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Retention of Conservation Acquired by Instructional Methods, Eight Months After Termination of Instruction

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RETENTION OF CONSERVATION ACQUIRED BY INSTRUCTIONAL METHODS, EIGHT MONTHS AFTER TERMINATION OF INSTRUCTION

by

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Wenden W. Waite

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ABSTRACT

Retention of Conservation Acquired by Instructional Methods, Eight Months After Termination of Instruction

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This study attempted to determine if subjects that had been instructed in the principle of conservation, maintained conservation after termination of instructions. Using subjects from kindergarten to third grade that had received instructions by use of both concrete example and mental imagery methods. Those S's that received instructions were compared with S's that had received no instructions. A test of conservation was administered to a total of 96 S's approximately eight months after termination of instructions to determine if the scores received on a test of those students that had received instructions exceeded those S's that had not received instructions.

A statistical analysis of the data indicated that instructions were of no value to kindergarten or first grade students, but that second grade students showed a significant improvement in their ability to conserve after receiving instructions and the third grade group achieved the competence on test performance as their

peers that had exceeded them before instructions were given. The results thus would indicate that instructions could be valuable in acquiring conservation if the S's have reached a certain chronological or maturational level in his development.

(49 pages)

CHAPTER I

INTRODUCTION

Man has always been concerned about understanding and predicting human behavior. The ancient Greeks speculated on the nature of the human mind. In the seventeenth century, philosophers first purposed a realistic inquiring attitude of the mind. Finally, in 1879 Wilhelm Wundt established the first psychological laboratory in Germany (Kagan and Havemann, 1968). The time, from the first inquiry of the Greeks to Wundts first experimental approach to psychology, required many years for the emergence of psychology as a science. Since this time, great advancements have been made in the field of psychology.

Great men such as Wundt, Galton, James, Watson, Thorndike and Darwin, to give tribute to a few, have left their names and contributions in the field of psychology. The effects of these great men have not only contributed to the field of psychology, but have spread to other areas.

It is still premature to place any of today's psychologists in the company of Wundt, Galton, James, Watson and the other great psychologists, but if one could hypothesis, Jean Piaget might very well be one among the greatest. Baldwin (1968, p. 171) revered Piaget as, "The century's most prolific writer and theorist on the development of the child." Sigel and Hooper (1968, p. 2) introduce Piaget by stating, "No other investigator has produced as encompassing and exposition within a developmental framework of the acquisition of

cognitive structures." John H. Flavell compliments Piaget by saying:

> . . . he has given us more information . . . about intellectual development than anyone else has. What Piaget has done is to show us that our mundane and commonplace axioms in the most basic realms of human experience--space, time, causality and so--exist and have aximoatic status only at the end of a complex and highly interesting evolution, not at the onset . . . it will become increasingly hazardous for anyone planning research in the area to ignore his work . . . (Flavell, 1963b, pp. 245-248).

Great men like Piaget not only contribute to their field with their work, but they also open up many new avenues for others to follow. Such is the case with this study. The organization of this study will be presented in six parts:

1. The Introduction: To give tribute to Piaget's work and set the outline of the organization of the study.

2. Statement of Problem: To include the study in question and the steps leading to the origin of the study.

3. Review of Literature: Consisting of a general review of Piaget's theories of conservation and the related studies in this area conducted by those other than Piaget.

4. Research Design: A description of the plan for the study to include the procedures followed, by the objectives and hypothesis.

5. Results of Findings: The results of statistical findings.

6. Discussion: An interpretation of the findings and implications for future studies.

7. Summary and Conclusion: A brief summary and concluding remarks concerning the study.

CHAPTER II

STATEMENT OF PROBLEM

Countless studies and years of research have been conducted in the field of education in an attempt to better define good teaching methods and how a teacher might be most effective in his teaching. Much praise and encouragement is given when a scientific breakthrough or new discovery is made. Often overlooked, however, are the hours of preparation and research which have contributed to the development of the great scientist's thinking capacity or who motivated the individual to such heights of achievement.

James, Thorndike, Ebbinghaus, Pavlov, Hull, Watson, Tolman and Skinner, to give tribute to but a few, have contributed to the investigation of how organisms, including men, learn. Effective learning is a very complex process which involves many factors. Frandsen (1967) lists seven factors that are important in providing structural learning of general verbal-abstract reasoning and problem solving skills. In addition to structural learning, there is incidental learning. Either may effect past or future learning positively or negatively. These are but a few of the problems involved with the complexity of learning and may be one reason why it is so difficult to isolate the problems a human organism has in his development and his learning.

Jean Piaget, a Swiss psychologist, is one of the most colorful individuals of our day in the field of learning. His work, with the development of children and how this development relates to learning, has contributed greatly to the field of psychology and education.

Based on very thorough and scientific observations, Piaget has purposed four distinct, but chronologically successive, models of intelligence. The four developmental stages purposed by Piaget are: (1) The sensory motor period, which starts at birth and continues to about age two. (2) The preoperational thought period, which begins at about age two and continues to about age seven. (3) The concrete operational period, which begins at about age seven and continues to about age eleven. (4) The formal operational period, which begins at about age eleven and continues to adulthood (Ripple and Rockcastle, 1964).

