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THE IDENTITY-EQUIVALENCE CONSERVATION PARADIGM: DEVELOPMENT RELATIVE TO AGE AND TASK CRITERIA

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THE IDENTITY-EQUIVALENCE CONSERVATION PARADIGM: DEVELOPMENT RELATIVE TO AGE AND TASK CRITERIA

by

Roberta R. Hoover

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Elkind's identity-equivalence paradigm defined the conservation process as two distinct operations. Identity conservation, which occurred first, related to one stimulus before and after it had undergone a transformation. Equivalence conservation, the standard conservation problem, was defined as the comparison between two stimuli before and after transformation of one of the stimuli. The developmental progression of the operations, the age of the child at which they could be observed, and the criteria most likely to identify their existence were unanswered questions which became the focus for this study.

Methodology consisted of the administration of one introductory language experience and four conservation tasks, two each on Number and Substance content. One identity task (Papalia & Hooper, 1972) and one equivalence task (Goldschmid & Bentler, 1968) were presented in each content area. Subjects were 60 preschoolers, 20 4-year-olds, 18 5-year-olds, and 22 6-year-olds from a private preschool program. Each of the five tasks was administered for five trials, with the last trial followed by a request for a verbal justification. Passing a task consisted of four out of five correct responses, with or without a verbal justification.

Analysis of data identified six combinations of task competence. Within those groups significant differences

were found for subjects able to complete the Substance Equivalence and Number Identity tasks. The Number Identity task was the only task passed with the other three tasks being failed at the same time, substantiating the developmental priority of identity conservation. Subjects within that group were all 4-year-olds and young 5-year-olds. The paradigm was not apparent with the older children. Evidence of the paradigm remained strong regardless of criteria used, for the majority of the subjects who were able to solve the tasks were able to provide appropriate verbal responses.

Placement in a readiness class and task competence were compared with older students, having an additional year in the preschool program and demonstrating more conservation ability. The question of school placement of these subjects with 5-year-olds who did not have the same conservation abilities was presented.

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CHAPTER I

INTRODUCTION

Piagetian theory has provided numerous constructs to assist in the identification and definition of the processes necessary for, and contributing to, cognitive development. Of those constructs, one has been identified by Piaget (1952) as being "a kind of functional a priori of thought," the sine qua non of operational intelligence (Piaget, 1950). That construct is conservation.

Simply, conservation can be defined as the recognition of the quantitative invariants of a substance. Therefore, the processes of conservation must deal with the compositions of certain transformations or changes affecting those quantitative invariants (Rosen, 1977). And unless there are transformations, there can be no conservation (Piaget, 1976).

Length, weight, volume and number can be conserved and emerge in the following developmental progression (Elkind, 1967; Miller, 1977; Wadsworth, 1978):

Area	Age
Number Conservation	5-6 years
Length Conservation	6-7 years
Solid Quantity Conservation	7-8 years
Liquid Quantity Conservation	7-8 years
Weight Conservation	9-11 years
Volume Conservation	11-12 years

Conservation of length, weight, and volume deals with the quantitative nature of those substances, while conservation of a group, in the mathematical sense, deals with the extension of that group. Therefore, the conservation of number refers to the quantity of the individual objects that make up the group when the distribution of the parts or subgroups has been modified, and is as quantitative as that of weight, length, and volume (Piaget, 1976).

With the definition of the conservation construct comes the need to measure its existence. But how can one be sure that it is conservation that is being measured? Moreover, is it feasible to conjecture that there may be more than one conservation process and that those processes can be evaluated as individual entities?

Piaget's Conservation Paradigm

Piaget and Inhelder (1962, p. 15) stated that true conservation can only be assessed when there is a "conflict between immediate experience or the givens of perception on one hand and mental operations on the other." Conservation problems, therefore, are directed toward presenting the child with a situation which creates cognitive dissonance.

The standard equivalence conservation problem, regardless of the substance being measured, initially presents the subject with a variable (V) and a standard stimulus (S) that are equivalent in both the perceptual and quantitative

sense. The subject is then asked to make a judgment regarding their quantitative equivalence. After the judgment has been made, the variable stimulus is subjected to a transformation, $V \rightarrow V^1$, which alters the perceptual but not the quantitative equivalence between variable (V) and standard (S). When the transformation is complete, the subject is asked to judge the quantitative equivalence between the standard (S) and transformed variable (V^1). The conservation paradigm can be conceptualized in the following way:

t_0	t_1	t_2
S+V	$V \rightarrow V^1$	? V^1

(Elkind, 1967)

As an example of weight conservation, Piaget and Inhelder (1962) presented the following:

The child is presented with two clay balls (V and S), equivalent in size, appearance and weight. The child is then asked if the two balls are the same weight. The child may use a balance to determine the equivalence of the balls. One of the balls is then made into a "pancake" or a "sausage" or into a number of "little balls" ($V-V^1$) after which the child is asked to judge whether V^1 has <u>more</u>, <u>less</u>, or the <u>same</u> weight as S.

Hypothesizing about the process utilized by the child in solving an equivalence conservation problem, Piaget and Inhelder (1952, 1962) identified a cognitive mechanism which they labeled "equation of differences" or "compensation". It was through this mechanism that the child was to become

cognizant of the fact that a change in one dimension of a substance is exactly compensated by an equal and inverse change in the second dimension of that substance. This awareness was to provide the foundation for the child's understanding that transformations are reversible with the object remaining invariant.

However, in analyzing Piaget's definition of the equation of differences or compensation, and its application to the standard conservation problem, Elkind (1967) postulated that the conservation problem could not be solved using only the equation of differences. For the equation of differences, as interpreted by Piaget (1952) and reviewed by Elkind (1967) related to the changes not between the standard (S) and the variable (V), but rather to changes within one and the same object (V and V^1). If the equation of differences was the mechanism used to account for the equation of V and V^1, it could not at the same time explain V^1 and S (Elkind, 1967).

Identity Conservation-- Equivalence Conservation Paradigm

Elkind's (1967) analysis of the role of the equation of differences mechanism led him to conclude that it was not the only cognitive mechanism needed to solve conservation problems. Logically, he determined that the equation of differences related to only one aspect of conservation; identity conservation, and Piaget's standard conservation

task, using the equation of differences, was aimed primarily at explaining identity rather than equivalence conservation.

Identity Conservation

Elkind (1967) has defined identity conservation as that facet of conservation that concerns itself with conservation of a given weight, length, number, etc., across a reversible transformation with respect to itself alone. A single ball of clay rolled into a sausage and equated for weight would be identity conservation. Given that in the standard conservation problem the subject never compares V and V^1 directly, identity conservation must always be inferred from the child's judgments regarding S and V, and S and V^1. Identity conservation can be conceptualized in the following way:

Conservation of Identity	Nonconservation of Identity
S judges S = V	S judges S = V
S judges S = V^1	S judges S
E infers V = V^1	E infers V

(Elkind, 1967)

The theoretical base for identity conservation developed from a study looking at length conservation using a classic conservation task. In that study Elkind (1967) presented children, 4-7 years of age, with pencils placed first in parallel and then in staggered positions. The children were then given the Müller Lyre test consisting of drawing two lines of equal length, evaluating the length of the lines, and then adding arrowheads on each end while

the child observed the transformation. The children were then asked to identify the shorter or longer line and indicate if they were of equal length. Results indicated that the children displayed conservation of length on the Müller Lyre and the classic conservation task simultaneously. Since differences point in the same direction on the Müller Lyre test, rather than in different directions, as on the pencil task, it was impossible to equate differences. The fact that the children arrived at equivalence conservation in a situation where the equation of differences between the standard (S) and the variable (V) simply would not work, lead Elkind (1967) to conclude that the equation of differences did pertain to changes in the variable itself and not to the relation between the variable and the standard. Elkind and Schoenfeld (1972) were later to refine this construct, suggesting a single variable rather than a paired stimulus variable be used in the identity conservation task.

Equivalence Conservation

In addition to measuring the object with respect to itself and any applied transformations, the conservation task must also assess the child's knowledge of the invariance of a quantitative relation across a transformation of one of the elements of that relation. Elkind (1967) labeled this process Equivalence Conservation.

Equivalence conservation could be conceptualized as the following:

Conservation of Equivalence	Nonconservation of Equivalence
S judges S = V	S judges S = V
S judges V = V^1 (covertly)	S judges S (covertly)
S judges S = V^1	S judges V

Based on Elkind's premises, the solution of the equivalence conservation task does, in part, depend on the successful completion of identity conservation (V = V^1). Therefore, conservation of identity is a necessary condition for the conservation of equivalence and must developmentally precede equivalence.

It was not sufficient, however, in that the standard conservation task presents an additional problem. The child was presented with S and V^1 in isolation. The difficulties of problem solving when presented with stimulus in isolation had been demonstrated by Beilin. In his study (1968) children well past the age reported by Piaget (1968) as being able to conserve area, were unable to equate areas as equal when they were presented in isolation. Consequently, the equation of differences could not explain the child's judgment with respect to area.

Piaget (1968) did initially present another construct, transitive inference, which was to define the relationship between two elements or objects being carried over to other elements related to the first two, as between S and V and S and V^1. Piaget's transitivity problem (Piaget, Inhelder, & Szeminska, 1960) asks the child to compare X with Y and

Z with Y. The child should discover that X is longer than Y and Y is longer than Z. Based on those facts, the child must deduce that X is longer than Z.

However, the research dealing with the developmental relationship of conservation and transitive inference tasks presents an ambiguous profile. Obviously, Piaget considers the mastery of conservation of quantitative invariants and an understanding of transitive inference to be logical and developmental counterparts (Piaget, Inhelder, & Szeminska, 1960) but several recent studies have shown transitive inference tasks to be easier than conservation (Brainerd, 1973). Therefore, it may not be the only explanation for the solution of the conservation problem. Based on Elkind's (1967) hypothesis, the standard conservation task, equivalence conservation, must utilize both identity conservation via the equation of differences and a deductive argument based on inferences from past experiences.

This proposed dichotomy served a useful purpose for if identity and equivalence were to develop simultaneously, they would have to serve both as party to the conflict, the cognitive dissonance necessary in a conservation problem, and mediator of its solution.

The terms of identity and equivalence conservation did not originate with Elkind, however, having been identified as utilized by Piaget in his own research findings. Difficulties with Piaget's use of the terms, however, arose

as the result of Piaget's tendency to use the terms interchangeably, making it impossible to discern the specific process being identified. For example, in Chapters 1 and 2 (1952), Piaget used conservation to refer primarily to equivalence, while in other writings conservation was used to refer primarily to identity (Piaget, 1968, pp. 23, 27, 31).

Further, Elkind (1967) suggests that regardless of the type of conservation task Piaget states he is addressing, assessment of conservation using equation of differences explains only identity conservation. In support of his position, Elkind (1967) describes Piaget's attempts at using children's verbal explanations of conservation on an equivalence conservation tasks. The three types of explanations given by the children were:

(a) Nothing has been added or taken away so it is the same (identity).

(b) If you made it like it was before it will be the same (reversibility).

(c) What it lost in one way it gained in another (equation of differences).

Given all the responses were concerned with identity conservation responses to an equivalence conservation task, Elkind (1967) suggested that they are really post hoc rationalizations rather than vertical reflections of the process.

If the child were really to verbalize the way he arrived at the solution, he would have to say something like this:

"This (V) was equal to that (S) before, and the change ($V \rightarrow V^1$) doesn't change anything, so this (V^1) must still equal this (S)" (Elkind, 1967). Elkind (1967) said verbal explanations are significant, not for their content, but rather for the fact that they reflect the child's perception that conservation is a logical necessity and must be justified.

Conclusions

From the preceding discussion, it is apparent that Elkind (1967) determined that Piaget's equivalence conservation tasks actually measure identity conservation and that the mechanism used to account for the equation of V and V^1 cannot at the same time explain the equation of V^1 and S.

