76-6512

HARDIN, Mary Juanita Pate, 1950-
EFFECTS OF TREATMENT ON CONSERVATION OF CONTINUOUS QUANTITY TASKS IN YOUNG CHILDREN.

The University of North Carolina at Greensboro, Ph.D., 1975
Home Economics

Xerox University Microfilms, Ann Arbor, Michigan 48106

EFFECTS OF TREATMENT ON CONSERVATION OF CONTINUOUS QUANTITY TASKS IN YOUNG CHILDREN

by

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

Greensboro
1975

Approved by

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APPROVAL PAGE

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Date of Acceptance by Committee

HARDIN, MARY JUANITA PATE. Effects of Treatment on Conservation of Continuous Quantity Tasks in Young Children. (1975) Directed by: Dr. Helen Canaday. Pp. 131.

The purpose of the experiment was to determine whether or not children five years of age could be taught to conserve continuous quantity. It was hypothesized that there would be no difference in conservation performance of children in the cognitive conflict group, the reversibility group, the cognitive conflict-reversibility group, and the control group on the conservation of continuous quantity pretest and posttest; that there would be no difference in conservation performance of children according to the conditions of visual screening on the conservation of continuous quantity pretest and posttest; and that there would be no difference in conservation performance of children according to race or sex on the conservation of continuous quantity pretest and posttest.

The subjects were selected from all of the five-year-old children attending kindergarten in the Hoke County Public School System, the Hoke County Head Start Program, and from children attending kindergarten in six schools in the Robeson County Public School System. The age range of the children was from 5 years 5 months to 5 years 11 months.

Pretest I was given to 232 children to determine whether or not the children understood the meaning of the words, "same," "more," and "less." Pretest I was composed of nine items which were passed by 160 children.

Pretest II was administered to the 160 children who responded correctly to all nine items of pretest I. Pretest II was a test of conservation of continuous quantity. The test included two conservation tasks. An explanation of the response on each of the tasks was required.

After Pretest II, 144 of the 160 children were randomly divided into three experimental groups and one control group by race and by sex. Three conditions of visual screening were used in each treatment group by race and by sex. The Ss were 48 American Indians, 48 Caucasians, and 48 Negroes; composed of one-half males and one-half females for each racial group.

In one experimental group the Ss were given cognitive conflict experiences. In another experimental group the Ss were given training in reversibility concepts. In the third experimental group the Ss were given both cognitive conflict and reversibility experiences. Each S was given two standardized teaching sessions on two successive days. The control group spent two sessions on successive days drawing pictures. A posttest was given to all the subjects two weeks later.

The data were analyzed statistically using chi-square. Hypothesis I was rejected; the results showed that there were significant differences between the Ss in the three experimental groups and the control group in performance on the conservation of continuous quantity pretest and posttest. More Ss in the reversibility group and the cognitive conflict-reversibility group conserved on the posttest as compared to the other groups. However, there was no significant difference between the frequency of conserving Ss in either the reversibility or the cognitive conflict-reversibility groups.

Results revealed that Ss who were not given screening during training performed as well as Ss given screening conditions. There was no significant difference in conservation performance on tasks measuring conservation of continuous quantity by race or by sex. The results of the study indicated that children five years of age could be taught to conserve continuous quantity.

ACKNOWLEDGMENTS

The researcher wishes to acknowledge her indebtedness to the following persons:

To Dr. Helen Canaday, committee chairman, for her support and critical evaluation in supervising this project.

To Dr. J. Allen Watson, Dr. Garrett Lange, Dr. Mildred Johnson, and Dr. John Edwards, Committee members, for their critical reading of the manuscript and their constructive criticisms.

To all the children who were subjects in the experiment, for their cooperation and interest.

To Dr. Ellen Champoux for inspiring the researcher to begin the long journey of which this volume is the culmination.

To her husband, Elwood, for his assistance in conducting the investigation and his encouragement and moral support.

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CHAPTER I

INTRODUCTION

Piaget has proposed the most comprehensive theory of cognitive development. According to Piaget (1950) intelligence develops according to constant interaction between the organism and the environment.

In articulating his theory of intellectual development, Piaget has been concerned with developmental stages which reflect the course of mental development (Sullivan, 1967b). Piaget (1950) divided the child's cognitive development into four main stages: The sensori-motor stage, the preoperational stage, the stage of concrete operations, and the stage of formal operations. The stages are characterized as appearing in an invariant sequence; however, the age ranges are approximations. According to Piaget (1967) cognitive development proceeds from one stage to the next, and is influenced by biological maturation, experience with the physical and social environment, and equilibration. Equilibration is an internal self-regulating process which coordinates the influence of maturation and the physical and social environments (Furth, 1969).

Inhelder and Piaget (1958) delineated the four major stages of cognitive development. The four stages are the sensori-motor stage; the preoperational stage; the concrete operational stage; and the stage of formal operations.

The first, the sensori-motor stage, is from birth to about two years. During this stage the child learns to coordinate perceptual and motor functions in dealing with external objects. He realizes that objects exist when outside his perceptual field. He can coordinate parts of objects into a whole recognizable from different perspectives. Elementary forms of symbolic behavior appear.

The preoperational stage extends from the beginnings of organized symbolic behavior--language in particular--until about six years of age. This stage is characterized by representation through language and symbolic play. The child represents the external world by generalization from a motivational model (e.g., the stars, like himself, have to go to bed). He has difficulty separating his own goals from the means for achieving them. The child learns correct relationships through trial and error.

Between seven and eleven years, the child acquires the ability to carry out concrete operations. He has the ability to organize means for dealing with the properties of the immediately present world. Thought, at this stage, is logical and reversible. The child can operate in thought on concrete objects or their representatives. He can serialize, extend, subdivide, differentiate, or understand the logic of relations and classes. He can coordinate series and part-whole relationships dealing with concrete things.

The final stage, preparatory to adult thinking, takes place between twelve and fifteen years and involves the appearance of formal as opposed to concrete operations. The most important features of the stage of formal operations are the development of the ability to use hypothetical reasoning based on a logic of all possible combinations. The youngster can think about thought or theories rather than about concrete realities.

Much of the Piagetian research has been concerned with the transition in cognitive processes that occurs as the child advances from the preoperational stage to the stage of concrete operational thought (Sullivan, 1967b, p. 2). One of the most salient features of this transition is the acquisition of conservation. Piaget (1950) defined conservation as the realization that a particular dimension of an object or situation may remain invariant despite changes in other irrelevant aspects of the object or situation.

Piaget (1952) contends that there are three stages in the development of conservation. During the first stage, "Absence of Conservation," the child evaluates quantity by global perceptual qualities, ignoring relationships between elements or dimensions.

During the second stage, "Beginning of Construction of a Permanent Set," the child fluctuates in that sometimes he conserves and sometimes he does not conserve. This stage appears to begin at about four years of age and to last until age six or seven.

During the third stage the child is quite capable of conserving. He no longer has to reflect in order to conserve. Piaget has indicated that this third stage of conservation appears in the child at six or seven years of age.

In his theoretical and experimental work having to do with the development of intelligence, Piaget placed much emphasis on the development of the concept of conservation (Pratoomraj and Johnson, 1966). According to Piaget (1950) the attainment of conservation represents a significant advance in the intellectual development of the child.

Need for Research

Piaget's ideas on conservation are salient whenever research is done on early cognitive development; however, their salience is much less widespread in formulations of goals and processes in early education (Kohlberg, 1968).

In reference to the research studies on conservation it appears that there are a variety of variables contributing to the acquisition of conservation. Some research presents evidence to substantiate the assumption that cognitive conflict (Smedslund, 1961e, 1961f, 1963); reversibility

(Wallach and Sprott, 1964; Wallach, Wall, and Anderson, 1967); and screening (Frank, 1964; Greenfield, 1966; Sigel, Saltz, and Roskind, 1967) may play a valuable role in the acquisition of conservation. Research has been conducted to determine the effects of cognitive conflict training on conservation of continuous quantity using balls of clay and on conservation using discontinuous materials. Reversibility training has been used to teach conservation of number. One condition of screening has been used to teach conservation of continuous quantity using liquid.

Research is needed on the effects of cognitive conflict, reversibility, and screening versus nonscreening on the acquisition of conservation of continuous quantity using liquid. Investigations of conservation of quantity are of considerable importance to the research in concept development and its application to the fields of learning and education. The basic notion of conservation is fundamental to all scientific and mathematical thought. Before the concept of numbers can develop, the child must grasp the principle of conservation of quantity. When the child realizes that quantity is conserved despite changes in appearance, he is ready to accept the fact that the number of objects in a group does not vary with rearrangements (Pulaski, 1971).

Conservation is a prerequisite in advancing from the preoperational period to the period of concrete operations. The acquisition of conservation of quantity during preschool would allow the child to move more easily and more gradually in the educational process. Information on the effects of cognitive conflict, reversibility, and screening would have much practical value in enabling teachers to structure the preschool environment to allow for the development of the logical concept of conservation of quantity.

Statement of the Problem

The basic problem for educators centers around the promotion of cognitive development. More information is needed about the conservation of continuous quantity performance ability of five-year-old children and whether this ability can or cannot be taught. There is need to specify the kinds of experiences that facilitate the development of thought from the preoperational stage to the stage of concrete operational thought.

It was the purpose of this investigation to determine the effectiveness of training procedures, derived from Smedslund's (1961e, 1961f) cognitive conflict hypothesis; Wallach and Sprott's (1964) reversibility hypothesis; and Frank's (1964) perceptual hypothesis, on the acquisition of continuous quantity using liquid.

Background for the Study

Following the indications of some research on conservation that cognitive conflict, reversibility, and screening may play an important role in the acquisition of conservation (Smedslund, 1961e, 1961f, 1963; Wallach and Sprott, 1964; Wallach, Wall, and Anderson, 1967; Frank, 1964; Greenfield, 1966; Sigel, Saltz, and Roskind, 1967), this study attempted to determine whether the above factors could induce acquisition of the logical concept of conservation of quantity in five-year-old children.

It is the position of Piaget (1967) that conservation develops as a result of internal reorganization or equilibration. Piaget (1952) contends that young children fail to conserve because they evaluate quantity by global perceptual qualities, ignoring relationships between elements. Piaget (1967) asserts that the young child cannot conserve because he lacks reversibility. Previous research has shown that some genuine acceleration of conservation may be induced if the instructional methods used follow from the conceptions of cognitive structure implied by Piaget's theory.

Smedslund (1961e) hypothesized that cognitive conflict could induce a reorganization of the subject's intellectual actions; and that this cognitive reorganization could lead to conservation. Cognitive conflict training proceeds along the lines postulated by Piaget's equilibrium model. Cognitive conflict is created by a situation in which a subject is subjected to a transformation (i.e., changing the shape) and an addition or subtraction of liquid in the same or in separate operations. According to Smedslund, the operations of addition and subtraction have a greater clarity for the S, and hence will come to dominate over the transformation operation, which is more ambiguous because of perceptual cues and which eventually will disappear completely, even in pure transformation situations without the addition or subtraction.

Piaget (1967) hypothesized that the child in the pre-operational stage fails to conserve because he lacks reversibility.

> It is this reversibility which enables the child to understand the conservation of a quantity or of a set when its spatial disposition is altered, since when the modification is seen as reversible, it follows that the quantity in question remains invariant (p. 130).

Wallach and Sprott (1964) and Wallach, Wall, and Anderson (1967) induced conservation of number in six-, and seven-year-old Ss by teaching reversibility. Wallach and Sprott (1964) suggested that other conservations, such as that of quantity, may be acquired through experience with reversibility. Thus, for example, the realization that the amount of liquid does not change when it is poured from one container into another may result from experience with the fact that if the liquid is poured back into the original container again, it will always fit it to just the same degree it did initially.

Frank, as cited by Bruner (1964), induced conservation of continuous quantity using liquid in five-, six-, and seven-year-old Ss by screening the beakers so that the Ss could not see the level of the liquid after the liquid was poured from one of the standard beakers into the third beaker. Frank's study showed the effects of one screening condition on the conservation of continuous quantity. Frank's study did not show the effects of the conditions of screening, nonscreening, and screening-nonscreening on the conservation of continuous quantity using liquid. This study investigated the effects of these three screening conditions.

