

**THE EFFECT OF TEMPORARY OWNERSHIP ON THE EXPRESSION
OF QUANTITY CONSERVATION**

A Thesis

Presented to

the Department of Psychology

Kansas State Teachers College of Emporia

In Partial Fulfillment

of the Requirements for the Degree

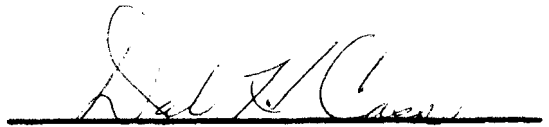
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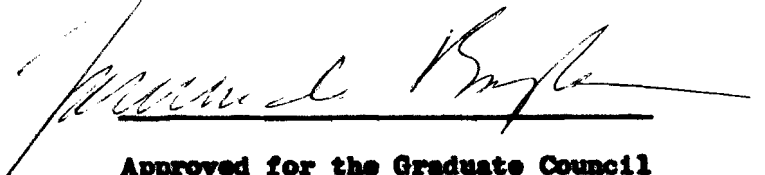
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Chapter 1

THE PROBLEM AND DEFINITIONS OF TERMS USED

The process of mental development has been studied extensively by Jean Piaget. Piaget has identified stages within the overall developmental process, each recognizable by unique characteristics. This contribution of the stage construct, as well as stage definitions, has greatly influenced developmental psychology.¹

Three major stages of mental development have been identified: pre-operational, concrete operational, and formal operational. Transition to the concrete operational stage is seen as marking the beginning of the early use of logic. Early logic is apparent as the concrete operational child views situations conceptually rather than perceptually. Conservation is the term used to describe this change from a perceptual to conceptual frame of reference.²

Piaget attributed development of mental processes to adaptation which is viewed as requiring a balance between assimilation and accommodation. Thus, if adaptation is to occur, information entering thought processes must do so at a rate which allows the prevailing thought

¹Irving Sigel and Frank Hooper (eds.), Logical Thinking in Children: Research Based on Piaget's Theory (New York: Holt, Rinehart and Winston, Inc., 1968), p. 2.

²Arthur T. Jersild, Child Psychology (Englewood Cliffs: Prentice-Hall, Inc., 1968), p. 446.

structure to incorporate it.³ Successive and more sophisticated adaptations which occur throughout mental development demonstrate the principle of equilibration.⁴

THE PROBLEM

Conservation has been defined as a type of thought process which allows the expression of understanding concerning a relationship in spite of existing perceptual distortions. Since the concrete operational stage is often characterized by a gap between the presence and the expression of conservation, conservation must be overtly displayed in order to be evaluated.⁵

Research has indicated that conservation is not fully developed at its onset, but is initially expressed in intermittent form. As the use of conservation becomes more established in the thought processes, it is expressed more regularly. Finally, mature thought processes include frequent expression of conservation.⁶

Piaget has indicated that behavior is dependent upon both cognitive and affective factors. Since the expression of conservation is a manifestation of behavior, it, too, depends upon the cognitive and

³Jean Piaget, Six Psychological Studies (New York: Random House, 1968), p. 8.

⁴Ibid., p. xxii.

⁵Jean Piaget, Judgment and Reasoning in the Child (Totowa, New Jersey: Littlefield, Adams and Co., 1969), p. 214.

⁶Irving Sigel and Frank Hooper (eds.), Logical Thinking in Children: Research Based on Piaget's Theory (New York: Holt, Rinehart and Winston, Inc., 1968), p. 9.

affective demands of the situation.⁷ In early conservation, expression might be inhibited or facilitated if the cognitive aspects of the situation are held constant and the affective demands are varied.

The present study presented a situation in which the cognitive level of difficulty was held constant and the affective aspects were varied. To alter the affective demands of the situation, temporary ownership was introduced to amplify personal involvement. In this way, the effect of affective demand on the expression of conservation was determined.

Statement of the Problem

Does temporary ownership of one of two compared objects affect the expression of conservation concerning those objects? Does the effect on the expression of conservation of temporary ownership of one of two compared objects used in the conservation task remain constant among males and females at the midpoint age level of quantity conservation? That is, do males and females with moderately developed expressions of conservation respond similarly under the condition of temporary ownership?

Statement of Hypotheses

The following hypotheses were tested at the .05 level of significance to determine possible effects of temporary ownership upon the expression of conservation: (1) temporary ownership of one of two compared objects by children at the approximate midpoint age level of quantity conservation (mass, weight, and volume) does not significantly

⁷Jean Piaget, Psychology of Intelligence (Totowa, New Jersey: Littlefield, Adams and Co., 1966), pp. 4-5.

alter the expression of conservation concerning those objects; (2) there is no significant difference in the amount of expressed conservation between males and females at the approximate midpoint age level of quantity conservation; (3) the effect of temporary ownership of one of two compared objects on the amount of expressed conservation concerning those objects does not differ significantly between males and females at the approximate midpoint age level of quantity conservation.

Purpose of the Study

The purpose of the present study was to determine if varied affective involvement, as introduced through the condition of temporary ownership of one of two compared objects, had a significant effect upon the expression of conservation concerning those objects. The study further purposed to examine possible differential effects of that condition between males and females whose ages corresponded to the approximate midpoint age level of quantity conservation.

Significance of the Study

The present study investigated the possibility that situations which demand a greater degree of affective involvement may interfere with or accelerate the manifestation of conceptual thinking. Concepts which are moderately established in the thought processes may be most efficiently expressed under certain degrees of affective involvement. For example, if this were applied in the school setting, the teacher who presents material for development of concepts might examine the degree of affective involvement possessed by the students. Students may learn and express concepts most efficiently at some optimal level of affective involvement.