Elkind's (1967) hypothesis that identity preceded equivalence thereby creating a decolage, would help resolve this contradiction by viewing the conflict as between the anticipation of identity conservation mediated by the equation of differences, and the perception of inequality presented by the illusion of V^1 paired with S. The child thinking of a single quantity and its transformations is convinced the quantity is conserved because he can equate differences and anticipate the results of the transformation. Piaget, himself, frequently noted that the preoperational child knows perfectly well that in the conservation problem nothing was

added or taken away and if returned to the starting point, would be the same (Elkind, 1967).

What he did not anticipate was the S and V^1 illusion, and because the equation of differences was not useful in his attempts to equate S and V^1, he resorted to a deductive argument. Consequently, the conservation conflict became dependent upon identity conservation and the solution upon the equivalence conservation. And because equivalence conservation was partially dependent upon identity conservation, it would developmentally follow identity in the conservation sequence and thus create the identity-equivalence conservation decolage.

In an attempt to further define the existence of Elkind's proposed identity equivalence decolage, relative to the age of the child and criteria used to ascertain its existence, the following hypotheses were formulated for this study:

1. There will be no difference in the ages of the children who respond in six patterns under criterion conditions of judgment only.
2. There will be no difference in the ages of the children who responded in six patterns under criterion conditions of judgment plus explanations.
3. There will be no relationship between placement in the transitional class and conservation task performance.

CHAPTER II

REVIEW OF LITERATURE

Identity Conservation-- Equivalence Conservation Paradigm

Brainerd and Hooper (1978) stated that there had been a tendency among researchers to accept Elkind's analysis of identity conservation and equivalence conservation as logically sound but to add the ad hominem argument that for reasons unknown, there was no developmental distinction between the concepts which correspond to Elkind's logical distinctions. The question, therefore, did not relate to the existence of the constructs, but rather to their developmental syncrony.

Research Findings

As early as 1966, Nair (in Bruner & Greenfield) examined the existence of an identity equivalence decolage. Questioning children on identity conservation prior to equivalence conservation, she found children more apt to answer both identity and equivalence questions correctly. When the order was reversed, the number of correct responses decreased. Nair concluded that the identity questions highlighted equivalence concepts, thereby appearing to provide a mechanism helpful in solving equivalence problems.

Using perceptually relevant stimuli, Legos (children's blocks), Teets (1968) presented weight identity and equivalence

conservation tasks to 120 first, second, and third grade subjects of two socioeconomic levels. Stimuli were four configurations of different colored blocks (discontinuous quantity) which maintained the same weight despite alterations. Eighty-two subjects passed identity and equivalence tasks; 24 subjects failed both tasks; 8 subjects failed the weight identity but passed the weight equivalence tasks; 6 subjects passed the identity but failed the equivalence tasks. With the majority of the subjects either passing or failing both tasks, and approximately equal numbers passing one but not both of the tasks, Teets concluded that the identity-decolage hypothesis could not be supported.

Approaching the problem of the perceptual information presented in the task from another perspective, Schwartz and Scholnick (1970) attempted to assess the affects of two different stimulus conditions presented for both identity and equivalence conservation of liquid or continuous quantity. The tasks presented to 40 nursery- and kindergarten-aged children were as follows:

(a) The glasses to be judged were the same in diameter.

(b) The glasses to be judged were of different diameter.

When the containers were of identical diameter, identity and equivalence judgments were of equal difficulty. When the containers differed in diameter, and perceptual illusions intervened, judgments of equivalence were more difficult. Schwartz and Scholnick (1970) interpreted these results as

supportive of Elkind's (1967) contention that equivalence conservation was preceded by identity because it required additional cognitive processes.

Of all the studies examining the identity equivalence decolage, the one which was later to become the focal point of debate between the area's major researchers was Hooper's (1969b) independent measures design. In that study Hooper investigated the developmental priority of quantitative identity conservation versus equivalence conservation, using one identity and two equivalence tasks of discontinuous quantity (seeds) derived from the traditional conservation format.

Subjects were drawn from two elementary schools in predominately white middle-class neighborhoods. Eighteen males and 18 females from each of the following grade levels, Kindergarten (6-year-olds), first (7-year-olds), and second (8-year-olds), were randomly assigned to the various conservation tasks. Results for the percentages passing identity, 50, 75, and 75, compared to 9.1, 54.2, and 66.7 for equivalence conservation for the respective samples. Some children were noted to pass only the identity task, but no child passed equivalence but failed identity.

Earlier, Hooper (1969a) had found the same general trend for low socioeconomic subjects 5½ to 6½ years of age. Although 75% of those children failed both identity and equivalence tasks for conservation of discontinuous quantity

(seeds), 13.75% passed both tasks, 11.25% passed identity and failed equivalence, whereas no child passed equivalence but failed identity. Based on the results of these studies, Hooper (1969a, 1969b) concluded that equivalence conservation appeared later than identity conservation because the equivalence tasks require the additional deductive sequence.

In direct contradiction to Hooper's findings regarding both identity and equivalence were studies by Braine and Shanks (1965) and Mossler (1978) who found children 4 and 5 years of age able to conserve, and Smedslund (1961) who did not find conservation (equivalence) present in the thinking of children younger than 7 or 8 years of age.

In one of the studies, Hooper (1969b) added an additional variable for determining competence: judgment plus explanation responses. In judgment plus explanation situations, the child not only responded, but was also expected to explain the response. In analyzing the types of justifications used to explain identity and equivalence, Hooper (1969b) found that identity explanations were generally based on addition-subtraction schemas, while equivalence judgments were frequently explained by reference to the previous state of equality between stimuli A and B, an integral aspect of the postulated deductive sequence.

The question of criterion, using judgments only or judgments plus explanation to discriminate the identity-equivalence

paradigm, was pursued by Northman and Gruen (1970). Gruen (1966) had indicated earlier the importance of explanations in conservation judgments in that they reflect a more mature set of operational structures, subsequently being evidenced in older children and suggesting the simultaneous development of identity and conservation. In their study, however, Northman and Gruen (1970) used a judgment-only criterion with second and third graders in standard conservation tasks. They did not find indications of the identity-equivalence paradigm. Consideration should be given to the age of the children being tested, however, in that they may have created a ceiling effect which presupposed the existence of the decolage.

Murray (1970), investigating number conservation, using judgments only and four different mode presentations, did not find a developmental decolage.

Papalia and Hooper (1971) presented a study in which identity had been partitioned into two subdivisions: qualitative identity and quantitative identity. This division was based on the earlier work by Bruner (1966) who defined qualitative identity as the "sameness" of a substance in the face of an irrelevant attribute. Qualitative identity was regarded as a necessary prerequisite for success on the quantitative equivalence task (Bruner, 1966).

Piaget (1968) agreed that qualitative identity is the earlier appearing concept, although his definition of identity

depended on the age of the subject he was discussing. For Piaget, preoperational identity was similar to Bruner's qualitative identity.

Papalia and Hooper (1971) stated that at a later developmental stage, the concept of identity acquired the characteristics of an operation, actions which were reversible, interiorized, and coordinated into systems (Papalia & Hooper, 1971). Once the notion of identity became a part of an operations structure, it allowed quantification and conservation.

Following the logically consistent pattern, Papalia and Hooper (1971) presented tasks directed as measuring the following: qualitative identity, quantitative identity, and equivalence conservation of quantity and number problems. Tasks were presented in both judgment and judgment-plus explanation conditions to 60 four-, five-, and six-year-old children, 10 boys and 10 girls in each age range, of middle socioeconomic backgrounds. Tasks were counterbalanced, with each task having 5 trials and a control check after each task.

Scalogram analysis of the without-explanation presentation supported the hypothesized order of acquisition:

qualitative identity of quantity,
qualitative identity of number,
quantitative identity of number,
quantitative identity of quantity,
equivalence conservation of number, and
equivalence conservation of quantity.

In the with-explanation conditions, a different pattern emerged:

quantitative identity of number,

equivalence conservation of number

quantitative identity of quantity

qualitative identity of number,

equivalence conservation of quantity.

Analysis of the mean number of trials passed on each task combined across ages and sexes indicated that the predicted order of difficulty was found for quantity conservation but not for number conservation concepts. In the without-justification condition a trend in the direction of performance superiority on qualitative identity over quantitative identity ($t(2) = 2.60$, p $10 < > .05$) and significant performance differences in qualitative identity versus equivalence ($t(2) = 4.44$, $p < .025$) and quantitative identity versus equivalence conservation ($t(2) = 7.00$, $p < .01$) were found. The only significant performance difference for the quantity conservation tasks in the justification condition was the superiority of performance on quantitative identity over equivalence conservation ($t(2) = 3.50$, $p < .05$). For number conservation, no significant differences were found under either scoring criterion.

In analyzing the rationale offered to explain conservation, judgment distinctions between identity and equivalence conservation in quantity conservation tasks were noted.

Responses to identity observations centered on "statement of the operation performed" and less frequently on the "sameness of seeds." Equivalence conservation tasks, in contrast, were generally explained by reference to the previous state of equality between standard containers A and B. The rationale appeared to follow a logical deductive sequence supporting the contention that equivalence conservation emerges after identity conservation and that the paired stimulus equivalence task is not the most valid method for determining identity conservation performance. Identity conservation tasks should present the subject with a single stimulus (Papalia & Hooper, 1971). In contrast, the number conservation tasks focused on a "statement of operations performed." Therefore, the distinction between identity and equivalence conservation may be confined to certain content areas (Papalia & Hooper, 1971).

In comparing with- and without-justification conditions, a trend in the direction of performance superiority in the without justification condition was apparent for both males and females.

Finally, the question of continuous versus discontinuous process was addressed. Piaget viewed development of conservation as a discontinuous process, with Papalia and Hooper's (1971) findings contradictory, finding the developmental sequence of identity and equivalence indicating a continuous process.

The variability in the developmental sequence of identity and equivalence relative to the substance being assessed found by Papalia and Hooper (1971) provide the theoretical base for Elkind and Schoenfeld's (1972) study evaluating the judgments made regarding the conservation of identity and equivalence for four types of substances: number, length, liquid, and mass. Twenty-two 4-year-olds and 22 6-year-olds were tested with the following results:

(a) Older children were better conservers than young children.

(b) Conservation of identity was easier than conservation of equivalence.

(c) Some types of quantity (number) are easier to conserve than others (liquid, length, mass).

(d) Differences between identity and equivalence conservation are most pronounced in young children.

The results of the study were interpreted as supporting the hypothesis that identity and equivalence conservation require different cognitive processes. Consequently, the identity-equivalence decolage should be more apparent among young children who are still in the transitional Stage 2 of conservers than among older children, who are probably Stage 3 conservers. This was evident in the test results of the 4-year-old subjects scoring significantly higher on identity conservation than on equivalence conservation tasks. That finding did not hold for the 6-year-old subjects.

Moynahan and Glick (1972), using verbal explanations as well as judgments for scoring criteria, presented 57 kindergarten (mean age = 5.11) and 39 first-grade (mean age = 6.9) children in a middle-class suburban school identity and equivalence conservation tasks within four conceptual domains: number, length, continuous quantity, and weight.

For each task, there was a substantial number of conservers, as well as nonconservers, indicating that the subjects were, as a group, in the transitional stage of conservation acquisition. Based on the contingency table of their results, Moynahan and Glick (1972) noted that only for the first length transformation was there a significant tendency for identity conservation to be manifest without equivalence conservation. Of the subjects performing differently on the two tasks, 12 passed identity but not equivalence conservation, while only 3 showed the reverse pattern. For the other seven transformations, however, the number of subjects with identity but not equivalence conservation did not differ from the number showing the reverse pattern. In addition, individual subjects tended to perform similarly on the two tasks. Thus identity and equivalence tended to co-occur; if a subject passed one task, he was very likely to have passed the other task. These results are in agreement with Northman and Gruen (1970) and Murray (1970) but contradict Hooper (1969a, 1969b).

