks. On the informal tasks, the subjects were asked to "put in order" five barrels of different sizes and colors. On this task, 27 of the 32 subjects were able to seriate the barrels.

Both tasks required the subjects to "order objects in a sequence according to some physical characteristic," size, but one task was much easier for the subjects to accomplish. Perhaps the formal tasks with the ten dowel rods require greater skills in visual discrimination, in number skills, and require a longer attention span. In any case, the informal task, using barrels, does measure basic skills of seriation. The question remains as to whether Piaget's seriation task, using the dowel rods, requires more than basic knowledge of seriation.

Analysis of the data revealed no significant differences in the number of conservers or seriators on any of the six formal tasks. This seems to indicate that no one task was significantly more difficult than any other task, for those presented in a formal situation. No significant differences were found in the number of conservers or seriators on any of the six informal tasks for the afternoon group. For the total group and the morning group, there were significant differences in the number of conservers or seriators. These differences were found with the conservation of length task being the most difficult (15 of the 32 subjects in the total group succeeded, 3 of the 16 subjects in the morning group succeeded) and the second seriation task being the easiest (27 of the 32 subjects in the total group succeeded, 13 of the 16 subjects in the morning group succeeded).

One possible explanation for the difference in the responses of the morning and afternoon groups could be the age range of the two groups. The age range in the morning group was 20 months (3:10 - 5:6) while the age range in the afternoon group was only 12 months (4:4 - 5:4). This lack of younger children in the afternoon group could enable them to proceed more quickly on certain mathematical concepts which could have better prepared these subjects for the tasks presented to them.

Investigation of differences in the probability of conservers or seriators and the probability of non-conservers or non-seriators revealed some interesting findings. Significant differences were consistently found for the total group, the five-year-old subjects, the female subjects, the five-year-old male subjects, and the four-year-old female subjects with three formal tasks. Those tasks included conservation of liquid continuous quantity, conservation of length, and the second seriation task. The indications were that there were significantly more non-conservers than there were conservers on the formal tasks.

The groups which influenced the outcome but which showed no significant differences were the four-year-old male and the five-year-old female subjects. There were only four subjects in each of these groups which prevented significant differences being identified even when subjects in the group were <u>all</u> conservers or <u>all</u> non-conservers. The four-year-old males were less able to succeed at the tasks than any other group of subjects. This may indicate a possible relationship among sex, age and the ability to conserve or seriate. However, with only four subjects in this group, factors other than that they were all four-year-old males could have influenced the results. There were also only four subjects in the five-year-old female group. Again, results from this group would be questioned because of the small number of subjects.

The five-year-old male subjects responded in much the same way that the four-year-old female subjects responded. Once again, this points to a possibility of a relationship among sex, age and the ability to conserve or seriate. However, many subjects were inconsistent in their responses according to sex or age. Further research would be needed to correlate these factors.

Differences in the probability of conservers on the formal tasks and the probability of conservers on the informal tasks were not shown as statistically significant in the majority of cases. However, of the 54 binomial tests run for this hypothesis, 50 showed greater numbers of conservers or seriators on the informal tasks than on the formal tasks. This tends to extend the results from Hypothesis I, which indicated that more subjects were able to conserve or seriate when tasks were presented in an informal setting. The four tests which did not show greater numbers of conservers or seriators on the informal tasks came from the responses of the four-year-old male and the five-year-old female subjects. As earlier mentioned, each of these groups were made up of only four subjects and their responses could be questioned as a result.

Summary

The general purpose of this study was to investigate the relationship between the preschool child's responses to Piagetian tests of conservation and seriation in a free-play situation and in a formal testing situation. The child's responses in both settings on each of the six formal and six informal tasks were examined in relation to the child's sex, age, and program (whether he was in the morning or afternoon group).

The sample was composed of 32 children selected from the Oklahoma State University Child Development Laboratories in Stillwater, Oklahoma. There were 16 girls and 16 boys in the sample ranging in age from 3 years 10 months to 5 years 6 months. All children were judged to be from an upper-middle class background.

The six formal tasks were administered to all the subjects prior to presentation of the informal tasks. All subjects were given the six formal and the six informal tasks. The examiner responded in the same manner to all subjects when administering the tasks so that no child would feel that he was "right" or "wrong" in his responses. Therefore, the "correct" response was not given to the subject during or following the administration of the formal tasks.