DEFINITION OF TERMS

Terms used in the present study are listed below.

Center. The perceiving of only one dimension of an object or situation without regard for other existing dimensions.⁸

Concrete operations. A thought process based on elements of logic, displaying the process of grouping.⁹

Conservation. Thinking coordinated to permit the understanding that certain properties remain invariant in spite of physical transformations.¹⁰

Decenter. The ability to perceive and understand more than one dimension of an object or situation simultaneously.¹¹

Equilibration. The principle that mental growth progresses toward more complex and stable levels of organization.¹²

Grouping. A coordinated internalized series of operations from which logical thinking may be derived.¹³

⁸J. H. Flavell, The Developmental Psychology of Jean Piaget (Princeton: Van Nostrand Company, Inc., 1963), p. 167.

⁹Jean Piaget, Psychology of Intelligence (Totowa, New Jersey: Littlefield, Adams and Co., 1966), p. 140.

¹⁰Flavell, op. cit., p. 245.

¹¹Ibid., p. 203.

¹²Jean Piaget, Six Psychological Studies (New York: Random House, 1968), p. xxii.

¹³Jean Piaget, Psychology of Intelligence (Totowa, New Jersey: Littlefield, Adams and Co., 1966), pp. 36-37.

Horizontal decalage. Repetition within a period of development. In the present study this referred to mass, weight, and volume conservation within quantity conservation.¹⁴

Mass conservation. The insistence that the amount of substance of an object remains invariant despite its physical shape.¹⁵

Midpoint age level of quantity conservation. The age of the subjects used in the present study which was at the nine to ten year level. This corresponds to an age midway through the reported quantity conservation sequence which extended from ages seven to approximately twelve.¹⁶

Operations. Acts of combination which are organized according to logic and the laws of grouping.¹⁷

Pre-operations. A process of combining units or ideas in pre-logical manners.¹⁸

Quantity conservation. A particular type of conservation in which invariance is understood in physical quantity concepts of objects

¹⁴Flavell, op. cit., p. 22.

¹⁵Ibid., p. 299.

¹⁶David Elkind, "Children's Discovery of the Conservation of Mass, Weight, and Volume: Piaget Replication Study II," The Journal of Genetic Psychology, 1961, 98, 225.

¹⁷Jean Piaget, Psychology of Intelligence (Totowa, New Jersey: Littlefield, Adams and Co., 1966), p. 139.

¹⁸Ibid., p. 135.

despite certain changes in the object's shape. Conservation of quantity includes mass, weight, and volume conservation.¹⁹

Temporary ownership. A condition characterized by both of the following: (1) the subject was given a pile of clay at the beginning of the testing session and told that the clay would be his during the time he was to be tested; (2) the experimenter used appropriate possessive adjectives when reference to the subject's clay was made.

Volume conservation. A particular type of quantity conservation in which the child insists that the volume of an object remains constant despite physical alterations in the shape of the object.²⁰

Weight conservation. A condition of quantity conservation in which the child insists that the weight of an object remains constant despite changes in the shape of the object.²¹

LIMITATIONS OF THE STUDY

One major limitation of the present study arose from the reliance upon the temporary ownership procedure used to affect the degree of affective involvement of the subject in the task. There was no assurance that the procedure caused the subjects to experience the same degree of involvement, if any at all.

¹⁹Jean Piaget and Barbel Inhelder, The Psychology of the Child (New York: Basic Books, Inc., 1969), pp. 97-99.

²⁰Flavell, op. cit., p. 299.

²¹Ibid.

A second limitation was seen as the present study used subjects only from the third grade. Children at different age levels might show different responses to the conditions which were presented. For this reason the results of the study must not be generalized to include all ages.

Chapter 2

REVIEW OF LITERATURE

A review of related literature has indicated that numerous verification studies have been based on Piaget's approach to mental development. Piaget's insistence of qualitatively different stages of cognitive development, each identifiable by unique products and structures, has been examined by researchers using many research designs and techniques. Observations of Piaget, gained initially through clinical observation, have been subsequently tested and largely verified by experimental studies.¹

Review of the literature has included two basic types. First, the literature which contained Piaget's original observations was reviewed. The contribution of this literature has been to establish the theoretical base upon which the present, as well as other, studies have been set. Secondly, review of the literature has included subsequent experimental studies based on Piaget's theory. The contribution of these studies has been to test the original theoretical position, and to offer clarification and refinement for following studies.

The literature reviewed is presented in three sections. The first section compares pre-operational and concrete operational stages in mental development. Differences, similarities, and comparisons along

¹Joachim F. Wohlwill, "From Perception to Inference: A Dimension of Cognitive Development," Monographs of the Society for the Research in Child Development, eds. W. Kessen and C. Kuhlman, 1962, 27 (2), 92.

certain dimensions were presented. The second section reviews the topic of conservation. A primary characteristic of the concrete operational period, this topic has been the object of numerous experimental studies.² An examination is made concerning the stages through which conservation gradually appears, and the ages at which these stages occur. The third section is concerned with factors affecting the expression of conservation. This section examines the correlation between the actual presence of conservation in thought processes and the extent to which it is expressed in the conservation tests which are presented. A final consideration is concerned with the stimulus qualities of the objects presented for comparison in the conservation tests. It is shown that physical stimulus qualities of objects used in the testing procedures affect the expression of conservation.³ Research has not been conducted, however, on the way in which affective stimulus qualities of objects influence the expression of conservation.