Cognitive conflict, reversibility, and screening are three areas that could prove to be important to the research in concept development and its application to the field of early childhood education.

Investigations comparing race are limited. However, studies, which have used Caucasian Ss (Feigenbaum, 1963; Brison, 1966); Negro Ss (Mermelstein and Shulman, 1967; Greenfield, 1966; Price-Williams, 1961); and Hong Kong Ss (Goodnow and Bethon, 1966), have shown that the Ss attained conservation in the same sequence and at the same ages. It was the hypothesis of this study that there would be no difference in performance on conservation tasks by race.

Studies have been conducted to determine the effect of sex on conservation. With one exception, studies have revealed that there is no difference in the attainment of conservation according to sex. Goldschmid (1967), however, reported significant sex differences in favor of males. It was the hypothesis of this study that there would be no difference in conservation performance by sex.

For clarity, the null hypotheses were stated as follows:

Hypothesis I. There are no significant differences in the number of Ss in the cognitive conflict group, the reversibility group, the cognitive conflict-reversibility group, and the control group in performance on the conservation of continuous quantity pretest and posttest.

Hypothesis II. There are no significant differences in the number of Ss in the screening group, the nonscreening group, and the screening-nonscreening group in performance on the conservation of continuous quantity pretest and posttest.

Hypothesis III. There are no significant differences in the number of Indians, Negroes, and Caucasians in performance on the conservation of continuous quantity pretest and posttest.

Hypothesis IV. There are no significant differences in the number of females and males in performance on the conservation of continuous quantity pretest and posttest.

Limitations

This study was limited to five-year-old children who were enrolled in the kindergartens of the Hoke County Public School System, in six kindergartens in the Robeson County

Public School System, and in the Hoke County Head Start Program. Another limitation was that the study was limited to a period of six weeks with only one posttest. A further limitation was that the discussion of conservation of continuous quantity referred to that ability as it could be measured by the instrument utilized in this study.

Assumptions

An assumption in relation to this study was that the conservation of continuous quantity tasks would measure conservation of continuous quantity and that the tasks were appropriate in degree of difficulty for five-year-old children. It was also assumed that two teaching sessions for each of the experimental groups would be sufficient to teach conservation of continuous quantity to five-year-old children. A further assumption was that the question of whether the Ss understood conservation was unanswerable, especially if they did not know the meaning of the words, "same," "more," and "less."

Definition of Terms

The following words were defined for the purpose of clarifying the meanings.

Cognitive conflict referred to the creation of a state in which the S had to combine his impression of the transformation (pouring the colored liquid from glass B into a third glass of a different size) with the observation of the addition or subtraction of an ounce of the colored liquid.

Reversibility referred to the pouring of the colored liquid from glass B into glass C or set D, and then pouring the liquid from glass C or set D back into glass B.

Screening referred to placing glass C behind a wooden screen and pouring the colored liquid from glass B into glass C, or from glass C back into glass B; or to pouring the liquid from glass B into glass C and performing the operations of addition or subtraction.

Control group referred to those Ss who were not given any cognitive conflict, reversibility, cognitive conflict-reversibility, screening, nonscreening, or screening-nonscreening experiences.

Standard glasses referred to two glasses (A and B) which were the same size and which contained the same amount of colored liquid.

Transformation referred to the pouring of the colored liquid from glass B into a third glass or set of glasses of a different size.

Glass A referred to the glass of colored liquid that was never transformed.

Glass B referred to the glass of colored liquid that was transformed by being poured into a third glass or set of glasses of a different size.

Glass C referred to the glass into which the colored liquid was poured from glass B.

Set D referred to four smaller glasses into which the colored water was poured from glass B.

Standard conservation question (S.C.Q.) referred to the question that was asked after a transformation, a transformation along with an addition or subtraction, or a reversal during either pretest II, the training, or the posttest. The question was as follows: "Is there the same, more, or less water to drink here (pointing to glass C or B, or set D) as compared to here (pointing to glass A)?"

Conservation of Quantity

Conservation of quantity and conservation of substance are used interchangeably in the literature. Conservation of quantity is of two types. One type is conservation of discontinuous quantity, which is measured by using beads, marbles, tiny pieces of wood, linoleum or other small single objects. The second type is conservation of continuous quantity which is measured by using either balls of clay or plasticine or glasses of liquid. This study measured conservation of continuous quantity using liquid.

CHAPTER II

REVIEW OF LITERATURE

The growing number of studies in the literature reflect an interest in Piaget's contributions. A considerable amount of research in cognitive development has been generated by Piaget's (1950) theory of intellectual development. One of the most widely investigated concepts related to the theory is that of conservation. Investigations have tended to focus on factors involved in conservation, and on training effects.

Factors Influencing Conservation

Piaget and Inhelder (1941) found that the attainment of conservation followed a regular sequence. The attainment of conservation of quantity was attained first; the conservation of weight was next, followed by the conservation of volume. This sequence has been verified in several studies (Lovell and Ogilvie, 1960; Elkind, 1961; Smedslund, 1961; Feigenbaum, 1963; Uzgiris, 1964; Goldschmid, 1967).

Studies have been conducted to isolate the ages at which children develop the ability to ignore particular kinds of changes and to recognize when material is conserved. Piaget and Inhelder (1941) found that conservation of quantity was attained at about age 7; the conservation of weight at about age 9; and the conservation of volume at about age 12.

Elkind (1961) replicated one of Piaget's (1940) investigations dealing with the ages at which children discover the conservation of quantity, weight, and volume using balls of clay. Elkind tested 175 children 5 to 11 years of age. For each quantity the S was asked first to predict, next to judge, and then to explain his conservation or non-conservation response. Elkind, like Piaget, found that the conservation responses increased with age.

Feigenbaum (1963) conducted an investigation to evaluate Piaget's study of the child's development of the concept of conservation of discontinuous quantities. Tests were administered to 90 children, four to seven years of age. Feigenbaum's study corroborated Piaget's finding that there is a strong positive relation between age and success in understanding conservation of discontinuous quantity.

Goldschmid (1967) and Schenck (1973) found that older Ss consistently performed on a higher level than younger Ss. Other studies (Lovell and Ogilvie, 1960; Smedslund, 1961; Hood, 1962; Wohlwill and Lowe, 1962; Gruen, 1965; Pratoomraj and Johnson, 1966; Rothenberg, 1969) also confirm Piaget's finding of an increase in conservation with an increase in age.

Age trends which conflict with Piaget's age norms for the development of the conservations have been found by

Bruner and his associates at the Harvard Center for Cognitive Study. Bruner, Frank, et al., contend that five-year-old children have the ability to conserve, and that they fail to conserve because of misleading perceptual cues. They found that five-year-olds conserved when the misleading perceptual cues were eliminated through a screening condition. This finding is supported by the research of Braine (1959), and Braine and Shanks (1965). However, Sigel (1968) criticized the criteria of the Harvard group as being inadequate in that explanations were not required of the S.

Feigenbaum (1963) and Goldschmid (1967) criticized Piaget for his lack of attention to differential intelligence. Research has shown that IQ may be a factor in successfully solving conservation problems. A study by Hood (1962) indicated that chronologically older, low mental-age Ss do worse on Piagetian tasks than do younger children with whom they were matched on mental age. Feigenbaum's (1963) study indicated a positive relation between IQ and knowledge of the concept of conservation. In a number of cases the performance of younger Ss with higher IQs was superior to that of older Ss with lower IQs. Goldschmid (1967) suggested that IQ may differentiate children of equal age with respect to their performance on conservation tasks.

Keasey and Charles' (1967) study also supports the correlation of IQ and conservation. Six tests of conservation of quantity using balls of plasticine were administered to a group of normal children and to a group of mentally retarded children. The purpose of the study was to determine the effect of chronological age as compared to mental age on conservation of quantity. The Ss in each group were matched on mental age as measured by the Peabody Picture Vocabulary Test. The mental age was between 5 and 11 years. The chronological age of the mentally retarded Ss ranged from 13 to 28; that of the normal Ss was within six months of their mental age. The results showed that understanding of the concept of conservation of quantity correlated highly with the mental age of the S as opposed to the chronological age.

Conservation of females as compared with conservation of males has been investigated. With the exception of a study by Goldschmid (1967), investigations have revealed that sex differences are nonsignificant in the attainment of conservation. Goldschmid reported significant sex differences in favor of boys.

According to Sigel, Roeper, and Hooper (1968) Piaget assigned a subordinate role to language as a necessary condition in the development of conservation. Piaget maintains that changes in cognitive structures are not directly accomplished by verbal facility. For Piaget, the advent of concrete operations permits more meaningful use of abstract language and not the converse. Studies which employed nonverbal measures of conservation have supported Piaget's position. Mermelstein and Meyer (1969) suggested that concepts of conservation are acquired without the use of language since children in their study performed better overall on nonverbal tasks. Wohlwill and Lowe (1962) found significant pre- to posttest improvement on a nonverbal measure of conservation. In a similar study Mermelstein and Shulman's (1967) findings showed that Ss performed better on nonverbal tests of conservation.

One factor that may influence a S's response to conservation tasks is his understanding of the relational terms "more," "same," and "less." Griffiths, Shantz, and Sigel (1967) reported that young children, 4-1 (four years one month) to 5-2 had difficulty in understanding the words "more," "less," and "same." Sigel and Goldstein (1969) maintain that the concept of conservation cannot be assessed unless children recognize sameness.

In recent studies conservation attainment has been measured through standardized formats of questioning. Standardized formats of questioning provide a more comparable situation for all Ss. However, a major difficulty, within the limits of a standardized format, is in the vocabulary level.

Studies (Griffiths, Shantz, and Sigel, 1967; Shantz and Sigel, 1967; Rothenberg, 1969) have stressed the importance of assessing the S's comprehension of the key words (i.e., "same," "more," "less") used in the standardized conservation questions.

Pratoomraj and Johnson (1966) tested Piaget's conservation of quantity study using balls of clay to determine the effect of kinds of questions on Ss' responses. Thirty-two children, 16 males and 16 females, at each of four age levels from four through seven were divided into four groups. Four kinds of questions were used in the study: "Is it the same?" "Is it more?" "Is it less?" "Is it different?" Following the transformations (e.g., rolling one of two clay balls into a sausage shape), each group was asked one of the questions. The findings revealed that the kind of question had little effect on conservation responses. Smedslund's (1966) and Mermelstein and Shulman's (1967) findings on question-phrasing support those of Pratoomraj and Johnson (1966).

Perception appears to be another factor in attainment of conservation. Before acquisition of conservation, children rely mainly on perceptual appearance in their judgments (Smedslund, 1963; Uzgiris, 1964). Bruner (1964) and Braine and Shanks (1965) suggested that the difficulties encountered by children in conserving physical concepts (e.g., mass, length) were essentially due to perceptual factors. According to Ginsburg and Opper (1969) perceptual factors have too strong a hold on the child in the pre-operational stage. These perceptual factors "are not yet sufficiently controlled by mental actions which can compensate for apparent discrepancies in visually perceived information (p. 151)."

Bruner (1964) suggested that children are misled by the perceptual elements. He argued that the young child can conserve if misleading perceptual cues are eliminated. If the child were shielded from the perceptual cues, "there would be less likelihood of a perceptual representation becoming dominant and inhibiting the operation of symbolic process (p. 6)." The results of the Sigel, Saltz, and Roskind study (1967) were consistent with Bruner's position that failure of conservation is due to competing perceptual cues.

The criteria of conservation determined whether or not an S was categorized as a conserver or a nonconserver. In the classical Piagetian task, logical justification of the judgment "same" had to be given. Studies have been conducted that have not required explanations of conserving responses (Braine, 1959; Frank, 1964; Uzgiris, 1964; Braine and Shanks, 1965; Fleischmann, Gilmore and Ginsburg, 1966; Mehler and Bever, 1967; Mermelstein and Shulman, 1969; Rothenberg and Courtney, 1969).

Gruen (1966) has noted that more conservers were selected when justification of the response was not required. Sigel (1968) asserted that a response indicating conservation without an adequate explanation would be considered by Piaget as insufficient evidence for conservation.

Sigel (1968) has summarized the explanations that have been given by Ss who have conserved in experiments. The explanations are as follow: (a) reversibility statements, e.g., "You can change it back and it will be the same"; (b) addition and subtraction statements, e.g., "You did not add or take anything away"; (c) compensatory statements, e.g., "It is taller and thinner, so it is still the same"; (d) descriptive statements of action, e.g., "You didn't do anything, you just rolled it out"; and (e) reference to previous state (p. 523).