The results of the analysis of the data of this study were as follows:

1. Significantly more ($p < .001$) subjects were able to conserve or seriate on the informal tasks than on the formal tasks.
2. For the subjects who changed on the conservation of continuous liquid and solid quantity tasks, significantly more ($p < .01$, $p < .02$, respectively) subjects changed from non-conservers or non-seriators

on the formal tasks to conservers or seriators on the informal tasks in the total group, the female subjects, and the five-year-old subjects.

3. For the subjects who changed on the conservation of number and length tasks, significantly more ($p < .05$) subjects changed from non-conservers or non-seriators on the formal tasks to conservers or seriators on the informal tasks in the total group.
4. For the subjects who changed on the seriation task using Cuisenaire rods, no significant changes were recorded. In all cases, there were more subjects (8) who changed from non-seriators on the formal tasks to seriators on the informal tasks than there were subjects (2) who changed in the opposite direction.
5. For the subjects who changed on the second seriation task, using dowel rods and toy barrels, significantly more subjects changed from non-seriators on the formal tasks to seriators on the informal tasks in the total group ($p < .001$) and for the four-year-old, five-year-old, male and female subjects ($p < .01$ for all other groups).
6. For the total group, the morning group, and the afternoon group, no significant differences were revealed for the probability of a child being able to conserve or seriate on any of the six formal tasks.
7. For the afternoon group, no significant differences were found for the probability of a child being able to conserve or seriate on any of the six informal tasks.
8. For the morning and total groups, significant differences ($p < .001$, $p < .01$, respectively) were found for the probability of a child

being able to conserve or seriate on the six informal tasks, indicating that fewer children were able to conserve on the conservation of length task and more children were able to seriate on the second seriation task.

9. The total group, the five-year-old subjects, and the five-year-old male subjects revealed significantly more non-conservers or non-seriators than conservers or seriators on three formal tasks, conservation of continuous liquid quantity ($p < .01$, $p < .05$, $p < .01$, respectively), conservation of length ($p < .01$, $p < .05$, $p < .02$, respectively), and the second seriation task ($p < .001$, $p < .05$, $p < .01$, respectively).

10. The female subjects and the four-year-old female subjects showed significantly more non-conservers or non-seriators than conservers or seriators on two formal tasks, conservation of continuous liquid quantity ($p < .01$, $p < .05$, respectively) and the second seriation task ($p < .01$, $p < .01$, respectively).

11. The male subjects revealed significantly more non-conservers or non-seriators than conservers or seriators on two formal tasks, conservation of length ($p < .05$) and the second seriation task ($p < .02$). The four-year-old subjects showed significantly more non-conservers or non-seriators than conservers or seriators on the second seriation task ($p < .01$).

12. The female subjects showed significantly more conservers or seriators than non-conservers or non-seriators on two informal tasks, conservation of continuous solid quantity ($p < .02$) and the second seriation task ($p < .01$). The five-year-old subjects' responses indicated significantly more conservers or seriators than were there

non-conservers or non-seriators on the informal conservation of number task ($p < .02$) and the informal second seriation task ($p < .01$).

13. Significantly more conservers or seriators than non-conservers or non-seriators were found on the informal second seriation task for the total group ($p < .001$), the male subjects ($p < .02$), the five-year-old male subjects ($p < .01$), and the four-year-old female subjects ($p < .05$).
14. Significantly more conservers were found on the informal task than conservers were found on the formal second seriation task for the total group ($p < .001$), the four-year-old subjects ($p < .01$), the five-year-old subjects ($p < .01$), the male subjects ($p < .02$), the female subjects ($p < .01$), the five-year-old male subjects ($p < .02$), and the four-year-old female subjects ($p < .01$).
15. Significantly more conservers were found on the informal task than were conservers found on the formal conservation of continuous liquid quantity task for the total group ($p < .05$) and the five-year-old subjects ($p < .05$).