Pre-Operational and Concrete Operational Thought

Piaget has distinguished between pre-operational and concrete operational modes of thought. Pre-operational thought can be characterized by reasoning based on perceptual input, whereas reasoning based on concrete operational thought occurs as perceptual input remains subordinate to existing knowledge.⁴ Developmentally, thought which is

²J. H. Flavell, The Developmental Psychology of Jean Piaget (Princeton: Van Nostrand Company, Inc., 1963), p. 164.

³Ina C. Uzgiris, "Situational Generality of Conservation," Child Development, 1964, 35, 831-841.

⁴Jean Piaget and Barbel Inhelder, The Psychology of the Child (New York: Basic Books, Inc., 1969), p. 99.

pre-operational occurs first, and is later followed by concrete operational thought.

Differences. Differences between the two types of thought have been identified both in characteristics of the outcome of thought processes and in the structures of the processes themselves. The outcome of pre-operational thought dependent upon perceptual input is essentially subjective in nature. Opposed to this, the outcome of concrete operational thought, dependent upon existing knowledge, is essentially objective. Piaget reasoned that this occurs because of the characteristics of progressive assimilation. In pre-operational thought assimilation of perceptual input progressively alters the original position, thus characterizing the distorting subjective quality. In concrete operational thought, however, the position from which one assimilates experience remains unchanged, despite progressive assimilation. This allows thought to remain objective.⁵

Differences in the structures of the two thought processes have been indicated by Piaget as he compared perception and intelligence.

. . . we can say that perception differs from intelligence in that the structures are intransitive, irreversible, etc. and not composed in accordance to the laws of grouping.⁶

Piaget has contended that operations present in pre-operational thought are not organized into groupings until concrete operational thought has been achieved. Five conditions of groupings which must be accomplished for thought to become concrete operational have been

⁵Jean Piaget, Psychology of Intelligence (Totowa, New Jersey: Littlefield, Adams and Co., 1966), pp. 75-76.

⁶Ibid., p. 78.

identified as: (1) combinativity, (2) reversibility, (3) associativity, (4) identity, and (5) tautology.⁷

Other researchers have emphasized differences in the two types of mental activity based on their dependence upon the immediate stimulus field. Dependence upon the immediate stimulus field, both spatial and temporal, has been reported to decrease as concrete operations are achieved. Wohlwill suggested that with the decreased reliance upon the immediate stimulus field in concrete operational thought, there is an increased intervention of symbolic processes.⁸ Zimiles confirmed this in the area of number conservation where children possessing concrete operational thought showed (1) decreased reliance upon perceptual cues in estimating distance, and (2) greater reliance on quantification abilities.⁹ In a study by Feigenbaum concerning quantity conservation, possession of concrete operational thought was indicated by the decreased use of perceptual cues and an increased use of logical procedures.¹⁰ The most basic difference between the two modes of thought was indicated by Wohlwill who identified changes in pre-operational thought as quantitative and changes in concrete operational thought as qualitative.¹¹

⁷Ibid., pp. 36-42.

⁸Wohlwill, op. cit., p. 87.

⁹Herbert Zimiles, "A Note on Piaget's Concept of Conservation," Child Development, 1963, 34, 691-695.

¹⁰K. D. Feigenbaum, "An evaluation of Piaget's study of the child's development of the concept of discontinuous quantities." Paper read at Amer. Psychol. Ass., New York, 1961. cited by J. H. Flavell, The Developmental Psychology of Jean Piaget (Princeton: Van Norstrand Company, Inc., 1963), p. 387.

¹¹Wohlwill, op. cit., p. 95.

Similarities. Some researchers have indicated that there are similarities between the two types of thought. Werner saw perceptual groupings to be analogous to conceptual classification of the abstract sphere. The common factor to both activities was seen as the tendency toward organization.¹² Piaget and Morf studied partial correspondence between pre-operational and concrete operational thought by indicating parallels. Parallels were noted between: (1) perceptual groupings and conceptual classes, (2) perceptual consistencies and conceptual conservations, and (3) perception of stimulus relationships and the conceptual representation of the relationships at the symbolic level.¹³

Comparisons along different dimensions. A final comparison is presented along the dimensions of redundancy, selectivity, and contiguity. First, as thought becomes concrete operational, the amount of redundant information which is necessary for knowledge to take place decreases. Because of increased intervention of symbolic processes in concrete operational thought, less redundant cues were reported to be necessary. Opposing evidence to this contention has been offered by Bruner, Goodnow, and Austin who reported redundancy as being built into the established language system.¹⁴ A comparison along the second

¹²Heins Werner, Comparative Psychology of Mental Development (New York: Science Editions, Inc., 1948), p. 225.

¹³Jean Piaget and A. Morf, "Les isomorphismes partiels entre les structures logiques et les structures perceptives." In J. S. Bruner and others, Logique et perception. Etudes d'epistemologie genetique, Vol. 6. Paris: Presses Universitaires, pp. 40-116. Logical Thinking in Children: Research Based on Piaget's Theory, eds. Irving Sigel and Frank Hooper (New York: Holt, Rinehart, and Winston, Inc., 1968), pp. 478-479.