The effect of the number stimuli produced on the difficulty of the conservation task was addressed by Koshinsky

and Hall (1973). In their study, 72, 12 each of kindergarten, first and second graders, modal ages being 5, 6, and 7, respectively, were given three conservation tasks: (1) Identity, (2) Equivalence I in which the perceptual cues were comparable to those in Identity, and (3) Equivalence II, the traditional Piagetian Conservation task. Chi square analysis of the data showed that there was a statistically significant relationship between grade level and performance on both the identity task ($x^2(2) = 10.94$, $p \leq .01$) and the equivalence task ($x^2(2) = 7.20$, $p < .05$). The trend of the data was children in Grade 1 and 2 performing better than kindergarten children on both the identity and equivalence tasks, but no difference between the performance in the first and second grades. Most subjects (62 out of 72) either passed both or failed both identity and equivalence, showing an all-or-none pattern. Of the ten who did not follow this pattern, seven failed identity and passed equivalence, directly contradicting Elkind's (1967) hypothesized developmental order. Performance on the equivalence task was slightly better than performance on identity at the kindergarten level; performance on the two tasks was the same at the first grade level; at the second grade level, performance on equivalence was again better than performance on identity (Koshinsky & Hall, 1973). Further, Koshinsky and Hall (1973) suggest that with the number of studies that have found high percentage of subjects who conserve in an all-or-none fashion

(Hooper, 1969b; Moynahan & Glick, 1972; Northman & Gruen, 1970; Papalia & Hooper, 1971), the distinction between identity and equivalence, at least at the empirical level, may not be necessary.

Thus far, many of the variables associated with the studies addressing the identity and equivalence decolage have been examined. Rose and Blank (1974), trying to provide additional clarifying information as to the stimulus itself provoking a spurious finding, the decolage, analyzed the number of questions presented in the task situations. They found that children performed better on the equivalence tasks if the initial question were omitted and only the final conservation question were asked. They hypothesized that the presentation of the second question indicated an incorrect first response to the child, thereby subtly encouraging them to change it. Thus, the difficulty of equivalence conservation task relative to the identity conservation task increased.

The studies by Koshinsky and Hall (1973) and Rose and Blank (1974) required an additional skill for successful task completion, for in both of those studies the child had to depend heavily on memory of tasks presented with two stimuli and/or two questions.

Rybash, Roodin, and Sullivan (1975) investigated the memory factor in a study of subjects, 12 boys and 12 girls, three each of 4-, 5-, and 6-year-olds, who were given tests on three types of conservation judgments (qualitative,

quantitative, and equivalence) for both continuous and discontinuous substance. Half of the subjects were given a memory aid, while half were not. With conservation ability determined both with and without verbal justification, results found the memory aid increased the number of equivalence conservation responses only when verbal justification was not required, but had no effect on qualitative or quantitative identity conservation. Therefore, it was concluded that the memory aid provided a remainder of the initial comparison only for the equivalence task.

Comparing the with- and without-justification conditions, more conservers were noted in the without-justification condition than in the justification condition. Additionally, the order of conservation task attainment was, in part, a function of the scoring criteria. When verbal justifications were scored, quantitative identity and equivalence conservation appeared to be simultaneous developmental acquisitions. However, when verbal justifications were not scored, significantly more conservation responses were found for the quantitative identity task than the equivalence task (Rybash, Roodin, & Sullivan, 1975).

Rybash, Roodin, and Sullivan (1975) interpreted their findings as supportive of Gruen's (1966) position that a more mature set of operational structures are assessed when the child must give justifications as well as the simultaneous development of identity-equivalence conservation in the

older child. Their study did, however, also exhibit the identity-equivalence decolage in the without-justification condition.

In another study, Brainerd and Hooper (1975) attempted to delineate the ages at which the identity-equivalence paradigm existed. In a 3 x 2 x 2 x 2 mixed model, they presented 180 children, 60 preschool, 60 kindergarten, and 60 third-grade children, aged 4, 6, and 8 years respectively, identity and equivalence conservation tasks dealing with length and weight. Judgments and judgments plus explanations were used for criteria. Analysis of the results indicated large and highly significant effects for age, task, and criteria.

Tests for the age effect indicated the tasks more difficult for preschoolers than they were for kindergarten ($p < .001$) or third graders ($p < .001$), and that the tasks were more difficult for kindergarteners than they were for third graders ($p < .001$). Equivalence tasks were more difficult than identity tasks, and more trials were passed with a judgment-only criterion than with a judgment-plus explanations criterion.

Interactions were observed for Age x Task, Task x Criterion, and Age x Criterion. The Age x Task interaction found equivalence tasks more difficult than identity tasks for preschoolers and kindergarteners, but not for third graders. The Task x Criterion interaction indicated

performance differences significantly greater between identity and equivalence tasks for the judgments-only criterion with that discrepancy more pronounced for preschool and kindergarteners than for third graders. On the Age x Criterion interaction, preschoolers and kindergarteners did not differ.

Based on their findings, Brainerd and Hooper (1975) stated that the Age x Task interaction prompts the identity-equivalence decolage in younger but not older children, and the Task x Criterion interaction was indicative of the need to use the judgment-only criterion to observe the identity-equivalence decolage.

Chiseri (1977), attempting to explain the variance between identity and equivalence found in some cases, but not others, combined several variables to assess interactive effects. Using problems of continuous and discontinuous quantity in two identity and two equivalence tasks, 96 kindergarten-aged, mean age = 5.1 years, children were presented problems with the following experimental variables:

(a) identity vs. equivalence tasks

(b) cue (cue present vs. cue absent)

(c) memory (recall aid vs. no recall aid to the pre-transformed quantitative equality).

Performance differences were found only for the cue factor, chi square = 14.5, $p < .001$, with the cue-present paradigm more difficult than the cue-absent paradigms

regardless of the identity-equivalence dichotomy. In fact, when the configurative disparity was represented by a present cue, performance was worse, regardless of the identity-equivalence dichotomy, which did not account for any performance differences.

The author concluded that his study did not support Elkind's proposal, but did state that the evidence did indicate that an ability to make transitive inferences, in conjunction with a grasp of the variance just sufficient for success in the cue-absent identity task, would not ordinarily suffice in the standard cue-present conservation paradigm. His findings regarding the decolage could therefore be regarded as mixed.

One of the more recent and comprehensive studies on the quantitative identity conservation, equivalence conservation paradigm, was completed by Miller (1977). Utilizing tests of quantitative identity and quantitative equivalence for the conservation of number and continuous quantity, 64 kindergarten children, 16 boys and 16 girls, mean age = 5.6 years, in each of the four experimental conditions, were tested. Two types of identity trials were included: a standard version using a single stimulus and a modified version which paralleled the equivalence task in its use of two stimuli. In addition, half the children were asked two questions on each trial, one preceding and one following

the transformation, whereas half were asked only the post-transformation question.

Findings indicated that neither the number of stimuli used nor the number of questions asked had any effect on performance. Of greater importance, however, was the finding that no difference existed between identity and equivalence either within or across conditions which would indicate identity problems being easier than equivalence problems. That conclusion held even when applied to task presented in the typical conservation format.

There has been only one longitudinal study addressing the identity-equivalence decolage and that was done by Hooper, Toniolo, and Sipple (1978). In that study, an analysis of the logical reasoning relationships of 102 subjects was conducted in 1973, followed up one year later with the administration of a series of conservation and transitive inference tasks, specifically length and weight. In the second year of the study, an additional sample of matched cohort/grade subjects (48 first and 54 fourth-grade students, mean ages 6.10 and 9.10 respectively) were assessed to permit evaluation of repeated measurement biases for the longitudinal sample. Results indicated that there were no effects of presentation order, selective survival, repeated measurement, sex or content areas and that these variables did not interact with each other.

However, there were significant main effects for grade level factor, $\underline{F}$ (1, 142) = 34.24, $\underline{p} < .001$, with fourth-grade

subjects' scores superior to the first grade; conservation tasks, F (1, 142) = 16.35, $p < .001$, identity conservation scores higher than equivalence conservation scores, and scoring criteria, F (1, 142) = 69.23, $p < .001$, objective response scores higher than those requiring a logical explanation.

In comparing conservation and transitive inference task difficulties, main effects were found for grade level and assessment year for each content case. Additionally, main effect of task type was significant for the length, F (1, 98) = 19.20, $p < .001$, and weight, F (1, 98) = 72.61, $p < .001$. Grade x task interaction for the weight content areas was significant, F (1, 98) = 13.72, $p < .01$, which reflected the greater performance disparity favoring the transitivity task at the younger grade level. Considerable evidence of the greater difficulty of conservation over transitive inference also was exhibited. Moreover, 62% to 92% of the second-year cases showed the subjects to be passing transitivity and continuing to fail conservation or to be passing both concept tasks, suggesting that the solution of the transitive inference task may be a developmental precursor of conservation concept mastery.

Comparing transitive inference competencies to identity and conservation tasks, they found that only the kindergarten and combined sample conservation of weight cases revealed a significant number of children passing identity while failing

the counterpart equivalence task ($p < .01$ for the McNemar test). Thus, the majority of children fell into "pass both" or "fail both" categories indicating that the identity-equivalence sequence is developmentally much less robust in comparison to the transitivity-conservation sequence.

In their conclusions, the authors noted that they did confirm the interactive influences of response criteria used and subject age ranges assessed upon the identity-equivalence distinctions. They added, however, that their findings suggested the developmental priority of transitive inference preceding conservation concept acquisition, with concept acquisition indicating within stage sequences rather than concurrences. They stated, "There is simply no manner in which identity conservation could follow the acquisition of equivalence conservation" (Hooper, Toniolo, & Sipple, 1978, p. 681). They noted that the critical difference between the transitive inference task and conservation of equivalence developmental sequence rested in the role the transformation stimulus ($B\text{-}B^1$) plays in the conservation task.

Additional support for the conservation decolage came from a study by Litrownik, Franzini, Livingston, and Harvey (1978) comparing the developmental conservation sequence of normal and moderately retarded children. In the component dealing with children who were of average intelligence, 48 children (CA 51-69 months) from middle socioeconomic homes were divided into groups of 5 boys and 5 girls and assessed for both identity and equivalence conservation.

The groups were then randomly selected to receive demonstration training for continuous quantity and number for either both or neither identity and equivalence or only identity or equivalence.

Results of the study supported the developmental priority of identity conservation in normal developing children. In addition, it suggested that the most effective training procedure was one that included attempts to accelerate both identity and equivalence, but training in identity did not lead to the acquisition of equivalence. The authors further concluded that the results of this study were partially dependent on the ages of the children used which correlated with two studies, Brainerd and Hooper (1975) and Elkind and Schoenfeld (1972), who found the conservation decolage only in younger (4- and 5-year-old) children.

Using the "Identity Theory" which states that simple recognition of the maintenance of identity may be sufficient for conservation and that the emergence of compensation often follows the emergence of conservation, Acredolo and Acredolo (1979) studied anticipation of water-level changes in 96 kindergarten and first-grade children. They made the following predictions about their results:

1. Nonconserving children who possess covariation (and could anticipate change in levels in the anticipation of conservation task) will rely on evaluation by identity in an anticipation of conservation task,

where attention has not yet been drawn to the water levels and then switch to an evaluation by levels in the standard task (identity level switching).

2. Some noncovarying children will attain conservation solely on a recognition of identity; they will fail to anticipate a change in levels despite passing both the anticipation of conservation and standard conservation task.

Concurrent with the evaluation of the anticipation of levels tasks, the question of the relationship between identity conservation and equivalence conservation was posited.

In attempting to replicate a study cited by Piaget and Inhelder (1969), Acredolo and Acredolo (1979) used anticipation of water levels task with kindergarten and first-grade children. Testing consisted of three phases: (a) a simple pretest, (b) a sequence of anticipation of conservation and anticipation of levels questions, and (c) a final sequence of standard liquid conservation tasks.

Results of the testing did not coincide with those of Piaget and Inhelder (1969) with 37.5%, instead of the 10% Piaget reported, of the conserving subjects using identity conservation. In addition, a high incidence of switching from an evaluation by identity to an evaluation by levels, 42.4% of the sample, was observed. Using a more stringent scoring criterion to eliminate spurious findings, Acredolo

and Acredolo (1979) found that children using conservation by identity were no less consistent in their judgment, nor were they less likely to be able to justify their judgment, but they were less likely to be able to offer an adequate explanation on each and every trial.