Implications of the Study

The results of this study demonstrated that more children are able to conserve or seriate when Piagetian-type tasks are presented in a free-play situation rather than in a formal testing situation. It would appear that preschool children have not succeeded in conservation and seriation tasks previously presented by other researchers because of the setting in which the tasks were presented rather than because the children were not ready for these concepts. Age and sex may influence a child's ability to conserve or seriate but no definite results were found from this study with regard to this influence.

Teachers in a program for preschool children should use the results of this study in planning a curriculum for young children. Preschool children are ready for mathematical concepts dealing with conservation and seriation at some level. Every group of children will require different concepts depending on their individual needs and abilities. A teacher must keep in mind the need of young children for informal settings if learning is to occur. Many experiences requiring verbal instructions in great detail, long attention spans, and verbal responses from the children may prove unsuccessful. If the experiences are presented informally and geared to the child's level of understanding, success will be more readily achieved when dealing with preschool children. Not all children under six will be ready for all concepts of conservation and seriation but some children are ready for these experiences.

Teachers of young children should utilize informal tasks of conservation and seriation as a means to evaluate where a child is in his development of these concepts. From the results of these tasks, a teacher can see where a child lacks knowledge, where he has false concepts regarding conservation and seriation, if he is ready for certain experiences relating to these concepts. The use of these tasks in an informal setting will help a teacher provide the experiences her children are ready for without pushing them into areas for which they are unprepared.

Recommendations for Further Research

The investigator feels that further study of the relationships among age, sex, and the child's ability to conserve or seriate on informal tasks is indicated as a result of this study. It is suggested that two groups, one of very young four-year-olds and one of very young five-year-olds, be presented with informal tasks similar to those in this study to compare significant differences in the ability to conserve or seriate.

The investigator also recommends that a study be conducted to determine what, if any, influence a child's preschool program has on his ability to succeed at informal conservation and seriation tasks. The age range of children in the program, as well as the curriculum, should be factors examined in a study of this nature.

Research is also needed to develop materials which could be utilized in a preschool program to aid in developing the concepts of conservation and seriation. Guides could also be developed which would aid teachers in ordering experiences dealing with the various concepts of conservation and seriation.

SELECTED BIBLIOGRAPHY

Almy, M.C. *Young children's thinking*. New York: Teachers College Press, Columbia University, 1966.

Baldwin, A.L. The study of child behavior and development. *Handbook of research methods in child development*. New York: Wiley and Sons, 1960.

Beard, R.M. The order of concept development studies in two fields. *Educational Review*, 1963a, *15*, 105-17.

Beard, R.M. The order of concept development studies in two fields - part II. *Educational Review*, 1963b, *15*, 228-37.

Brainerd, C.J. & Brainerd, S.H. Order of acquisition of number and quantity conservation. *Child Development*, 1972, *43*, 1401-06.

Caldwell, B., Honig, A., & Tannenbaum, J. Patterns of information processing used by and with young children in a nursery school setting. *Child Development*, 1970, *41*, 1045-65.

Compton, N.H. & Hall, O.A. *Foundations of home economics research*. Minneapolis: Burgess Publishing Company, 1972.

Craig, G.J., Love, J., & Olim, E. Perceptual judgements in Piaget's conservation-of-liquid problem. *Child Development*, 1973, *44*, 372-75.

Elkind, D. Children's discovery of the conservation of mass, weight, and volume: Piagetian replication study II. *Journal of Genetic Psychology*, 1961, *98*, 219-27.

Elkind, D. Conservation across illusory transformations in young children. *ACTA Psychologica*, 1966, *25*, 389-400.

Fogelman, K.R. *Piagetian tests for the primary school*. London: National Foundation for Education Research in England and Wales, 1970.

Gardner, K.L., Glenn, J.A., & Renton, A.I.G. (Eds.). *Children using mathematics*. New York: Teachers College Press, Columbia University, 1966.

Hymes, J.L. *Teaching the child under six*. Columbus, Ohio: Charles E. Merrill, 1968.

Inhelder, B. & Piaget, J. The early growth of logic in the child. London: Routledge and Kegan Paul, 1964.

Leeper, S., Dales, R.J., Skipper, D.S., & Witherspoon, R.L. Good schools for young children (3rd ed.). London: Macmillan, 1974.

Lovell, K., Healey, D., & Rowland, A.D. Growth of some geometrical concepts. Child Development, 1962, 33, 751-67.