¹⁴J. Bruner, J. Goodnow, and G. Austin, A Study in Thinking (New York: John Wiley and Sons, Inc., 1956), pp. 11-15.

dimension of selectivity indicated that concrete operational thought is able to tolerate more irrelevant information without damage to the outcome than is possible with pre-operational thought. Thirdly, a comparison along the dimension of contiguity was made indicating that concrete operational thought is able to integrate material over greater spatial and temporal distances than is true for pre-operational thought.¹⁵

Conservation

A major attainment of the concrete operational period was reported to be the onset of conservation.¹⁶ The structures of conservation are governed by the laws of logic, rather than by perceptual grouping.¹⁷ Flavell defined conservation as:

. . . the cognition that certain properties (quantity, number, length, etc.) remain invariant (are conserved) in the face of certain transformations (displacing objects or object parts in space, sectioning an object into pieces, changing its shape, etc.)¹⁸

Piaget further identified conservation as being in a state of mobile equilibrium. The distinguishing characteristic is that perception is decentered in a systematic manner, and that thinking based on mobile equilibrium, "co-ordinates all the different viewpoints in a system of objective reciprocities."¹⁹

¹⁵Wohlwill, op. cit., pp. 98-103.

¹⁶Jean Piaget, Psychology of Intelligence (Totowa, New Jersey: Littlefield, Adams and Co., 1966), pp. 139-140.

¹⁷Piaget and Inhelder, op. cit., pp. 97-98.

¹⁸Flavell, op. cit., p. 245.

¹⁹Jean Piaget, Psychology of Intelligence (Totowa, New Jersey: Littlefield, Adams and Co., 1966), p. 142.

Stages of conservation. The onset of conservation has been identified, not as appearing in an all-or-nothing fashion, but with intermittent periods of presence and absence. Initially, conservation has been seen as being expressed with rare frequency, ultimately being generalized to more situations and appearing with greater frequency. The equilibration of cognitive actions, which makes conservation possible, has been divided into four steps: (1) perception is able to center upon only one aspect of a problem or object, (2) centering occurs on more than one aspect of the problem or object, but the centerings are isolated and not coordinated, (3) different aspects of the problem or object are heterogeneously centered and decentered, and (4) successive decentralized transformations occur, decentering being achieved in a coordinated manner.²⁰

The four steps of equilibration of cognitive actions have been used to explain three functional stages which describe the onset of conservation. The functional stages which describe the onset of conservation are listed below: (1) the stage of no conservation in which no coordinated decentering occurs (steps 1 and 2), (2) the stage of transitory conservation in which the appearance of coordinated decentering is intermittent (step 3), and (3) the stage of conservation in which thinking is governed by successive decentralizations (step 4).²¹

Conservation of quantity. Conservation of quantity is one dimension of total conservation. In quantity conservation thought is

²⁰Flavell, op. cit., pp. 246-247.

²¹Ibid., p. 299.

concerned with examining relationships regarding the physical structures of objects. Within quantity conservation, three aspects of quantity have been defined: mass, weight, and volume conservation. Conservation of these three aspects are reported to occur at different age levels and in an invariant sequence. Conservation of mass is reported to occur before the onset of weight conservation, which is followed by conservation of volume.²² Verification has been offered by Elkind,²³ Koositra,²⁴ Lovell,²⁵ and Smedslund.²⁶ Hyde reported from her findings that the invariant order was not a necessity since conservation of weight was expressed without expression of mass conservation.²⁷

²²Ibid., p. 22.

²³David Elkind, "Children's Discovery of the Conservation of Mass, Weight, and Volume: Piaget Replication Study II," The Journal of Genetic Psychology, 1961, 96, 225.

²⁴W. Koositra, "Developmental Trends in the Attainment of Conservation, Transitivity, and Relativism in the Ontogenetic Foundations," (unpublished Doctoral dissertation, Wayne State University, 1963), cited by Irving Sigel, A. Roeper, and Frank Hooper, "A Training Procedure for Acquisition of Piaget's Conservation of Quantity: A Pilot Study and Its Replication," Logical Thinking in Children: Research Based on Piaget's Theory, eds. Irving Sigel and Frank Hooper (New York: Holt, Rinehart and Winston, Inc., 1968), p. 305.

²⁵K. Lovell, The Growth of Basic Mathematical and Scientific Concepts in Children (New York: Philosophical Library, 1961), pp. 59-74.

²⁶Jan Smedslund, "The Acquisition of Conservation of Substance and Weight: I. Introduction," Logical Thinking in Children: Research Based on Piaget's Theory, eds. Irving Sigel and Frank Hooper (New York: Holt, Rinehart and Winston, Inc., 1968), pp. 265-276.

²⁷D. M. Hyde, "An Investigation of Piaget's Theories of Development of the Concept of Number," (unpublished Doctoral dissertation, University of London, 1959), cited by J. H. Flavell, Developmental Psychology of Jean Piaget (Princeton: Van Nostrand Company, Inc., 1963), p. 387.

Piaget referred to the conservation of mass, weight, and volume within quantity conservation as a horizontal decalage because of the repetition which takes place within a single period of development.²⁸

Age at onset. The literature has indicated little variance in results supporting the invariance of the order of acquisition, however, more variance has been shown in the age of onset of the stages. Initial findings reported by Piaget found the age of mass, weight and volume conservation to be as follows: (1) conservation of mass occurred around the ages of seven to eight, (2) conservation of weight occurred at approximately ages nine to ten, and (3) volume conservation occurred at approximately age twelve.²⁹ Some researchers have indicated that the ages presented by Piaget are lower than ages their studies have supported. Lovell and Olgivie have supported initial findings of age of conservation,³⁰ though studies by Elkind³¹ and Ungiris³² have found ages to be greater than Piaget reported. Ungiris attributed the variance to different testing procedures and scoring criteria used by various researchers.³³ Lovell and Olgivie attributed variance in volume

²⁸Flavell, op. cit., p. 22.

²⁹Jean Piaget, Psychology of Intelligence (Totowa, New Jersey: Littlefield, Adams and Co., 1966), p. 123.