Four categories of explanations were used by Smedslund (1961b). They were (a) symbolic-logical statements that nothing was added or subtracted, (b) symbolic statements referring to previous events in the same test item, (c) perceptual statements referring to observable features of the situation, and (d) ambiguous statements which cannot be subsumed under the preceding categories (p. 74).

Studies have been attempted to demonstrate the effect of nonschooling versus schooling on a S's ability to conserve continuous and discontinuous quantities. On a series of Piagetian tasks of conservation of continuous and discontinuous quantities, Mermelstein and Shulman (1967) found no significant difference between schooled and unschooled samples. Performances of a sample of sixty six- and nine-year-old Negro children from Prince Edward County, Virginia, a community which had been without public schools for four years were compared with performances of a matched sample of Negro children from a community which had been in regular school attendance.

Mermelstein and Shulman's finding was supported by Greenfield in Senegalese children. Greenfield (1966) tested 166 schooled and nonschooled children for conservation of continuous quantity. Although initially some retardation was found in nonschooled Senegalese children, this retardation disappeared when the child was allowed to do the pouring himself. Thus, effects due to beliefs about magical attributes of white authorities were eliminated since the child did not attribute any special powers to himself. Goodnow and Bethon (1966) found no difference between unschooled Hong Kong children and comparable IQ schooled children in various types of conservation. Price-Willaims (1961) found that bush West African children without schooling attained conservation of continuous and discontinuous quantities at about the same age as Western children.

Subjects used in the majority of conservation studies have been middle-class children. However, there are some studies which demonstrate the performance of children from lower socio-economic groups on conservation tasks.

Mermelstein and Shulman (1967) found no differences in ability to conserve between socio-economic groups. Rothenberg and Courtney (1969) and Baker and Sullivan (1970) found that conservation ability was manifested significantly more often by middle-class than by lower-class children. Rothenberg and Orost (1969) found only slight differences in conservation learning between socio-economic groups in favor of the middle-class as compared to the lower-class.

Most conservation studies have used normal subjects. However, studies have been conducted to compare normal children with emotionally disturbed children (Goldschmid, 1967) and mentally retarded children (Hood, 1962; Keasey and Charles, 1967). Significant differences were found in all three studies in favor of the normal subjects.

Although the majority of inventive experiments have been confined to American and European children, investigations have been carried out with subjects from the cultures of West Africa (Price-Williams, 1961; Greenfield, 1966) and Hong Kong (Goodnow and Bethon, 1966). Children from these cultures seem to perform much the same as do American and European children.

Studies emphasizing the comparison of race on the development of conservation have been limited to investigations of cultures.

Conservation of Quantity and Weight Studies Involving Training

Cognitive development, in relation to learning theory, is the result of repeated associations between specific discriminative stimuli, and of specific reinforcements following the responses. Learning theorists would assert that conservation can be taught using principles of behavior modification.

Equilibrium theory is the position of Piaget and his co-worker (Piaget and Inhelder, 1941), who assert that logical structure is not originally present in the child's thinking, but that it develops as a function of a process of equilibration or internal reorganization, which is heavily dependent on activity and experience. Piaget believes that conservation evolves over a period of time (Pulaski, 1971).

A number of conservation of quantity and weight training studies have been attempted to accelerate conservation by giving a child specific experiences. Some of these studies have supported Piaget's position; others have been successful in inducing conservation. In an experiment on conservation of quantity and weight, Smedslund (1959), as cited by Smedslund (1961e), administered three test items which were deformation items in that one of two equally heavy balls was deformed. The fourth item created a cognitive conflict situation in that a small piece of plasticine was taken away from one of the two equally heavy balls and placed visibly on the table; the other ball was then deformed. The fourth item set up a state of cognitive conflict for the S, in that they had to combine their impressions of the deformation with the observation of the addition or subtraction. Twenty-one Ss conserved on all four items in the test, and 24 Ss did not conserve on any of the items. Eleven did not conserve on the first three items, but conserved on the fourth, and one S conserved on the first three items, but not on the fourth.

Smedslund (1961a) published a series of research reports in the area of the acquisition of conservation. In his first experiment, Smedslund (1961b) pre- and posttested forty-eight five- to seven-year-old children on conservation of substance and on conservation of weight using balls of clay. Group I was given external reinforcement on conservation of weight over deformations in that they were allowed to test their predictions by weighing the standard ball and the deformed ball on a balance. Group II was also given external reinforcement in that they were allowed to use a balance to determine the effects of addition and subtraction of material as compared to the weight of a standard ball. Group III took only the pre- and posttests. Smedslund concluded that none of the experimental conditions were sufficient for a significant acquisition of principles of conservation.

In a subsequent experiment Smedslund (1961c) showed that 11 children, who had acquired conservation of weight by controls on a balance, quickly relinquished it when confronted with evidence at variance with what they had learned. Thirteen children who had acquired the concept "naturally" resisted the experimenter's attempts to extinguish the conservation responses. All 24 Ss were shown that two balls of clay weighed the same. One of the balls was deformed and a piece of clay was taken away surreptitiously. The child then made a prediction of the conservation of weight. Subsequent weighing of the two balls on a balance showed results that were contrary to the conservation hypothesis. The results were consistent with Piaget's position that conservation is not easily acquired through training.

Smedslund's (1961d) third experiment focused on fostering conservation in nonconservers by providing experience with the unreliability of immediate perception. Eleven 6-year-old children were given repeated opportunity to observe that size does not necessarily determine the weight of objects. After 36 training trials, none of the Ss changed from no conservation of substance and weight in the pretest to stable conservation in the posttest. The Ss continued to base their judgments on the visual appearances of the deformed object. His data, thus, supported Piaget's theory.

Smedslund (1961e) tested his hypothesis that creating a state of cognitive conflict in an S could induce conservation. Thirteen 5- and 6-year-old nonconserving Ss were given three practice sessions in situations involving repeated cognitive conflict without external reinforcement. The conflict was induced by deforming one of the two objects and at the same time adding or subtracting from the same or another object. A control group was not used. Four Ss made the transition from nonconservation to conservation accompanied by logical explanations. Smedslund maintains that cognitive conflict is essential for the development of conservation in the child.

Smedslund (1961f) continued the study of the effects of practice in conflict situations. He administered four tests of conservation of continuous and discontinuous quantity along with addition and subtraction manipulations to 154 children between 4-9 and 7-3. From the 154 children, 44 children who did not respond correctly to any of the four pretest items were chosen to participate in the experiment. One group was given practice on continuous material in problem situations involving addition and subtraction. Another group practiced on discontinuous material. A third group served as the control. The results showed that the experimental groups displayed a significant increase in conservation. The discontinuous group had the most frequent acquisition of conservation; then the continuous group;

whereas in the control group only two subjects improved. Smedslund maintains that experience with cognitive conflict should prove to be effective in early acquisition of conservation.

Frank, as cited by Bruner (1964), investigated conservation of continuous quantity using 40 children four, five, six and seven years of age. Frank performed the classic conservation of continuous quantity tasks as a pretest to determine which children exhibited conservation. After the child judged the two standard beakers to contain equal amounts of water, the two beakers along with a third wider beaker were partially hidden by a screen. The experimenter poured the water from one of the standard beakers into a wider beaker. Without seeing the water, the child was asked the standard conservation question. In comparison with the unscreened pretest, there was an increase in correct equality judgments (conservation) at all age levels. After the screen was removed, all the four-year olds changed their judgments; virtually all of the five-, six-, and seven-year-olds continued to conserve. A posttest revealed that the four-year-olds were unaffected by the screening procedure; the five-, six-, and seven-year-olds continued to conserve.

Greenfield (1966) used Frank's screening technique with Senegalese children and found that 30 percent of the eighty-one who did not have conservation on the pretest showed an improved performance on the posttest. Gilmore (1966), however, found no increase in conservation, either with or without the screening.

Sonstroem (1966) adapted Frank's screening technique for use with conservation of quantity using balls of clay. Sonstroem's results showed that screening had no effect on learning.

Fleischmann, Gilmore, and Ginsburg (1966) found that when visual cues were eliminated, a small proportion of children conserved. The researchers further reported that children did not continue to conserve when the cues were again present.

Sullivan (1966) investigated the acquisition of conservation of substance through film modeling techniques. One experimental group was exposed to a filmed adult model who maintained conservation of substance without articulating a verbal explanation. Another experimental group was exposed to a filmed adult model who maintained conservation of substance and articulated a verbal explanation. The study revealed that both experimental groups performed better than the control group on conservation of substance. However, there was no significant difference between the two experimental groups. Sullivan's study showed that conservation of substance can be induced by using film-mediated models.

A study by Sigel, Roeper, and Hooper (1968) reported a significant difference between experimental and control Ss in substance and weight conservation following a five-week period of structural teaching involving verbalization and demonstrations. An attempt was made to train children in operations Sigel, Roeper, and Hooper considered prerequisites for the acquisition of conservation of quantity. These pre-requisite operations were (a) multiple classification or multiple characteristics of objects (b) multiple relations or the combining of characteristics in various ways to produce new categories; and (c) reversibility of reorganization by bringing the object back to the original. The results revealed that the children who were exposed to the teaching sessions increased in their ability to conserve correctly. The control group showed no change in ability to conserve.

Sonstroem (1966) tested to determine whether or not a child's physical performance of the appropriate mental operations facilitated his acquisition of conservation of quantity using balls of clay. The operations of reversibility and compensation were translated into physical actions. Twenty-two of 41 children learned conservation when they were allowed to manipulate the clay themselves, whereas only 13 of 40 Ss learned when they watched the experimenter's manipulations. Sonstroem concluded that action makes a difference in learning to conserve.

Brison (1966) conducted an experiment to induce conservation of continuous quantity. The Ss were 24 nonconserving five- and six-year-old children. Twenty-six matched Ss who did not receive training served as the control group. The Ss were trained in the conservation of inequalities of liquid. Training involved a situation wherein the S's expectation of an event was reversed (e.g., the Ss had the expectation that the narrow container had more juice; this expectation was reversed). Twelve of the 24 experimental Ss showed evidence of acquiring conservation, as opposed to one of the control Ss.

Fleischmann, Gilmore, and Ginsburg (1966) attempted to train four- and five-year-old Ss to conserve continuous and discontinuous quantities. In a series of experiments, quantification, feedback, continuity of the transformation, and continuity of the transformation combined with reduction of visual cues were emphasized. Their training methods were found to be ineffective in eliciting conservation in the majority of Ss. The results support Piaget's contention that the four- and five-year-old child is incapable of conservation of continuous and discontinuous quantities.

Other Conservation Studies

Another area of interest in conservation has been that of number. Many conservation of number studies have been conducted. Dodwell (1960, 1961) administered a battery of Piagetian number tasks on both an individual and a group basis. The Ss were 250 kindergarten, first- and second-grade Canadian children. The results confirmed Piaget's contention that young children can understand the operation of counting, and yet be unable to conserve number.

Wohlwill and Lowe (1962) investigated conservation of number. The Ss were 72 kindergarten children. There were three conditions of training involving counting, addition and subtraction, and disassociation of numerical value from perceptual cues. A control group was included. The results showed no significant differences attributable to the conditions of training.

Wallach and Sprott (1964) induced number conservation in six- and seven-year-old children by giving them experience with the reversibility of rearrangement which they, prior to conservation, regarded as implying changes in number. All 15 Ss in the experimental group showed conservation on a posttest, whereas, only one S in the control group conserved. The results supported the hypothesis that conservation may be acquired by experience with reversibility. Wallach, Wall, and Anderson (1967) also induced six- and seven-year old children to conserve number by using reversibility training.

Mehler and Bever (1967) found that children as young as 2-6 could conserve on tasks involving unequal numbers of objects. They found a decrease in conservation scores between the ages of 3-2, and 4-6; and that after 4-6 conservation scores increased.

Beilin (1968) replicated the Mehler and Bever study. Beilin's study did not confirm the Mehler-Bever finding that very young children conserved the concept of number; lost, and later regained the concept. Beilin found that Ss between the ages of 3-0 and 4-7 did not conserve number.

