

Utah State University

DigitalCommons@USU

All Graduate Theses and Dissertations

Graduate Studies

5-1971

Comparative Study of Four-Year-Old Preschool Children in the Area of Conservation

Joleen Mae Harwood
Utah State University

Follow this and additional works at: <https://digitalcommons.usu.edu/etd>



Part of the [Social and Behavioral Sciences Commons](#)

Recommended Citation

Harwood, Joleen Mae, "Comparative Study of Four-Year-Old Preschool Children in the Area of Conservation" (1971). *All Graduate Theses and Dissertations*. 2602.

<https://digitalcommons.usu.edu/etd/2602>

This Thesis is brought to you for free and open access by the Graduate Studies at DigitalCommons@USU. It has been accepted for inclusion in All Graduate Theses and Dissertations by an authorized administrator of DigitalCommons@USU. For more information, please contact digitalcommons@usu.edu.



COMPARATIVE STUDY OF FOUR-YEAR-OLD PRESCHOOL CHILDREN
IN THE AREA OF CONSERVATION

by

Joleen Mae Harwood

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Family and Child Development

ACKNOWLEDGMENTS

The Millville Headstart in Millville, Utah, under the direction of Mrs. Sheri Lewis, and the Utah State University Child Development Laboratory were both very cooperative in supporting this study. I would like to acknowledge all of the people affiliated with these two organizations for their assistance.

This study was under the direction of Dr. Carroll Lambert, Head of the USU Child Development Laboratory. I would like to express my sincere appreciation for her encouragement and help. I would also like to thank Dr. Don Carter, Head of the Department of Family Life and Child Development, for his critical evaluations and contributions; Dr. David Stone, professor of psychology, for his guidance and support; and Miss Loa Thomson of my Graduate Committee for her helpful suggestions.

Finally, I wish to express my gratitude to my two wonderful parents, without whose patient understanding and support this thesis would never have been written.

Joleen Mae Harwood

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	ii
LIST OF TABLES	iv
ABSTRACT	v
INTRODUCTION	1
Statement of the Problem	5
Purpose	6
Hypotheses	6
REVIEW OF LITERATURE	8
Conservation of Discontinuous Quantity or Number Conservation	8
Conservation of Continuous Quantity or Liquid Conservation	11
Conservation of Mass or Substance	12
Language and Question Format	14
METHOD OF PROCEDURE	18
Setting	18
Sample	18
Outline of Procedure	19
Number Conservation Task	21
Liquid Conservation Task	22
Mass Conservation Task	23
Definition of Terminology	24
Pilot Study	25
RESULTS AND DISCUSSION	29
Findings	29
Discussion of Findings	34
Discussion of Non-conservers	35
SUMMARY AND CONCLUSION	38
Summary	38
Conclusion	39
Recommendations for Further Research	40
SELECTED BIBLIOGRAPHY	42
APPENDIX	47
VITA	51

LIST OF TABLES

Table	Page
1. The distribution of responses for sex groupings and preschool groupings for all three tasks combined	30
2. Percentage distribution of all explanations for the total number of subjects combined according to type of conservation task	30
3. Distribution of children by ability to conserve for task one, number conservation, according to preschool groupings and sex groupings	31
4. Distribution of children by ability to conserve for task two, liquid conservation, according to preschool groupings and sex groupings	31
5. Distribution of children by ability to conserve for task three, mass conservation, according to preschool groupings and sex groupings	32

ABSTRACT

Comparative Study of Four-Year-Old Preschool Children

In the Area of Conservation

by

JoLeen Mae Harwood, Master of Science

Utah State University, 1971

Major Professor: Dr. Carroll Lambert

Department: Child Development

The purpose of this study was to determine if four-year-old children are able to conserve and to investigate the influence of social class and sex on the development of this capacity. Collection of data was accomplished by interviewing forty preschool children on three conservation tasks, discontinuous quantity, continuous quantity, and mass. From the findings of this study, it was concluded that the development of the capacity to conserve is so limited among four-year-old preschool children that the influence of social class and sex of the child on conservation ability remains unknown.

(56 pages)

INTRODUCTION

A child is not a miniature adult. He does not act in accordance with adult behavior, and especially, he does not think or reason as an adult. This idea that a child goes through different thought processes than an adult is rather new. It was unrecognized for several years that children must learn to reason logically. Jean Piaget, in the 1920's, was one of the first researchers to recognize this. While working with epileptic children, Piaget carried in his pocket four coins and four beads. He would place each bead by a coin, forming a line of beads and a line of coins in a one-to-one correspondence, and then hide one of the coins. When the three remaining coins were stretched out into a longer line, the epileptic children said there were more coins than beads. Piaget thought that he had found a test to help diagnose possible abnormal children. However, when he performed the same test on what were considered normal children, he found that they reasoned the same way as the epileptic children (Hall, 1970). This was the beginning of the concept that Piaget was later to call conservation. As Piaget began working with this concept, he found that it could be applied to several different areas besides number, such as liquid, weight, mass, volume, time. Gradually conservation became an

essential part of Piaget's developmental theory of intelligence.

Before conservation is attained, a child reasons that a change in the outward appearance of an object constitutes an internal change in certain properties of the object. A young child relies heavily on his senses, especially sight, to interpret the events that are happening in his world. If something looks different from how it was comprised in the original state, it must be different. When a child begins to conserve, he can see that certain properties of an object stay the same when the appearance of the object is changed. Flavell, who has done extensive research on Piaget's work, provides a concise definition of conservation which is congruent with Piaget's ideas. According to Flavell (1963a, p. 245), conservation is "the cognition that certain properties (quantity, number, length, etc.) remain invariant (are conserved) in the face of certain transformations (displaying objects or object parts in space, sectioning an object into pieces, changing shape, etc.)." This is the basic definition utilized for this study.

Several studies have attempted to set down the specific ages at which children acquire the various concepts of conservation. In Piaget's view of intellectual development, the child passes through four major periods: sensori-motor (birth to two years); pre-operational (two to seven years); concrete operational (seven to eleven years); and formal operational (above eleven years). It is not until the child reaches the first two operational stages around six or seven years of age that he begins to acquire the various concepts of conservation (Phillips, 1969). Elkind (1961a), in one of his replication studies of Piaget's work, states that the child masters the conservation

of discontinuous quantity and mass at about age six or seven. Uzgiris (1964) agrees with Elkind's findings concerning ages of conservation. The ages at which about half of the subjects in his sample conserved mass are reasonably consistent with those suggested by Piaget and other investigators.

According to Ginsburg and Opper (1969), Piaget has gone to great lengths to clarify some misinterpretations concerning these set stages with their specified ages. Each individual child varies in his own development, and this overall development varies from culture to culture. However, this development is continuous. Different groups of children may vary as much as two to three years in their attainment of conservation, but the pattern of development is similar for all children. Every child goes through three stages in acquiring conservation. First, the child is a non-conserver; second, in the transition stage, the child sometimes conserves and sometimes does not; and finally, the child has the complete concept of conservation. Therefore, a child is not characterized one day by stage one and the next day by stage three.

Love11 and Ogilvie (1959) found that the concept of conservation is applicable only to highly specific situations at first, and it increases in depth and complexity with experience and maturation. Thus, children who are conservers of continuous quantity in one situation are not inevitably conservers in another. Pratoomraj and Johnson (1966) concur that conservation responses seem situation specific at the younger ages and appear to become relatively general at age seven. Rothenberg (1969), in her study of younger children ages four and five, found that most subjects who were conservers on one or more problems did not tend to be conservers on all of them. Feigenbaum (1962) also

agrees that there is a strong positive relation between age and success in understanding the conservation principle. Success in solving the conservation tasks gradually increases with age until a full comprehension of the concept is attained. From these studies emerge a general trend of development. The child begins to acquire a limited understanding of conservation in the pre-operational stage, and upon entering the formal operational stage at approximately age eleven, the concept is complete.