The follow-up work of Piaget's four development stages, has been substantiated by Smedslund (1961), Sargent and Stafford (1965), Ripple and Rockcastle (1964), Inhelder (1966) and others. The aim of Piaget and his followers was to trace the development of intelligence as it comes to deal with increasingly more complex problems or to deal with simple problems in an increasingly more efficient way. One of the major steps involved in the development process is called conservation. This process, consisting of moving from part to whole learning and from self-centered to society centered thinking, is according to Piaget, acquired by the "majority" of individuals somewhere between the pre-operational and concrete operational periods at about age seven.

Piaget is said to have remarked that, whenever Americans are told of a process, one of the first questions is "How can you accelerate it?" (Almy, 1966, p. 42) Piaget does not say that good pedagogy cannot aid the child's mental structure, but sees little sense in intensive, specific training of a task. His feeling is that no learning of significance will occur. Even though a response may be learned it will have little or no value on their general level of

understanding (Ripple and Rockcastle, 1964). Piaget (1964) also cautioned that the ultimate test to determine if a child is conserving or not is determined by the duration and generalization of the concept. Piaget's idea on accelerating instructions is also upheld by others.

> Taken as a whole, the experimental studies that have attempted to accelerate the understanding of conservation in young children who were clearly nonconservers have been rather unsuccessful. On the other hand, they do reveal the complexity of the cognitive processes that are involved in the concept. (Almy, 1966, p. 42)

Wohlwill and Lowe (1962) and Zimles (1963) also concluded that training had no effect on the acquisition of conservation. These studies and more have sustained Piaget's position reference to acceleration of conservation via instructional method, but these views are questioned by others.

Beilin and Franklin (1962) and Lovell and Ogilive (1960) in their studies differ with Piaget in that they believe instruction can contribute significantly in acquiring conservation. Smedslund (1961) and Sweetland (1968) have proposed accelerating conservation through instruction. Richards (1968) concluded that conservation can be taught to the mentally retarded. Sweetland taught students in the Ellis Elementary School of Logan, Utah, and concluded that the students were able to acquire the principle of conservation when taught by two different methods, i.e., concrete example and mental imagery methods.

Thorough review of the literature has failed to reveal any study which has attempted to compare or show that conservation acquired through different methods of instructions is as complete as conservation acquired through "natural" development; furthermore, no

evidence has been found of any studies attempting to test the effects of instruction upon conservation following any considerable period of time when instruction was not given.

Piaget (Ripple and Rockcastle, 1964), in talking of learning of structures, states that learning is subordinal to development and if operational structures are taught they should be able, as those acquired "naturally", to answer three questions: (1) "Is this learning lasting?" (2) "How much generalization is possible?" (3) "In the case of each learning experience what was the operational level of the subject before the experience and what more complex structures has their learning succeeded in achieving?"

It therefore seems logical to assume that if acceleration of conservation is proposed, it should have some follow-up that could attempt to answer the three preceeding questions. The purpose of this study was to locate a study which had attempted acceleration of conservation through instruction and then test it later (8 months in this study). And to determine if it was lasting, had generalized to other areas and compare the operational level of conservation with peers who had acquired conservation naturally.

CHAPTER III

REVIEW OF LITERATURE

William James in 1890 wrote, "to the infant, sight, sound, touch and pain form probably one unanalyzed bloom of confusion" (Tuddenham, 1966, p. 490). Today we can go further and describe in some detail how this "bloom of confusion" of an infant becomes the world of a child. Objects, space, time and causality become coherent organizations. We owe a great deal of this understanding to Piaget and his analysis of childhood development.

For many years, Piaget's work was almost unkown in the United States. Piaget's first significant work with child development was published in 1921. About 10 years later, a flurry of interest appeared in the United States, but it was not until about 1955 that Piaget's theory was actively studied in the United States.

There are many different approaches that might be taken in explaining Piaget's theory. I have selected to approach it from a developmental standpoint and include the vocabulary terms used by Piaget in the appropriate developmental stages. There is no general agreement on the number of stages used to define Piaget's theories. For example, Berlyne (1951) and Maier (1965) talk of five stages: (1) the sensory motor stage; (2) the preconceptual stage; (3) the intuitive thought stage; (4) the concrete operations stage; and (5) the formal operations stage.

Segil and Hooper (1968) and Dodwell (1963) includes the intuitive

thought stage with the preoperational thought stage and defines four periods of cognitive development: (1) the sensory-motor period; (2) the properational thought period; (3) the concrete operations period; and (4) the formal operational period.

Piaget, himself, in his most recent visit to the United States in March 1964 to Cornell University, spoke of four stages of cognitive development (Ripple and Rockcastle, 1964): (1) the sensory motor or pre-verbal stage; (2) the preoperational stage; (3) concrete operations stage; and (4) formal or hypothetic-deductive operations stage.

Flavell (1963a), in his analysis of Piaget's theory presents only three stages of cognitive development: (1) the period of sensory motor intelligence; (2) the period of preparation for an organization of concrete operations; and (3) the period of formal operations. In reviewing Piaget's theory of cognitive development the writer will follow the four periods as outlined by Piaget himself at Cornell in March 1964 (Ripple and Rockcastle, 1964).