Summarizing the results of their study, Acredolo and Acredolo (1979) stated:

a. More first graders than kindergarteners conserved on the final standard conservation task using a judgments-plus-explanations criterion.

b. There were no sex or order effects.

c. A high incidence of subjects, 26.7% of conserving subsample, were using identity.

d. Children who displayed conservation by identity were consistent in their judgments but were less likely to offer adequate explanations on each and every trial.

e. Children displaying conservation by identity were less completely established as Stage 3 conservers.

f. A large proportion of nonconserving children anticipated conservation through a reliance on an evaluation by identity rather than an evaluation by anticipated levels.

g. During a particular period of late preoperations, the identity-conservation task was somewhat easier than the equivalence conservation task.

h. When standard conservation tasks are presented in the identity conservation format, one stimulus at a time, children find it considerably easier to ignore illusions presented by the stimulus and continue to rely on evaluation by identity.

i. Prior to acquisition of compensation, children can and do rely on an evaluation by identity rather than anticipated as Piaget argues.

j. Identity conservation infrequently appeared in equivalence conservation where illusions are maximized.

Acredolo and Acredolo (1979) also addressed the issue of internal dissonance as it pertains to the development of cognitive patterns. In accepting the identity theory, they suggest that "every transformation has the potential of arousing dissonance since in any transformation an evaluation by identity suggests the maintenance of conservation." Identity theory places the child in a stage of internal dissonance, or disequilibrium very early in the preoperational stage (p. 533). It is through the evaluation by identity that children are motivated to explain illusions that require the development of compensation.

Analysis of Identity-Equivalence Research

Brainerd and Hooper (1978) were in agreement with Elkind's (1967) identity-equivalence paradigm and postulated a statistical question as partial explanation for their support.

If the identity-equivalence decolage appeared merely by chance, would it not then be logical to expect the reverse sequence to be evidenced just as frequently? As of 1979, however, an equivalence-identity sequence had not been reported in the literature.

Why, then, are there discrepant findings within the specific body of literature? Brainerd and Hooper (1975) identified three major causative variables:

1. Relative task sensitivity.
2. Response criteria used with judgment-only criteria more likely to reveal decolage.
3. Age of subject samples with younger children more likely to demonstrate the decolage.

Using Task (T), Criteria (C) and Age (A), Brainerd and Hooper (1975) outlined the interactive effects of the causative variables labeling them Task (T), Task x Age (TxA) and Task x Criteria (TxC). They stated: "Identity appears in preschoolers and when less stringent judgment-only response criteria is used to infer conservation" (p. 365).

In sharp contrast to the conclusions drawn by Brainerd and Hooper (1978) was Miller (1978), who in analyzing the same studies, stated: "The identity-equivalence sequence, if it exists at all, is considerably weaker and less important than Brainerd and Hooper argued" (p. 59).

Using the variables presented by Brainerd and Hooper (1975), Task, Criteria, and Age, an analysis of the supportive and nonsupportive studies will be presented.

Task Sensitivity

The sensitivity of any Piagetian task is the probability, given that it is present in the subjects to whom the task is administered, it will be judged present. Thus, sensitivity is simply the inverse of the Type II (false negative) error. Brainerd and Hooper (1975) felt that task sensitivity decreased when stimulus variables, not essential to measuring the underlying concept, make additional demands on the subjects. The Müller Lyre task, placing arrowheads on the ends of equal length lines, thereby presenting the subject with a task requiring conservation of the initial equivalence and resisting a countervailing illusion, is such a task. It is known that many subjects who are capable of performing the standard conservation task will not be able to resist the illusion (Keller & Hunter, 1973; Roodin & Gruen, 1971).

Flavell (1971) suggested that the relative sensitivities of Piagetian tasks may be the source of measurement error in the literature dealing with the order of emergence of Piagetian concepts, masking some sequences and manufacturing spurious ones. Psychometrically, Flavell's position is sound when addressing the identity-equivalence question.

Given that concepts A and B are presented, and using an appropriate sample of subjects, a very insensitive test of A, and a very sensitive test of B, the A $\longrightarrow$ B sequence may not be observed in the resulting data because most of the

subjects in the critical A/not B category would be incorrectly judged to be not A/not B. If A and B emerged simultaneously, however, it was likely that a spurious B→A sequence would appear in the data because most of the subjects in the A/B category would be incorrectly judged to be not A/B.

In a recent review of studies dealing with the development of transitivity and conservation, Brainerd (1973c) found that Piagetian tasks are rarely equated for sensitivity. With many of the early tests, finding conservation preceding conservation, the transivity test appeared much less sensitive than the conservation tasks (Brainerd & Hooper, 1975). Because of the perceptual illusion of the Müller Lyre which had been included in the transitivity but not the conservation task, the conservation→transivity sequence may be an artifact of the Type II error. Later studies, finding transivity preceding conservation, eliminated the illusions from transivity tests (Brainerd, 1973b, 1975; Toniolo & Hooper, Note 1). Brainerd (1975) stated that examples such as that noted on the transivity→conservation sequence should emphasize the importance of Flavell's argument and may in fact explain the discrepant findings in identity-equivalence studies. Brainerd (1975) went on further to state, however, that in reviewing the supportive and nonsupportive studies, there was no evidence to suggest that:

a. Insensitive identity tests used in conjunction with reasonably sensitive equivalence tests tended to be used in the nonsupportive studies.

b. Insensitive equivalence tests were used in conjunction with reasonably sensitive identity tests in the supportive studies.

Miller (1978) reviewed two other aspects of the tasks which could account for the difficulty of the equivalence task. Noting that the equivalence task presented two perceptually discrepant stimuli simultaneously, Miller (1978) felt that the task was more likely to provoke a nonconservation response because the illusion presented in that task was much more powerful than the memory of the stimulus prior to a transformation.

However, of all the studies concerned with perceptual demands of identity tasks and equivalence tasks (Chiseri, 1977; Hooper, 1969b; Koshinsky & Hall, 1973; Miller, 1977), only the Chiseri study reported an effect on the degree of perceptual illusion. In that study, differences between identity and equivalence disappeared under conditions that equated the perceptual illusion for the two tasks.

The number of questions presented in the task was addressed by Rose and Blank (1974) who found that children performed better on the equivalence task if the initial question is omitted and only the final question asked. The suggestion of need to change response was thought to be indicated by the children. That conclusion was supported by Miller's

(1977) study comparing one and two question conditions, on both identity and equivalence tasks. Looking at the language utilized in identity and equivalence questions, Miller (1978) suggested that past tense vs. present tense wording of the conservation questions may affect the examinee's expectations relative to the difficulty of the two tasks. Miller (1977) concluded, however, by stating that there may not be a single right way to present such tasks to determine their logical interrelatedness.

Criteria x Task

Throughout Piagetian literature there is an obvious lack of consensus among investigators regarding the appropriate scoring criteria for inferring the presence of Piagetian concepts (Beilin, 1968; Brainerd, 1973a, 1973b). The question of the criteria used by the supportive vs. nonsupportive studies has been addressed with focus placed on the following aspects:

1. Did the nonsupportive studies use more stringent response criteria for identity tasks than that used for equivalence tasks, thereby masking a real identity-equivalence sequence?
2. Did the supportive studies use more stringent response criteria for equivalence tasks than that used for identity tasks, thereby producing a spurious sequence?

3. Did the nonsupportive studies use a judgment-plus explanation criterion for both identity and equivalence items?
4. Did the supportive studies use a judgment-only criterion for both identity and equivalence?

The stringency of responses required in the identity-equivalence tasks, as presented in the first two questions, was addressed by Brainerd and Hooper (1977). In reviewing the response criteria in relevant studies, they found no discernable differences in the stringency criteria applied in the identity or equivalence tasks. And while acknowledging that the criteria stringency differed from one study to another (e.g., Koshinsky & Hall, 1973; Schwartz & Scholnick, 1970), individual studies typically chose a criterion a priori and applied it consistently to both identity and equivalence responses.

Questions three and four, relative to judgments and judgment-plus explanations criteria, did evidence variance between supportive and nonsupportive studies. Supportive evidence by Elkind and Schoenfeld (1972), Schwartz and Scholnick (1970), Rybash, Roodin, and Sullivan (1975), Brainerd (1977), and Litrownik et al. (1978) all used judgment-only criteria. Papalia and Hooper (1971) were supportive only in judgments, while Hooper (1969a, 1969b) and Acredolo and Acredolo (1979) were supportive under both conditions.

Miller (1975) noted some inconsistencies in studies purported to be supportive. While Papalia and Hooper (1971)

were supportive on the judgment-only criteria, the decolage was found for discontinuous substance; it did not appear for number. Critical to the argument is the fact that those differences were not specific to the judgment-only criteria; they emerged for judgments plus explanation as well.

Brainerd and Hooper (1977) found Hooper's (1969a, 1969b) findings less substantial in regard to the decolage, for while they entail a judgment-plus explanations criterion, methodological problems result in minimal importance being placed on the results. Miller (1977), however, was unable to specify any reasons for the lack of importance for these studies and maintained their importance by demonstrating the presence of identity-equivalence main effect with both judgments and judgment-plus explanations criteria. Miller questioned further the Schwartz and Scholnick (1970) study of nonverbal test of conservation, stating that the technique used could only measure equivalence conservation because of the need for two simultaneously present quantities. Thus, the study did not relate to the identity-equivalence paradigm.

The criterion used by the nonsupportive studies was thought by Brainerd and Hooper (1978) to be creating Type II errors, thereby reducing the visibility of a real identity-equivalence sequence. Of specific note were the studies by Moynahan and Glick (1972) and Koshinsky and Hall (1973), both of which used a judgment-plus explanations criterion for both tasks.

Miller (1977), however, in a more detailed analysis of the data of the two preceding studies, reached different conclusions. He did not question the nonsupportiveness of the studies, but rather dealt with the criteria. In discussing the Koshinsky and Hall study (1973), Miller noted that in addition to the judgments and judgment-only explanation criteria used, two additional types of criteria were used with no evidence of or identity-equivalence sequence with any of the three criteria. Reanalyzing the data of Moynahan and Glick (1972), using judgment-only data, Miller (1977) still found no support for the identity equivalence decolage.

Studies by Northman and Gruen (1970) and Murray (1970) were exceptions to the rule that nonsupportive studies tended to employ a judgment-plus explanation criteria. In both cases, the subjects were classified as conservers or nonconservers of identity and equivalence on a judgment-only criteria. It should be noted, however, that the age of the subjects employed in those studies was sufficiently above the level at which one expects to find the identity-equivalence sequence regardless of the response criteria (Brainerd & Hooper, 1978).

Criteria has not, however, provided definitive indications of the conservation decolage. Miller (1977) found no differences between identity and equivalence with either judgments or judgment-plus explanations criteria. Chiseri (1977) obtained differences between identity and equivalence

under some but not all task conditions, with none of the identity and equivalence comparisons affected by the criteria used. Of note are the more recent studies of Acredolo and Acredolo (1979), who noted that results did not differ as the result of the criteria used and Gallagher and Kirk (1978), who suggested that both judgment and explanation criteria were needed to assess cognitive structures. When dealing with the judgments and judgment-plus explanations criteria, there did not appear to be a consensus among researchers as to the efficacy of using one criterion in deference to the other.

Age x Task

The Age x Task interaction was the last of the interactive effects noted by Brainerd and Hooper (1975). Citing the Elkind and Schoenfeld (1972) study as one example, Brainerd and Hooper note that the observation of the identity-equivalence paradigm occurred with young children before the ages of 6 or 7 years, who were still using preoperational mental structures, not having developed the concrete operational skills needed for the equivalence task.

The study by Elkind and Schoenfeld (1972), with half of its population at the preschool level, was but one of several using younger children and exhibiting the emergence of the identity-equivalence paradigm. One-fourth of the subjects in Schwartz and Scholnick's (1970) study were preschoolers,

as were one-third of Papalia's and Hooper's (1971) subjects. Acredolo and Acredolo (1979) had one-half of their population comprised of preschool-aged children. Other studies in which the T effect was observed with preschoolers were those of Chiseri (1977), Rybash et al. (1975), and Litrownik et al. (1978).