Wohlwill and Lowe (1962) and Dodwell (1961), in testing children of various socioeconomic levels on Piaget-type tasks, suggested that the enriched environment of the middle-class child helps him to acquire the conservation concepts sooner than the lower-class child. Piaget has suggested that an enriched environment with many first-hand experiences does aid in the development of this concept (Furth, 1970). However, Rothenberg (1969) felt that lower-class children are most likely to be inaccurately assessed in terms of conservation than middle-class children. This is due to a whole realm of attributes characteristic of the lower-class disadvantaged. Complexity of the language used in the conservation task would be most detrimental to the disadvantaged child. The lack of first-hand sensory experiences would also be an unfavorable condition.

Thus, it would seem that young middle-class children who have had numerous enriching experiences may be able to conserve in several situations where a lower-class child would not be able to conserve. These experiences may help the child to rely less on his sense of sight and more on other sensory and reasoning input. It is believed, therefore, that four-year-old middle-class children who have been exposed to

many first-hand sensory experiences in a preschool situation may have some knowledge of the conservation concept.

In comparing boys and girls and their ability to conserve, sex differences were found to be insignificant in the following studies: Pratoomraj and Johnson, 1966; Braine, 1959; Dodwell, 1962; Feigenbaum and Sulkin, 1964. This is contrary to what might be expected. In most cases girls mature physically at a younger age than boys. In some cultures this seems to prompt earlier development in other areas, such as social and emotional development. Girls in the western industrialized nations of the world have less difficulty adjusting to the school situation and usually do better in academic subjects than boys. Consequently, there is some reason to believe that girls in this western culture would be able to conserve at a slightly younger age level than the boys, although this has not been substantiated by research.

Statement of the Problem

The problem investigated in this study was the influence of social class and sex factors on the ability of four-year-old children to conserve, with specific reference to the following three types of conservation:

1. Conservation of Discontinuous Quantity (Number Conservation)

The number of objects in a set does not change when mere physical arrangement of the objects is altered. The number of red chips in a row does not change when the row is fashioned into a stack of chips, so long as nothing is added or subtracted.

2. Conservation of Continuous Quantity (Liquid Conservation)

The amount of liquid remains the same, or is conserved, whether it

is poured into one container or another, so long as nothing is added or subtracted.

3. Conservation of Mass or Substance

The amount of matter in an object remains the same during mere changes in form. The amount of play dough in a ball remains the same when the ball is flattened, so long as nothing is added or subtracted.

Purpose

Extensive research has been done on Piaget's concept of conservation, but much remains to be done, especially in coordinating findings and in verifying results. Several factors appear to play a significant role in the attainment of conservation. This study has focused on three of the factors involved, age of the subject, socioeconomic level of the subject, and sex of the subject. An attempt was made to measure the ability of four-year-old preschool children to conserve on three conservation tasks. The purpose of the study has been to determine if four-year-old children are able to conserve and to investigate the influence of social class and sex on the development of this capacity.

Hypotheses

1. A majority of preschool children, four years of age, will demonstrate an understanding of the three types of conservation: discontinuous quantity, continuous quantity, and mass.
2. Social class differences will influence the development of the ability to conserve among four-year-old children.

3. There will be a difference in the ability of four-year-old boys and girls of the same age in their ability to conserve.

REVIEW OF LITERATURE

Conservation of Discontinuous
Quantity or Number Conservation

Most of the research pertaining to conservation has been done in the area of number conservation. It appears that, usually, this is the first concept of conservation that a child acquires. The pattern of development of number conservation follows a general pattern similar for all conservation. The child of about four years tends to center on either the length of the rows or on their density; the child of about five or six begins to decenter, and instead of concentrating on only one dimension, centers alternately on both length and density; and the child of about seven and above coordinates both of the dimensions simultaneously and relates them to the transformations performed (Ginsburg and Opper, 1969). Dodwell (1960, 1961) agrees with Piaget generally in reference to the acquisition of discontinuous quantity; however, he wishes to emphasize that the pattern of development is not precise or rigid.

Wohlwill and Lowe (1962) point out that inability to conserve is associated with failure to differentiate number from such irrelevant perceptual cues as length, and this has not received enough attention in Piaget's theoretical account of conservation. Peters (1967) found that the youngest child in his study (around four years of age) made his row the same length as that of the experimenter without reference to the number of objects in it. That is, the child was content to make a rough shape approximation. The child takes a visual approach to the comparison, and the first reaction is to focus upon the length of the

row. According to Peters, manipulation of the dimension, length, by the experimenter, may reinforce the subject's impression that this dimension is of prime importance. Zimiles (1963) discovered that in most conservation tasks, length is the variable that is manipulated. This being the case, it is to be expected that the subject would be more inclined to turn to this spatial orientation. Therefore, according to Zimiles, the decisive clue might be the change introduced by the experimenter.

It appears, then, that in most conservation tasks involving number, researchers are also dealing with conservation of length. Gottfried (1969) realized that in his own study the conservation of length more than number was relevant to the solution of the problem in training children in number conservation. The important variable, therefore, in Gottfried's opinion, was to leave length constant and only to vary number. Gottfried found that number conservation performance for all groups in his study was superior to length conservation.

Peters (1967) emphasized that if the objects used in the task have some value to the subject, the attention behavior will be greater. For example, dolls placed with cribs in a one-to-one correspondence are effective in stimulating the interest of young girls. The materials used and the way they are presented are crucial for almost any study, but they are especially pertinent in a conservation experiment, because the concept is involved with the materials directly. Feigenbaum (1962) in his study of young children found there was a definite relation between the number of beads used and success on the tasks. Namely, young children work best with the first few numbers of the number system, specifically, two, three, or four items.

In teaching conservation, several researchers have focused on relevant conditions for the apparent acquisition of conservation. Feigenbaum and Sulkin (1964) found that if they reduced irrelevant stimuli such as perception by blindfolding the child, he was able to grasp the concept of conservation with much more success. This supports the observation by some researchers that children can predict accurately the solution to a conservation problem if they do not see what actually happens. After the manipulations of the objects are observed, the child often changes his mind. This enhances the idea that children are focusing on the length or spatial orientation rather than the number.

There are some interesting studies attempting to induce conservation in children who are non-conservers. Some researchers feel that they have been successful in teaching conservation and maintaining lasting effects, while others have concluded that it is impossible to teach a child conservation until he is ready. That is, when a child is ready, this concept of conservation will unfold within him without any external supervision. Wallach and Sprott (1964) have claimed that they were able to induce number conservation in first-grade children by giving them experience with reversibility. Reversibility was defined as the recognition that two sets of objects which are initially matched can be matched again despite changes in rearrangement. According to the results, these children were able to transfer their learning to new sets of objects. Also, when the children were tested several weeks later, their concept of conservation was maintained.

Other studies do not agree with Wallach and Sprott. Kaplan

(1967) attempted to teach conservation to disadvantaged children who were non-conservers. The training included reversibility and also reinforcement which allowed the child to practice or train on the tasks. The study showed that while it was possible to train disadvantaged children to conserve number, the effects were not lasting. Because they forgot the concept, they could not have had a complete understanding. Findings from Sigel, Roper, and Hooper (1966) indicate that given training in such operations as classification and reversibility, conservation, at some level, has a greater probability of appearing. From this, they concluded that children who were in the transition stage of conservation would benefit the most from the training experience. Wallach, Wall, and Anderson (1967) believe that in order for a child to conserve he must both recognize reversibility and not rely on inappropriate cues.

Estes (1956) did not agree with Piaget. Her conclusions were (a) that if children could count, they counted correctly whatever the arrangement of objects; (b) they did not confuse extension of line with increase in number; (c) they did not mistake an apparent increase with a true increase in number. This was the only study that differed significantly with Piaget. Although there are specific areas of disagreement concerning such things as Piaget's method, several other studies since 1956 have generally confirmed Piaget's theory.

Conservation of Continuous Quantity or Liquid Conservation

In comparison with number conservation, very little research has been done directly with conservation of continuous quantities such as salt or water. Results from number conservation studies have been

applied to conservation in general. Therefore, the principles and problems that were discussed under number conservation would also be applicable to liquid conservation. This concept is acquired in approximately the same period as number conservation; however, in most cases, the concept of liquid conservation develops somewhat after number conservation and somewhat before conservation of mass. Hyde (1959) and Beard (1957) both pointed out that the children in their studies who were non-conservers in a conservation task utilizing balls of clay (mass) were found to be conservers when using liquid in a conservation task.