³⁰K. Lovell and E. Olgivie, "A Study of the Conservation of Substance in Junior School Children," Logical Thinking in Children: Research Based on Piaget's Theory, eds. Irving Sigel and Frank Hooper (New York: Holt, Rinehart and Winston, Inc., 1968), pp. 19-30.

³¹Elkind, op. cit., p. 226.

³²Ungiris, op. cit., pp. 831-841.

³³Ibid., p. 838.

conservation to different types of volume situations and indicated that no single test is sufficient to measure the broad category of volume conservation.³⁴

The Expression of Conservation

The literature has revealed that testing procedures have been devised to indicate presence or absence of conservation in the thought process. Testing for the presence of mass, weight, and volume conservation has generally been accomplished by presenting the subject with two objects to compare and answer questions about. After physical alteration of the object's shape, the experimenter asks the subject questions to elicit answers indicating presence or absence of conservation.

Procedures have generally required the subject to respond verbally to questions in order to demonstrate the status of conservation. This requirement of the child to be able to verbally construct answers to indicate presence of conservation in the thought process has been the object of criticism.³⁵ Another criticism of testing procedures used in detection and measurement of conservation has dealt with the types of objects used in the testing procedures.³⁶

Verbal expression and conservation. Evidence has been reported that a reliability gap exists between the verbal expression of conservation, as measured on Piagetian tests, and the existence of conservation

³⁴K. Lovell and E. Olgivie, "The Growth of the Concept of Volume in Junior School Children," Logical Thinking in Children: Research Based on Piaget's Theory, eds. Irving Sigel and Frank Hooper (New York: Holt, Rinehart and Winston, Inc., 1968), pp. 30-52.

³⁵Flavell, op. cit., p. 434.

³⁶Ungiris, op. cit., p. 838.

in the thinking process. Piaget indicated that there was a difference between the plane of action and the verbal plane. A child could conduct his behavior expressing the presence of conservation, yet if he were asked to express his position verbally, he was unable to appropriately respond. These findings were most prevalent in the concrete operational period.³⁷ Perhaps conservation is present in the thought process long before it is expressed on Piagetian tests.

The role of vocabulary in influencing success on conservation tasks has been stressed by many researchers. In a study of quantity conservation, Berko and Brown pointed out the correlation between knowledge of vocabulary and performance on conservation tasks.³⁸ Gruen supported this by reporting that training in the use of terms before the administration of conservation tasks improved conservation scores.³⁹

Wohlwill and Lowe indicated the advantage of using non-verbal techniques. They introduced procedures which developed conservation in the thinking of the child and reported these changes to be detected by non-verbal procedures, but not detected by standard verbal methods.⁴⁰

Charlesworth presented a third method for testing presence of conservation. Subjects were presented visual inconsistencies and the

³⁷Jean Piaget, Judgment and Reasoning in the Child (Totowa, New Jersey: Littlefield, Adams and Co., 1969), p. 214.

³⁸J. Berko and R. Brown, "Psycholinguistic Research Methods," Handbook of Research Methods in Child Development, ed. P. H. Mussen (New York: John Wiley and Sons, Inc., 1960), pp. 536-537.

³⁹Gerald Gruen, "Experiences Affecting the Development of Number Conservation in Children," Child Development, 1965, 36 (4), 977-979.

⁴⁰J. Wohlwill and R. Lowe, "Experimental Analysis of the Development of Conservation of Number," Child Development, 1962, 33 (1), 164-165.

presence of conservation was determined from the degree of startle expressed. Conservers and non-conservers reacted differently to visual inconsistencies.⁴¹

Stimulus quality of objects used. Research methods used in testing for quantity conservation have generally presented the subject with two objects for comparison. Inconsistent results in age of onset of conservation have resulted from the variance in objects used by different researchers.

One major consistent error has been attributed to the use of continuous versus discontinuous objects. Smedslund found that discontinuous objects, as illustrated by blocks, were conserved at a significantly earlier age than continuous objects, like clay.⁴²

Another approach was taken by Ungiris who examined physical stimulus qualities of both continuous and discontinuous objects. Because certain types of continuous and discontinuous objects elicited expressions of conservation, while others did not, Ungiris concluded that certain types of objects were easier to conserve than others.⁴³

Studies which have examined dependence of conservation expression upon stimulus quality of the objects used in the testing procedure have given concern only to physical stimulus qualities of the objects. There has been a lack of studies examining the role of affective

⁴¹W. Charlesworth, "Development and Assessment of Cognitive Structures," Piaget Rediscovered (A report of the conference on cognitive studies and curriculum development), R. Ripple and N. Rockcastle (eds.), Cornell University and University of California, 1964, 85-91.

⁴²Smedslund, op. cit., pp. 265-276.

⁴³Ungiris, op. cit., p. 838.

stimulus qualities of the objects on expression of conservation. No studies have examined the role between affective involvement with the objects used in the testing procedure and the differential expressions of conservation deriving from that condition. Also, studies have been lacking with regard to possible variance in conservation expression between males and females. It is to these points that the present study directs itself.

Chapter 3

PROCEDURE

Review of related literature has indicated that quantity conservation has generally been examined using testing procedures which measure mass, weight and volume conservation separately. Detection and measurement of quantity conservation has been accomplished by testing its three constituent aspects.

Procedures testing for mass, weight and volume conservation have been similar in numerous studies. The subject is supplied with two objects about which he must visually compare and answer questions. The presence of conservation in the subject's thought process is determined from his answers. If the experimenter wishes to test for mass conservation he will ask the subject to compare the amount of substance in the two objects. If conservation of weight is being examined, the experimenter asks the subject to compare the two object's weight. Finally, if conservation of volume is being tested, the experimenter asks the subject to compare the volume occupied by the two objects.