The review of the four stages outlined by Piaget (Ripple and Rockcastle, 1964) will be synoptic and will in no way attempt to discuss the development of a child in detail. The purpose of the general review is merely to acquaint the reader with a general theory of child development as outlined by Piaget.

Before any overview of Piaget's theory can be discussed, there are some terms which must be defined. The terms requiring definition at this point include: schema, assimilation, accommodation, and egocentrism. A schema is an "active process" (Flavell, 1963a, p. 56) or a "psychological unit of behavior" (Maier, 1965, p. 96). The schema in man parallels the biological structure viewpoint necessary

in animals for their survival. The identity of structures at each age level and how they adapt to environmental demands and how in turn they effect the environment are functions of the schema. For example, by walking, a childs able to obtain goals otherwise unattainable. This new schema also allows the child access to new goals that he would not have otherwise had (Baldwin, 1968). A schema generally includes a variety of acts under different circumstances, not just a specific response to a specific stimuli. In summary, Flavell (1963a) states, the schema refers to a class of total acts, acts distinct from one another yet sharing common features.

Assimilation is two or more schemas, which have developed independently then unite to form a new pattern. It is somewhat akin to the process of generalization and discrimination. Accommodation is another adaptation process that allows the organism to become able to manage situations that are at first too difficult (Baldwin, 1968). Accommodation requires new activities to change old ones and could be equated to the process of differentiation.

Piaget uses the term egocentrism widly. It is used to denote that state in infancy and early childhood in which the child sees reality in only one persective--his own (Sweetland, 1968). Reality for the egocentric mind is destorted, lacks dimension and tends to be flat (Piaget, 1952).

The first state of development explained by Piaget is the sensory motor or preverbal stage. This stage begins at birth and continues until the child reaches 18 to 24 months. This stage involves a great deal of change in growth and development of a child and is thus divided into six additional sub-periods to more adequately

cover the development that occurs during the first two years of life (Piaget, 1952; Flavell, 1963a; Baldwin, 1968).

The first subphase of this period is from birth to about 1 month and is called the reflexive stage. Reflex meaning a rigid, predictable response. The first reflexive response in the infant is sucking (Piaget, 1952). In this stage, Flavell (1963a) sees the absence of intelligent behavior and sees assimilation and accommodation as undifferentiated.

Out of the reflexive stage, the child grows into the primary circular response stage, lasting until about the fourth month. An example of a circular response is thumbsucking. This is an adaptation beyond the reflex or basic schema to accommodate new experiences into the environment. This process causes the infant to repeat responses even though they may be non-intentional and form basic habits (Maier, 1965). The secondary circular reaction phase covers the periods from 4 to 8 months. This subphase sees the child beginning to make intentional adaptations. This stage seems to occur when a desire for gratification preceedes the act. It also extends beyond the child himself to his environment. It is actually the first real exploration of the outside world (Flavell, 1963a).

Substage four, 8 to 12 months, is called the coordination of secondary schema and it's application to new situations. During this phase the child begins to utilize familiar schemes as a means to an end. He now can execute old behavior patterns in new situations.

Substage five, the tertiary circular reaction stage, lasting from 12 to 18 months, sees the child discovering new "mean schema."

This occurs after the child has established his mode of operation.

The behavior pattern differs from the means to an end in substage four in that coordination of two schemas now appear in place of separate schemas themselves. This substage finds the child adjusting to his environment through trial and error. In substage six, 18 to 24 months, invention of new means evolve through active participation in mental combinations. This stage resembles substage five, but is unique in that in substage five new solutions were obtained through overt trial and error. Substage six sees internalization of solutions by covert means. Piaget refers to this as "symbolic images" (Flavell, 1963a, p. 120). To summarize the sensory-motor period of development with it's six substages Baldwin (1968, p. 220) states:

> At first his behavior is limited to those reflexes with which he is born, although even those are modified and expanded through experience. Then he begins to acquire new schemas that are extensions of these reflex patterns but have new end results. By Stage 3 he can acquire completely new behavior patterns which occur accidently in the course of random movement and reproduce or prolong an external event. In Stage 4, the child becomes capable of genuinly intentional activities and can put together sets of schemas in a means-end relationship using his schemas much more freely and flexibly, and in a more mobile manner. Stage 5 is marked by the appearance of intentional variation of behavior to produce new behavior; and finally Stage 6 is characterized by the possiblity of mental representation.

The second period of development, according to Piaget, is the preoperational thought period beginning at about two years and continuing to about the seventh year. During this period the child begins to develop the "symbolic functions" that enable him to apply past experiences to his present situations. He also forms classes of of objects like dogs and cats which are grouped as animals. Although

these generalizations are made, he cannot assimilate from past experience (Morgan and King, 1966).