Spatial orientation as it pertains to the height of a column of liquid is utilized as a perceptual cue by non-conservers. The problems of length conservation would apply in the same way but in reference to height rather than length. Therefore, the pattern of development of liquid conservation would follow the general pattern as that outlined for number conservation by Ginsburg and Opper (1969). The child of about four years of age tends to center on either the height of the column of liquid or on the circumference; the child of about five or six begins to decenter and concentrate on both of these dimensions rather than just one; and the child of about seven years or above coordinates both of these dimensions so that a concept of conservation is acquired.

Conservation of Mass or Substance

Research in the area of mass conservation has generally been in conjunction with conservation of weight and volume. Studies have concerned themselves with the order of development of these concepts. Elkind (1961b) in his replication study found that the conservation of

mass or substance did not usually appear before age seven to eight; the conservation of weight did not usually appear before the age of nine to ten; and the conservation of volume did not in most cases appear before the age of eleven. Conservation of mass is recognized to be at a higher level than conservation of number or liquid; so therefore, it is usually the last of these three types of conservation to be acquired.

The general organization of development is similar to number and liquid conservation; only in this conservation task, a ball of clay is predominantly utilized. In reference to Elkind's study (1961b), one of two identical balls of clay is rolled into a sausage shape. In the first stage of a child's development of conservation of mass, the child gives a non-conservation response because to his general impression the sausage is different than the ball. When the child is forced to break down this impression by explaining his answer, he judges the substance by single dimensions which he is unable to coordinate one with the other. In the second stage or transition stage of development, the child gives non-conservation responses in the sausage experiment, because to the child's impression the sausage is both more (in length) and less (in width) than the ball. He is unable to resolve the contradiction that it is more and less. When asked to explain his answer, he resorts back to judging the substance by one of the dimensions. It is not until the final stage that the child is able to conserve. This is, of course, very similar to the dilemma observed in number conservation and liquid conservation.

Smedslund (1961f), in his study concerning the acquisition of conservation of substance and weight in children, came to the conclusion

that external reinforcement such as practice or training on various tasks was not effective in bringing about the concept in children who were non-conservers.

Language and Question Format

Piaget adopted the clinical method in his research with conservation. This method is quite flexible and provides a general framework for questioning the child rather than a set or standardized form. This has been a major criticism of Piaget's work, so researchers have made a special effort to standardize the conservation tests by adopting a more stringent testing method. The essential feature of the testing method is a series of questions which are posed in the same way to all who take the test. In working through this method, researchers have found specific flaws, especially with the language used in the conservation tasks.

Braine (1959) believes that there are other factors besides logic which are involved in the studies of conservation. One of the major factors is probably vocabulary development. Braine emphasized particularly the meaning of words such as "measure," "same length," etc. In his opinion, the effect such factors have is probably to conceal the reasoning ability of many of Piaget's subjects. Wallace (1966) agrees that with the most common standard questions, a major problem arises in the interpretation of the subjects' responses. In other words, among the children who failed to conserve, it has not been possible to know whether this failure was due to inability to understand the vocabulary of the question or the concept of conservation or both. Braine and Shanks (1965) have suggested that non-conserving children interpret "same" as meaning "look alike" rather than numerically

equivalent. Hood (1962) has suggested that "more" may mean to the non-conserving child only that the shape of the set is changed, and that the space it occupies is greater than it was before.

Piaget recognized this himself when he stated:

It might be argued (in considering the responses of children at stage one) that the mistakes are due to lack of understanding of the words used. May it not be that the child does recognize that the number of bottles and glasses remain the same when grouped together and that when he says, there are more, he is merely expressing the idea that the shape of the set has changed and the space it occupies is greater. (Piaget, 1952, p. 105)

However, Piaget answers his critics by stressing the confidence and clarity of mind the child displays when he does reach stage three and is able to conserve in all situations. Therefore, Piaget would emphasize that the difficulty young children have in conserving is not all linguistic.

Griffiths, Shantz and Sigel (1967) stress the importance of assessing each child's comprehension of the key words, such as "same" and "more," used in the conservation questions, and/or training each child in his understanding of these terms before he is tested on his level of conservation attainment. Sinclair and Kamii (1970) taught a group of non-conservers the necessary vocabulary for conservation. They trained the children in the use of such words as "long," "short," "wide," "narrow." They wanted to ascertain if the concept of conservation would be attained once the language was learned. Their results were negative.

Hood (1962), from time to time in his study, took a definite non-conserver and carefully explained to the child just why his answer was wrong and what the correct answer should have been. Nineteen children were coached in this way and were retested after an interval of three to four days. In every case, the child on being retested was still a

non-conserver. It seemed evident to Hood that when a child was questioned immediately after the working session, he could usually give the correct response, but mainly because he was repeating to the examiner what he had in effect been told to say, and there was little or no evidence of temporary insight into the problem.

In the testing method utilized by most researchers dealing with conservation, there is a general format for the questions asked. Wallach and Sprott (1964) and Zimiles (1963) used a type of question containing a number of separate parts. An example would be, "Is there more water in this glass, or in this glass, or are they both the same?" According to Rothenberg (1969), this type of question is particularly difficult for young children to remember because it is long and complex. Hood (1962) feels that with three-part questions, children tend to repeat the last thing they were asked. Hood suggests that the most valid results can be accomplished by presenting standard single-event questions in several forms for each conservation problem.

Another important factor to consider is the hidden emotional connotations that may be found in the wording of some questions. Distinguishing the objects in a set by use of personal pronouns may lead to biased responses by the child. For example, by asking the child if he has more or if the experimenter has more, the child may answer according to his own personal feelings. If the child is told this is a game and he feels that he is in competition, he may respond consistently that he has more. He may try to please the examiner by saying that the examiner has more (Mussen, 1960).

Rothenberg (1969) states that questions dealing with a single event have the advantage of presenting a single phrase short enough to

be remembered. However, it does have the disadvantage of tending to favor either a conserving or a non-conserving response by virtue of the emphasis in the question on "same" or "more." Dodwell (1960), Elkind (1961b), Wallach, Wall, and Anderson (1967), and Wohlwill and Lowe (1962) all utilized a single-part question in their studies. Dodwell (1960) in his study used two presentations with equal numbers in each series; they differed only in the nature of the materials. He found that a much greater percentage conserved when the subjects were asked if there were the same number in the two sets than when they were asked which set had more. Rothenberg (1969) and Richards (1968) agree with Hood (1962) on the importance of using various combinations of these types of questions and to avoid making any conclusions based on the child's first response.

There is still controversy over the importance of the explanation given by the child in rating his ability to conserve. Some students only require a child to make a judgment about the transformation without explaining his answer. Braine (1959) argues that inappropriate explanation is merely an indication of the child's lack of verbal skills rather than the absence of logical operations. On the other hand, Smedslund (1961a) holds that an appropriate explanation is essential as evidence of conservation. Pratoomraj and Johnson (1966) noted, especially at the young age levels of four and five, the ability to explain a conservation response to one problem is no guarantee that this subject will show conservation in responding to other problems. Hunt (1968) suggests that previous findings have not indicated a clear-cut relationship between making a conservation response and the explanation offered by the child for his judgment.

METHOD OF PROCEDURE

Setting

Two preschool centers located in the Cache Valley area were chosen for the setting of this study. The Utah State University Child Development Laboratory is located on the Utah State University Campus. Applicants for admission to the USU Laboratory draw from a rather extensive waiting list. Many of the children are registered on the list a short time after they are born. Some applications are reserved for children with special problems and newcomers to the community. There are two classrooms in the laboratory; two classes meet in the morning and two classes meet in the afternoon. There are approximately twenty children with one master teacher and three to four student teachers in each class.

Millville Headstart is situated in a small farming community in Cache Valley. The program is located in a former elementary school building. There are two classes which meet in the morning only. Each class has one teacher with twenty children and one or more teacher-aides. One aide works full-time; the other aides include parents, university students, and community people who volunteer part-time. Children are selected to attend this program in accordance with the guidelines stipulated by the United States Office of Economic Opportunity.