Extending the age range into the early school years, Brainerd and Hooper (1975) and Acredolo and Acredolo (1979) found the paradigm to exist with preschool children (4-year-olds) and kindergarteners (6-year-olds) with little performance difference demonstrated between the two groups. Hooper's studies (1969a, 1969b), while being supportive, used no preschoolers.

In contrast to the supportive data in studies using younger subjects, were the nonsupportive studies using older subjects. Moynahan and Glick's (1972) 6-year-olds, Northman and Gruen's (1970) 6-year-olds, and Koshinsky and Hall's (1973) 5-year-olds were the youngest subjects within those studies. Only the Koshinsky and Hall study and Hooper studies had lower age bounds which created overlaps between the supportive and nonsupportive research. Miller (1975), however, suggested the findings of the Koshinsky and Hall (1973) and Hooper (1969b) studies were important with Koshinsky and Hall failing to find the identity equivalence decolage in 5-year-olds, while Hooper (1969b) failed to find the decolage in 5-year-olds. Miller also referred to his own

study (1977) and that of Chiseri (1974) which found equivalence performance on identity and equivalence tasks for a kindergarten and a combined nursery school and kindergarten sample. In addition is the Rybash et al. (1975) study, where a significant main effect for identity versus equivalence was found in 4-, 5-, and 6-year-olds, but an interactive effect of Age x Task was not observed.

Based on the preceding, Miller (1978) contended that while there appears to be some correlation between age and outcome of task, it is probably weak. Further, he suggested that the development of identity-equivalence conservation may not be constant across domains with at least eight studies disconfirming the identity-equivalence paradigm for at least one of the conservation domains under study.

The study by Moynahan and Glick (1972) did not find the effect of age ceiling limits on the identity-equivalence comparison, and suggested that the transivity component, necessary for the equivalence task, may develop in an across-the-board fashion, in contrast to what appears to be the content-specific identity component. Consequently, identity-equivalence differences would occur only for young children and developmentally early conservations (e.g., number). However, differences between identity and equivalence disappeared when children were given a memory aid for the initial equality of the stimulus, thus suggesting to those authors the possibility of the deficit of being unable to complete a conservation task more related to memory function.

Transitive inference may be the causal variable when dealing with Age x Task. For if the child must have transitive inference skills to solve concrete operations, but not preoperational problems, why do so many 5- and 6-year-olds fail identity tasks? And if identity is solved on a preoperational basis, why do children give explanations with operational-sounding explanations? (Miller, 1978)

In counter-argument, Brainerd and Hooper (1978), reviewing the recent research, stated that the critical age for Age x Task interaction was not kindergarten and younger/ but was younger than kindergarten age. In addition, Brainerd and Hooper stated that the T effect had been observed in all studies with preschoolers and in some studies with kindergarteners (Acredolo & Acredolo, 1979; Hooper, 1969a, 1969b; Koshinsky & Hall, 1973). It should be noted that none of the nonsupportive studies tested preschoolers. Thus, the T effect was observed in all studies with preschoolers and that preschool samples had not been tested in any nonsupportive studies (Brainerd & Hooper, 1978).

In hypothesizing the A x T effect, Brainerd and Hooper (1978) suggested that testing preschoolers results in moderate variation on identity tests and no variance on equivalence tests (subjects fail all items). Older children demonstrated moderate variation on both tests. Considering developmental variance, Brainerd and Hooper (1978) suggested that a level of identity knowledge must be attained before acquiring

equivalence concepts. Once that level was attained, however, the rate of improvement was greater than for identity (Brainerd & Hooper, 1978).

Conclusions

Since Elkind's statement on the identity-equivalence conservation paradigm, numerous studies have been done focusing on validating the existence of that construct. Many investigators have been supportive of Elkind's (1967) statement with Hooper (1969a, 1969b) being among the first. Subsequent investigations were done by Elkind and Schoenfeld (1972), Schwartz and Scholnick (1970), Brainerd and Hooper (1975), Hooper, Toniolo, and Sipple (1978), Litrownik, Franzini, Livingston, and Harvey (1978), and Acredolo and Acredolo (1979), all showing that identity precedes equivalence for quantitative parameters such as discontinuous quantity, liquid quantity, length, solid continuous quantity, and number. Papalia and Hooper (1971) evidenced support under some but not all conditions.

Concurrently, however, studies were failing to find the decolage. In replicating Hooper's (1969b) second study, Koshinsky and Hall (1973) failed to replicate his findings. Moynahan and Glick (1972), Northman and Gruen (1970), Rose and Blank (1974), Chiseri (1974), and Miller (1977) all found equivalence and identity appearing at the same time. Rybash, Roodin, and Sullivan (1975), often noted as a supportive study, had mixed findings with the decolage appearing under the justification-only conditions.

Summarizing the literature review, the following variables have been discussed frequently as paramount to the isolation of the identity-equivalence decolage:

1. Task Sensitivity. It appears that the major studies, both supportive and nonsupportive, have not emphasized tasks more sensitive to their particular stance on this issue. Consequently, task sensitivity has discounted as a causative variable. Of note, however, is the need to use one stimulus variable, rather than the typical paired stimulus variables presented in the conservation problem, to assess identity conservation.
2. Criterion. The research appears equally supportive in the use of judgment-only or judgment-plus explanations criteria. Brainerd and Hooper (1977) asserted that judgment-only criteria are most likely to discriminate the decolage, while Miller (1978) stated that may not be true. More recent studies, Acredolo and Acredolo (1979) and Gallagher and Kirk (1978), have been in disagreement on this issue and have provided little further clarification. Therefore, the question of the role of judgments and judgments plus explanations remains unresolved regarding its effects on the task outcome.
3. Age of the Subject. Brainerd and Hooper (1978) have stated that the identity decolage is apparent only in children who are younger than kindergarten age,

noting the T effect evidence only in some studies with kindergarteners. The specific age of the preschool child is not noted and remains unclear, varying from study to study. Miller (1977) asserted that younger children, of kindergarten age, were included in some studies which did not evidence the decolage.

As with the criterion issue, it is not possible, based on present research, to reach a definitive conclusion about the age variable.

From the foregoing review it becomes apparent that the research focusing on the identity equivalence decolage has provided few definitive answers. However, interest in the area has been intense enough to warrant the suggestion of the development of a specific "Identity Theory" (Acredolo & Acredolo, 1979).

If identity conservation does play an important role in leading children to conservation, and if it can provide indicators of the cognitive development of the child (Hamel et al., 1972) and suggest effective training techniques (Beilin, 1965; Smith, 1968), the importance of the construct cannot be minimized.

Therefore, the major hypothesis of this study will focus on the identity-conservation-equivalence conservation paradigm and its existence relative to the ages of the subjects tested and the criterion, judgment and/or judgment plus explanations, employed.

CHAPTER II

METHODOLOGY AND PROCEDURE

The directional hypotheses for the present study were:

1. There will be a difference in the ages of the children who respond in six patterns under criterion conditions of judgment only, with the younger children able to perform only identity task and the older children able to do all conservation tasks.
2. There will be no difference in the ages of the children who responded in six patterns under criterion conditions of judgment plus explanations, with children who are able to conserve also able to provide adequate verbal justifications.
3. There will be a relationship between conservation performance and class placement, with the older children in the transitional class more competent conservers.

The basic intent of the study was to provide additional information and support relative to the importance of identity and equivalence conservation in young children. Based on the literature review, the writer supported the contention that these two conservation skills do appear in a developmental progression with identity appearing first, and with

the identity-equivalence paradigm more observable in younger children. It was also the contention of the writer that the majority of children who solved conservation tasks will be able to give verbal justifications for their answers.

Given that younger children are thought to evidence the decolage, the writer anticipated finding the transitional class, composed of older children, more competent in conservation. It was also anticipated, however, that these children, who were originally placed in that group because of lack of school readiness, would display a wider range of abilities than the other two classes.

Subjects

Sixty subjects from middle- to upper-middle-class socioeconomic status attending a church-sponsored preschool program in Greensboro, North Carolina, participated in the study. All subjects were white. The subjects were taken as intact classes: two 4-year-old groups (mean age = 48.06), 10 boys, 10 girls; one 5-year-old group (mean age = 68.23), 14 boys, 12 girls; and one transitional class (mean age = 75.36), 13 boys and 11 girls. The transitional class was comprised of 5- and 6-year-olds who were judged by their teachers as needing additional preschool experiences to develop school readiness.

Procedure

Subjects were tested by the examiner in a room within the preschool building. An attempt was made to provide a relaxed atmosphere to encourage maximal verbal responses. The subjects received a preliminary experience to familiarize them with the examiner, materials, and basic processes. The introductory experience used a 100ml beaker and two smaller 30ml containers. After the subject poured corn kernels into the 100ml beaker, the examiner poured unequal amounts of corn into the two 30ml containers. The subject was then asked, "What can you tell me about the corn in these two glasses?" Following the subject's response that one container has more corn, the examiner poured more seeds into the other container until amounts in both were equal. The subject was again asked, "What can you tell me about the corn in these two glasses?" A record was kept of those subjects who spontaneously used the terms "same" or "equal amounts" of corn. If the subject was unable to conclude spontaneously that the amount of seeds were equal, it was pointed out with special emphasis placed on the term "amount." This was to acquaint the subjects with the criterial phrases, "more corn" and "some amount of corn" (Hooper, 1969b). Following that procedure, administration of the conservation tests began.

Quantity Battery

Quantitative identity. Corn was poured by the subject from a 50ml beaker into a comparison container of similar physical configuration. Following the transformation the subject was asked: Does this glass (gesturing toward comparison container) have the same amount of corn or more corn than this glass had before? (Papalia & Hooper, 1971)

Quantitative equivalence. Two leveled glasses, filled with equal amounts of corn (150ml) were placed in front of the child, one on the right side and one on the left side of the table, with the examiner saying: "See, here are two glasses both filled with the same amount of corn. Is there as much corn in this glass as in that one, or does one have more?" If the subject said they have the same, the following occurred:

> The corn was poured from the large glass into five small glasses (arranged in a circle placed where the large glass stood to the right of the examiner, and left of the child), in equal amounts, saying: "Watch what I do. See, I am pouring the corn from this glass into all of these glasses." When finished, ask: "Now, is there as much corn in this one (large glass) as in all of these together, or does one side have more?"

If the subject said one has more, the following occurred:

> Adjustments continued to be made between the two glasses until he said they both have the same amount. The

examiner said, "Let's make them the same. See, I am pouring some corn from this glass into that one. Now, is there as much corn in this one as in that one, or does one have more?

When the subjects agreed that the amounts were the same, the task with five glasses was presented (Goldschmid & Bentler, 1968).

Number Battery

Number identity. The subject was presented with an array of five colored poker chips spaced approximately one inch apart. The subject was asked to spatially rearrange the chips into one of five predetermined stimulus configurations (adapted from Rothenberg, 1969). Following each transformation, the subject was asked: Is this (gesture toward new array) the same number of chips or more chips than before?

The five configurations were as follows (Rothenberg, 1969):

1. Lateral Displacement--more chips from one end to the other end
2. Collapsing--move all chips closer together.
3. Resubgrouping--break into groups of 2 chips and 3 chips.
4. Equal Group--move chips back into original position.
5. Three subgroups--break into 2 groups of 2 chips and 1 single chip.

Equivalence Conservation

Six red poker chips were placed in a straight line about four inches apart. Parallel to and below the red chips, six white chips were placed in corresponding position, also in a straight line, while the examiner said, "Watch what I do." When finished, the examiner said: "Are there as many red chips as white chips or are there more red chips than white chips?" If subject said there were as many red as white chips:

> The two lines of chips were left in a horizontal position, one line below the other, but spread out the white chips (6 inches apart), and the red chips moved closer together (2 inches apart), saying "Watch what I do." When finished, the child was asked: "Now, are there as many red chips as white chips, or is there more of one kind?"