Miller, P.H. Attention to stimulus dimensions in the conservation of liquid quantity. Child Development, 1973, 44, 372-75.

Piaget, J. The child's conception of number. London: Routledge and Kegan Paul, 1952.

Piaget, J. The child's conception of geometry. London: Routledge and Kegan Paul, 1960.

Piaget, J. Quantification, conservation and nativism. Science, 1968, 162, 976-79.

Read, K. The nursery school. Philadelphia: W.B. Saunders Company, 1971.

Schnall, M., Alter, E., Swanlund, T., & Schweitzer, T. A sensory-motor context affecting performance in a conservation task: a closer analogue of reversibility than empirical return. Child Development, 1972, 43, 1012-23.

Spodek, B. Teaching in the early years. New Jersey: Prentice-Hall Inc., 1972.

Wallach, L. & Sprott, R.L. Inducing number conservation in children. Child Development, 1964, 35, 1057-71.

Wallach, L., Wall, A.J., & Anderson, L. Number conservation: the roles of reversibility, addition, subtraction and misleading perceptual clues. Child Development, 1967, 38, 425-42.

Wann, K.D., Dorn, M.S., & Liddle, E.A. Fostering intellectual development in young children. New York: Teachers College Press, Columbia University, 1962.

Wohlwill, J.F. & Lowe, R.C. Experimental analysis of the development of the conservation of number. Child Development, 1962, 33, 153-67.

APPENDIX A

EVALUATION GUIDE -- LOGICAL EXPLANATIONS

EVALUATION GUIDE -- LOGICAL EXPLANATIONS

Conservation of Continuous Quantity (Liquid and Solid)

1. Acceptable

   a. "If we poured the liquid back they would be the same." or "If we rolled the ball back they would be the same" (Brainerd & Brainerd, 1972).

   b. "Because there is just as much (playdough) water" (Craig, et al., 1973).

   c. "There's the same space but it's longer now" (Piaget, 1960).

   d. Answers dealing with compensation for the action, irrelevancy of transformations, or noting the previous equality (Miller, 1973).

2. Unacceptable

   a. "Same size" or "still as big" (Miller, 1973).

   b. "I don't know" (Brainerd & Brainerd, 1972).

   c. "It's more because it's higher up" (Craig, et al., 1973).

Conservation of Number

1. Acceptable

   a. "If they're the same, they're the same...When they are pulled they don't look it but they're the same" (Schnall, et al., 1972).

   b. "It's the same...There's the same amount of beads" (Piaget, 1952).

   c. "If I put them closer together they'd still be the same" (Piaget, 1952).

   d. Recognition of the action that made one row appear longer but did not change the number (Schnall, et al., 1972).

2. Unacceptable

   a. "Mine is longer" (Piaget, 1952).

   b. "There are more bottles" (Piaget, 1952).

   c. "There are more where it's bigger" (Piaget, 1952).

<u>Conservation of Length</u>

1. Acceptable

   a. "They're both the same but they're placed differently" (Piaget, 1960).

   b. "It's the same length but one has been moved. You pushed one but they stay the same" (Piaget, 1960).

   c. "They're always the same length and they'll always stay the same" (Piaget, 1960).

2. Unacceptable

   a. "It's bigger because you pushed it. The stick is longer" (Piaget, 1960).

   b. "That one is smaller because it doesn't touch here" (Piaget, 1960).

APPENDIX B

BEHAVIORAL CHARACTERISTICS OF STAGES FOR PIAGETIAN TASKS OF CONSERVATION AND SERIATION

BEHAVIORAL CHARACTERISTICS OF STAGES FOR PIAGETIAN TASKS OF CONSERVATION AND SERIATION

I. Conservation of Continuous Quantity (Liquid)

A. Stage One -
The child will be able to recognize the "sameness" of the two larger glasses of water prior to pouring liquid from one glass into the smaller glasses. He will judge either the larger glass or the smaller glasses to contain more liquid after the water is poured (Piaget, 1952; Brainerd & Brainerd, 1972; Craig, et al., 1973).

B. Stage Two -
The child will conserve when the water from one tall glass is poured into two smaller glasses but not when water is poured into three or more smaller glasses. He can also note equality in liquid if the height inside one glass of the liquid is not greatly different from the height inside the other glass (Piaget, 1964).