Sample

The subjects included two groups of twenty preschool children, all four years of age (48 months to 59 months). One group of twenty

children, ten boys and ten girls, were selected from the Utah State University Child Development Laboratory, all subjects having attended at least one quarter in the laboratory prior to their attendance in the present quarter of testing. For the convenience of the examiner, the subjects were selected from the two morning classes. The number of girl subjects who met the qualifications totaled exactly ten, eliminating the possibility of a random selection of names, because all possible subjects were utilized. However, because there were not enough boy subjects who qualified, four boys were selected from one of the afternoon classes. This included the first four boys on the alphabetical listing of names who met the requirements.

The other group of twenty children, ten boys and ten girls, were from the Millville Headstart program, all having attended Headstart during the fall of 1970. For this study ten children, five boys and five girls, were selected from each of the two morning classes. The subjects who qualified were selected from an assortment of names, not alphabetically listed. With the exception of two names, all possible subjects were used in the study; therefore, a random selection of names was not employed.

Outline of Procedure

Each subject was approached individually in the preschool situation by the examiner and persuaded to help the examiner play a game in an adjoining room for approximately four to five minutes. To help establish a successful relationship, the examiner was the only adult present with the child. The child and the examiner were seated next to each other with the materials for the conservation task placed on a table in front of them. Recording of responses was made on a tape

recorder which was turned on during the entire session. All forty children were tested during a six-week period from February 1 to March 12, winter quarter of 1971.

During the study, the examiner met with each subject three times, once for each type of conservation task; first, number; second, liquid; third, mass. All three tasks followed the same five-step procedure. First, sameness was established with two similar items. Second, a transformation was made with one of the items. Third, reversibility was applied by returning the transformed material to its original state. Fourth, a second transformation was made, different from the first transformation. The final step was to return the transformed material again to the original state. A similar three-part question was employed in all three tasks. The subject was only asked for a response on the first and final steps. However, for the second, third, and fourth steps, the child was asked to explain his response by answering the question, "Why?" If a subject did not respond the first time a question was asked, the question was repeated a second and a third time. The examiner used gestures to help illustrate the question when it was repeated. The question was also repeated in three separate parts rather than as one question. For example, the question for number conservation was divided into three parts when it was repeated. The first question was, "Are they the same amount?" The second question was, "Are there more blue chips?" The final question was, "Are there more red chips?"

The above information provides a general outline for the procedure. The specific materials and language, of necessity, had to be different

for each task. Therefore, the following three sections give a more complete description of the procedure for each task.

Number Conservation Task

Preceding task one, number conservation, the examiner introduced a warm-up task to establish rapport between the subject and the examiner. The materials for this task consisted of a large rectangular sheet of white paper (12 inches by 18 inches) with a solid black line through the center and twelve small red blocks from the cuisenaire set of rods. The rods were referred to as small blocks, because this was a more familiar term than rods. No standardized sets of questions were used. Instead, the examiner instructed the subject by using the blocks to demonstrate the concepts "same" and "more." To demonstrate sameness, two rows of six blocks were placed in a one-to-one relation on the sheet of white paper. The black line on the paper was used as a guide with a row of blocks on each side of the line. While still maintaining equal length for both rows, two blocks were taken from one side and placed on the other side of the black line. This was to demonstrate the concept "more." To re-establish sameness, the blocks were rematched in a one-to-one relation. This warm-up task took approximately two to three minutes.

The materials for the number conservation task included five round plastic red chips (diameter 1 1/2 inches), five similar blue chips, and the same sheet of white paper (12 inches by 18 inches) previously used in the warm-up item. The examiner made a straight line with five red chips, approximately one-half inch apart, parallel to the black line on the top half of the white sheet of paper. Next, the examiner handed the subject the five blue chips and told the subject, "This row of red

chips will be mine. You make a row of blue chips on this side of the paper (bottom half of the paper). Now you have a row of blue chips the same as my row of red chips." The examiner offered verbal and physical help in placing the chips in the appropriate place when necessary.

For number conservation, the standard three-part question was, "Are they both the same, or are there more blue chips or are there more red chips?" The subject was questioned after each of the five steps. After the second, third, and fourth responses, the examiner asked the subject, "Why?" For the first transformation, the examiner spread the row of red chips so that each chip was approximately 1 1/2 inches apart. In the third step, the subject was asked to place each one of the blue chips by one of the red chips, to reverse the transformation and to establish a one-to-one correspondence. The fourth step involved the second transformation. The examiner compressed the row of red chips so each chips was approximately one-fourth inch apart. In the final step, the subject was again told to place a blue chip by each red chip. (Refer to Appendix--Data Collection Sheet I.)

Liquid Conservation Task

The materials included four clear glass containers with holding capacity of 250 milliliters each and one clear glass pitcher containing colored red water. No measurement markings appeared on any of the containers. Each glass had a small spout molded into the rim to promote easier pouring. Each of the glasses were the same identical size, while one glass was clearly shorter but wider than each of these two, and one clearly taller but thinner than these two. After the subject entered the room, the examiner gave one of the identical glasses to the

subject and kept one for herself, explaining that both glasses needed to have the same amount of water. Giving the subject the pitcher of red water, the examiner encouraged the subject to fill the glass about half full. Then the examiner filled her glass to the same level.

The three-part question for liquid conservation was, "Are they both the same, or do you have more red water, or do I have more red water?" The examiner employed this question after each of the five steps; however, the subject was only required to explain his response after steps two, three, and four. For the first transformation, the subject was asked to pour his glass of water into the tall, thin glass. In the third step, to show reversibility, the subject was told to pour his water from the tall glass back into one of the two identical glasses. The second transformation involved having the subject pour the water from his glass into the short, wide glass. In the final step, the subject poured his glass of water from the short glass into the identical glass. (Refer to Appendix--Data Collection Sheet II.)

Mass Conservation Task

Blue commercial play dough was utilized for this task. The play dough was rolled into four balls before the subject entered the testing room. Two balls were identical in size, approximately 1 1/2 inches in diameter. The other two balls were very much different in size from the two identical balls and from each other. The large ball was three inches in diameter and the small ball was approximately one-half inch in diameter. When the subject entered, he was asked to choose the two balls that had the same amount of play dough from the array of four balls. If the subject needed some assistance, the examiner asked some pertinent questions concerning size of the balls, employing such terms

as "big" and "little." The large ball and the small ball of play dough were removed from the table. Next, the examiner gave one ball of play dough to the subject and kept one ball for herself.

For mass conservation, the question utilized was, "Are they both the same, or do you have more play dough or do I have more play dough?" After each of the five steps, the subject was asked this question. Again for steps two, three, and four, the examiner asked the subject for an explanation. The examiner asked the subject to make his ball of play dough into a worm for the first transformation. For some children it was necessary to demonstrate skills in working with clay, such as rolling it on the table or between the hands. The worm was rolled back into a ball by the subject in the third step to return the material to its original state. In the second transformation, the subject was told to smash the ball into a pancake. In the final step, the subject rolled the pancake into a ball. (Refer to Appendix--Data Collection Sheet III.)

Definition of Terminology

For each of the conservation tasks, a subject was classified as a conserver if he maintained that the two items remained the same through all five steps of the procedure, the critical steps in each case being steps two and four when the transformations were made. If a subject answered that the items were the same on only one of the two transformations, either the second or the fourth step, he was considered a partial conserver. If a subject failed to maintain that the items were equal for the two crucial steps of transformation, he was classified as a non-conserver. In arriving at a classification for each subject, the important criterion was the child's judgment.

Although, for parts of each task, the child was asked for an extended explanation to interpret his response, this was excluded in the final classification. After the results of the study were collected, a fourth category was also employed, which included subjects who did not recognize sameness on any step, even when the items were identical. This category was labeled nonclassifiable, possibly due to such factors as inadequate vocabulary, misconception of the requirements of the task, or other factors involved in the interview situation.