Conceptualizations prevent decentering from occuring as much as it did in the previous period (sensory-motor). During the period of preoperational thought the child develops "mental imagery." This is referred to by Baldwin (1968) as the first step in cognitive representation. This initates a variety of representative schemas, some because of verbal development, while others remain somewhat subjective and symbolic. The development of concepts occurs in a piecemeal fashion and oscillates between logical coherent structures and concrete intuitive stages. A good example of this is shown when a child is presented with identifying the amount of beans placed in a concealed glass. This is done by showing a child two piles of beans with an equal number of beans in each pile. The child then watches while a bean is placed in a jar he can see and beans from the opposite pile are placed in a jar screened from his sight. The second jar, not visible, is of different dimensions (either taller and thinner or shorter and fatter). A child in the preoperational stage of development will answer that both containers have an equal number of beans in them as long as he can't see them both, but will change his mind if the containers are made visible again; because he sees the taller thinner container as having more beans because they are higher (Bruner, 1964). The older child or the adult does not care how the beans look in the new container. The relevant data are in the original equality and in the transference. The older child is able to evaluate all relevant data and is not handicapped in seeing only one dimension of the problem as is the

preoperational child.

Piaget believes that the preoperational child is revealing the lack of reversibility in his schema when he fails the invariance problem. The child does not realize that the beans can be transferred back into their original pile (Baldwin, 1968).

The third period to evolve is the concrete operations period appearing at about age 7 and lasting until about age 11. In this stage the first operations appear, but they operate on objects and cannot be hypothesized verbally.

One very important part of Piaget's work, which this study will deal with, is the acquisition of conservation by using instructional methods. Conservation is the acquisition of structures that seem to follow from a developmental process. It becomes established in about 50 percent of the children between the preoperational and concrete operational periods. It is a process which bridges the gap between the two periods and occurs at about age 7. Prior to age 7, if the average child is shown two balls of clay of the same mass and watches while one is distorted into a sausage shape, he will answer that the sausage now has less clay in it because it is thinner or there is more clay in the sausage because it is longer. The non-conserving child sees only one dimension and the image of the dimension he sees takes presidence over his reasoning ability. This is the same deficient process mentioned earlier with the beans. A "conserver," on the other hand, considers all dimensions in the plane and can reason that the mass of clay remains unchanged when it's shape is distorted (Berlyne, 1951). The "conserver" has a more effective approach to problem solving because he can conceive

and perceive a more complex problem correctly because he is able to conceptualize the reversal process. He has obtained reversibilty. This suggests acceleration of acquiring the principle of conservation would enable more complete, or earlier completion, of more effective problem solving methods. This would be possible because the child would have more structures in operation to utilize in solving problems.

In addition to the difference that exists in reversibility, the difference between the concrete operational and pre-operational stages is, that the child in the concrete operations stage has acquired not only representational thought but has developed well defined cognitive systems which the child in the preoperational stage lacks. This is exemplified in the process of conservation.

If the child can integrate all of the rules of grouping into a congnitive structure, then the child can tolerate and integrate an increasingly complex number of points of view. In the concrete operations stage, he can achieve conservation, become less egocentric, and even become somewhat logical. By decreasing centration and gaining in the ability of abstraction, the child becomes capable of utilizing more symbolic manipulations in his environment.

One of the significant aspects of concrete operations is to be discovered in the term "operations" itself. An operation is achieved when a level of cognitive sophistication is reached. Operations signify that the child is cognitively functioning in closely knit mental totalities; structure has been achieved and regulates or balances assimilation and accommodation (Sweetland, 1968).

Berlyne (1951), and Maier (1965) suggest several major characteristics of cognition during this phase of development. One, the "awareness of reversibility" is gradually achieved. This allows the child to return to the starting point of a mental operation.

Two, equilibration now pervades his mental functioning, where, in the past, the child was dominated by assimilation or accommodation, he is now capable of considering alternate solutions to a problem without the necessity of committing himself to anyone (Flavell, 1963a).

Third, the child becomes aware of the logic of conservation, the order of conservation is mass (7 to 8 years), weight (9 to 10 years) and volume (11 to 12 years) (Sigel and Hooper, 1968).

Fourth, the child's concept of time, prior to the concrete operations stage, limited to "before" is now expanded. He now not only considers before and after, but develops the concept of past, present and future.

In summary, the period of concrete operations is the time in which a child acquires an understanding of a variety of groupings dealing with observations of concrete events present in the environment (Baldwin, 1968).

The period of formal operations, beginning at about age 11 and continuing to age 15, is the period in which the child reaches his full adult intelligence in all areas of mental functioning. He can engage in abstract thinking, which extends the realms of reality beyond those things visible. The child can now consider many ideas without being committed to anyone and has entered the realm of intellectual maturity. The child can now reason on hypothesis. He is

capable of constructing preoperational logic and not just the operations of classes, relations and numbers (Ripple and Rockcastle, 1964).

CHAPTER IV

RESEARCH DESIGN

Procedures

Method

The population for this study was drawn from kindergarten, first, second and third grade students from the Ellis Elementary School in Logan, Utah. From this population a sample of 96 students was used that had previously been assigned to four different groups (Sweetland, 1968).

1. Groups 1 and 2 consisted of 30 and 34 students, respectively, a total of 64 students. The subjects for these two groups were randomly assigned from a group of 26 students, 16 from each grade, kindergarten, first, second, and third grades. The parameters for these two groups consisted of scores of three or less from a total of 12 questions in conservation administered by Sweetland. This score constituted a failure and defined the population from which Groups 1 and 2 were assigned. These two groups of students from each grade received instructions in conservation by two different mentods, i.e., concrete example (Group 1) and mental imagery (Group 2).