C. Stage Three -
The child will recognize the equality of liquid regardless of any changes resulting from liquid being poured from one glass to two or three glasses. A child will also be able to give an acceptable explanation (see Appendix A) for his responses concerning equality of the liquid in the glasses (Piaget, 1964; Schnall, et al., 1972).

II. Conservation of Continuous Quantity (Solid)

A. Stage One -
The child will recognize the equality of the two balls of playdough but will not see equality when one ball is made into a "hot dog" or a "pancake" (Piaget, 1952; Brainerd & Brainerd, 1972).

B. Stage Two -
The child will be able to recognize equality of the two pieces of playdough, especially if the differences in shape are not great. However, he cannot give any explanations for his response concerning equality of the pieces of playdough (Piaget, 1964).

C. Stage Three -
The child will recognize the equality of the two pieces of playdough regardless of any change in the shape of one of the pieces. He will also be able to give an acceptable explanation (see Appendix A) concerning his responses about equality (Piaget, 1964; Schnall, et al., 1972).

III. <u>Conservation of Number</u>

A. Stage One -
The child will be unable to put the poker chips or flannel circles in one-to-one correspondence. He will be able to recognize equality of the two rows of poker chips or circles as long as they are of the same length (Piaget, 1964; Almy, 1966).

B. Stage Two -
The child will be able to set up a one-to-one correspondence between the two rows of poker chips or flannel circles. However, if one row is made longer, the child will not be able to recognize equality of the number of items (Almy, 1966; Piaget, 1964).

C. Stage Three -
The child will recognize that the number of objects in each row remain the same despite the length of either row. He will be able to explain or demonstrate (see Appendix A) the equality of the two rows of items (Piaget, 1964).

IV. <u>Conservation of Length</u>

A. Stage One -
The child will be able to recognize equality of length in the dowel rods or pipe cleaners when one is placed directly below another. However, any movement in one rod or pipe cleaner destroys the equality, according to the child (Piaget, 1960).

B. Stage Two -
The child will be able to conserve length of the rods or pipe cleaners when pushing one slightly ahead of the other. However, when moved to resemble a letter T or V, the child cannot conserve length (Piaget, 1960).

C. Stage Three -
The child will be able to recognize equality of length regardless of movement of the rods or pipe cleaners. He will also be able to demonstrate (see Appendix A) why he knows the rods or pipe cleaners are equal (Piaget, 1960).

V. <u>Seriation</u>

A. Stage One -
The child will be able to find the smallest and the largest rod or barrel but will not be able to make a true seriation of all items involved (Piaget, 1952).

B. Stage Two -
The child will be able to order at least three of the rods or barrels but it may involve a "trial-and-error" action where he puts in several before deciding which is correct (Piaget, 1952).

C. Stage Three -
The child will be able to seriate all of the objects and will also be able to insert at least one additional rod into the seriation. The child displays a systematic order to seriating, because he will search for the smallest and move on searching for the next longest rod or barrel (Piaget, 1964; Piaget, 1952). (On the informal task, the child will not be required to insert an additional barrel to be scored as being in Stage Three. He will be required to seriate <u>all</u> barrels.)

APPENDIX C

CONSERVERS AND NON-CONSERVERS ON THE SIX FORMAL TASKS

CONSERVERS OR SERIATORS AND NON-CONSERVERS OR NON-SERIATORS FOR THE MORNING GROUP ON THE SIX FORMAL TASKS

Subject	Liquid	Solid	Number	Length	Cuisenaire	Second Seriation	Total Successes	Age	Sex
a	0	1	0	0	1	0	2	4	F
b	0	0	0	0	0	0	0	4	F
c	1	1	1	1	1	0	5	4	F
d	0	1	1	1	0	0	3	5	M
e	0	0	1	0	0	0	1	5	M
f	1	0	0	0	1	0	2	4	M
g	0	0	0	0	0	0	0	5	M
h	0	1	1	0	1	0	3	5	M
i	0	0	0	0	0	0	0	5	M
j	0	0	1	0	0	0	1	4	F
k	0	0	0	0	1	0	1	4	F
l	0	0	0	0	0	0	0	5	M
m	0	0	0	0	0	0	0	4	F
n	0	0	1	1	1	1	4	5	F
o	0	0	0	0	0	0	0	5	M
p	0	0	0	0	0	0	0	4	F
Total	2	4	6	3	6	1	22		