Bever, Mehler, and Epstein (1968) contended that Beilin did not replicate the Mehler-Bever study in that he did not use children under age three. In an additional study, their results supported the findings of Mehler and Bever.

Rothenberg and Courtney (1968) used 117 children, 2-4 to 4-7 years of age in a replication of the Mehler and Bever study. Their results did not support those of Mehler and Bever. They found that only a small percentage of Ss aged 2-4 to 4-7 could conserve on number.

Rothenberg and Orost (1969) taught conservation of number to kindergarten children through the presentation of a sequence of steps thought to be possible antecedents of conservation. Experimental Ss showed significant growth in conservation while the control Ss exhibited no noticeable growth. The effects of the training were generalized to conservation of discontinuous quantity.

Mermelstein and Meyer (1969) trained children three and one-half to six years of age on number conservation.

The techniques used for training were cognitive conflict, multiple classification, verbal rule instruction and language activation. The purpose of the study was to ascertain whether these training techniques on conservation of number could influence the acquisition of the concept of conservation of substance. The results indicated the "Piagetian" concept of conservation of substance was not induced by any of the training techniques on conservation of number.

Schenck (1973) attempted to teach 72 three-, four-, and five-year-old children to conserve number. Teaching methods included counting, addition-subtraction, one-to-one correspondence, and basic understanding of terms. The results supported Piaget's contention that teaching has little influence on the development of number conservation.

Conservation of length has been investigated by some researchers. Conservation of length studies have sometimes been studied along with number, area, or weight. Beilin and Franklin (1962) investigated the effect of training on length and area measurement. The subjects (first-graders and third-graders) were given a one-session program of instruction in skills and concepts by the use of concrete examples. All the first-graders improved on conservation of length on the posttest. Only the third-graders showed improvement in area measurement. Thus, the results showed that length measurement is achieved prior to area measurement.

Smedslund (1963) studied six-year-old's acquisition of conservation of length. The training procedures used involved repeated conflicts between addition/subtraction and perceptual appearance, a series of gradual increments in the strength of perceptual illusion, the anticipation of the outcome of displacement of the object, and finally a composite of the first four. The results showed some acquisition of conservation of length in all groups with the greatest increment in the anticipation group, and the lowest in the increase-in-illusion group.

Kingsley and Hall (1967) used learning set analysis to teach young children length and weight conservation. Learning set analysis utilized a demonstration, an explanation, and elicitation of response by the S. The results yielded highly significant training effects. In addition to improving more in length and weight conservation, experimental groups improved significantly more than control groups in substance conservation.

Gelman (1969) used discrimination learning set theory to teach Ss to conserve length and number. The Ss were instructed as to which cues (e.g., amount, length, size, etc.) they should attend. Feedback was given to the Ss to reinforce differentiation of the relevant, invariant cues and the irrelevant changing cues. Posttests of conservation of length and number indicated significant training effects.

The training effects also transferred to conservation of quantity.

Until Goldschmid's study in 1967, studies had compared only two or three types of conservation (e.g., Smedslund, 1961; Elkind, 1961). Goldschmid assessed conservation of substance, weight, continuous and discontinuous quantity, number, area, distance, length, 2-dimensional and 3-dimensional space and their relation to age, sex, IQ, and vocabulary.

Price-Williams, Gordon and Ramirez (1969) administered a series of conservation tests of number, liquid, substance, weight, and volume to Mexican children. The Ss ranged in age from six to nine years. The experimental group was composed of children from pottery-making families. A control group was composed of children matched on age, years of schooling, and socioeconomic class, but who were not from pottery-making families. The results on the four tasks of number, liquid, weight, and volume were not significant. However, the results on conservation of substance were found to be significant in favor of the pottery-making group. This study suggests that manipulation may be a necessary prerequisite in the attainment of conservation.

Sigel, Saltz, and Roskind (1967) investigated an abstract conservation problem, that of social role, which is consistency of role in the face of changing contexts. The Ss who were 120 five- to eight-year-olds were posed with problems such as a father's studying and becoming a doctor. As the problems were posed, visual representations were used. The S was asked the question, "Is he still a doctor?" The ability to conserve the concept of social role increased significantly with age.

In 1967 Pflederer investigated conservation as it related to musical tasks of tonal and rhythmical patterns. Five-year-old and eight-year-old children were asked to conserve tone and rhythms that were changed or transposed. The eight-year-old children were found to be better able to conserve by distinguishing and carrying in mind a pattern different from the uniform pattern. The five-year-olds showed a lack of this conservation as is typical, according to Piaget, of preoperational thought.

Champoux, et al., (1974) tested Piaget's theory of conservation as it related to the solving of four psychomotor tasks. The Ss used in the study were 172 children, two to six years of age. The study sought to discover whether children in the preoperational stage would be able to conserve--"to maintain the invariance of the configuration of specific psychomotor problem-solving tasks (p. 57)." Champoux, et al., found that children begin to conserve configurations in psychomotor problem-solving tasks at age four and five. However, with the exception of one task, 75 percent of the five-year-olds were unable to conserve. Thus, support was given to Piaget's theory in that psychomotor problem-solving development and preoperational development were closely related.

CHAPTER III

METHOD

An experimental 4 x 3 x 3 x 2 pretest-posttest control group design was used to investigate the effects of the following variables on the conservation of continuous quantity using liquid:

1. Conditions of
    a. Cognitive conflict experience
    b. Reversibility experience
    c. Cognitive conflict-reversibility experience
    d. Control
2. Conditions of
    a. Screening
    b. Nonscreening
    c. Screening-nonscreening
3. Race
    a. Indian
    b. Negro
    c. Caucasian
4. Sex

The independent variable was instruction in conservation given the experimental groups, and the dependent variable was performance on conservation of continuous quantity tasks. The Ss were randomly assigned to experimental and control groups.

Two chi-square tests of significance were executed to test each of the four hypotheses. The level of significance was $p < .05$.

Subjects

The Ss were selected from 232 five-year-old children attending six kindergartens in the Robeson County Public School System, all the kindergartens in the Hoke County Public School System, and the Hoke County Head Start Program. Pretest I, a test to determine understanding of word meaning, was given to all 232 children. Pretest II, a test of conservation of continuous quantity, was administered to the 160 children who passed pretest I. After pretest II, 144 of the 160 children were retained in the study.

The Ss were 144 children, 48 Indians, 48 Caucasians, and 48 Negroes; composed of one-half males and one-half females of each race. The Ss were randomly divided into three experimental groups and one control group by race and by sex as is shown in Table 1. Three conditions of screening were used in each treatment group by race and by sex as is shown in Tables 2, 3, and 4.

Each S was tested individually by the experimenter (E). Sessions took place during regular school days in a quiet room apart from other children.

Table 1

Division of Ss by Group, Race, and Sex

	CC		R		CC-R		Control		Total	
	M	F	M	F	M	F	M	F	M	F
Indian	6	6	6	6	6	6	6	6	24	24
Negro	6	6	6	6	6	6	6	6	24	24
Caucasian	6	6	6	6	6	6	6	6	24	24
Total	18	18	18	18	18	18	18	18	72	72

Table 2

Division of Ss by Group and by Screening Condition

	CC	R	CC-R	Control	Total
Screening	12	12	12	12	48
Nonscreening	12	12	12	12	48
Screening-Nonscreening	12	12	12	12	48
Total	36	36	36	36	144

Table 3

Division of Ss by Race and by
Screening Condition

	Indian	Negro	Caucasian	Total
Screening	16	16	16	48
Nonscreening	16	16	16	48
Screening-Nonscreening	16	16	16	48
Total	48	48	48	144

Table 4

Division of Ss by Sex and by
Screening Condition

	Male	Female	Total
Screening	24	24	48
Nonscreening	24	24	48
Screening-Nonscreening	24	24	48
Total	72	72	144

Apparatus

The materials used for pretest I were an 18 x 12 inch green tray and nine red styrofoam balls; three (1 inch in diameter), three (1½ inches), and three (2 inches). The materials used for pretest II were two identical glasses, 4 3/4 inches high and 2 1/2 inches in diameter, each filled with 4 ounces of green colored water; one taller glass, 6 inches high and 1 1/2 inches in diameter; and four shorter glasses, 3 1/2 inches high and 2 1/2 inches in diameter.

The materials used with the experimental groups were four identical pairs of glasses, 4 3/4 inches high and 2 1/2 inches in diameter, each pair filled with 4 ounces of either orange, blue, yellow, or green colored water; one shorter, wider glass, 3 1/2 inches high and 3 inches in diameter; one taller, wider glass, 7 inches high and 3 inches in diameter; one glass, 7 1/2 inches high and 1 3/4 inches in diameter; two clear 1 ounce measuring cups; a 12 x 6 inch wooden screen; and four 3 x 3 x 1 inch wooden blocks. Three sheets of plain paper and crayons were the only materials necessary for each S in the control group.

The materials used for the posttest were two identical glasses, 4 3/4 inches high and 2 1/2 inches in diameter, each filled with 4 ounces of red colored water; one taller glass, 6 inches high and 1 1/2 inches in diameter; and four shorter glasses, 3 1/2 inches high and 2 1/2 inches in diameter.

Pilot Study

A pilot study was carried out with a total of 24 children as Ss. The Ss ages ranged from 5-5 (5 years 5 months) to 5-11. The children were from the three public school kindergarten classes at Pembroke Elementary School located in Pembroke, N.C. A screening-nonscreening condition was used in each of the experimental groups. The purposes of the pilot study were as follow: (a) to determine the children's reactions to the pretests, the teaching sessions, and the posttest; (b) to determine the children's reactions to the materials used in the pretests, training, and posttest; (c) to determine the time required for pretest I, pretest II, the posttest, and for each of the teaching sessions; (d) to determine the needed number of teaching sessions; and (e) to allow E to gain experience in administering the pretests, the teaching sessions, and the posttest.

The styrofoam balls worked well for pretest I. The three sizes were easily manipulated by the children. Clay balls lost their shape with manipulation. The colored water and the other materials (glasses, measuring cups, wooden screen, and wooden blocks) used in pretest II, the teaching sessions, and the posttest were found to hold the children's interest and attention.

The maximum time required was 2 minutes for pretest I, and 3 minutes for pretest II. Eighteen minutes was the maximum time that a child's attention and interest could be maintained in a teaching session. Two teaching sessions of conservation of continuous quantity using liquid seemed sufficient for the children. Toward the end of the second teaching session, the children seemed to have reached a plateau in their learning and their attention began to wander.

Experiences during the teaching session revealed the need to keep the colored water on a lower table, out of sight, in order to keep the child's attention on the task. Materials used in the sessions were removed from the lower table, manipulated according to the instructions, and returned before other materials were removed.

The screening condition (screening-nonscreening) was used in the pilot study. After the completion of the pilot study, two additional screening conditions (screening and nonscreening) were implemented in order to add to the validity of the effects of screening.

A chi-square test of significance revealed a significant difference at the .01 level between the number of Ss in the cognitive conflict, reversibility, cognitive conflict-reversibility, and control groups who conserved on both, one, or neither of the two conservation tasks.

Procedure

The procedure was as follows: All 232 five-year-olds were administered pretest I. The 160 children who passed pretest I were administered pretest II, a test of conservation of continuous quantity. Of the 160 children pretested, 144 were randomly divided into experimental and control groups. The experimental groups received instruction in conservation of continuous quantity for two sessions. The control group spent two sessions drawing pictures. All treatment groups received a posttest on conservation of continuous quantity. Pretest I and II were administered to each S on the same day. The teaching sessions took place on successive days. The posttest was administered to all Ss two weeks after the second teaching session.

Pretest I lasted approximately 2 minutes; pretest II, 3 minutes. The time required for the teaching sessions ranged from 5 to 15 minutes depending on the treatment. The posttest lasted approximately 3 minutes.

Subjects were trained individually. The sequence in pouring from right to left and from left to right was counterbalanced for all treatment conditions.

Pretest I

Each of the 232 children was tested individually in an isolated room. The child was seated at a table opposite the investigator and told that he was going to play some games. Each child was pretested to assess his comprehension of the words, "same," "more," and "less." The child was shown balls of different sizes and asked questions about relationships. (See Appendix A for the comprehension of language pretest). An observer recorded the responses of each child on a sheet of paper. (See Appendix B for the comprehension of language response sheet).