If the subject was unable to see the initial equality between the red and white lines, say: "No, look. There is one red chip for every white chip. Do you see now that there are as many red chips as white chips?" Demonstrating continued until subject agreed that they were equal, then the preceding transformation was given (Goldschmid & Bentler, 1968).

Each task was comprised of five trials for each task, the first four trials required a judgment-only response, while the fifth trial required a judgment-plus explanations

response. At the end of each task, the subject was presented with a deliberate inequality to control for rote responding.

Assignment to Tasks

Because the age variable was of prime concern, subjects were divided into three major age groups, 4-, 5-, and 6-year-olds, and then randomly assigned to one of the two presentation orders: relational terms, quantity conservation tasks (quantitative identity, equivalence conservation), number conservation tasks (quantitative identity and equivalence conservation); or relational terms, number conservation (quantitative identity and equivalence conservation), substance conservation tasks (quantitative identity, equivalence conservation). The task content areas were presented in a counterbalanced design, but the order of tasks within the content area remained in a constant sequence which corresponded to the identity-equivalence decolage. Because of the small number of subjects in this study and the fact that the age rather than presentation order was a major variable, randomization of tasks as presented by Miller (1977) was not done. If the fixed order of task presentation as presented in this study still demonstrates the identity-equivalence decolage, in spite of the admittedly facilitative effect of this sequence, stronger confirmation of the developmental priority of identity conservation would be present (Elkind, 1961).

Test Administration and Scoring

All subjects were tested by the examiner during one session which was tape recorded in its totality. Subjects were encouraged to participate actively in all manipulations. Total test time was between 20 and 30 minutes per child.

Two related scoring criteria were used on each and all tasks in the battery. The first criterion focused only on the total number of correct responses to the task presentation. The second criterion dealt with the verbal justifications given for the responses. The criteria were used singularly and in combinations in the following manner:

1. Correct responses 4 out of 5 times = pass.
2. Correct responses 4 out of 5 times, plus adequate explanations (justifications) for a task = pass.
3. Correct responses but inadequate justifications = pass on judgment only criterion.
4. Incorrect responses but adequate justifications = fail.

Inadequate justifications were those based on the perceptual features of the situation or irrelevant considerations. Adequate justifications included: statements of the operation performed, addition-subtraction, compensatory relations-proportionality, "sameness" of materials used, reversibility, counting, and reference to previous state of equality (Papalia & Hooper, 1971).

Analyses of Results

A one-way analysis of variance (ANOVA) on chronological age by 6 task combinations was done. Six task combinations were determined by total number responding in the six highest combinations of tasks. Task combinations were:

1. Passing all 4 tasks (P-P-P-P)
2. Failing only Substance Equivalence, passing other other 3 tasks (P-F-P-P)
3. Failing Substance Identity, failing other 3 tasks (F-P-P-P)
4. Failing Substance items, passing Number items (F-F-P-P)
5. Passing only Number Identity, failing 3 other tasks (F-F-P-F)
6. Fail all tasks (F-F-F-F)

A Newman-Keuls analysis was done to find specific significant differences.

Looking at the relationship between class participation and task pattern, a 3 x 6 matrix of frequencies examined specific age distribution and percentages of subjects in each combination. An additional 3 x 6 matrix of mean age in class and task was done.

CHAPTER IV

TEST RESULTS

Administration of the Piagetian tasks followed the design format with analysis of the data done in the following progression:

1. Analysis of individual items
2. Combinations of identity versus equivalence conservation tasks
3. Content items (Substance and Number)
4. Comparison of six task combinations both with and without justifications
5. Comparisons of age and task combinations
6. Comparisons of class and task combinations both with and without justification
7. Comparisons of justification responses
8. Conclusions

Individual Item Analysis

Analysis of the data began with analysis of individual tasks to ascertain number of subjects passing tasks and the mean ages of those groups. Task analysis and combinations of identity-equivalence tasks and content area tasks are presented in Table 1.

Table 1

Analysis of Tasks[a] by Age, Identity-Equivalence and Content

Task[b]	Subjects	
	Mean Age	N
1	5.75	29
2	5.87	30
3	5.68	47
4	5.75	40
1 and 3	5.66	2
2 and 4	5.75	1
1 and 2	5.66	2
3 and 4	5.76	7

[a]Tasks successfully completed without justification.

[b]Task 1 = Substance Identity (SI)
Task 2 = Substance Equivalence (SE)
Task 3 = Number Identity (NI)
Task 4 = Number Equivalence (NE)

Reviewing the number of subjects passing individual tasks, it became apparent that each task was passed by at least 50% of the total population tested. The most frequently passed task was Number Identity, followed by Number Equivalence, Substance Equivalence, and Substance Identity. Tasks placed in duo combinations, by either identity-equivalence or content area, did not, however, exhibit a specific response pattern. Combining the Number and Substance Identity tasks, 1 and 3, a total of two subjects were observed. For combinations of tasks 2 and 4, one subject was observed, while in the Substance content area, task 1 and 2, there was a total of two subjects. The only combination of any significance was the Number content area, tasks 3 and 4, having 11% of the total population. Combining the total number of subjects contained within the four dyad groupings accounted for only 12 subjects or 20% of the total population, excluding 76% of the group. Thus the majority of the subjects were not contained with pairs of tasks but possibly combinations of all four conservation tasks. To determine if that were the case, a breakdown of all possible pass-fail task combinations was performed. The groups containing the largest number of subjects is presented in Table 2. Within the six groups, 92% of the total population is represented. The 8% excluded from the six groups exhibited the patterns presented in Table 3. One of these subjects was from the 4-year-old group, with the remaining four in the younger 5-year-old

Table 2

Task Combinations without Justification

Group	Task 1 Substance Identity	Task 2 Substance Equivalence	Task 3 Number Identity	Task 4 Number Equivalence	Mean Age	N
1	P	P	P	P	5.77	21
2	P	F	P	P	5.58	4
3	F	P	P	P	5.97	7
4	F	F	P	P	5.76	7
5	F	F	P	F	4.93	6
6	F	F	F	F	5.77	10
						55

Table 3

Task Combinations Excluded from Sample

Pattern	Task 1	2	3	4	Mean Age	N
1	P	P	P	F	5.9	2
2	F	F	F	P	5.7	1
3	P	P	F	F	5.7	2
						5

group. Consequently total subjects for 4-year-olds equals 19, and 14 for the younger 5-year-olds.

From this point on, analysis of the data treated the subjects as Groups 1 to Group 6 as defined by the task breakdown, and Substance Identity as SI, Substance Equivalence as SE, Number Identity as NI, and Number Equivalence as NE.

Analysis of Task Combinations

Using a one-way analysis of variance, an analysis of the six task combinations was completed with the results presented in Table 4.

Significant differences between the groups were found, $F\ (5, 49) = 2.67$, $p < .03$, with Cochorans $C = 0.3684$ (p 0.070) judging the standard deviations of the groups as they are presented in Table 5 to be equal. Consequently, H_1: There will be no age differences in the ages of the children who respond in the six patterns under criteria conditions of judgment only, was rejected.

To find where specific significant differences between groups were occurring, the Newman-Keuls procedure was used. This procedure adjusts the size of the critical region according to the means spanned in comparison to the sorting of subjects into groups. The Newman-Keuls identified two homogenous subsets:

Table 4

Analysis of Variance of Combinations of Four Tasks by Age

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	5	675.8821	135.1764	2.67	0.0324
Within Groups	49	2475.5048	50.5205		
Total	54	3151.3870			

Table 5

Age Parameters of Groups

Group	Count	Mean Age	S.D.	Minimum Age	Maximum Age
1	21	5.77	7.31	4.58	7.0
2	4	5.58	4.08	5.08	5.83
3	7	5.97	9.97	5.00	7.08
4	7	5.76	3.38	5.33	6.16
5	6	4.93	5.30	4.50	5.58
6	10	5.44	7.80	4.66	6.91
Total	55	5.63	7.63	4.5	7.08

Subset 1

Group	5	6	2	4
Mean	4.93	5.44	5.58	5.76

Groups 1 and 3 had means significantly different from the groups in Subset 1.

Subset 2

Group	6	2	4	1	3
Mean	5.44	5.58	5.76	5.77	5.97

Group 5 had a mean which was significantly different from the groups in Subset 2. Differences, therefore, do exist between the groups and varied according to the ordering of the groups themselves. When groups were ordered 5, 6, 2 and 4, Groups 1 and 3 were different. Group 1 contained subjects who passed all tasks. Group 3 contained subjects who passed tasks 2, 3, and 4 but failed Task 1. Both groups, however, contained the only subjects passing Task 2, Substance Equivalence. In addition, the only task differentiating Groups 1 and 3 was Task 1, Substance Identity.

In Subset 2, when groups were ordered 6, 2, 4, 1 and 3, only Group 5 was significantly different. Group 5 subjects were unique in that they passed Task 3, Number Identity, while failing all other tasks. Group 5 was the only group that demonstrated that pattern.

Age and Group Composition

To provide a more comprehensive analysis of the groups, an age breakdown was performed and is presented in Table 6.

Comparing age ranges within Groups 1 and 3, several significant observations can be made. In Group 1, only two 4-year-olds (10%) appeared while there were 12 5-year-olds (57%) and seven 6-year-olds (33%). This age breakdown reflected a definite break between the 4-year-olds and 5- and 6-year-olds in total task competence. The break between the 5- and 6-year-olds is difficult to assess because there were fewer 6-year-olds (transition class students) in the total sample.

In Group 3, the clusters were comprised totally of 5-year-olds (N = 5, 43%) and 6-year-olds (N = 4, 57%). As noted earlier, Groups 1 and 3 were the only groups competent (passing) on the Substance Equivalence task, with their only difference failure of Group 3 to pass Substance Identity.

Thus it appeared that of the total population only two 4-year-olds or 5% of that age group were competent (passing) on all four tasks. In contrast, a total of 15 or 45% of all 5-year-olds were at or near total competence (passing) level as were seven or 50% of all 6-year-olds.

Comparing the performances of only 5- and 6-year-olds in Groups 1 and 3, a reversed clustering appeared. In Group 1, 12 5-year-olds and seven 6-year-olds appeared, while Group 3 had only two 5-year-olds and four 6-year-olds. The

Table 6

Analysis of Age Dispersion Within Groups

Group	Ages						Total Age Range
	4 yr.	N	5 yr.	N	6+ yr.	N	
1	4.5	1	5.08	1	6.08	1	4.58-7.00
(P-P-P-P)	4.11	1	5.16	1	6.16	1	
			5.20	1	6.25	1	
			5.33	1	6.33	1	
			5.50	1	6.50	1	
			5.60	1	6.80	1	
			5.70	2	7.00	1	
			5.75	2			
			5.83	1			
			5.91	1			
2	0		5.08	1	0		5.08-5.83
(P-F-P-P)			5.66	1			
			5.75	1			
			5.83	1			
3	0		5.00	2	6.00	1	5.00-7.00
(F-P-P-P)			5.58	1	6.40	1	
					6.80	1	
					7.00	1	
4	0		5.3	1	6.0	1	5.3-6.2
(F-F-P-P)			5.5	1	6.2	1	
			5.7	2			
			5.8	1			
5	4.5	1	5.0	1	0		4.5-5.5
(F-F-P-F)	4.9	2	5.2	1			
			5.5	1			
6	4.6	1	5.2	2	6.9	1	4.6-6.9
(F-F-F-F)	4.8	1	5.3	1			
	4.9	1	5.6	1			
			5.7	1			
			5.8	1			
Totals		8		33		14	

5-year-olds displayed more overall task competence, while 6-year-olds displayed more difficulty with the Substance Identity than did the 5-year-olds. It was also the 6-year-olds who were in the transitional class, indicating delays in areas of school readiness.