Note: Non-conservers or non-seriators = 0 Conservers or seriators = 1

CONSERVERS OR SERIATORS AND NON-CONSERVERS OR
NON-SERIATORS FOR THE AFTERNOON GROUP
ON THE SIX FORMAL TASKS

Subject	Liquid	Solid	Number	Length	Cuisenaire	Second Seriation	Total Successes	Age	Sex
aa	1	1	1	0	1	0	4	5	M
bb	1	1	0	0	0	0	2	4	M
cc	1	0	0	0	0	0	1	4	M
dd	0	0	1	0	0	1	2	5	M
ee	0	0	0	0	1	0	1	5	F
ff	1	1	1	1	0	0	4	4	F
gg	0	0	0	0	0	1	1	5	F
hh	0	0	0	0	1	0	1	4	F
ii	0	0	0	0	0	0	0	4	M
jj	0	1	1	0	1	0	3	5	F
kk	1	1	1	1	1	1	6	5	M
ll	0	0	1	0	1	0	2	5	M
mm	0	1	0	1	0	0	2	4	F
nn	0	1	0	0	1	0	2	5	M
oo	0	0	1	1	0	0	2	4	F
pp	0	1	0	0	0	0	1	4	F
Total	5	8	7	4	7	3	34		

Note: Non-conservers or non-seriators = 0   Conservers or seriators = 1

APPENDIX D

CONSERVERS AND NON-CONSERVERS ON THE

SIX INFORMAL TASKS

CONSERVERS OR SERIATORS AND NON-CONSERVERS OR NON-SERIATORS FOR THE MORNING GROUP ON THE SIX INFORMAL TASKS

Subject	Liquid	Solid	Number	Length	Cuisenaire	Second Seriation	Total Successes	Age	Sex
a	0	1	0	0	1	1	3	4	F
b	0	0	0	0	0	0	0	4	F
c	1	1	1	1	1	1	6	4	F
d	1	1	1	0	0	1	4	5	M
e	0	0	1	0	0	0	1	5	M
f	0	0	0	0	0	0	0	4	M
g	0	0	1	0	0	1	2	5	M
h	1	1	1	1	1	1	6	5	M
i	0	0	1	0	1	1	3	5	M
j	1	1	1	0	0	1	4	4	F
k	0	0	0	0	1	1	2	4	F
l	0	1	0	0	1	1	3	5	M
m	0	0	0	0	0	1	1	4	F
n	1	1	1	1	1	1	6	5	F
o	0	0	1	0	1	1	3	5	M
p	0	1	0	0	0	1	2	4	F
Total	5	8	9	3	8	13	46		

Note: Non-conservers or non-seriators = 0 Conservers or seriators = 1

CONSERVERS OR SERIATORS AND NON-CONSERVERS OR NON-SERIATORS FOR THE AFTERNOON GROUP ON THE SIX INFORMAL TASKS

Subject	Liquid	Solid	Number	Length	Cuisenaire	Second Seriation	Total Successes	Age	Sex
aa	1	1	1	1	1	1	6	5	M
bb	0	0	0	0	1	1	2	4	M
cc	1	0	1	1	0	1	4	4	M
dd	1	1	1	0	1	1	5	5	M
ee	1	1	0	1	1	1	5	5	F
ff	1	1	1	1	1	1	6	4	F
gg	1	1	1	1	1	1	6	5	F
hh	0	1	1	1	1	1	5	4	F
ii	1	0	1	0	0	0	2	4	M
jj	1	1	1	1	0	1	5	5	F
kk	1	1	1	1	1	1	6	5	M
ll	1	1	0	1	1	1	5	5	M
mm	1	1	1	1	1	1	6	4	F
nn	1	1	1	1	1	1	6	5	M
oo	1	1	1	1	0	0	4	4	F
pp	0	1	0	0	0	1	2	4	F
Total	13	13	12	12	11	14	75		

Note: Non-conservers or non-seriators = 0 Conservers or seriators = 1

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