One hundred sixty children passed, i.e., responded correctly to all nine items. The 72 children who did not respond correctly to all the items were not included in the remainder of the study.

Pretest II

Pretest II was administered to the 160 children who responded correctly to all nine items of pretest I. Pretest II consisted of two tasks to determine whether or not the child was a conserver of continuous quantity using liquid. The two tasks were a modification of the tests used in classical conservation experiments as given by Bruner (1966, p. 184). (See Appendix C for the conservation of continuous quantity pretest). An observer recorded the responses and explanations of each child on a sheet of paper. (See Appendix D for the conservation of continuous quantity response sheet).

Manipulations

One hundred forty-four of the 160 children were randomly divided into four treatment groups by race and by sex. (See Table 1). Three conditions of screening were used in each treatment group by race and by sex. One-third of the Ss in each treatment group received screening; one-third received nonscreening; and one-third received both screening and nonscreening. Screening conditions were assigned to the Ss in the control group only as a means of comparison.

Cognitive Conflict Experience

The S was seated at a table directly opposite the investigator. The cognitive conflict experience used with this group was a modified version of Smedslund's (1961f) practice on continuous and discontinuous material. Modification was made since another material (liquid) was used. Each S was given two training sessions on two successive days. Cognitive conflict training involved experience in the transformation of liquid along with the effect of addition or subtraction. A complete session comprised four items, each with differently colored water and a different glass C. (See Appendix E for the cognitive conflict teaching sessions). An observer recorded the responses of each S on a sheet of paper. (See Appendix F for the cognitive conflict teaching sessions response sheet).

Reversibility Experience

The S was seated at a table directly opposite E. Each S was given two training sessions on two successive days. Reversibility training involved experience in the transformation of the liquid along with the reversal of that transformation. A complete session comprised four reversibility items in which the S was exposed to differently colored water and a different glass C. (See Appendix G for the reversibility teaching sessions). An observer recorded the responses of each S on a sheet of paper. (See Appendix H for the reversibility teaching sessions response sheet).

Cognitive Conflict-Reversibility Experience

The S was seated at a table directly opposite E. Each S was given two training sessions on two successive days. Cognitive conflict-reversibility training involved experiences in (1) the transformation of liquid along with the effect of addition or subtraction, and (2) the transformation of liquid along with the reversal of that transformation. A complete session comprised four items, each with differently colored water and a different glass C. (See Appendix I for the cognitive conflict-reversibility teaching sessions). An observer recorded the responses of each S on a sheet of paper. (See Appendix J for the cognitive conflict-reversibility teaching sessions response sheet).

Control Group

The S was seated at a table directly opposite E. Each S was given two drawing sessions on two successive days. (See Appendix K for the drawing sessions).

Posttest

The Ss were tested individually in an isolated room. Each S was seated at a table directly opposite the investigator. The posttest was administered two weeks after the second training session. The posttest was the same as pretest II, except that the water was red instead of green. (See Appendix C). An observer recorded the responses and explanations of each S on a sheet of paper. (See Appendix D).

Criteria for Conservation

After the deformation and the response by the S that the two quantities (A and C, or A and set D) were the same, more, or less; he was asked why he thought that the two quantities were the same, more, or less.

Each S's response on each of the conservation of continuous quantity tasks was classified as correct if he responded, "same," or as incorrect if he responded "more," or "less." In order to be classified as conserving on a task, the S had to respond that the two quantities were the same and to give a conserving explanation of that response. If an S gave a correct response with a conserving explanation on both tasks, he was classified as a conserver or as conserving. If an S gave a correct response with a conserving explanation on one task, and on the other task gave (1) an incorrect response with a nonconserving or a conserving explanation, or (2) a correct response with a nonconserving explanation; he was classified as fluctuating on conservation. If an S gave, on either or both tasks, (1) an incorrect response with a nonconserving or a conserving explanation, or (2) a correct response with a nonconserving explanation; he was classified as a nonconserver or as not conserving.

This experiment used the five explanations summarized by Sigel (1968) and the last two used by Smedslund (1961b) as a basis for classifying the Ss' performance on the conservation of continuous quantity tasks.

Following are the types of explanations that were accepted as conserving explanations.

1. Reversibility statements, e.g., "You can change it back and it will be the same (Sigel, 1968, p. 523)."

2. Addition and subtraction statements, e.g., "You did not add or take anything away (Sigel, 1968, p. 523)."

3. Compensatory statements, e.g., "It is taller and thinner, so it is still the same (Sigel, 1968, p. 523)."

4. Descriptive statements of action, e.g., "You didn't do anything, you just poured it from there into there." (Sigel, 1968, p. 523).

5. Reference to previous state, e.g., "It was the same when it was in that glass." (Sigel, 1968, p. 523).

Following are the types of explanations that were classified as nonconserving explanations.

1. Perceptual statements, e.g., "It is bigger." (Smedslund, 1961b, p. 74).

2. Ambiguous statements, e.g., "I don't know." (Smedslund, 1961b, p. 74).

CHAPTER IV

RESULTS

Performance of five-year-olds who received instruction in concepts prerequisite to conservation was compared with the performance of five-year-olds who did not receive instruction. A comparison was made of the performance of Ss who received screening during instruction, of Ss who did not receive screening during instruction, and of Ss who received both a screening and a nonscreening condition during instruction. A comparison was made of performance by race and by sex.

Tests of Hypotheses I, II, III, and IV involved chi-square analyses. In Hypothesis I it was stated that there would be no difference in the number of Ss in the cognitive conflict group, the reversibility group, the cognitive conflict-reversibility group, and the control group in performance on the conservation of quantity pretest and post-test. Two chi-squares were computed to test Hypothesis I. A 3 x 4 contingency table was set up in each test to compare the effects of the four treatment groups on the number of Ss in each of the three response categories. Each chi-square test utilized six degrees of freedom. The frequency of subjects by treatment and by performance on the pretest is shown in Table 5. The results of the computation revealed an observed chi-square value of 2.09. This chi-square value was not significant at the .05 level.

Table 5

Frequency of Ss by Treatment and by Performance on Pretest II

	CC	R	CR-R	Control	Total
Conserving	0	0	0	0	0
Fluctuating	1	3	1	1	6
Not Conserving	35	33	35	35	138
Total	36	36	36	36	144

A chi-square test of significance was computed on the frequency of Ss by treatment and by performance on the post-test. These frequencies are shown in Table 6. The results indicated a highly significant difference between treatment groups by performance. An observed chi-square value of 46.07 was obtained; a chi-square value at the .05 level is only 12.59. Thus it was clear that Hypothesis I must be rejected; there was a significant difference between the number of Ss in the cognitive conflict group, the reversibility group, the cognitive conflict-reversibility group, and the control group in performance on the conservation of quantity pretest and posttest.

Table 6

Frequency of Ss by Treatment and by Performance on Posttest

	CC	R	CC-R	Control	Total
Conserving	1	16	20	1	39
Fluctuating	3	2	2	3	10
Not Conserving	31	18	14	32	95
Total	36	36	36	36	144

Since the results indicated a highly significant difference between treatment groups by performance, three additional chi-squares were computed on the frequency of Ss who conserved on the posttest in the three experimental groups. The level of significance for the three additional chi-square tests was $p < .01$. The results of one chi-square test indicated that there was a significant difference between the frequency of conserving Ss in the cognitive conflict group and in the reversibility group. The results of a second chi-square test indicated that there was a significant difference between the frequency of conserving Ss in the cognitive conflict group and in the cognitive conflict-reversibility group. The results of a third chi-square test indicated that there was no significant difference between the frequency of conserving Ss in either the reversibility or the cognitive conflict-reversibility groups.

In Hypothesis II was stated that there would be no significant difference between the Ss in the three conditions of screening in performance on the conservation pretest and posttest. Two chi-squares were computed to test Hypothesis II. A 3 x 3 contingency table was set up in each test to compare the effects of the three screening conditions on the number of Ss in each of the three response categories. Each chi-square test utilized four degrees of freedom. The frequency of Ss by conditions of screening and by performance on pretest II is shown in Table 7. The observed chi-square value was 3.18. The chi-square value at the .05 level is 9.49. Therefore the observed chi-square value was not significant.

A chi-square test of significance was computed on the frequency of Ss by conditions of screening and by performance on the posttest. These frequencies are shown in Table 8. The results of the computation revealed an observed chi-square value of 5.67. This chi-square value was not significant at the .05 level. The results, thus, support the statement of Hypothesis II, that there would be no significant differences between the number of Ss in the screening group, the nonscreening group, and the screening-nonscreening group in performance on the conservation of quantity pretest and posttest.

Results also support Hypothesis III. In this hypothesis it was stated that there would be no difference

Table 7

Frequency of Ss by Conditions of Screening and by Performance on Pretest II

	Screening	Non-Screening	Screening-Nonscreening	Total
Conserving	0	0	0	0
Fluctuating	1	4	1	6
Not Conserving	47	44	47	138
Total	48	48	48	144

Table 8

Frequency of Ss by Conditions of Screening and by Performance on Posttest

	Screening	Non-Screening	Screening-Nonscreening	Total
Conserving	8	15	16	39
Fluctuating	2	4	4	10
Not Conserving	38	29	28	95
Total	48	48	48	144

between the Ss by race in performance on the conservation of quantity pretest and posttest. A 3 x 3 contingency table was set up in each chi-square test to compare the effects of the three races on the number of Ss in each of the three response categories. Each chi-square test utilized 4 degrees of freedom. The frequency of Ss by race and by performance on pretest II is shown in Table 9. The results of a chi-square computation revealed an observed value of 3.18. The chi-square value at the .05 level is 9.49. Therefore the observed chi-square value was not significant.

Table 9

Frequency of Ss by Race and by Performance on Pretest II

	Indian	Negro	Caucasian	Total
Conserving	0	0	0	0
Fluctuating	3	0	3	6
Not Conserving	45	48	45	138
Total	48	48	48	144

The frequency of subjects by race and by performance on the posttest is shown in Table 10. The results of a chi-square computation revealed an observed value of 1.07. This chi-square value was not significant at the .05 level. Thus Hypothesis III was retained; there were no significant differences between the number of Indians, Negroes, and

Table 10

Frequency of Ss by Race and by Performance on Posttest

	Indian	Negro	Caucasian	Total
Conserving	14	12	13	39
Fluctuating	4	4	2	10
Not Conserving	30	32	33	95
Total	48	48	48	144

Caucasians in performance on the conservation of continuous quantity pretest and posttest.

In Hypothesis IV it was stated that there would be no significant difference between the Ss by sex in performance on the conservation of continuous quantity pretest and post-test. Two chi-squares were computed to test Hypothesis IV. A 3 x 2 contingency table was set up to compare the effects of sex on the number of Ss in each of the three response categories. The chi-square test utilized 2 degrees of freedom. The frequency of Ss by sex and by performance on pretest II is shown in Table 11. The results of the computation revealed an observed chi-square value of 0.00. A chi-square value at the .05 level is 5.99. It is clear that this observed chi-square is not significant.

A chi-square test of significance was computed on the frequency of subjects by sex and by performance on the

Table 11

Frequency of Ss by Sex and by Performance on Pretest II

	Female	Male	Total
Conserving	0	0	0
Fluctuating	3	3	6
Not Conserving	69	69	138
Total	72	72	144

posttest. These frequencies are shown in Table 12. The results of the chi-square computation revealed an observed value of 0.43. Thus, this chi-square value was not significant at the .05 level. The results thus support the statement of Hypothesis IV, that there would be no significant differences between the number of females and males in performance on the conservation of continuous quantity pretest and posttest.

Table 12

Frequency of Ss by Sex and by Performance on Posttest

	Female	Male	Total
Conserving	20	19	39
Fluctuating	4	6	10
Not Conserving	48	47	95
Total	72	72	144

CHAPTER V

DISCUSSION AND CONCLUSIONS

An investigation was conducted to determine whether children given instruction in concepts prerequisite to conservation and children given no instruction would perform significantly different on the conservation of quantity pretest and posttest. Clearly, the question of whether or not children have the concept of conservation cannot be assessed unless children understand the meaning of same, more, and less. A total of 72 children were not used in the study after pretest I because they failed to respond correctly to the items which tested the understanding of the words "same," "more," and "less." It was assumed that the question of whether these children understood conservation of continuous quantity was unanswerable if they did not know the meaning of the words.