2. Group 3 consisted of 14 students; 3 from grade one, 4 from grade two and 8 from grade three, who were eliminated from the teaching study because they had acquired conservation through natural development prior to Sweetland's study and instructions on conservation. Their assignment to Group 3 was determined by passing a pretest ad-

ministered by Sweetland. A score of 9 or more from a total of 12 questions constituted a pass.

3. Group 4 consisted of 18 non-conserving students; 8 from kindergarten, 4 from grade one, 5 from grade two and 1 from grade three, who had failed the pretest and were not randomly assigned to an instructional group. The total of 96 students included in the study is 6 less than the original number of 102 due to moves away from the school during the year.

The data for the analysis of variance, were compiled from the scores received on a test of conservation. These scores were analyzed together as a group, all grades, and between each grade separately. The test was administered on four different days, and followed a similiar method established by Sweetland (1968). Testing was conducted in a teacher's workroom and a small storage room, both of which were well suited for test administration. All doors were closed so that no outsiders could observe the subjects being tested. The testing was conducted individually and administered by the author. Each subject was seated at the end of a table, size 3 feet x 7 feet, and the examiner was seated adjacent to the subject. Materials used in the test were arranged in a chair next to the examiner and out of the view of the subject.

There was no time limit placed on testing: the examiner was cautious not to require any subject to answer the problems presented before he was ready. The average time for each pretest was twelve minutes.

The examiner recorded the scores given by the subject, out of view of the subject. For each question correctly answered, the

subject received one point. No points were given for incorrect anwers.

The nature of the test will be described subsequently. One grade was tested each day with the order of testing being third, first, second and kindergarten in that order. This was the same order used by Sweetland (1968) when he administered his test eight months earlier. All students were tested by the author and all tests were administered before the author had knowledge of which group each subject was assigned. This provided an unbiased test. The test administered consisted of 10 questions on conservation. Each test required from 10 to 15 minutes to administer, thus requiring 4 to 5 days to perform the testing. The test was constructed by the author utilizing standard conservation problems as outlined in Ripple and Rockcastle (1964) (see appendix). A different test than the one utilized by Sweetland (1968) was used to establish an adequate ceiling for second and third grades. This was considered necessary because of the time lapse in the two tests. When this study was conducted, the average second and third grade student was over 7 years of age. This is the point when 50 percent of the children acquire conservation "naturally," so two more difficult questions were used to help establish the ceiling level.

Groups 3 and 4 served as control groups for this study. Group 3 consisted of the subjects from each grade with the exception of kindergarten that passed the pretest administerd by Sweetland (1968) and Group 4 is the group from each grade, with the exception of the third grade, that failed the pretest

administered by Sweetland (1968) and were not randomly assigned to one of the instructional groups.

The comparison of all four groups should answer at least two questions related to this study: Are the groups that received instructions, Group 1 and Group 2, now after an eight-month period, conserving as well as the group which was conserving prior to the instructional period, Group 3, and which received no instructions on conservation? Has the group which failed Sweetland's pretest and received no instructions in conservation, Group 4, (Sweetland, 1968) gained, over an eight-month period, as much in their ability to conserve as the group that received instructions in conservation, Group 1 and Group 2?

Data

The questions on the examination included questions of both concrete example and mental imagery. That is question analyzing the problem with concrete objects such as water and clay which the subject could manipulate and watch as the questions were asked (concrete example) and questions requiring the subject to visulize mentally the transformations of materials (mental imagery). The questions were interchanged, so the concrete example questions and mental imagery questions were interspensed. The results of the test were scored in percent correct and analysis of variance was conducted to determine the relationship between groups.

Method of evaluation

Each question was marked either correct or incorrect, out of

the sight of the subject to prevent any effect that might occur from feedback.

Question 1, was presented concretely and repeated imagerally in Question 7. The subject was shown two glasses of equal size and the examiner said, "Watch what I do," then filled the two glasses with equal amounts of water and asked, "Where is there more water?" This question, "Where is there more?" was asked throughout the test because it required the subject to make a statement without guessing, since this question required the subject to respond that neither had more water. If the correct response was not obtained, the student was corrected until it was certain that he understood they were the same. Then the contents were poured into different size containers. One approximately twice as high as the other and the tall container was about one-third as large in diameter as the other. The subject was then asked, "Now where is there more water, or are they the same?"

When this question was presented as Question 7 in imagerial form, the examiner said to the subject, "I want you to imagine two glasses the same size, then a glass taller and thinner than the two and one shorter." Then using his finger to indicate sizes, the examiner described the containers, the rest of the question was followed talking through the problem.

Question 2 was presented imagerially and repeated concretely in Question 6. The examiner began by saying, "I want you to imagine two big balls of clay the same size. And two little balls of clay the same size, show me how big they are. Now I'll mash this little ball into the big ball and the other little ball into the other big

ball. Which ball now has the most clay in it, or are they the same?"

When the question was presented concretely, the examiner began by saying, "I have two big balls that are just the same size and two little balls that are just the same size. Watch what I do." The examiner then mashes each of the little balls into the big balls and askes, "Which ball now has the most clay in it, or are they the same?"