The present study employed a method of detecting, measuring, and evaluating conservation of mass, weight and volume similar to that used by Elkind¹ in his replication study of Piaget's work in quantity conservation. The basic method was extended to examine the effects of the

¹David Elkind, "Children's Discovery of the Conservation of Mass, Weight, and Volume: Piaget Replication Study II," The Journal of Genetic Psychology, 1961, 98, 219-227.

experimentally introduced condition of temporary ownership of one of the two compared objects on the amount of expressed conservation concerning those objects. The present procedure further divided the subject group into gender groups to examine possible differential effects of the experimental condition upon males and females.

Subjects

The third grade classes from Butcher Children's School in Emporia, Kansas and Madison Elementary School in Madison, Kansas participated in the present study. A total of fifty-five children, thirty-three males and twenty-two females took part in the study.

Hereafter, in this chapter, these subjects will be referred to as Ss and the experimenter as E.

Group Assignment

The Ss were divided into four groups according to the following procedure: (1) the Ss were initially divided according to gender, (2) both gender groups were further divided into two equal or near equal experimental and control groups, establishing the final four groups.

Division of the gender groups was accomplished by random assignment. Assignment took place for each school separately. The Ss from Butcher Children's School were assigned to groups and tested first. The Ss from Madison Elementary School were tested later.

Assignment of Tasks

Of the four groups, one male and one female group was assigned to the experimental condition (Task B), while the remaining male and female groups were assigned to the control condition (Task A).

All four groups were also given an initial task (Task E) immediately preceding their other assigned task. The scores from Task E were analyzed to determine if randomization had provided groups similar in initial conservation expression.

The number of Ss in the assigned groups is presented below:

	Experimental Group	Control Group	
	(Task B)	(Task A)	Total
Males	17	16	33
Females	<u>11</u>	<u>11</u>	<u>22</u>
Total	28	27	55

Description of Tasks

Three tasks were presented to the Ss, Task E, Task A, and Task B. The control group was presented Task E followed immediately by Task A while the experimental group was presented Task E immediately followed by Task B.

Testing occurred in the afternoons of all days of the school week. Each S was taken from his room by the E and brought to another room in which they could be isolated from others. The S was seated directly across the table from the E. Every S was tested individually with individual testing sessions ranging from ten to fifteen minutes. In all cases the S was presented Task E followed immediately by the other assigned task. Each task included the measurement of mass, weight, and volume conservation. Three questions were asked concerning each aspect of quantity conservation: prediction, judgment, and explanation questions.

Task E. Two round masses of white clay, each six ounces in weight, were placed side by side in front of the S. The distance between the two masses was approximately six inches. The S was initially asked if the two balls contained the same amounts of clay. If the S was not satisfied that the balls contained equal amounts, he was allowed to add or subtract clay until he believed the amounts to be equal. The S was then asked if the amount of clay would still be equal if one ball were to be rolled out to form a hot dog. (See APPENDIX A for questions). This question represented the prediction question. The ball of clay positioned on the S's right was rolled out by E to form the shape of a hot dog approximately six inches in length. The S was again asked if there was still the same amounts of clay in the hot dog as in the ball (judgment question). After the S responded he was asked why that was so (explanation question). The hot dog was then rolled back into the original shape. During the task the E recorded the responses of the S. This procedure measured the expression of conservation of mass.

Weight conservation was measured using a similar procedure with questions referring to the weight rather than to the amount of clay.

Conservation of volume employed a similar procedure. A clear plastic rectangular box with the dimension of $12 \times 6\frac{1}{2} \times 3\frac{1}{2}$ inches was placed over the two masses of clay. Questions were asked concerning the room the clay occupied inside the box.

Task A. A similar procedure was used in Task A as in Task E, with the exception of the use of green and blue clay instead of white clay. The blue clay was consistently placed on the right of the green

mass, as the S viewed it. The blue clay was rolled out to form the hot dog, the green remaining in the shape of a ball. Questions were altered to refer to the colors of clay. (See APPENDIX B for questions).

Task B. The procedure used in Task B was similar to that of Task A except the S was given temporary ownership of the green ball of clay at the beginning of the task. This was accomplished by a verbal statement by E (see APPENDIX C for statement and questions) followed by E handing the green clay to the S. Questions in this task contained possessive adjectives when reference was made to the S's clay.

Task E is similar to testing procedures commonly used in mass, weight, and volume conservation testing. It was presented to all Ss initially to determine if the groups formed by randomization procedures differed in conservation ability. Task A presented to the control group differed from Task E only in that it used blue and green clay instead of white clay. The experimental group was presented Task B which was identical to Task A with the exception of experimental procedures which established the condition of temporary ownership of the green mass of clay. The conditions included: (1) the E initially told the S that the green clay would belong to him and the clay was handed to the S; (2) questions used in the testing procedure used possessive adjectives to refer to the S's clay.

Evaluation of Responses

Evaluation of S's responses by the E was done in accordance to the system of evaluation used by Elkind.² For the prediction and

²Elkind, loc. cit.

judgment questions, if the S indicated that the clay remained unchanged along the dimensions measured (mass, weight, or volume), a point was recorded indicating the presence of expressed conservation. If the S insisted that the clay had changed along the dimension measured, no points were recorded, indicating that conservation had not been expressed. In the explanation question, if the S said that changing the shape without addition or subtraction of clay did not alter the dimension under consideration, a point was recorded indicating that conservation had been expressed. Similarly, no points were given for a response which did not include the above criteria.

There were a possible nine points on each task; three points for mass, three points for weight, and three points for volume conservation. Scores could range from zero (indicating no expressed conservation) to nine (indicating full expression of quantity conservation). Each S earned two conservation scores, one on Task E and one on the other assigned task.