Pilot Study

For the pilot study, the same general procedure was utilized as has been outlined above. For each task, two items were compared by use of the terms, "same" or "more." For number conservation, two rows containing five chips each were compared; for liquid conservation, two containers of water; for mass conservation, two balls of play dough. The subject was asked if both items were the same or which item had more. In every case, the two items remained the same in amount. Thus, if a child was conserving, he would always respond that the items were the same. It was possible to phrase the conservation question in each task in two different forms. This was a crucial aspect of the study, because it has been found that children, especially young children, simply repeat the last phrase heard when given a multiple-choice question. Therefore, this became a language pilot study utilizing two forms of the same question. Question A format first asked if the items were both the same, or which item had more. Question B format first asked which item had more, or if they were both the same. It was hypothesized that if these children simply repeated the last phrase they heard, there would be a larger number of

conservers with question B format than with question A format.

Eight subjects were chosen for the pilot study, none of whom participated in the original study. Two boys and two girls were from the USU Child Development Laboratory, and two boys and two girls were from the Millville Headstart. All subjects were four years of age. Question A format was administered to four of these subjects, one boy and one girl from the USU Laboratory and one boy and one girl from Millville Headstart. Question B format was given to the remaining four subjects. For task one, number conservation, there were three conservers and one non-conserving subject with question B format. There were four non-conservers and no conservers when question A format was utilized. On task two, liquid conservation, question B format showed two conservers and two non-conservers. For question A format, all four subjects were non-conservers. The last task was mass conservation. Question B format resulted in one conserver and three non-conservers, while question A format again produced no conservers. The total for all three tasks indicated that with question B format there were six conservers and six non-conservers; for question A format there were no conservers. From this brief pilot study, it was surmised that the original study would possibly be more valid if question A format was utilized. This format first asked if the items were both the same, or which item had more.

All of the subjects in the pilot study demonstrated a general difficulty with language. Most of the children indicated a misconception of the words "same" and "more." Some of the children responded by saying, "this has more, and that has more," indicating that both items had more. The subjects seldom used the word "same," although it could

be assumed from the above statement that sameness was implied by the young child.

For each task, the subject helped the examiner make the transformations. For task one, number conservation, the subject placed the chips in a one-to-one correspondence. For task two, liquid conservation, the subject poured the water into the various containers. The subject molded the play dough into different shapes for task three, mass conservation. It was believed that participation by the subject would stimulate attentive behavior, and manipulation of the actual objects would encourage thought processes. In the number conservation task, it was found that most of the subjects could not position the chips in a one-to-one correspondence with one chip in front of another chip without some guideline to follow. Therefore, for this particular task, a large rectangular sheet of white cardboard (12 inches by 18 inches) with a solid black line through the center was appropriated for the original study. The chips were placed next to the black line as a guide, one set of chips on each side of the line. These young subjects also had a difficult time pouring the liquid in task two and in molding the play dough back into a ball in task three. Therefore, the examiner found it necessary to help some of these young children with these manipulations.

It was decided to administer a warm-up item along with task one, partly to provide base line data on the subject's understanding of the necessary concepts "same" and "more" and also to establish a comfortable relationship between the examiner and the subject. During the pilot study, some subjects were hesitant to leave the preschool situation with the examiner the first time. To help overcome this

apprehension, the examiner spent two mornings working in the Millville Headstart program to familiarize herself with all of the children. Because the examiner had previously been a student teacher in the USU Laboratory, the children in this situation were familiar with her. After some rapport was established, the subjects were all eager to help with the other two tasks.

The warm-up task consisted of twelve small red blocks from the cuisenaire set of rods. These items were referred to as small blocks, because this was a more common term than rods. No standardized sets of questions were used. The examiner placed six blocks on each side of the black line on the piece of white paper. The subject was not asked questions directly, but was told that both rows contained the same number of blocks. While still maintaining equal length for both rows, two blocks were taken from one side and placed on the other side of the black line, and the examiner and the subject discussed the concept "more." To re-establish sameness, the blocks were rematched in a one-to-one relation. From this warm-up period, which lasted approximately two to three minutes, the subject and examiner progressed directly into task one, number conservation. Therefore, this extended the length of time required for the first task to six to seven minutes because of the initial warm-up item.

RESULTS AND DISCUSSION

Findings

The first hypothesis was that a majority of preschool children, four years of age, would demonstrate an understanding of the three types of conservation: number, liquid, and mass. This was not substantiated, because there were very few conservers in this total group of forty preschool children. With forty subjects and three tasks, there were one-hundred and twenty possible conservation responses. However, during the entire study for all three tasks, only four subjects were classified as conservers. Only two of the subjects were categorized as partial conservers. For the whole study, over fifty per cent of the responses were non-conserving responses, and over forty per cent of the responses were nonclassifiable. (Refer to Table 1.) A subject was classed as a conserver on the basis of his verbal responses to questions. Although the child was asked to interpret his responses part of the time, an adequate explanation was not considered essential for classifying a subject as a conserver. However, when taking this distribution into account, over sixty per cent of the explanations for each conservation task were categorized as perceptual interpretations. (Refer to Table 2.) In other words, to explain their responses, over half of the subjects relied on visual clues rather than conservation logic, lending further support to the impression that four-year-old children are unable to conserve. In analyzing the distribution of conservers for each task, none of the subjects in the main study conserved on all three tasks. Of the four

subjects who did conserve, only one subject conserved on task one, number conservation; only one subject conserved on task two, liquid conservation; and two subjects conserved on task three, mass conservation. (Refer to Tables 3, 4, and 5.) This further substantiates the finding that the major proportion of these four-year-old children were not able to conserve. The results from this first hypothesis had a direct influence on the verification of the following hypotheses.

Table 1. The distribution of responses for sex groupings and pre-school groupings for all three tasks combined.

	conservers	partial conservers	non- conservers	non- classifiable
Girls Responses (60)	1	1	38	20
Boys Responses (60)	3	1	25	31
USU Laboratory Responses (60)	3	2	31	24
Headstart Responses (60)	1	0	32	27
Total Responses (120)	4 (3 1/2%)	2 (1 1/2%)	63 (52 1/2%)	51 (42 1/2%)

Table 2. Percentage distribution of all explanations for the total number of subjects combined, according to type of conservation task.

	Number Task One	Liquid Task Two	Mass Task Three
Conservation	3%	3%	8%
Counting	2%	not applicable	not applicable
Perception	68%	64%	67%
Irrelevant	5%	5%	10%
No Response	22%	28%	15%

Table 3. Distribution of children by ability to conserve for task one, number conservation, according to preschool groupings and sex groupings.

	conservers	partial conservers	non- conservers	non- classifiable
USU Laboratory				
girls (10)	0	0	9	1
boys (10)	0	1	6	3
Millville Headstart				
girls (10)	0	0	8	2
boys (10)	1	0	5	4
Total Girls and Boys				
girls (20)	0	0	17	3
boys (20)	1	1	11	7
Total Children				
USU Lab. (20)	0	1	15	4
Headstart (20)	1	0	13	6
Total Children (40)	1 (2 1/2%)	1 (2 1/2%)	28 (70%)	10 (25%)

Table 4. Distribution of children by ability to conserve for task two, liquid conservation, according to preschool groupings and sex groupings.

	conservers	partial conservers	non- conservers	non- classifiable
USU Laboratory				
girls (10)	0	1	7	2
boys (10)	1	0	4	5
Millville Headstart				
girls (10)	0	0	4	6
boys (10)	0	0	8	2
Total Girls and Boys				
girls (20)	0	1	11	8
boys (20)	1	0	12	7
Total Children				
USU Lab. (20)	1	1	11	7
Headstart (20)	0	0	12	8
Total Children	1 (2 1/2%)	1 (2 1/2%)	23 (57%)	15 (38%)

Table 5. Distribution of children by ability to conserve for task three, mass conservation, according to preschool groupings and sex groupings.