Question 3 was presented concretely and repeated imagerially in Question 9. The subject was shown two sheets of paper of equal size, 3 x 36 inches and asked, "Where is there more paper?" (Assures S knows they are the same) Then continues by saying, "Watch what I do." The examiner then folds one paper in five folds and replaces it by the other paper and asks, "Where is there more paper, or are they the same?"

When the question was presented imagerially in Question 9, the examiner said to the subject, "I want you to imagine two sheets of paper the same size." Then using his fingers to outline the size the examiner preceeded through the rest of the problem talking through the question. Question 4 was presented as a paper and pencil test (see appendix) and was one of the questions used to establish the ceiling for the test. The instructions given were to present the subject with a copy of the diagram and say, "See these two roads are both one mile long, one is straight and the other is crooked, it goes through the mountains. I am going to travel along this road which is crooked and goes through the mountains and then you travel along your road exactly the same distance as I do." The examiner then made a mark at the end of the upper diagram and then handed the pencil to the subject so he could mark his response.

Question 5 was presented imagerially and repeated concretely

in Question 10. The examiner began by saying, "I want you to imagine two rows of peppermints the same length with the same number of peppermints in each row (five); show me where they are on the table. Now, if I take two from the middle of this row and place them on the end of the row which row will have the most peppermints, or are they the same?" When the question was presented concretely the examiner proceeded using actual peppermints and ommitting, "I want you to imagine," from the instructions.

Question 8 was presented concretely and used as one of the two questions used to establish a ceiling in this test. The subject was shown two strings of equal length (approximately 3 feet long) and two small toy race cars, one red and one blue. The subject was then told, "These two cars are going to travel down these two roads. This car (the red one) starts here, approximately half way down the 3 foot string, and this one (the blue one) starts here, near the end of the 3 foot string." The cars were then both advanced almost to the end of the strings with the red car approximately one car length ahead of the blue car. This resulted in the blue car moving almost twice the distance of the red car. The subject was then asked, "Which car went the fartherest?"

Objectives

The objectives of this study were: (1) To determine if the principle of conservation can be acquired by instructional method and if so, will this conservation be maintained after termination of instruction for approximately eight months. Also, to determine if students receiving instructions in conservation eight months

previously are presently conserving as well as students who have acquired the principle of conservation by the natural developmental process as determined by pre-test scores, and did not receive instructions in conservation. (2) To determine if students receiving instructions in conservation eight months previously are presently conserving significantly more than subjects who were equal to them, as measured by a pre-test eight months previously, but did not receive instructions in conservation.

Null Hypothesis

There will be no significant difference in test scores within each grade between the concrete example (C) Group 1, mental imagery (I) Group 2, pass (P) Group 3, or fail (F) Group 4.

The purpose for this chapter was to outline procedures including a description of the test instrument used and brief comments concerning the methods and procedures of testing. This was followed by the objectives of the study and the hypothesis that was tested.

CHAPTER V

RESULTS OF FINDINGS

This section deals with the statistical analysis of the null hypothesis obtained for the study from test scores, on a test of conservation designed and administered by the author. The results were analyzed at the computer center at Utah State University.

Although this study attempted to answer only one hypothesis, there were several dimensions that had to be measured in order to satisfactorily answer the question posed in the hypothesis. As mentioned before, the students tested were previously shown to have improved in their ability to conserve, as measured by pretest and posttest scores, 25¼ percent after receiving instructions on the principle of conservation (Sweetland, 1968).

The hypothesis for this study was designed to evaluate the significance of this increase, eight months after termination of the instructions. Table 1 compares the scores obtained by four different groups of students in the Ellis Elementary School of Logan, Utah. Groups 1 and 2 consisted of those students who showed a 25¼ percent increase due to teaching conservational materials by Sweetland (1968). Groups 3 and 4 received no instructions and were either conserving (Group 3) or not conserving (Group 4) at the time Groups 1 and 2 received instructions.

The results of Table 1 are a compiled score of all groups at different age levels and was included to show relationships between all groups.

Table 1. Comparison of scores of four different groups of students from kindergarten to third grade

Groups	Number	Mean score	Standard deviation
All groups	96	56.94	27.6
Group 1	30	62.55	33.8
Group 2	34	60.29	37.1
Group 3	14	78.00	23.0
Group 4	18	19.41	23.8

Table 2 is an analysis of variance of the four different groups combined.

Table 2. Comparison of groups kindergarten through third grade for all grades

Source of variance	df	MS	F
Groups	3	10762.28	12.3**
Error	90	1051.82	

**Significant at 1 percent level.

The results of this analysis of variance shows a significant difference in groups at the 1 percent level. Further analysis of this significance will be explained later in the analysis by grade level.

In the further analysis by grade level, we see the results from Table 3 through Table 6 presenting the scores obtained by the four

different groups assigned by Sweetland (1968).

Table 3. Comparison of scores of four different groups of students in kindergarten

Groups	Number	Mean score	Standard deviation
All groups	24	19.17	19.8
Group 1	7	27.14	26.2
Group 2	9	16.67	26.5
Group 3	0[a]		
Group 4	8	15.00	20.0

[a]There were no kindergarten students who passed the pretest given by Sweetland.