Chapter 4

RESULTS

Analysis of results was accomplished using the procedure shown by Wilson which analyzes variance of distribution-free data. This method was used due to the lack of normality of the score distribution.¹

Analysis was initially performed on Task E scores of the four subject groups. Using the median as the score of central tendency, the chi-square value was used to determine if the scores of any group differed significantly from each other. The median conservation scores of the four groups on Task E are presented below:

	Experimental Groups	Control Groups
Males	5.6	5.5
Females	5.5	5.5

Analysis of Task E scores indicated that the four groups formed by randomization did not differ significantly in the amount of initial expression of quantity conservation ($\chi^2 = .22$; $df = 3$; $p > .80$). Consequently, it can be assumed that all groups began the study at an equal level of conservation.

Analysis of Task A and Task B scores was performed using the same procedure to test the previously stated hypotheses. The median

¹K. V. Wilson, "A Distribution-Free Test of Analysis of Variance Hypothesis," Psychological Bulletin, Vol. 53, No. 1, 1956, 96-101.

conservation scores of the four groups on Task A and Task B are presented below:

	Experimental Groups	Control Groups
	(Task B)	(Task A)
Males	5.3	5.7
Females	5.5	5.9

Table 1, below, shows the results of the analysis of variance of Task A and Task B. According to the .05 level of significance previously stated, the results were as follows: (1) there was no significant difference in conservation scores due to the experimental condition of temporary ownership; (2) there was no significant difference in conservation scores between male and female subjects; (3) the effects of temporary ownership on the expression of conservation did not significantly differ between male and female subjects.

Table 1
Summary of Analysis of Variance
of Task A and Task B

Source of variance	Degrees of freedom	Chi-square value	p
Gender	1	.11	
Ownership	1	3.05	.08
Interaction (Gender x Ownership)	1	.07	
Total	3	3.23	

Chapter 5

CONCLUSIONS, RECOMMENDATIONS, AND SUMMARY

Conclusions and recommendations from the present study are presented followed by the summary.

CONCLUSIONS AND RECOMMENDATIONS

It was concluded that increased affective involvement, as introduced by the experimental condition of temporary ownership, did not affect the amount of expressed quantity conservation at the .05 level of significance. Also, temporary ownership did not have differential effects on males and females with moderately developed quantity conservation. However, since it was shown that the expression of conservation was inhibited as a result of temporary ownership at the .08 level of significance, in the thinking of this writer, further study of the relationship between conservation and affective involvement is needed. In addition, three observations were noted which were not directly involved in hypothesis testing.

The first observation concerned the subject's performance on the two tasks given to him. The possibility arose that learning effects from having done Task E first could influence performance on the second task. Comparing the medians, only the control groups performed better on their second task (Task A). The scores of the experimental group on their second task (Task B) remained the same or deteriorated. A possible explanation for this occurrence might be included in Wohlwill's term

of selectivity.¹ Conceptual thought is able to tolerate more irrelevant data without damage to the product than is true with perceptual thought. Specifically, since quantity conservation was either moderately or tentatively established in the thought processes of the subjects, learning effects were interfered with by the introduction of the irrelevant condition of temporary ownership. Further research could profitably examine the learning effects which occur between conservation tasks in which controlled amounts of irrelevant data are introduced. For example, the hypothesis could be tested that children with early or moderately established conservation would show decreased conceptual expression with an increase of irrelevant information.

The second observation was that most of the effects due to temporary ownership occurred at the level of weight conservation. Children at the age level used in the study generally have mass conservation well established in the thought processes and are not deceived by perceptual or affectional inconsistencies. Volume conservation, conversely, is generally poorly established and children are often fooled by perceptual inconsistencies. With an absence of volume conservation expression in the control groups, the use of the experimental groups could not add to the identification of differential affects. That is, if children do not display volume conservation initially, further deterioration cannot be measured. Weight conservation is not as well established as mass conservation, but more established than volume conservation. This status of being moderately established, or in a

¹Joachim F. Wohlwill, "From Perception to Inference: A Dimension of Cognitive Development," Monographs of the Society for the Research in Child Development, eds. W. Kessen and C. Kuhlman, 1962, 27 (2), 98-103.

transitory condition, allows for it to be most affected by the experimental condition. Research involving children at different levels of conservation development could test this contention.

A third observation was made concerning the experimental group's answers to the explanation question, "Why is that?" Here the subject reasoned why he arrived at the conclusion he did concerning the compared objects. On the volume conservation task, subjects in both the control and experimental groups reasoned most often that the hot dog took up more room because it was now longer. However, the experimental group more often included that the hot dog was longer but theirs (the ball of clay) was higher. Apparently the factor of ownership forced a compensating remark concerning their clay along another dimension. Although this situation forced the subject to examine different dimensions of the object (decenter), it did not lead to a conceptual conclusion. This agrees with literature which indicates that decentering must be systematic and originate from the subject's insistence to produce conservation.

The present study revealed two areas in which recommendations are made.

The first recommendation is made concerning the degree to which the procedure of temporary ownership was able to increase affective involvement. It was assumed that the presentation of Task B would produce greater affective involvement than the control condition of Task A. There were no procedures to confirm this assumption, nor were there any procedures to confirm the homogeneity of the affective involvement throughout the group. It is recommended for further studies of this type that procedures be standardized which can, with a certain degree of confidence, produce increased group affective involvement. Also,

methods should be studied which would allow the experimenter to measure the degree of affective involvement of the individual within the group. With refinement along this dimension, it would be possible to present tasks which result in incremented affective involvement. Determination could be made if there is an optimum level of affective involvement at which concept learning and concept expression may most effectively occur.