	conservers	partial conservers	non- conservers	non- classifiable
USU Laboratory				
girls (10)	1	0	5	4
boys (10)	1	0	0	9
Millville Headstart				
girls (10)	0	0	5	5
boys (10)	0	0	2	8
Total Girls and Boys				
girls (20)	1	0	10	9
boys (20)	1	0	2	17
Total Children				
USU Lab. (20)	2	0	5	13
Headstart (20)	0	0	7	13
Total Children	2 (5%)	0	12 (30%)	26 (65%)

The second hypothesis was that social class differences would influence the development of the ability to conserve among four-year-old children. This hypothesis was also not supported. When all three tasks were combined, sixty conservation responses were feasible for each preschool group. The USU Laboratory had three conservers and two partial conservers as compared to the Millville Headstart which had one conserver and no partial conservers. (Refer to Table 1.) This slight difference took on shallow meaning when the total number of non-conservers was considered. It was not feasible to make any comparison in regards to social class due to the vast majority of children in this group who could not conserve. For each of the three tasks, the distribution of children for the two preschool groups was almost comparable in number, with never more than a difference of two subjects for each

category. For task one, number conservation, there was one conserver for Millville Headstart and no conservers for the USU Laboratory. (Refer to Table 3.) For task two, liquid conservation, there was one conserver for the USU Laboratory and no conservers for Millville Headstart. (Refer to Table 4.) There were two conservers from the USU Laboratory for task three, mass conservation, and no conservers for Millville Headstart. (Refer to Table 5.) All of this provided further evidence that there was not a measurable difference between the middle-class subjects, represented by the USU Laboratory children, and the lower-class subjects, represented by the Millville Headstart children.

The third hypothesis was that there would be a difference in the ability of four-year-old boys and girls of the same age, in their ability to conserve. This hypothesis was not substantiated either. With twenty subjects in each sex group and with the three tasks combined, this provided a basis of sixty conservation responses feasible for each sex group. The analysis of the total results showed that the boys had three conservers and one partial conserver, while the girls had one conserver and one partial conserver. (Refer to Table 1.) Further analysis of each individual task indicated that with regard to each possible category, these two groups were classified in a similar fashion. On task one, there was one boy conserver and no girl conserver. (Refer to Table 3.) The results for task two were identical to the results for task one, with one boy conserver and no girl conserver. (Refer to Table 4.) There was one girl conserver and one boy conserver for task three, mass conservation. (Refer to Table 5.) Thus, the boys and the girls in this study could not be compared, because the majority of both sex groups could not conserve.

Discussion of Findings

In support of Piaget's theory, the major proportion of four-year-old preschool children in this study were unable to conserve, because they had not yet reached the concrete operational stage of development. Those subjects in this study who did demonstrate conservation on one task, did not demonstrate this concept on all three tasks. (It should be noted here that one subject in the pilot study did conserve on every task and was able to adequately explain his responses.) This further substantiates Piaget's observation that young children advance through stages in the development of conservation. The child in the transition stage may conserve in certain situations, but not in all situations. Those subjects who did conserve were most probably in the transition stage.

One non-conserving subject made the comment that if he rolled his ball of play dough so many times, "it would get little, little, little." From such observations, it appears that development of language is correlated with the acquisition of the mental processes of conservation. With the attainment of conservation comes a working comprehension of the vocabulary involved. To say that a child does not understand the conservation task because he does not understand the vocabulary involved appears to have merit. However, a child does not acquire the mental meaning of a word until he has had concrete operations or experiences with the word to impart to it a workable definition. A subject cannot know conservation unless he understands the language; nor can he understand the language until he has had some practical first-hand experiences. Therefore, it is believed that most of the subjects had difficulty with the language involved in the conservation tasks,

because they did not have an intelligible grasp of the conservation concept.

One of the three classrooms used in this study from the USU Laboratory provided the children in their class with some experiences involving the conservation principle. The idea was introduced that objects can change shape or texture and still remain the same. The hard texture of macaroni was transformed during cooking; the same amount of water was poured into various containers. This happened during the first week of winter quarter, three weeks before testing began, unbeknown to the researcher. It was anticipated that because of these experiences, there would be more conservers from this morning classroom than from the other two laboratory classrooms. However, only one of the conservers in the results came from this classroom. The other two conservers and the two partial conservers were associated with the other two classrooms. This further substantiates the idea that a child will not conserve until he is ready.

Discussion of Non-conservers

Most of the subjects who were non-conservers followed a set pattern. Relying almost totally on perception, the subjects would answer according to what they had observed, whether this referred to dimensions of the objects involved in the task or the manipulations made by the examiner and the subject.

For task one, number conservation, length, and not density, was the discriminating dimension. If the two rows of chips were equal in length, they were the same amount; if one of the rows was longer, it contained more chips. Approximately seventy per cent of the forty subjects followed this pattern. They recognized that the rows were

the same for steps one, three, and five. For the first transformation, step two, when the red chips were spread apart, these subjects claimed there were more red chips. Only two of the subjects out of the total of forty children attempted to count the number of chips to arrive at their answer. However, both subjects counted incorrectly. (Refer to Table 3.)

In the case of task two, liquid conservation, height and width were both discriminating dimensions. When the liquid was poured into the tall, thin glass, the majority of subjects perceived this glass to contain more in amount. However, when the liquid was poured into the short, wide container, there was some confusion. Many subjects hesitated, unable to coordinate both of the dimensions. (Refer to Table 4.)

Because of the familiarity with the testing situation and the examiner, the subjects were much more verbal for task three, and there were fewer "no response" explanations. It appeared that because of the nature of the material (play dough), the subjects had more problems discriminating visual clues. They could not coordinate the dimensions of the object to obtain a satisfactory logical solution. For this particular task the subjects relied on manipulation of the object as a clue to the solution. Because the subjects had introduced some type of change to their ball of play dough, most of them discerned that in comparison with the ball shape, the worm shape and the pancake shape had more in amount. (Refer to Table 5.)

Contrary to expectations, there were approximately the same proportion of conservers for each of the three tasks. It was anticipated that there would be more conservers on task one, number conservation, than on task three, mass conservation, because number conservation is

usually acquired first from among the various concepts of conservation. There was one subtle indication to suggest that the subjects had more difficulty with task three than with task one or two. For number and liquid conservation, better than one-half of the subjects were classified as non-conservers. But for task three, only about one-third were categorized as non-conservers, because better than two-thirds were non-classifiable. In other words, the majority of subjects could not recognize sameness on any step of the mass conservation task. (Refer to Tables 3, 4, and 5.)

SUMMARY AND CONCLUSION

Summary

This study has investigated the influence of social class and sex of the child on the development of the capacity to conserve among four-year-old children. The assumptions were formulated in the following three hypotheses (a) a majority of preschool children four years of age, would demonstrate an understanding of number, liquid, and mass conservation; (b) social class differences would influence the development of the ability to conserve among four-year-old children; (c) there would be a difference in the ability of four-year-old boys and girls of the same age, in their ability to conserve.

Collection of data was accomplished by interviewing forty preschool children on their ability to conserve. Twenty subjects, ten boys and ten girls, were selected from the Utah State University Child Development Laboratory. The remaining twenty children, ten boys and ten girls, attended Millville Headstart. All subjects were four years of age. At three separate times, each child was tested individually on three conservation tasks, number, liquid, and mass. A warm-up item was initiated before task one to help establish rapport between the subject and examiner and to provide base line data on the subject's comprehension of necessary vocabulary. This warm-up period consisted of a discussion of the concepts "same" and "more" with two rows of red cuisenaire rods, each row containing six rods. These rods, or blocks as they were referred to, were matched in a one-to-one correspondence and were also transformed so that one row contained more blocks than

the other row. For the first task, number conservation, two rows of round chips were utilized. One row contained five red chips; the other row, five blue chips. The transformations involved lengthening and shortening the row of red chips. After each transformation, reversibility was utilized by rematching the two rows of chips in a one-to-one relation. Four glass containers and a pitcher of red water were employed for task two, liquid conservation. Two identical glasses contained the same amount of water. The water was transformed by pouring it into a tall, thin glass and into a short, wide glass. After each transformation, the process was reversed by pouring the liquid back into the identical container. For task three, mass conservation, the subject selected two identical balls from an array of four balls of play dough. Of the four balls, two were identical in size, one was much larger, and the other ball was much smaller. There were two transformations. One of the two identical balls was rolled into a worm first, and then later, flattened into a pancake. The transformations were reversed by rolling the play dough into a ball after each change in shape.