Table 4. Comparison of scores of four different groups of students in grade one

Groups	Number	Mean score	Standard deviation
All groups	23	56.09	38.1
Group 1	8	53.65	38.4
Group 2	8	62.50	39.5
Group 3	3	62.50	34.0
Group 4	4	36.67	46.2

Table 5. Comparison of scores of four different groups of students in grade two

Groups	Number	Mean score	Standard deviation
All groups	25	68.40	30.7
Group 1	8	83.75	12.0
Group 2	8	77.50	23.8
Group 3	4	82.50	17.0
Group 4	5	18.00	14.8

Table 6. Comparison of scores of four different groups of students in grade three

Groups	Number	Mean score	Standard deviation
All groups	23	85.65	19.20
Group 1	7	86.43	7.6
Group 2	9	85.29	7.2
Group 3	7	84.29	16.0
Group 4	0[a]		

[a]There was only one student in the third grade that failed Sweetland's pretest that was not included in Groups 1 and 2. Due to this fact, Group 4 was not included at this grade level.

The hypothesis stated was that there would be no significant difference in the four groups tested as determined by their scores on a test of conservation. Tables 7 through 8 present a further breakdown of Table 2 and summarize the analysis of variance between the four different groups within each grade level as defined in this study.

Table 7. Comparison of groups within kindergarten

Source of variance	df	MS	F
Groups	2	317.2119	< 1
Error	18	658.2422	

Table 8. Comparison of groups within grade one

Source of variance	df	MS	F
Groups	3	825.7268	< 1
Error	17	1490.678	

Table 9. Comparison of groups within grade two

Source of variance	df	MS	F
Groups	3	5409.746	15.3**
Error	17	352.9446	

**Significant at 1 percent level.

Table 10. Comparison of groups within grade three

Source of variance	df	MS	F
Groups	2	1.864651	<1
Error	17	95.78442	

An analysis of the preceding data shows that the null hypothesis can be rejected since there was a significant difference at the 1 percent level in the groups at grade two. The results indicate that the group which did not receive instructions in conservation and were not conserving at the time (Group 4) fell behind the other three groups on scores obtained on a test in conservation. This would suggest that the instructions received by Groups 1 and 2 did have an effect on students in the second grade in obtaining the principle of conservation.

CHAPTER VI

DISCUSSION

The results obtained from this study follow one aspect of the development of the child as defined by Piaget. Sweetland (1968), in his dissertation, recommended that a follow-up study be carried out to determine how lasting conservation is when acquired by instructional methods. This recommendation was made because, to my knowledge, there was no such data of this type available. Sweetland recommended retesting from 15 to 30 days after termination of instruction. This study went well beyond this time period to extend to approximately 180 days after Sweetland completed his work. Recoginizing the factors of history and maturation that may effect the test results over this period of time, it was controlled for by the random assignment made to the different groups used in the study.

The test results obtained for each of the four grades involved are consistent with Piaget's findings as far as the acquisition of conservation by children is concerned. Piaget states (Ripple and Rockcastle, 1964) that where a question is said to be solved by a seven-year-old, one-half of the six-year-olds can solve it, and one-third of the five-year-olds can solve it. This could be considered analagous to the percentages of scores in the different grades, i.e.:

The mean percent of kindergarten subjects was 19.16.

The mean percent of first grade subjects was 56.08.

The mean percent of second grade subjects was 68.08.

The mean percent of third grade subjects was 85.65.

The results show a progressive increase in the acquisition of conservation of different age levels and varies from 19.16 at kindergarten to 85.65 at third grade. The statistical results of this study reveal no significant sex difference in ability to conserve. Furthermore, when Sweetland gave instructions on conservation to this group of subjects, he used two different methods of instruction. Group 1 was instructed using the concrete example methods and Group 2 received instructions by the imagerial method. There was no significant difference between these two instructional methods.

In kindergarten, all three groups used failed Sweetland's pretest and approximately eight months later there was no difference in the two groups which received instruction and a group that received no instructions in conservation. This would tend to confirm Piaget's hypothesis that children are about seven-years-old before they begin to conserve, and teaching has little effect on the individual prior to this age. The child at kindergarten, Piaget would say, is lacking in either one or all of the following elements necessary for learning: maturation, experience, social transaction or equilibration. He may learn a correct way of responding to test items but does not actually conserve (Ripple and Rockcastle, 1964).

The first grade students showed no significant difference in groups tested, but the mean scores of the groups were more varied than the kindergarten students.

The second grade students showed the greatest variation in group scores and this variation was statistically significant at the 1 percent level. This suggests that students in the second grade of the Ellis Elementary School of Logan, Utah, did improve from their instructions in conservation. This, at first appearance, would be inconsistent with Piaget's theory, but a closer and more thorough examination might find this to be one of the findings Piaget would predict and is the purpose and objective of all good pedagogy. This assumption is based on the fact that Piaget would certainly say these students should be mature enough, would be capable of equilberation and have adequate opportunity for social transaction. The instruction provided by Sweetland should then give them enough exposure to the fourth requirement, experience, that Piaget mentions (Ripple and Rockcastle, 1964). The instruction should have provided the students in the second and third grades, who were not conserving, with a chance for discovering and confirming some of their hypothesis revelant to conservation.