The second recommendation is made with regards to rationale for group division. The present study divided the groups according to gender to examine possible differential effects of the experimental condition on males' and females' expression of quantity conservation. It is recommended that future subject groups be divided according to personality traits instead of according to gender. Certain personality traits might contribute to an overall manner of reacting to the experimental condition more than gender contributions. There is no overall "male" or "female" manner of reaction to temporary ownership, but there possibly could be identifiable manners based upon personality traits or profiles. Research could determine in this way which conditions and degrees of affective involvement are most efficient for concept learning and expression among individuals with differing personality profiles.

SUMMARY

Review of literature indicated that pre-operational thinking develops into concrete operational thinking with the onset of conservation. Conservation describes thought processes based upon concepts, rather than on percepts. Methods of testing for indications of quantity conservation (mass, weight, and volume) have relied heavily upon the child's ability to express himself verbally. Procedures have generally

demanded that the child compare two objects and answer certain questions about the objects. Variance in results has been attributed to the physical stimulus qualities of the objects. However, no literature was reported that examined the affective stimulus quality of the objects and its effect upon the expression of conservation. The present study was conducted to examine the effects of increased affective involvement in the task, as introduced through the experimental condition of temporary ownership of one of the two compared objects, on the expression of conservation concerning those objects. It further examined differential effects of this condition on males and females with moderately developed quantity conservation.

Fifty-five third graders were given standard mass, weight and volume conservation tasks. Half of the subjects (control groups) were given the standard tasks a second time. The remaining subjects (experimental groups) were given an identical set of tasks except that the experimental variable of temporary ownership was introduced.

Findings were as follows: (1) though the introduction of temporary ownership did not affect the expression of conservation at the predicted .05 level, a significance level of .08 was obtained; (2) male and female subjects did not differ in expressed conservation ability; and (3) the effect of temporary ownership was not significantly different between males and females.

It was concluded that temporary ownership interfered with the expression of conservation to a moderate degree. This needs to be taken into account and could explain some variance in results on traditional Piagetian tasks which have not controlled it as a variable.

Recommendations for further study focused on (1) the presentation of tasks in which affective involvement may be systematically varied and the correlation examined between the amount of interference and the degree of involvement present; and (2) the division of subject groups according to personality variables to examine the relationship between personality traits and amount of conservation interference.

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APPENDIX

APPENDIX A

Questions Asked on Task E

I. Conservation of Mass

- A. If I roll one of the balls out to make a hot dog, will there still be as much clay in the ball as in the hot dog? Will each still have the same amount of clay? (prediction question)
- B. Is there still as much clay in the hot dog as in the ball? Do they still have the same amount of clay or does one now have more clay? (judgment question)
- C. Why is that? (explanation question)

II. Conservation of Weight

- A. If I roll one of the balls out to make a hot dog, will there still be as much weight in the ball as in the hot dog? Will each still weigh the same? (prediction question)
- B. Is there still as much weight in the hot dog as in the ball? Do they still have the same amount of weight or does one now weigh more? (judgment question)
- C. Why is that? (explanation question)

III. Conservation of Volume

- A. If I roll one of the balls out to make a hot dog, will it still take up the same amount of room inside the box as the ball? Will they still take up the same amount of room? (prediction question)
- B. Does the hot dog still take up the same amount of room inside the box or does one now take up more room? (judgment question)
- C. Why is that? (explanation question)

APPENDIX B

Questions Asked On Task A

I. Conservation of Mass

- A. If I roll the blue clay out to make a blue hot dog, will there still be as much clay in it as in the green ball? Will each still have the same amount of clay? (prediction question)
- B. Is there still as much blue clay as green clay or does one now have more clay? (judgment question)
- C. Why is that? (explanation question)

II. Conservation of Weight

- A. If I roll the blue clay out to make a blue hot dog, will there still be as much weight in it as in the green clay? Will they both still weigh the same? (prediction question)
- B. Is there still as much weight in the blue clay as in the green clay or does one now weigh more? (judgment question)
- C. Why is that? (explanation question)

III. Conservation of Volume

- A. If I roll the blue clay out to make a blue hot dog, will it still take up the same amount of room inside the box as the green clay? (prediction question)
- B. Does the blue clay still take up the same amount of room inside the box as the green clay or does one now take up more room? (judgment question)
- C. Why is that? (explanation question)

APPENDIX C

Initial Statement And Questions Asked On Task B

I. Initial Statement

This time I want to give you some green clay to play with. Here is your green clay to play with while we're here. I would like you to take your green clay and compare it with this blue clay over here. Would you like to do that?

II. Questions Asked on Task B

A. Conservation of Mass

1. If I roll the blue clay out to make a blue hot dog, will there still be as much clay in it as in your green clay? Will they both still have the same amount of clay? (prediction question)
2. Is there still as much clay in the blue hot dog as in your green clay or does one have more clay? (judgment question)
3. Why is that? (explanation question)

B. Conservation of Weight

1. If I roll the blue clay out to make a blue hot dog, will it still have the same weight as your green clay? Will they both still have the same weight? (prediction question)
2. Is there still as much weight in the blue hot dog as in your green clay or does one now weigh more? (judgment question)
3. Why is that? (explanation question)

C. Conservation of Volume

1. If I roll the blue clay out to make a blue hot dog, will it still take up as much room inside the box as your green clay?
(prediction question)
2. Does the blue clay still take up the same amount of room inside the box as your green clay or does one now take more room? (judgment question)
3. Why is that? (explanation question)