Subset 2--Group 5

Group 5 (F-F-P-F) was significantly different from the groups presented in Subset 2. It was the only group where only one task was passed, with that task Number Identity. The age range of Group 5 ranged from the mid-4-year-old to the mid-5-year-old range. Group 6 was the only other group having 4-year-olds, with all tasks failed. Since many researchers (Elkind, 1967; Wadsworth, 1978) are in agreement that Number Conservation is the first content area to develop, the composition of Group 5 appeared age-appropriate and in agreement with the literature. Seventy-five percent (75%) of the 4-year-olds appeared in Groups 5 and 6; thus, it would be logical to assume that Group 5 was exhibiting the first stage in the development of conservation, specific Number Identity. The observation that Number Identity appeared as an individual skill from all the possible combinations supports Elkind's (1967) contention that there is an identity-equivalence decolage in conservation, with identity conservation preceding equivalence conservation. The age group clustered in Group 5 also supports Brainerd and Hooper's

(1975, 1978) contention that the decolage is evident in children of preschool age or younger. The two 4-year-olds who passed all four tasks were not thought to be contradictory of the existence of the decolage but rather suggestive of the advanced conservation skills in children whose mental ages exceed their chronological ages. This is substantiated by at least one study finding a significant correlation between conservation skills and mental age (Goldschmid & Bentler, 1968).

Based on the analysis of Groups 1, 3, and 5, the following statements were made:

1. Groups 1 and 3 contained the only subjects passing the Substance Equivalence.
2. Substance Identity was the only task separating Groups 1 and 3, with more 5-year-olds than 6-year-olds passing that specific task.
3. More 5- than 6- or 4-year-olds were competent in Group 1, passing all four tasks.
4. Group 5, with 4- and 5-year-olds able to pass only the Number Identity task, supported the identity-equivalence decolage. Further, in comparing the age progression from Group 6 to Group 5 to Group 4, from failing all tasks to passing Number Identity only, to passing Number Identity and Number Equivalence, a definite upward trend appeared. Younger children were in Group 6, with fewer young children in Group 5 to older 5- and 6-year-olds in Group 4.

That trend continued through Group 3, when the effect of the transitional class placement and the 6-year-olds who were not school-ready became apparent.

5. Comparing cell frequencies, Group 1 and twice as many 5-year-olds as did Group 6. Thus, 5-year-olds appear sometime during that age span to go through the process of developing conservation skills and can be observed at various stages during that time span.

Group 1 to Group 6: Responses with Justifications

To determine what, if any, effect verbal justifications had on task competencies, analysis of task response with correct justification was performed. Scoring included:

1. Passing task and passing justification
2. Passing task and failing justification
3. Failing task and passing justification

The last category evolved from data analysis was several children who, upon being asked to justify their responses, proceeded with the correct justification and recognition of their task error. In those cases, the task score was not changed, but note was made of the justification. Table 7 presents task and justification combinations.

Group 1 Justifications

On Tasks 1 and 4, Substance Identity and Number Equivalence, only one subject per task, ages 5.3 and 5.0 respectively, was unable to give correct justifications. On

Table 7

Task and Justification: Group 1--Group 6

Group	Task 1				Task 2				Task 3				Task 4			
	NP	JP	JF	A	NP	JP	JF	A	NP	JP	JF	A	NP	JP	JF	A
1	21	20	1	5.3 F	21	18	3	6.8 5.9 5.0 } F	21	18	3	6.8 5.9 5.0 } F	21	20	1	5.0 F
2	4	4	0		0	1	3	5.08 P	4	4	0		4	4	0	
3	0	1	6	5.58 P	7	5	2	6.4 5.5 } F	7	5	2	6.4 5.5 } F	7	7	0	
4	0	0	7		0	0	7		7	7	0		7	6	1	5.3 F
5	0	0	6		0	0	6		6	6	0		0	0	6	
6	0	0	10		0	0	10		0	0	10		0	0	10	

NP = Number passing
JP = Justification passed
JF = Justification failed
A = Age of lowest number in the group and task
P = Passing
F = Failed

Tasks 2 and 3 there appeared to be a pattern with the same three subjects unable to justify their responses to those tasks. The ages of those subjects ranged from 5.0 to 6.8 years, however, limiting conclusions relevant to age and inability to justify responses.

Group 2 Justifications

With the exception of Task 2, all subjects in that group passed both the task and the justification. On Task 2, one subject, 5.08 years old, was able to give an appropriate justification, although he was unable to solve the task initially.

Group 3 Justifications

Task justifications varied in that group, going from Task 4, where all passing responses matched with correct justifications, to Task 1, where one subject, 5.5 years old, was able to justify but not solve the task.

Tasks 2 and 3 followed a pattern similar to the one evidenced in Group 1, with the same two subjects passing the task but failing the justification. The ages of those two subjects fell within a 4-month span.

Group 4 Justifications

For Tasks 1, 2, and 3, all incorrect responses had corresponding incorrect justifications. Task 4 was the exception to that pattern, with six out of the seven subjects

providing the correct justification, and with one subject, 5.3 years old, passing the task but failing the justification.

Group 5 Justifications

Tasks 1, 2, and 4 had tasks failed and incorrect justifications. On Task 3, correct responses were matched with correct justifications.

Group 6 Justifications

All responses and justifications were incorrect.

Justification Profile

In total, there were 13 individual tasks which were passed by Groups 1 to 6, involving 137 subject responses. Of that number only 13 incidents or 9% of those responses were passed tasks but failed justifications. In addition, those 13 incidents involved only 8 subjects, with 5 of the subjects failing two justifications. Those 5 subjects were all in Groups 1 and 3, Tasks 2 and 3. Of interest is Task 2, Substance Equivalence, noted as being passed only by Groups 1 and 3.

Given that 9% of the subjects were unable to justify their responses, a total of 91% passing the task could justify their responses. Because of the scattering of ages of subjects who failed justifications, ranging from 5.0 to 6.8 years, correct justifications did not appear specific to an age factor. Consequently the second hypothesis, H_2: There

was no difference in the ages of the children who responded in six patterns under criteria conditions of judgment plus explanations, was accepted. Age did not affect the correctness of justification responses.

Groups and Class Placement

To establish the relationship between the groups and class placement, the subjects were considered in their intact class groupings defined as 4-year-olds, 5-year-olds, and 5 transitional classes. A cross-tabulation of class by group was done with the results presented in Table 8.

Because of the small number of subjects in 13 out of the 18 cells, statistical analysis of the data would have been questionable, but a visual examination was possible.

4-Year-Old Class

From the visual examination of the groups by class, it became apparent that 4-year-olds had almost twice as many subjects (N = 7, 12.7%) failing all tasks, Group 6, as passing all tasks (N = 4, 7.3%) in Group 1. The next largest clustering of 4-year-olds occurred in Group 5, (N = 5, 9.1%), passing Number Identity only. The remainder of the class was equally distributed among the remaining groups.

Comparing levels of task competence (passing), it appeared that at least 63% of the class solved one conservation task, 36% solved both Number tasks, and 31% solved both Number tasks and at least one of the Substance tasks.

Table 8

Group Membership by Class

	Class					
	4-year-olds		5-year-olds		5T	
Group	N	%	N	%	N	%
1	4	7.3	5	9.1	12	21.8
2	1	1.8	0	0	3	3.5
3	1	1.8	2	3.6	4	7.3
4	1	1.8	4	7.3	2	3.6
5	5	9.1	1	1.8	0	0
6	7	12.7	2	3.6	1	1.8
Total	19	44.5	14	25.5	22	40.0

Group 1 = (P-P-P-P)
Group 2 = (P-F-P-P)
Group 3 = (F-P-P-P)
Group 4 = (F-F-P-P)
Group 5 = (F-F-P-F)
Group 6 = (F-F-F-F)

Thus, the majority of 4-year-olds were competent in only one area, Number Identity, with only slightly more than a third able to do both Number task and one Substance task. Consequently, the 4-year-old group was considered to be at the beginning stages of conservation development.

5-Year-Old Class

The 5-year-old class displayed a more erratic pattern of conservation skills. While 35% of the 5-year-olds were able to pass all tasks, 14% were able to pass none. The next largest cluster of 5-year-olds (28%) was on Group 4, passing Number Identity and Number Equivalence, followed by Group 3 with 14% of the 5-year-olds able to pass Substance Equivalence and both Number tasks. The group containing the small cluster was Group 5, with 1 subject (7%) passing Number Identity only. There were no 5-year-olds failing only Substance Equivalence in Group 2.

In addition to those 5-year-olds placing in the various groups, an additional group of four 5-year-olds must be noted as not having fit any group. This was the largest number of any age group not included in the final analysis.

Five-year-olds, as a class, appeared in a state of great diversity in conservation skills. Some children were competent (passing) in conservation skills, while others in the same class were going through various development stages. With the exception of those with no conservation skills, all

12 of the remaining 5-year-olds in the sample had developed Number Identity. Of that group 11 subjects (78%) had both Number Identity and Number Equivalence. Thus, the 5-year-old group appeared to have reached a step above the developmental level of the 4-year-olds.

Transitional Class

The 5 transitional class had 95% of the class passing both Number Identity and Number Equivalence tasks. With at least one of the Substance tasks added to the Number tasks, 86% of the class was included. Thus, the majority of the five transition groups was able to pass both Number tasks and one Substance task.

Comparisons of the three classes by number of tasks passed is presented in Table 9.

Overview by Class

As the number of tasks were included, a downward progression in number of subjects competence was observed. The 4-year-old decreased from 63% able to solve at least one task to 31% able to solve three tasks. The regular 5-year-old class, while not exhibiting as dramatic a change, did range from 85% competent on one task to 50% competent on three tasks.

Of all groups, the 5 transitional class evidenced the smallest loss. For while 95% were competent on one task, 86% were still competent on at least three tasks. Based on

Table 9

Class by Number of Tasks Successfully Completed

	Tasks[a]					
Class	NI		NI, NE		NI, NE, SI/SE	
	N	%	N	%	N	%
4	12	63	7	36	6	31
5	12	85	11	78	7	50
5T	21	95	21	95	19	86

[a]NI = Number Identity
NE = Number Equivalence
SI = Substance Identity
SE = Substance Equivalence
SI/SE = either or both

that data, the third hypothesis, H_3: There is no relationship between placement in the transitional class and conservation task performance, was rejected. Those subjects in the transitional class were more competent when compared to 4- and 5-year-old classes on passing one or more conservation tasks. In addition, the developmental progression of identity conservation then equivalence conservation is evident in all three classes.

Class and Task Performance

In addition to reviewing the data by class and group, an additional breakdown by class and individual tasks, both with and without justifications, was performed. The breakdown of class and tasks are presented in Table 10.

The results of that breakdown agreed with earlier findings, again demonstrating the Number Identity, Number Equivalence, Substance Equivalence, Substance Identity developmental progression. Adding the Justification component to the same variables, an additional table was constructed. That table, Table 11, presents class, task, and justifications passed.

The earlier finding that the majority of the children in the groups was able to justify their responses held for class by task analysis. Of the 4-year-old group, 83% were able to justify their responses, as were 95% of the 5-year-olds and 94% of the 5 transitional class. Most subjects who

Table 10

Class and Task Summary[a] Without Justification Responses

Task[b]	Age							
	4 yrs.		5 yrs.		6 yrs.		Total	
	N	%	N	%	N	%	N	%
1	6	10.0	8	13.3	15	25	29	48.3
2	6	10.0	8	13.3	16	26.7	30	50.0
3	12	21.7	12	21.7	21	35.0	47	78.3
4	7	11.7	12	20.0	21	35.0	40	66.7

[a]Passing tasks only

[b]Task 1 = Substance Identity
Task 2 = Substance Equivalence
Task 3 = Number Identity
Task 4 = Number Equivalence

Table 11

Class and Task Summary with Justification Responses[a]

Task[b]	Age							
	4 yrs.		5 yrs.		6 yrs.		Total	
	N	%	N	%	N	%	N	%
1	5	8.3	7	11.7	15	25	27	44.3
2	5	8.3	7	11.7	14	23.3	26	43.3
3	11	18.3	13	21.7	19	31.7	43	71.7
4	5	8.3	11	18.3	21	35.0	37	61.6

[a]Did provide justification for correct (passing) response.

[b]Task 1 = Substance Identity
Task 2 = Substance Equivalence
Task 3 = Number Identity
Task 4 = Number Equivalence

were able to conserve could provide appropriate justifications regardless of their class placement.