The third grade students showed no significant statistical difference. This was compared between the two instructional groups and a pass group (Groups 1, 2 and 3). There was no Group 4 in the third grade, since only one student failed the pretest at the third grade level that was not included in the instructional groups (1 and 2). From this it could be concluded that these students were taught conservation or acquired it "naturally" or a combination of the two.

Table 2 is an analysis of variance of all groups in all grades and showed significant results. This is what one might expect since there was a significant difference at one grade level (second grade)

and the results would tend to be maxiumized because their were no pass subjects at kindergarten and only one fail subject at the third grade.

The test used for this study was constructed by the author. It was decided that a test differing from that used by Sweetland would be of more value in analyzing the results of the study since Groups 1 and 2 had already been exposed to Sweetland's test on two different occasions (pretest and posttest). The new test was constructed and administered to give each group equal opportunity in performing and to prevent any responses from being recalled from previous tests. The questioning technique used was the same method used by Sweetland, it consisted of asking the subject a directional question such as, "Which one now contains more?" This question was asked after the subject witnessed a change in the form of the clay or transfer of water, etc. This presentation is somewhat misleading, indicating falsely that one of the two objects contained more substance than the other. This, however, required the subject to make a rejection of the one possibility suggested and to formulate an independent decision. This method, in the opinion of the author, provides a more accurate measure of the subject's understanding of conservation.

There are several ways this study could be improved and it should be repeated to add reliability to the results obtained in this study. The main area for improvement could be to increase the number for the four different groups at each grade. This would be valuable in increasing the external validity of the study. This could further be increased by using more schools in different areas.

Variations of this study would be valuable as research to add more results to the scant information in this area.

CHAPTER VIII

SUMMARY

The purpose of this study was to investigate the possibility of accelerating the principle of conservation through instructional methods. A group of students from the Ellis Elementary School of Logan, Utah, were used as subjects. The group of subjects used had been selected previously for a dissertation study by Sweetland (1968) and part of the group had received instructions on the principle of conservation. The question this study attempted to answer is: "Did the subjects that received instructions from Sweetland maintain the improvement they appeared to gain from the instructions eight months after the instructions were terminated?" The results tend to indicate that the instructions were beneficial if the child had reached a given maturational level. The results showed no significant improvement in the groups receiving instruction on conservation over groups that had no instruction in conservation until the second grade. This is consistent with Piaget's theory which would indicate about seven or eight years is the age when the majority of students are conserving. The instructions given by Sweetland, on conservation, seemed to increase the ability of those who received the instructions when they reached the age of about eight years, but prior to this time no statistical significant difference was found. From the results obtained, it may be concluded that the acquisition of conservation

depends on more than exposure to this principle through instructional method and the four requirements mentioned by Piaget (Ripple and Rockcastle, 1964), i.e., maturation, social transmission, experience and equaliberation cannot all be acquired through instructions. A child must have a certain sophistication obtained in part by maturation in order to conserve.

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APPENDIX

Appendix A

Test of Conservation

1. Glasses of different sizes (concrete)

Say, "Watch what I do," then fill two glasses of equal size with equal amounts of water and ask, "Where is there more water?" (Correct the student and assure he understands they are the same.) Then, pour the contents into different size containers and ask, "Now where is there more water?"

2. Clay balls (imagery)

Say, "I want you to imagine two balls of clay the same size and two little balls the same size; show me how big they are. Now, I'll mash this little ball with the big ball. Which ball now has the most clay in it? This one or this one?"

3. Paper 3 inches x 36 inches (concrete)

Show two equal sheets of paper and say, "Where is there more paper?" (Assure the subject knows they are the same.) Say, "Watch what I do." Fold one paper in five folds and replace by the other paper and ask "Where is there more paper?"

4. The diagram  (concrete)

Present the subject with a copy of the diagram and say, "See these two roads are both 1 mile long, one is straight and the other is crooked, it goes through the mountain. I am going to travel along this road which is crooked and goes through the mountains and then you travel along your road exactly the same distance as I do."

5. Peppermints (imagery)

Say, "I want you to imagine two rows of peppermints the same length with the same number of peppermints in each, show me where they are on the table. Now if I take two peppermints from the middle of this row and place them on the end of the row; which row, now, has the most peppermints in it?"

6. Four balls of clay, two large and two small (concrete)

Say, "I have two big balls that are just the same size and two little that are just the same size. Watch what I do." Mash each of the little balls into the big balls, and ask, "Which ball is now the largest?"

7. Glasses of different sizes (imagery)

Used directions as given in #1 adding, "I want you to imagine."

8. Distance (concrete)

Present the subject with two strings with cars of different colors on each, and say, "These two strings are roads for each car. They are going to have a race, one car starts here and the other car starts here. The red car goes to here, and the blue car goes to here, which car has traveled the farthest?"

9. Paper fold (imagery)

Same directions as given in #3 adding, "I want you to imagine."

10. Peppermints (concrete)

Same directions as given in #5 omitting, "I want you to imagine."

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