The findings indicated that almost none of the four-year-old children were able to conserve. Because a majority of the children could not conserve, differences resulting from sex and social class could not emerge. Therefore, none of the hypotheses were supported by the data.

Conclusion

From the findings of this study, it may be concluded that the development of the capacity to conserve is so limited among four-year-old children that the influence of social class and sex of the child on conservation ability remains unknown.

Recommendations for Further Research

At this young age level, no meaningful differences were apparent between the two economic class levels represented by the middle-class USU Laboratory children and the lower-class Headstart children. In comparison, another group of lower-class subjects representing a more culturally disadvantaged group might have displayed more obvious disparities. The Millville Headstart children, although economically disadvantaged, exhibited many of the same values and attitudes as those held by middle-class children. Some observable differences might have been manifested if older children from both economic levels were compared, because more of the subjects at an older age level would be capable of conserving.

In this particular study, the conservation tasks were presented in the following order: first, number; second, liquid; and third, mass. It might be beneficial in some future research study to reverse the order of presentation of these conservation tasks. If mass conservation was introduced first, this might have an effect on the recognition of conservation in the other two tasks. Literature on conservation has stated that number conservation appears to be the easiest to acquire and is, therefore, attained before the other types of conservation. Research on the order of attainment of the various types of conservation could be very helpful.

Nothing was investigated in this study concerning intelligence of the subjects and their ability to conserve. Feigenbaum (1962) found a strong positive correlation between IQ as measured by the Stanford Binet and ability to solve the conservation problems. Dodwell (1960),

Elkind (1961a), and Hood (1962) also positively related intelligence to number conservation.

More research could be done and needs to be done in discovering how children learn to conserve. Some researchers claim that training in reversibility and reinforcement helps a child learn to conserve. Others claim that experiences with addition and subtraction and one-to-one correspondence benefit a child in learning number conservation. What experiences best prepare the child for the mental operations required for conservation? This knowledge would aid researchers in assessing a subject's true ability to conserve. As was stated earlier, a great deal of research has been done on Piaget's concept of conservation, but there still remains much that could be done.

SELECTED BIBLIOGRAPHY

- Beard, R.M. 1957. An investigation of concept formation among infant school children. Unpublished doctoral dissertation. University of London. Discussed In I.E. Sigel and F.H. Hooper (Eds.). 1968. Logical thinking in children: Research based on Piaget's theory. Holt, Rinehart, and Winston, New York. 541 p.
- Benson, F.A. 1967. An examination over an eight month period of Piaget's concept of number development and the presence or absence of certain interrelated tasks in a group of first grade children. EdD dissertation, University of Oregon. 244 p. (Original not seen; abstracted in Dissertation Abstracts 27(10): 3300A. April 1967.)
- Braine, M.D.S. 1959. The ontogeny of certain logical operations: Piaget's formulations examined by nonverbal methods. Psychological Monographs 73(5):1-43.
- Braine, M.D.S. 1962. Piaget on reasoning: A methodological critique and alternative proposals. Monographs of the Society for Research in Child Development 27(2):41-64.
- Braine, M.D.S., and B.L. Shanks. 1965. The conservation of a shape property and a proposal about the origin of the conservations. Canadian Journal of Psychology 19:197-207.
- Bruner, J.S. 1966. On the conservation of liquids, p. 183-207. In J.S. Bruner, R. Oliver, and O.M. Greenfield, et al. (Eds.). Studies in cognitive growth. John Wiley, New York.
- Cheng, T., and L. Mei-ke. 1960. An investigation into the scope of the conception of numbers among 6-7 year old children. Acta psychol. Acad. Sinica, Peking, China. No. 1, 28-35.-84. (Original not seen; abstracted in Psychological Abstracts 35:473, No. 4710.)
- Dodwell, P.C. 1960. Children's understanding of number and related concepts. The Canadian Journal of Psychology 14:191-205.
- Dodwell, P.C. 1961. Children's understanding of number concepts: Characteristics of an individual and of a group test. The Canadian Journal of Psychology 15:29-36.
- Dodwell, P.C. 1962. The relation between the understanding of the logic of classes and of cardinal number in children. The Canadian Journal of Psychology 16:152-160.
- Dodwell, P.C. 1963. Children's understanding of spatial concepts. The Canadian Journal of Psychology 17:141-161.

- Elkind, D. 1961a. The development of quantitative thinking: A systematic replication of Piaget's studies. *Journal of Genetic Psychology* 98:37-46.
- Elkind, D. 1961b. Children's discovery of the conservation of mass, weight, and volume: Piaget replication study II. *Journal of Genetic Psychology* 98:219-227.
- Elkind, D. 1967. Piaget's conservation problems. *Child Development* 38(1):15-27.
- Estes, B. 1956. Some mathematical and logical concepts in children. *Journal of Genetic Psychology* 88:219-222.
- Etuk, E.E.S. 1967. The development of number concepts: An explanation of Piaget's theory with Yoruba-speaking Nigerian children. EdD dissertation, Columbia University. 135 p. (Original not seen; abstracted in *Dissertation Abstracts* 18(4):129A. October 1967.)
- Feigenbaum, K. 1962. Task complexity and age as variables in Piaget's problem of conservation. *Child Development* 34:423-432.
- Feigenbaum, K. 1969. Activities to teach the concept of conservation. *Young Children* 24(3):151-153.
- Feigenbaum, K., and H. Sulkin. 1964. Piaget's problems of conservation of discontinuous quantities: A teaching experience. *Journal of Genetic Psychology* 105:91-97.
- Flavell, J.H. 1963a. The developmental psychology of Jean Piaget. Van Nostrand Company, Princeton, New Jersey. 472 p.
- Flavell, J.H. 1963b. Piaget's contributions to the study of cognitive development. *Merrill-Palmer Quarterly* 9(4):245-252.
- Furth, H.G. 1964. Conservation of weight in deaf and hearing children. *Child Development* 35:143-150.
- Furth, H.G. 1970. Piaget for teachers. Prentice-Hall, Englewood Cliffs, New Jersey. 163 p.
- Ginsburg, H., and S. Oppen. 1969. Piaget's theory of intellectual development: An introduction. Prentice-Hall, Englewood Cliffs, New Jersey. 237 p.
- Gottfried, N.W. 1969. The relationship between concepts of conservation of length and number. *The Journal of Genetic Psychology* 114:85-91.
- Griffiths, J., C. Shantz, and I.E. Sigel. 1967. A methodological problem in conservation studies: The use of relational terms. *Child Development* 38(3):841-848.

- Hall, E. 1970. A conversation with Jean Piaget and Barbel Inhelder. *Psychology Today* 3(12):25-32;54-56.
- Hood, H.B. 1962. An experimental study of Piaget's theory of the development of number in children. *British Journal of Psychology* 53(3):273-286.
- Hunt, J.L. (Ed.). 1968. *Early childhood education rediscovered: Readings*. Holt, Rinehart, and Winston, New York. 594 p.
- Hyde, D.M. 1959. An investigation of Piaget's theories of the development of the concept of number. Unpublished doctoral dissertation. University of London: Discussed In I.E. Sigel, and F.H. Hooper (Eds.). 1968. *Logical thinking in children: Research based on Piaget's theory*. Holt, Rinehart, and Winston, New York. 541 p.
- Jackson, C.L.L. 1970. The influence of age, sex, and colors on the number recognition and counting abilities of preschool children. Unpublished MS thesis. Utah State University, Logan, Utah. 150 p.
- Kagan, J. 1971. *Understanding children: behavior, motives, and thought*. Harcourt, Brace, Jovanovich, New York. 153 p.
- Kamii, C.K., and H.D. Sonquist. 1967. The application of some Piagetian concepts to teaching in a preschool for disadvantaged children. *Young Children* 22(4):231-240.
- Kaplan, J.D. 1967. Teaching number conservation to disadvantaged children. EdD dissertation, Columbia University. 130 p. (Original not seen; abstracted in *Dissertation Abstracts* 28(8):3492B. February 1968.)
- Kennedy, W.A. 1971. *Child psychology*. Prentice-Hall, Englewood Cliffs, New Jersey. 604 p.
- L'Abate, L. 1962. Consensus of choice among children: A test of Piaget's theory of cognitive development. *Journal of Genetic Psychology* 100:143-149.
- Lovell, K., and E. Ogilvie. 1959. A study of the conservation of substance in the junior school child. *British Journal of Educational Psychology* 30:109-118.
- Lovell, K., and E. Ogilvie. 1961a. A study of the conservation of weight in the junior school child. *British Journal of Educational Psychology* 31:138-144.
- Lovell, K., and E. Ogilvie. 1961b. The growth of the concept of volume in junior school children. *Journal of Child Psychology and Psychiatry* 31(2):118-126.
- Maier, H.W. 1956. *Three theories of child development: The contributions of E.H. Erickson, Jean Piaget, and Robert Sears*. Harper & Row, New York. 314 p.