The results of this study revealed that there were significant differences on the pretest and the posttest in the performance of Ss who received instruction in cognitive conflict, reversibility, and cognitive conflict-reversibility concepts; and in the performance of the control Ss. On pretest II none of the Ss conserved; six Ss fluctuated; and 138 did not conserve. After training, 39 Ss conserved on the posttest; 10 fluctuated; and 95 did not conserve. Shown in Tables 13, 14, 15, and 16 is the conservation performance of the Ss on the pretest and on the posttest by treatment group.

Table 13

Pretest to Posttest Conservation Performance of Ss Given Cognitive Conflict Training

Pretest	Ss	Posttest	Ss
Fluctuated	1	Did not Conserve	1
Did not Conserve	35	Conserved	2
		Fluctuated	3
		Did not Conserve	30
Total	36		36

Table 14

Pretest to Posttest Conservation Performance of Ss Given Reversibility Training

Pretest	Ss	Posttest	Ss
Fluctuated	3	Conserved	2
		Did not Conserve	1
Did not Conserve	33	Conserved	14
		Fluctuated	2
		Did not Conserve	17
Total	36		36

Table 15

Pretest to Posttest Conservation Performance of Ss Given Cognitive Conflict-Reversibility Training

Pretest	Ss	Posttest	Ss
Fluctuated	1	Conserved	1
Did not Conserve	35	Conserved	19
		Fluctuated	2
		Did not Conserve	14
Total	36		36

Table 16

Pretest to Posttest Conservation Performance of Control Group

Pretest	Ss	Posttest	Ss
Fluctuated	1	Conserved	1
Did not Conserve	35	Fluctuated	3
		Did not Conserve	32
Total	36		36

One S in the control group conserved on the posttest. However, during the pretest, this S fluctuated on conservation. Of the six Ss who fluctuated on the pretest, four (66%) advanced to conservation on the posttest. This progression gives support to Piaget's (1952) theory of the stages of the development of conservation.

None of the Ss in either of the treatment groups conserved on pretest II. During cognitive conflict training three Ss learned to conserve as compared to 29 Ss in the reversibility group, and 28 Ss in the cognitive conflict-reversibility group. One (33%) of the three Ss, who learned to conserve during cognitive training, continued to conserve on the posttest as compared to 16 (55%) of the 29 in the reversibility group; and 20 (71%) of the 28 in the cognitive conflict-reversibility group.

It appears that experience in reversibility and in both cognitive conflict and reversibility led to a greater number of conserving Ss as compared to the cognitive conflict group. The results indicated that there was no significant difference in the number of conserving Ss in either the reversibility group or the cognitive conflict-reversibility groups. However, it could be that experience with reversibility concepts helped the Ss learn to conserve on the cognitive conflict items. Of the 28 Ss who learned to conserve during cognitive conflict-reversibility training, 15 conserved on the reversibility items, while 13 conserved on both the cognitive conflict and the reversibility items. This number (13) is in contrast to three Ss who learned to conserve during cognitive conflict training alone. The 28 Ss in the cognitive conflict-reversibility group who learned to conserve during training, conserved first on the reversibility items; and then 13 of the 28 Ss learned to conserve on the cognitive conflict items. Shown in Tables 17, 18, and 19 is the conservation performance of Ss during cognitive conflict training, reversibility training, and cognitive conflict-reversibility training, respectively, along with the breakdown of performance on the posttest.

Table 17

Conservation Performance of Ss During Cognitive Conflict Training and on Posttest

Conservation During Training	Ss	Posttest	Ss
Conserved	3	Conserved	1 (33)*
		Fluctuated	1 (33)
		Did not Conserve	1 (33)
Did not Conserve	33	Conserved	1 (3)
		Fluctuated	2 (6)
		Did not Conserve	30 (91)
Total	36		36

*Percentage values are shown in parentheses.

Table 18

Conservation Performance of Ss During Reversibility Training and on Posttest

Conservation During Training	Ss	Posttest	Ss
Conserved	29	Conserved	16 (55)*
		Fluctuated	2 (7)
		Did not Conserve	11 (38)
Did not Conserve	7	Did not Conserve	7 (100)
Total	36		36

*Percentage values are shown in parentheses.

Table 19

Conservation Performance of Ss During Cognitive Conflict-Reversibility Training and on Posttest

Conservation During Training	Ss	Posttest	Ss
Conserved	28	Conserved	20 (71)*
		Fluctuated	2 (8)
		Did not Conserve	6 (21)
Did not Conserve	8	Did not Conserve	8 (100)
Total	36		36

* Percentage values are shown in parentheses.

The results revealed that there were no significant differences on the pretest and the posttest in the performance of Ss who received screening, nonscreening, and both screening and nonscreening during training. The performance of the Ss on the pretest and on the posttest by screening condition is given in Tables 20, 21, and 22.

Table 20

Pretest to Posttest Conservation Performance of Ss During Training with Screening

Pretest	Ss	Posttest	Ss
Fluctuated	1	Conserved	1
Did not Conserve	47	Conserved	7
		Fluctuated	2
		Did not Conserve	38
Total	48		48

Table 21

Pretest to Posttest Conservation Performance of Ss During Training with Nonscreening

Pretest	Ss	Posttest	Ss
Fluctuated	4	Conserved	2
		Did not Conserve	2
Did not Conserve	44	Conserved	13
		Fluctuated	4
		Did not Conserve	27
Total	48		48

Table 22

Pretest to Posttest Conservation Performance of Ss During Training with Both Screening and Nonscreening

Pretest	Ss	Posttest	Ss
Fluctuated	1	Conserved	1
Did not Conserve	47	Conserved	15
		Fluctuated	4
		Did not Conserve	28
Total	48		48

As in the treatment groups, none of the Ss in either of the conditions of screening conserved on pretest II.

During the training sessions with the condition of screening 18 Ss learned to conserve as compared to 22 in the nonscreening group, and 21 in the screening-nonscreening group. Seven (39%) of the 18 Ss, who learned to conserve with screening, continued to conserve on the posttest as compared to 15 (68%) of the 22 in the nonscreening group; and 15 (71%) of the 21 in the screening-nonscreening group. Shown in Tables 23, 24, and 25 is the conservation performance of the Ss exposed to the conditions of screening, nonscreening, and screening-nonscreening, respectively, along with the breakdown of performance on the posttest.

Table 23

Conservation Performance of Ss During
Training with Screening
and on Posttest

Conservation During Training	Ss	Posttest	Ss
Conserved	18	Conserved	7 (39)*
		Fluctuated	1 (5)
		Did not Conserve	10 (56)
Did not Conserve	18	Did not Conserve	18 (100)
Total	36		36

*Percentage values are shown in parentheses.

Table 24

Conservation Performance of Ss During
Training with Nonscreening
and on Posttest

Conservation During Training	Ss	Posttest	Ss
Conserved	22	Conserved	15 (68)*
		Fluctuated	3 (14)
		Did not Conserve	4 (18)
Did not Conserve	14	Fluctuated	1 (7)
		Did not Conserve	13 (93)
Total	36		36

*Percentage values are shown in parentheses.

Table 25

Conservation Performance of Ss During Training with Both Screening and Nonscreening and on Posttest

Conservation During Training	Ss	Posttest	Ss
Conserved	21	Conserved	15 (71)*
		Fluctuated	1 (5)
		Did not Conserve	5 (24)
Did not Conserve	15	Conserved	1 (6)
		Fluctuated	1 (6)
		Did not Conserve	13 (87)
Total	36		36

*Percentage values are shown in parentheses.

Since 18 Ss in the screening group learned to conserve during training and since less than half (39%) continued to conserve on the posttest; it appears that the screening condition stopped the 18 Ss from using misleading perceptual cues. When the screen was not present, during the posttest, 10 (56%) of the 18 Ss reverted to not conserving and one to fluctuating on conservation.

In comparing the Ss who were given nonscreening and both screening and nonscreening with the group that was given screening, it can be seen that the Ss exposed to the nonscreening condition and the Ss exposed to the screening-nonscreening condition outperformed those given the screening condition, although the difference between these three groups did not reach statistical significance. In comparing the nonscreening group with the screening-nonscreening group, there was approximately the same amount of improvement in both groups. Therefore, the Ss who were not shielded from the perceptual cues performed almost the same as the Ss who were given experience in shielded and unshielded transformations.

In order to be classified as a conserver on a task, an S had (1) to answer that the two quantities were the same and (2), to justify why he thought they were the same. Two conservation of continuous quantity tasks were presented to each S, and an explanation was required for each response.

The criteria that an explanation be given for each response contributed to the validity of the results. Shown in Table 26 are the responses and explanations given by Ss on the two conservation tasks of pretest II.

On pretest II two Ss responded correctly on both tasks but gave ambiguous explanations; therefore, they could not be classified as conservers. Two Ss, who were classisified as fluctuating, gave incorrect responses on the first task along with a conserving explanation. Two Ss, who were classified as nonconservers, gave incorrect responses on both tasks along with a conserving explanation. Another nonconserving S gave incorrect responses on both tasks along with a conserving explanation on the first.

Table 26

Responses and Explanations Given by Ss on the Two Conservation Tasks of Pretest II

Responses	Ss	Explanations	Ss
Both Correct	2	Ambiguous on Both	2
First Correct Second Incorrect	1	Reference on First Perceptual on Second	1
First Incorrect Second Correct	5	Descriptive on Both	2
		Perceptual on First Reference on Second	1
		Perceptual on First Descriptive on Second	2
Both Incorrect	136	Perceptual on Both	120
		Descriptive on Both	2
		Descriptive on First Perceptual on Second	7
		Ambiguous on Both	4
		Ambiguous on First Perceptual on Second	2
		Perceptual on First Ambiguous on Second	1
Total	144		144

Shown in Table 27 are the responses and explanations given by Ss on the two conservation tasks of the posttest. After training, the number of incorrect responses with conserving explanations increased on the posttest. Three Ss, who fluctuated, gave conservation explanations for an incorrect response. Three nonconserving Ss gave conserving explanations for both incorrect responses. Five nonconserving Ss gave incorrect responses on both tasks along with a conserving explanation on the first. On both the pretest and the posttest the conserving explanations, that were given for incorrect responses, were descriptive statements of action.

In considering the type of training given the Ss, it seemed that more Ss would have given reversibility or addition and subtraction statements of explanation. Of the 39 Ss who conserved on the posttest, only four gave reversibility explanations on both tasks; two gave a reversibility explanation on one task; one gave an addition and subtraction explanation on both tasks; and one gave an addition and subtraction explanation on one task. One fluctuating S gave a reversibility explanation on one task.

The results of the study revealed that there were no significant differences on conservation of continuous quantity between Indians, Caucasians, and Negroes who were given specific instruction. Previous research suggested that Caucasian Ss (Feigenbaum, 1963; Brison, 1966); Negro Ss

Table 27

Responses and Explanations Given by Ss on the Two Conservation Tasks of Posttest

Responses	Ss	Explanations	Ss
Both Correct	39	Descriptive on Both	18
		Reference on Both	7
		Reversibility on Both	4
		Addition-Subtraction on Both	1
		Descriptive on First Addition-Subtraction on Second	1
		Compensation on First Descriptive on Second	1
		Reversibility on First Reference on Second	1
		Reversibility on First Descriptive on Second	3
		Reference on First Descriptive on Second	1
		Descriptive on First Reference on Second	2
First Correct Second Incorrect	3	Descriptive on Both	1
		Descriptive on First Perceptual on Second	1
		Reversibility on First Perceptual on Second	1
First Incorrect Second Incorrect	7	Descriptive on Both	2
		Perceptual on First Descriptive on Second	2
		Ambiguous on First Descriptive on Second	1
		Perceptual on First Reference on Second	2

TABLE 27 (continued)

Responses	Ss	Explanations	Ss
Both Incorrect	95	Perceptual on Both	75
		Descriptive on Both	3
		Ambiguous on Both	8
		Descriptive on First Perceptual on Second	5
		Perceptual on First Ambiguous on Second	1
		Ambiguous on First Perceptual on Second	3
Total	144		144

(Mermelstein and Shulman, 1967; Greenfield, 1966; Price-Williams, 1961); and Hong Kong Ss (Goodnow and Bethon, 1966) attained conservation in the same sequence and at the same ages.

There were no significant sex differences observed, which corroborated previous studies except that of Goldschmid (1967) who reported significant sex differences in favor of males.

Conclusions

It is concluded that the "Piagetian" concept of conservation of continuous quantity, as measured by the specific criteria described, was induced by two teaching sessions in either cognitive conflict, reversibility, or cognitive conflict-reversibility. The findings are in opposition to Piaget's contention that teaching has little influence on the acquisition of conservation of quantity. The present study confirmed previous findings (Wallach and Sprott, 1964; Wallach, Wall, and Anderson, 1967) that experimental training in reversibility is influential in accelerating the acquisition of the concept of conservation. However, the findings did not support those of Smedslund (1961e, 1961f, 1963) that experience in cognitive conflict, alone, is effective in inducing conservation.

This study revealed that Ss who were not given screening during instruction performed as well as Ss who were given both a screening and a nonscreening condition. The Ss who received no screening outperformed those given screening, although the difference was not significant. Therefore, it is concluded that there is no evidence to support that screening was effective in inducing conservation of continuous quantity. This finding does not corroborate the findings of Frank, as cited by Bruner (1964), Greenfield (1966), and Sigel, Saltz, and Roskind (1967); but corroborates those of Gilmore (1966) and Sonstroem (1966). Frank, as cited by Bruner (1964), used a predictive item, in addition to the screening condition. That there was no evidence to suggest that screening was effective in inducing conservation of continuous quantity may have been due to the fact that the present study used three different visual screening conditions instead of using a predictive item along with screening.

There were no differences in the conservation performance of Indians, Caucasians, or Negroes on conservation of continuous quantity. No sex differences were evident in performance on conservation of continuous quantity.

From the results of this study, and since conservation of quantity is fundamental to mathematical thought, it was concluded that it would be well to devise teaching methods which would encompass reversibility. Cognitive conflict experiences could be included after reversibility is attained. Cognitive conflict training would give experience in the concept of the effects of addition and subtraction; a concept which is a prerequisite concept of conservation. Implementing reversibility and both cognitive conflict-reversibility experiences into the ongoing preschool curriculum could prove to be beneficial in terms of "number readiness" for the preschooler.

CHAPTER VI

SUMMARY

An experimental investigation was conducted to study the effects of instruction on five-year-old children's ability to conserve on continuous quantity tasks. A subject has achieved conservation of continuous quantity using liquid when he thinks that the amount of liquid which an object contains must remain unchanged during changes in form, so long as nothing is added or taken away.

Professionals and paraprofessionals need to know the types of experiences that would enable the child to proceed from the preoperational stage to the stage of concrete operations in cognitive development. Educators responsible for designing preschool curriculums need to know the concepts prerequisite to conservation of quantity and how to implement them into the curriculum.

A review of literature indicated that training sessions, in which cognitive conflict, reversibility, and screening conditions were implemented, would be effective in teaching five-year-old children to conserve continuous quantity. Since the studies reporting success in teaching conservation using cognitive conflict had been done with solid materials; and since the studies using reversibility were done to teach conservation of number, it seemed important to use cognitive conflict and reversibility to teach conservation of continuous quantity using liquid.

The following hypotheses were tested: (a) there are no significant differences in the number of Ss in the cognitive conflict group, the reversibility group, the cognitive conflict-reversibility group, and the control group in performance on the conservation of continuous quantity pretest and posttest; (b) there are no significant differences in the number of Ss in the screening group, the nonscreening group, and the screening-nonscreening group in performance on the conservation of continuous quantity pretest and posttest; (c) there are no significant differences in the number of Indians, Negroes, and Caucasians in performance on the conservation of continuous quantity pretest and posttest; and (d) there are no significant differences in the number of females and males in performance on the conservation of continuous quantity pretest and posttest.

The subjects (Ss) were 144 children whose ages ranged from five years five months (5-5) to five years eleven months (5-11). The distribution of Ss by race and by sex was 48 Indians, 48 Caucasians, and 48 Negroes; composed of one-half males (24) and one-half females (24) for each racial group. Subjects were randomly assigned to the three experimental groups and the control group. The Ss in one experimental group were given experience in cognitive conflict;

the Ss in another experimental group were given experience in reversibility; and the third experimental group of Ss was given both cognitive conflict and reversibility experiences. Three conditions of screening were used in each of the treatment groups.

A pilot study, using children from a school other than the schools used for the final study, produced the following information: (a) the pretests, training experiences, and posttest were appropriate for five-year-old children, (b) the materials used in the testing and training sessions worked well, and (c) two teaching sessions were sufficient.

The procedure involved the following: (a) a pretest given to 232 children to determine whether or not they understood the language to be used in the study; (b) a second pretest given to the 160 children who passed pretest I, to determine whether or not they could conserve on the conservation of continuous quantity tasks; (c) the random assignment of 144 of the 160 Ss, who had taken pretest II, to three experimental groups and one control group; (d) two sessions of instruction in concepts prerequisite to conservation of quantity for the experimental groups; and (e) a posttest for all Ss. The posttest was administered two weeks after the second session of instruction. The teaching sessions involving cognitive conflict were adapted from Smedslund's (1961f) study. The teaching sessions involving reversibility were devised by the investigator.

The experimental design was a 4 x 3 x 3 x 2 pretest-posttest control group design. The data were analyzed statistically by chi-square tests of significance.

An analysis of the results indicated that two sessions of instruction in conservation of continuous quantity using reversibility and cognitive conflict experiences were effective in teaching five-year-old children to conserve continuous quantity. Results indicated that a nonscreening condition during instruction was as effective as the conditions involving screening. No difference was found in the conservation of continuous quantity performance of Indians, Negroes, and Caucasians, or of males and females.

Implications for Further Research

1. The stability of conservation of continuous quantity attained during instruction could be investigated to determine whether the training had a fleeting or a lasting effect.

2. An investigation using video-taping would make possible the study of facial expressions and verbalizations of Ss confronted with conservation of continuous quantity tasks. Such a study could give indications as to what the S expected initially as compared to his response.

3. A study of the effects of manipulation by the Ss during training on conservation of continuous quantity performance could give insight as to whether or not manipulation by children is an experience that they need in order to learn to conserve continuous quantity.

4. An investigation could be conducted to determine whether the conservation of continuous quantity induced by training transfers directly to such different conservations as that of number.

5. A study of the effects of direct verbal training could indicate that verbal reinforcement is instrumental in a S's learning to conserve continuous quantity. During direct verbal training, the Ss would be repeatedly told: "This water is the same because we didn't change it. When we started it was equal and nothing has been added or taken away. It looks different merely because it was poured into another glass." The nature of the acquisitions initiated in this way could be checked by studying their stability, generality, and resistance to extinction.

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APPENDIX A

COMPREHENSION OF LANGUAGE PRETEST I

General Instructions

1. Instructions were typed on 5" x 8" index cards. Statements which E made in administering the items were typed in capital letters and directions for E were typed in lower case letters.
2. Establish rapport with the child before beginning the pretest. Say the following to the child: "Hello, (child's name). Do you like to play with balls? (Wait for response). We are going to play a game with these balls. Let's begin."
3. The balls were randomly distributed in a row in the middle of the tray.

Item I

Show the child the tray containing the nine red balls. Pick up one of the large balls; place it on the tray in front of the child.

LOOK AT THE BALLS ON THE TRAY. FIND A BALL THAT CONTAINS THE SAME AMOUNT AS THIS BALL.

Point to the large ball in front of the child. Put the large ball and the ball chosen by the child back into the row.

Item II

Pick up one of the large balls and one of the medium balls; place them on the tray in front of the child.

NOW LOOK AT THESE TWO BALLS. POINT TO THE BALL THAT CONTAINS MORE.

Put the two balls back into the row.

Item III

Pick up one of the medium balls and one of the small balls; place them on the tray in front of the child.

NOW LOOK AT THESE TWO BALLS. POINT TO THE BALL THAT CONTAINS LESS.

Put the two balls back into the row.

Item IV

Pick up one of the large balls and one of the small balls; place them on the tray in front of the child.

NOW LOOK AT THESE TWO BALLS. POINT TO THE BALL THAT CONTAINS LESS.

Put the two balls back into the row.

Item V

Pick up one of the small balls; place it on the tray in front of the child.

LOOK AT THE BALLS ON THE TRAY. FIND A BALL THAT CONTAINS THE SMALL AMOUNT AS THIS BALL.

Point to the small ball in front of the child. Put the small ball and the ball chosen by the child back into the row.

Item VI

Pick up one of the medium balls and one of the small balls; place them on the tray in front of the child.

NOW LOOK AT THESE TWO BALLS. POINT TO THE BALL THAT CONTAINS MORE.

Put the two balls back into the row.

Item VII

Pick up one of the large balls and one of the small balls; place them on the tray in front of the child.

NOW LOOK AT THESE TWO BALLS. POINT TO THE BALL THAT CONTAINS MORE.

Put the two balls back into the row.

Item VIII

Pick up one of the large balls and one of the medium balls; place them on the tray in front of the child.

NOW LOOK AT THESE TWO BALLS. POINT TO THE BALL THAT CONTAINS LESS.

Put the two balls back into the row.

Item IX

Pick up one of the medium balls; place it on the tray in front of the child.

LOOK AT THE BALLS ON THE TRAY. FIND A BALL THAT CONTAINS THE SAME AMOUNT AS THIS BALL.

Point to the medium ball in front of the child. Remove the tray from the table.

APPENDIX B

COMPREHENSION OF LANGUAGE RESPONSE SHEET

COMPREHENSION OF LANGUAGE
RESPONSE SHEET

Date________________________________

Name________________________________

School______________________________

Teacher_____________________________

Score____________

Circle the response of the subject.

Item	Response
I. SAME: 3	1 2 3
II. MORE: 2 - 3	1 2 3
III. LESS: 1 - 2	1 2 3
IV. LESS: 1 - 3	1 2 3
V. SAME: 1	1 2 3
VI. MORE: 1 - 2	1 2 3
VII. MORE: 1 - 3	1 2 3
VIII. LESS: 2 - 3	1 2 3
IX. SAME: 2	1 2 3

APPENDIX C

CONSERVATION OF CONTINUOUS QUANTITY PRETEST II AND POSTTEST ADAPTED FROM BRUNER (1966)

General Instructions

1. Instructions were typed on 5" x 8" index cards. Statements which E made in administering the tasks were typed in capital letters and directions for E were typed in lower case letters.
2. Shift from pretest I to pretest II by saying the following to the child: "Now we are going to play another game."

Task I

Show the child the two standard glasses (A and B), each filled with 4 ounces of green (red) colored water.

WHAT COLOR IS THE WATER?

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, place glass C on the table and pour the water from glass B into glass C.

S. C. Q.

Repeat the question if necessary. Wait for the child's response.

WHY DO YOU THINK IT IS THE SAME (MORE, LESS)?

Pour the water from glass C back into glass B, and remove glass C.

Task II

Place the four small glasses (set D) on the table. Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK:

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, pour the water from glass B into set D.

S. C. Q.

Repeat the question if necessary. Wait for the child's response.

WHY DO YOU THINK IT IS THE SAME (MORE, LESS)?

Wait for the child's response.

THAT WAS FUN, WASN'T IT? I'M GLAD YOU COULD COME AND PLAY WITH ME.

APPENDIX D

CONSERVATION OF CONTINUOUS QUANTITY RESPONSE SHEET

CONSERVATION OF CONTINUOUS QUANTITY RESPONSE SHEET

Date________________________________

Name________________________________

School______________________________

Teacher_____________________________

Treatment___________________________

Test________________________________

Task I Performance__________________

Task II Performance_________________

Place a check beside the child's response and record the explanation.

Task I	Explanation
Same____	
More____	
Less____	

Task II	Explanation
Same____	
More____	
Less____	

APPENDIX E

COGNITIVE CONFLICT TEACHING SESSIONS ADAPTED FROM SMEDSLUND (1961f)

General Instructions

1. Instructions were typed on 5" x 8" index cards. Statements which E made in administering the items were typed in capital letters and directions for E were typed in lower case letters.
2. One-third of the subjects, with an equal number of Indian, Negro, and Causasian and males and females, were given cognitive conflict training along with screening; one-third were given cognitive conflict training with nonscreening; and one-third were given cognitive conflict training with both screening and nonscreening.
3. When screening is used, put glass C behind the wooden screen and continue with the procedures in that item.