- Mussen, P.H. 1960. Interviewing Children, p. 561-603. In P.H. Mussen (Ed.). Handbook of Research Methods in Child Development. John Wiley, New York.
- Peters, D.L. 1967. Task variations and individual differences in Piaget's conservation of number. Merrill-Palmer Quarterly 13(4): 295-308.
- Phillips, Jr., J.L. 1969. The origins of intellect: Piaget's theory. W.H. Freeman, San Francisco. 149 p.
- Piaget, J. 1952. The child's conception of number. W.W. Norton, New York. 248 p.
- Pratoomraj, S., and R.C. Johnson. 1966. Kinds of questions and types of conservation tasks as related to children's conservation responses. Child Development 37:343-353.
- Richards, H.E. 1968. Variations of Piaget's pre-number development tests used as learning experiences. Unpublished doctoral dissertation. Utah State University Library, Logan, Utah. 67 p.
- Rothenberg, B.B. 1969. Conservation of number among four- and five-year-old children: Some methodological considerations. Child Development 40(2):383-406.
- Schiemberg, L.B. 1970. Piaget's theories and early childhood education. Children 17(3):114-116.
- Shantz, C.H., and C.D. Smock. 1966. Development of distance conservation and the spatial coordinate system. Child Development 37(4):943-948.
- Sigel, I.E., A. Roeper, and F.H. Hooper. 1966. A training procedure for acquisition of Piaget's conservation of quantity: A pilot study and its replication. The British Journal of Educational Psychology 36:301-311.
- Sigel, I.E., and F.H. Hooper (Eds.). 1968. Logical thinking in children: Research based on Piaget's theory. Holt, Rinehart, and Winston, New York. 541 p.
- Sinclair, H., and C. Kamii. 1970. Some implications of Piaget's theory for teaching young children. The School Review 78:169-183.
- Smedslund, J. 1961a. The acquisition of conservation of substance and weight in children: I. Introduction. Scandinavian Journal of Psychology 2:71-84.
- Smedslund, J. 1961b. The acquisition of conservation of substance and weight in children: II. External reinforcement of conservation of weight and the operations of additions and subtractions. Scandinavian Journal of Psychology 2:71-84.

- Smedslund, J. 1961c. The acquisition of conservation of substance and weight in children: III. Extinction of conservation of weight acquired "normally" and by means of empirical controls on a balance. *Scandinavian Journal of Psychology* 2:85-87.
- Smedslund, J. 1961d. The acquisition of conservation of substance and weight in children: IV. Attempt at extinction of the visual components of the weight concept. *Scandinavian Journal of Psychology* 2:153-155.
- Smedslund, J. 1961e. The acquisition of conservation of substance and weight in children: V. Practice in conflict situations without external reinforcement. *Scandinavian Journal of Psychology* 2:156-160.
- Smedslund, J. 1961f. The acquisition of conservation of substance and weight in children: VI. Practice on continuous vs. discontinuous material in problem situations without external reinforcement. *Scandinavian Journal of Psychology* 2:203-210.
- Smedslund, J. 1962. The acquisition of conservation of substance and weight in children: VII. Conservation of discontinuous quantity and the operation of adding and taking away. *Scandinavian Journal of Psychology* 3:69-77.
- Uzgiris, I.C. 1964. Situational generality of conservation. *Child Development* 35:831-841.
- Wallace, J.G. 1966. Some issues raised by a non-verbal test of number concepts. *Educational Review* 18:122-124.
- Wallach, L., and R.L. Spott. 1964. Inducing number conservation in children. *Child Development* 35:1057-1071.
- Wallach, L., J. Wall, and L. Anderson. 1967. Number conservation: The roles of reversibility, addition-subtraction, and misleading cues. *Child Development* 38:425-442.
- Wohlwill, J.F. 1960. A study of the development of the number concept by scalogram analysis. *The Journal of Genetic Psychology* 97:345-377.
- Wohlwill, J.F., and R.C. Lowe. 1962. Experimental analysis of the development of the conservation of number. *Child Development* 33:153-167.
- Zimiles, H. 1963. A note on Piaget's concept of conservation. *Child Development* 34:691-695.

APPENDIX

Data Collection Sheet I.

Child's name _____ Sex _____

Child's age _____ Test Date _____

Task 1: Number Conservation

Who has more?	Same	Examiner's Red Chips	Subject's Blue Chips
Chips are matched, one-to-one			
a) Red chips spread out			
b) Chips are matched again			
c) Red chips compressed together			
Chips are matched again			

Explanations:

a) _____

b) _____

c) _____

Classification of Explanations:

	a.	b.	c.
Conservation			
Counting			
Perceptual			
Irrelevant			
No Response			

Comments:

Data Collection Sheet II.

Child's name _____ Sex _____

Child's age _____ Test Date _____

Task 2: Liquid Conservation

Who has more?

Two identical glasses

- a) Poured into tall, thin glass
- b) Poured into identical glass
- c) Poured into short, wide glass
- Poured into identical glass

SameExaminer's
GlassSubject's
GlassExplanations:

a) _____

b) _____

c) _____

Classification of Explanations:

	a.	b.	c.
Conservation			
Perceptual			
Irrelevant			
No Response			

Comments:

Data Collection Sheet III.

Child's name _____ Sex _____

Child's age _____ Test Date _____

Task 3: Mass Conservation

Who has more?

Two similar balls

a) Worm shape formed

b) Two similar balls

c) Pancake shape formed

Two similar balls

SameExaminer's
Play DoughSubject's
Play DoughExplanations:

a) _____

b) _____

c) _____

Classification of Explanations:

Conservation

Perceptual

Irrelevant

No Response

a.

b.

c.

Comments:

VITA

Joleen Mae Harwood

Candidate for the Degree of

Master of Science

Thesis: Comparative Study of Four-Year-Old Preschool Children in the Area of Conservation

Major Field: Child Development

Biographical Information:

Personal Data: Born at Soda Springs, Idaho, February 27, 1947, daughter of Joseph A. and Mae R. Harwood; three older brothers, Keith, Gary, and Owen.

Education: Attended elementary school in Grace, Idaho, until 1955; moved to Bountiful, Utah, and attended Bountiful Elementary; attended South Davis Junior High, 1959 to 1962; graduated from Bountiful High in 1965; received the Bachelor of Science degree from the University of Utah in June, 1969, with a major in Child Development and Family Relationships; completed requirements for a Utah elementary teaching certificate in December, 1969; finished the necessary requirements for the Master of Science degree, specializing in Child Development, at Utah State University in 1971.

Honorary Organizations and Scholarships: "Honors at Entrance" Scholarship, University of Utah, 1965 to 1966; Spurs, women's sophomore honorary, 1966 to 1967; Sterling W. Sill Scholarship, 1967 to 1968; Omicron Nu Vice President, 1968 to 1969; Bennett Memorial Award, and Phi Kappa Phi, 1969.

Professional Experience: 1970, kindergarten teacher, Idaho School District #148, Grace, Idaho; 1970 to 1971, graduate assistant, Utah State University, Logan, Utah.