Cognitive Conflict Teaching

Item I

Show the child the two standard glasses (A and B), each filled with 4 ounces of yellow colored water.

WHAT COLOR IS THE WATER?

Point to Glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence

of the two quantities, place glass C on the table and pour the water from glass B into glass C.

S. C. Q.

If the child says that the amount of water in glass C is the same as that in glass A, go on to Item II.

If the child says that glass C has more water than glass A, subtract 1 ounce of water from glass C. If the child says that glass C has less water than glass A, subtract 1 ounce of water from glass A.

S. C. Q.

Add the subtracted ounce to the glass from which it was subtracted (A or C).

S. C. Q.

Remove the three glasses from the table.

Item II

Show the child the two standard glasses (A and B), each filled with 4 ounces of purple colored water.

WHAT COLOR IS THE WATER?

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, place glass C on the table; pour the water from glass B into glass C, and subrract 1 ounce of water from glass C.

S. C. Q.

Subtract 1 ounce of water from glass A.

S. C. Q.

Add 1 ounce to glass C.

S. C. Q.

Add 1 ounce to glass A.

S. C. Q.

Remove the three glasses from the table.

Item III

Show the child the two standard glasses (A and B), each filled with 4 ounces of orange colored water.

WHAT COLOR IS THE WATER?

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, place glass C on the table; pour the water from glass B into glass C, and subtract 1 ounce of water from glass C.

S. C. Q.

Subtract a second ounce of water from glass C.

S. C. Q.

Add 1 ounce of water to glass C.

S. C. Q.

Add the second ounce of water to glass C.

S. C. Q.

Remove the three glasses from the table.

Item IV

Show the child the two standard glasses (A and B), each filled with 4 ounces of blue colored water.

WHAT COLOR IS THE WATER?

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, place glass C on the table; pour the water from glass B into glass C, and subtract 1 ounce of water from glass C and 1 ounce of water from glass A.

S. C. Q.

Add 1 ounce of water to glass C and 1 ounce of water to glass A.

S. C. Q.

THAT WAS FUN, WASN'T IT? I'M GLAD YOU COULD COME AND PLAY WITH ME.

APPENDIX F

COGNITIVE CONFLICT TEACHING SESSIONS
RESPONSE SHEET

COGNITIVE CONFLICT TEACHING SESSIONS
RESPONSE SHEET

Date________________________________ **Check one**

Name________________________________ Screening______

School______________________________ Nonscreening___

Teacher_____________________________ Screening-Nonscreening___

Race______________, Sex_________

Place a check beside the child's response.

Item I	Item II	Item III	Item IV
(Tran. B)	(Tran. B, - C)	(Tran. B, - C)	(Tran. B, - C, - A)
Same___	Same___	Same___	Same___
More___	More___	More___	More___
Less___	Less___	Less___	Less___
(- C)	(- A)	(- C)	(+ C, + A)
Same___	Same___	Same___	Same___
More___	More___	More___	More___
Less___	Less___	Less___	Less___
(- A)	(+ C)	(+ C)	
Same___	Same___	Same___	
More___	More___	More___	
Less___	Less___	Less___	
	(+ A)	(+ C)	
	Same___	Same___	
	More___	More___	
	Less___	Less___	

APPENDIX G

REVERSIBILITY TEACHING SESSIONS

General Instructions

1. Instructions were typed on 5" x 8" index cards. Statements which E made in administering the items were typed in capital letters and directions for E were typed in lower case letters.
2. One-third of the subjects, with an equal number of Indian, Negro, and Caucasian and males and females, were given reversibility training with screening; one-third were given reversibility training with nonscreening; and one-third were given reversibility training with both screening and nonscreening.
3. When screening is used, put glass C behind the wooden screen and continue with the procedures in that item.

Reversibility Teaching

Item I

Show the child the two standard glasses (A and B), each filled with 4 ounces of yellow water.

WHAT COLOR IS THE WATER?

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence

of the two quantities, place glass C on the table and pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Remove the three glasses from the table.

<u>Item II</u>

Show the child the two standard glasses (A and B), each filled with 4 ounces of purple water.

WHAT COLOR IS THE WATER?

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, place glass C on the table and pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Remove the three glasses from the table.

Item III

Show the child the two standard glasses (A and B), each filled with 4 ounces of orange colored water.

WHAT COLOR IS THE WATER?

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, place glass C on the table and pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Remove the three glasses from the table.

Item IV

Show the child the two standard glasses (A and B), each filled with 4 ounces of blue colored water.

WHAT COLOR IS THE WATER?

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, place glass C on the table and pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

THAT WAS FUN, WASN'T IT? I'M GLAD YOU COULD COME AND PLAY WITH ME.

APPENDIX H

REVERSIBILITY TEACHING SESSIONS
RESPONSE SHEET

REVERSIBILITY TEACHING SESSIONS
RESPONSE SHEET

Date________________________________

Name________________________________

School______________________________

Teacher_____________________________

Race____________, Sex_________

Check one

Screening______

Nonscreening___

Screening-
Nonscreening___

Place a check beside the child's response.

Item I	Item II	Item III	Item IV
(Tran. B)	(Tran. B)	(Tran. B)	(Tran. B)
Same___	Same___	Same___	Same___
More___	More___	More___	More___
Less___	Less___	Less___	Less___
(C → B)	(C → B)	(C → B)	(C → B)
Same___	Same___	Same___	Same___
More___	More___	More___	More___
Less___	Less___	Less___	Less___
(Tran. B)	(Tran. B)	(Tran. B)	(Tran. B)
Same___	Same___	Same___	Same___
More___	More___	More___	More___
Less___	Less___	Less___	Less___
(C → B)	(C → B)	(C → B)	(C → B)
Same___	Same___	Same___	Same___
More___	More___	More___	More___
Less___	Less___	Less___	Less___

APPENDIX I

COGNITIVE CONFLICT-REVERSIBILITY TEACHING SESSIONS

General Instructions

1. Instructions were typed on 5" x 8" index cards. Statements which E made in administering the items were typed in capital letters and directions for E were typed in lower case letters.
2. One-third of the subjects, with an equal number of Indian, Negro, and Caucasian and males and females, were given cognitive conflict-reversiblity training along with screening; one-third were given cognitive conflict-reversibility training with nonscreening; and one-third were given cognitive conflict-reversibility training with both screening and nonscreening.
3. When screening is used, put glass C behind the wooden screen and continue with the procedures in that item.

Cognitive Conflict-Reversibility Teaching

Item I

Show the child the two standard glasses (A and B), each filled with 4 ounces of yellow colored water.

WHAT COLOR IS THE WATER?

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence

of the two quantities, place glass C on the table and pour the water from glass B into glass C.

S. C. Q.

If the child says that the amount of water in glass C is the same as that in glass A, go on to Item II.

If the child says that glass C has more water than glass A, subtract 1 ounce of water from glass C. If the child says that glass C has less water than glass A, subtract 1 ounce of water from glass A.

S. C. Q.

Add the subtracted ounce to the glass from which it was subtracted (A or C).

S. C. Q.

Pour the water from glass C back into glass B.

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Remove the three glasses from the table.

<u>Item II</u>

Show the child the two standard glasses (A and B), each filled with 4 ounces of purple colored water.

WHAT COLOR IS THE WATER?

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, place glass C on the table; pour the water from glass B into glass C, and subtract 1 ounce of water from glass C.

S. C. Q.

Subtract 1 ounce of water from glass A.

S. C. Q.

Add 1 ounce of water to glass C.

S. C. Q.

Add 1 ounce of water to glass A.

S. C. Q.

Pour the water from glass C back into glass B.

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Remove the three glasses from the table.

Item III

Show the child the two standard glasses (A and B), each filled with 4 ounces of orange colored water.

WHAT COLOR IS THE WATER?

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, place glass C on the table; pour the water from glass B into glass C, and subtract 1 ounce of water from glass C.

S. C. Q.

Subtract a second ounce of water from glass C.

S. C. Q.

Add 1 ounce of water to glass C.

S. C. Q.

Add the second ounce of water to glass C.

S. C. Q.

Pour the water from glass C back into glass B.

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Remove the three glasses from the table.

ITEM IV

Show the child the two standard glasses (A and B), each filled with 4 ounces of blue colored water.

WHAT COLOR IS THE WATER?

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the two quantities, place glass C on the table;

pour the water from glass B into glass C, and subtract 1 ounce of water from glass C and 1 ounce of water from glass A.

S. C. Q.

Add 1 ounce of water to glass C and 1 ounce of water to glass A.

S. C. Q.

Pour the water from glass C back into glass B.

Point to glasses A and B.

DO THESE TWO GLASSES CONTAIN THE SAME AMOUNT OF WATER TO DRINK?

If the child says that the two glasses do not contain the same amount, encourage him to help you make them the same. After the child agrees to the equivalence of the quantities, pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

Pour the water from glass B into glass C.

S. C. Q.

Pour the water from glass C back into glass B.

S. C. Q.

If the child responds that the water is not the same, again establish sameness.

THAT WAS FUN, WASN'T IT? I'M GLAD YOU COULD COME AND PLAY WITH ME.

APPENDIX J

COGNITIVE CONFLICT-REVERSIBILITY TEACHING SESSIONS RESPONSE SHEET

COGNITIVE CONFLICT-REVERSIBILITY TEACHING SESSIONS
RESPONSE SHEET

Date________________________ Check one

Name________________________ Screening______

School______________________ Nonscreening___

Teacher_____________________ Screening-Nonscreening___

Race__________, Sex______

Item I		Item II	
(Tran. B)	(Tran. B)	(Tran. B, -C)	(Tran. B)
Same___	Same___	Same___	Same___
More___	More___	More___	More___
Less___	Less___	Less___	Less___
(- C)	(C → B)	(- A)	(C → B)
Same___	Same___	Same___	Same___
More___	More___	More___	More___
Less___	Less___	Less___	Less___
(- A)	(Tran. B)	(+ C)	(Tran. B)
Same___	Same___	Same___	Same___
More___	More___	More___	More___
Less___	Less___	Less___	Less___
	(C → B)	(+ A)	(C → B)
	Same___	Same___	Same___
	More___	More___	More___
	Less___	Less___	Less___

Item III		Item IV	
(Tran. B, - C)	(Tran. B)	(Tran. B, - C, - A)	(Tran. B)
Same___	Same___	Same___	Same___
More___	More___	More___	More___
Less___	Less___	Less___	Less___
(- C)	(C → B)	(+ C, + A)	(C → B)
Same___	Same___	Same___	Same___
More___	More___	More___	More___
Less___	Less___	Less___	Less___
(+ C)	(Tran. B)		(Tran. B)
Same___	Same___		Same___
More___	More___		More___
Less___	Less___		Less___
(+ C)	(C → B)		(C → B)
Same___	Same___		Same___
More___	More___		More___
Less___	Less___		Less___

APPENDIX K

DRAWING SESSIONS CONTROL

General Instructions

1. Instructions were typed on 5" x 8" index cards. Statements which E made in administering the tasks were typed in capital letters and directions for E were typed in lower case letters.
2. The S is to spend one minute drawing each picture.
3. A pause of 15 seconds is to be taken between each drawing.

Drawing Session

Give the child a piece of plain paper and a box of crayon.

HERE ARE SOME CRAYONS AND PAPER. I AM GOING TO NAME SOME THINGS AND I WANT YOU TO DRAW THEM. WHEN I SAY "STOP," I WANT YOU TO STOP; AND I'LL NAME SOMETHING ELSE FOR YOU TO DRAW. NOW, THE FIRST THING I WANT YOU TO DRAW IS A FLOWER.

Allow one minute for the child to draw the flower.

STOP.

Take the picture of the flower and give the child another piece of paper. Pause for 15 seconds.

NOW I WANT YOU TO DRAW A TABLE.

Allow one minute for the child to draw the table.

STOP.

Take the picture of the table and give the child another piece of paper. Pause for 15 seconds.

NOW THE LAST THING THAT I WANT YOU TO DRAW FOR ME IS A BOAT.

Allow one minute for the child to draw the boat.

STOP.

Take the picture of the boat.

THAT WAS FUN, WASN'T IT? I'M GLAD YOU COULD COME AND PLAY WITH ME.