Justification Response Patterns

Although not part of the initial study, an analysis of the justifications given for each task was performed to determine possible patterns of responding. The analysis of those justifications by age and task is presented in Table 12.

The profile of all justification responses found significant errors on Substance Identity and Substance Equivalence by children using perceptual comparisons for task solution. The most often used justification for Substance Identity was the sameness of the material, while most children referred to the previous equality of the materials in solving the Substance Equivalence task. There were no correct justification with incorrect tasks in this group.

Within the Number content area, counting was the most frequently used justification on both tasks. This was followed by adding and subtracting with the child referring to the lack of those processes occurring. There were a total of seven children who gave correct justifications, although tasks were failed on the Number items with most of the children recognizing their errors as they counted out the chips after they had responded.

It appeared that basic one-to-one matching provides the basis for the problem solving on the Number content items,

Table 12

Justification Responses by Age and Task

	Task							
	1		2		3		4	
Age Interval	Response	N	Response	N	Response	N	Response	N
54-60	Add-Sub	1	Pre Eq	1	Add-Sub	1	Correct J	1
	Sameness	1	Per (Inc)	3	Sameness	2	Add-Sub	1
	Per (Inc)	7	Other (Inc)	3	Count	4	Count	2
	Other (Inc)	1			Per (Inc)	1	Pre Eq	1
					Other (Inc)	2	Per (Inc)	1
							Other (Inc)	4
61-67	Add-Sub	1	State Op	1	Correct J	1	Correct J	3
	Comp	1	Comp	3	Add-Sub	4	Add-Sub	1
	Sameness	2	Sameness	1	Sameness	2	Sameness	3
	Reverse	1	Pre Eq	3	Count	5	Count	4
	Pre Eq	1	Per (Inc)	9	Per (Inc)	1	Per (Inc)	4
	Per (Inc)	6	Other (Inc)	1	Other (Inc)	5	Other (Inc)	3
68-74	State Op	1	State Op	1	State Op	1	Add-Sub	5
	Add-Sub	2	Comp	1	Add-Sub	6	Count	11
	Sameness	6	Sameness	1	Sameness	2	Pre Eq	1
	Per (Inc)	4	Pre Eq	5	Count	5	Per (Inc)	3
	Other (Inc)	4	Per (Inc)	8	Per (Inc)	2	Other	2
			Other (Inc)	6	Other (Inc)	3		

Table 12 (continued)

Age Interval	Task 1 Response	N	Task 2 Response	N	Task 3 Response	N	Task 4 Response	N
75-81	Add-Sub	1	State Op	1	Add-Sub	2	State Op	1
	Comp	1	Add-Sub	1	Count	5	Count	4
	Sameness	2	Pre Eq	3				
	Per (Inc)	1	Per (Inc)	1				
82-85	State Op	1	Sameness	2	Correct J	1	Correct J	1
	Sameness	1	Other (Inc)	1	Add-Sub	1	Add-Sub	1
					Count	3	Count	3

Add-Sub--Addition-Subtraction
Comp--Compensation
Per (Inc)--Perceptual (Incorrect)
State Op--Statement of Operation
Pre Eq--Previous Equality
Correct J--Correct Justification

while children faced with the Substance items must first develop the ability to ignore or accommodate to the perceptual illusion they encounter. In agreement with Elkind (1967), the perceptual change does indeed prevent children from conserving.

Types of justifications used by different age groups did not indicate any significant trends, with the justification used generally determined by task content.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Elkind (1967), in redefining Piaget's conservation construct, hypothesized that conservation was composed of two, rather than one, operations. Piaget's conservation problem, requiring the comparison of two stimuli before and after change had effected the perceptual presentation of one stimulus, was thought by Elkind (1967) to be representative of equivalence conservation. Further, Elkind (1967) determined that before a child was able to complete an equivalence conservation task he must first develop identity conservation. Identity conservation, as defined by Elkind (1967), was the ability to perceive the sameness of one stimulus after it had been subjected to a perceptual change. Elkind then surmised that identity conservation occurred first, setting the foundation for the development of equivalence conservation at a later time.

The existence of identity conservation and equivalence conservation became generally accepted by researchers (Brainerd & Hooper, 1978) but the developmental progression, as proposed by Elkind, remained in question. Two distinct viewpoints developed with researchers (Brainerd & Hooper, 1957; Papalia & Hooper, 1972) agreeing that identity and

equivalence did indeed develop in the developmental progression suggested by Elkind. Other researchers (Moynahan & Glick, 1972; Murray, 1970), however, found that identity and equivalence were co-occurring and therefore of little developmental significance.

Brainerd and Hooper (1975) analyzed the studies which had been done, finally focusing on two variables thought to account for the discrepancies in the studies which tried to identify the identity-equivalence paradigm. Those variables were the ages of the children being tested and whether or not the criteria required verbal justifications. Brainerd and Hooper (1975) contended that the identity equivalence decolage was observed only in those children who were younger than kindergarten age and the criteria did not include verbal justifications. Miller (1978) was in disagreement with those findings, suggesting that Brainerd and Hooper were presenting an illogical argument. Miller was in agreement with Murray (1970) and Moynahan and Glick (1972) that the decolage would not be evident under any conditions. Thus, there appeared to be little agreement among researchers relative to the existence of the decolage.

The contradictions in the literature relative to the identity-equivalence paradigm provide the framework for this study. It was the intent of this study to examine the existence of the identity-equivalence decolage relative to the age of the child being tested and the criteria being used.

For that purpose, five tasks were administered to 60 preschool children. The group was comprised of 19 4-year-olds, 14 5-year-olds, and 22 5-6-year-olds (transitional class). The subjects were administered one introductory experience to determine their language development and ability to understand the task. Following the introductory task, four conservation tasks were presented. Those tasks were Number Identity, Number Equivalence, Substance Identity, and Substance Equivalence. Each subject had five trials on each task, with the last trial followed by a request from the examiner for a justification for their responses. Scoring considered passing one of the following:

a. Four out of five trials correct.

b. Four trials passed plus correct justification.

It was anticipated that younger children would more clearly demonstrate the decolage and that the children, in general, would be able to justify their responses. Further, it was suggested that the transitional class, composed of older preschool children, would be more competent in conservation but display a wider range of abilities.

Analysis of the data of the study resulted in the acceptance of one and the rejection of two of the presented hypotheses. The first hypothesis, stating that there will be no differences between the ages of the subjects in the various task combinations, was rejected. Based on total number of subjects involved, six combinations of tasks passed

and failed were identified and then analyzed to determine what, if any, differences existed between those six groups. Using the Newman-Keuls procedure, two subsets were then identified which had groups that were excluded from the subsets. In Subset 1, Groups 1 (P-P-P-P) and 3 (F-P-P-P) were found to be significantly different from the other four groups. Contained in Groups 1 and 3 were the only subjects, of the entire sample, who passed Substance Equivalence. In addition, the only task preventing the inclusion of Group 3 within Group 1 was the failure of those subjects to pass Task 1. Consequently, those groups were thought more alike than different and, when compared by age presentation, were found to contain most 5- and 6-year-olds.

In contrast to Subset 1 was Subset 2, which excluded only Group 5 (F-F-P-F). Group 5 was composed of those subjects passing Number Identity only and who were contained in either the 4- or 5-year-old classification. Of additional significance was the task passed by Group 5, Number Identity. Because that was the only task passed, it did provide support for Elkind's (1967) postulated identity equivalence decolage with identity demonstrating developmental priority.

Thus, differences were found between the six groups, with the older subjects demonstrating more competence than the 4-year-olds and with the 4-year-olds and some 5-year-olds exhibiting on initial stage of conservation development, identity conservation.

The second hypothesis changed the criterion conditions for passing the tasks. It required each subject to provide a verbal explanation after their final response to the task itself. Of the total sample, 91% of the subjects were able to provide correct verbal justifications while passing the task. The subjects who were unable to do so were of varying ages, not indicative of any specific pattern.

Comparing the performances of Groups 1 (P-P-P-P) and 3 (F-P-P-P), seven of the eight subjects who failed justifications appeared, with five of those seven missing two tasks, Task 2 and Task 3. These subjects were thought to be in a transitional stage, not yet being able to verbalize their actions.

Having noted earlier that failure of Task 1 was the only discriminating variable between Groups 1 and 3, it was interesting to note that of the two subjects in the study who failed the task but passed the justification, one was in Group 3 on Task 1. Thus there appeared to be transitions occurring in Group 3 which would lead to success on all tasks.

Group 5 (F-F-P-F) subjects, the 4- and 5-year-olds passing only Number Identity, were able to provide justifications for that task. Consequently, the second hypothesis was accepted, for there did not indeed appear to be an age variable associated with justifications. Further, because Group 5 which evidenced the decolage could provide adequate justifications, the use of verbal explanations, contrary to Brainerd and

Hooper's (1978) position, did not hinder the identification of the decolage. In addition, Gallagher and Kirk's (1978) assertion that verbal justifications were imperative for the discrimination of conservation skills was not supported. For the majority of the subjects could solve the task and explain the process with equal facility.

The third and final hypothesis related to placement in the transitional class and task performance. Comparing the three intact classes on task performance and using a total of passing of at least three tasks, significant differences appeared between the groups. The 4-year-old class had only 31% of its members in that category, the 5-year-olds had 50%, while the transitional, 5T, class had 86% of its subjects represented in the passing three tasks situation. Thus, the 5T class had a 36% increase in total competence over the 5-year-olds at that level. The 5T class was nearer total conservation competence, as a group, than were the 5-year-olds. Thus, the third hypothesis was rejected, with a relationship between class placement and conservation skills having been identified.

Conclusions

Based on the findings of this study, the following conclusions were reached:

1. The identity-equivalence decolage does exist and can be observed in children younger than kindergarten age.

2. When preschool-aged children were grouped according to age, a developmental progression of conservation skills from the 4- to the 6-year-old levels was observed. The 4-year-olds had limited conservation skills, followed by the 5-year-olds, who appeared in transitional stages, culminating with the 6-year-olds, who were adept at most conservation tasks.
3. The use of verbal justifications for task criteria did not decrease the ability to pass the task for the majority of the subjects.
4. The use of verbal justifications did not preclude the discrimination of the identity-equivalence decolage.
5. Task performance and class placement were related with the older students in the transitional class having more conservation abilities.

Limitations of the Study

While the findings of this study appeared initially to be of significance, several areas of concern, relative to the study, must be noted to preclude any inappropriate generalization of the results. The first concern focused on the sample used in the study which was a select group. The subjects were, for the most part, from upper-middle-class homes, not representative of the general population. In addition, the 6-year-old group, the transitional class, was

by its very nature unique. It was comprised of subjects who were determined by their teachers to need more readiness experiences, and thus not representative of the 6-year-old who is following a normal developmental progression. Finally, the total number of subjects was small, resulting in relatively small clusters within the various groupings.

From a statistical vantage point, it must be noted that only one statistic procedure, an ANOVA, was performed on any of the data. Because of the characteristics of the tasks, it was not feasible to perform further statistical analysis, and it must be recognized that the acceptance and rejection of Hypotheses 2 and 3 were based on percentage of subjects in various groupings and visual inspection of the data. Thus, from a statistical perspective, that data did not have the same strength as did that of the ANOVA used on the first hypothesis.

It should also be noted that while this study focused on conservation, it did in fact present only two conservation content areas, Number and Substance. The results, therefore, should be thought of as specific to those areas, and not generalized to other conservation areas.

Recommendations

The identity-equivalence decolage and its demonstrated existence in the preschool population, along with the observed developmental progression of conservation skills, should provide a theoretical framework for the development

of preschool programs. It should become obvious from the data in this study that the 4-year-olds are able to perceptually and cognitively focus on only one stimulus at any given time. Thus, presentation of tasks requiring them to draw conclusions based on the comparison of two or more objects is inappropriate. Conversely, 5-year-olds are in transitional stages needing exposure to tasks presenting both one and two stimuli. Within the 5-year-old group, one must also allow for greater variability of within-group differences.

In contrast to the 5-year-olds are the 6-year-olds (5T) who appeared to have developed many conservation skills and should, theoretically, then be ready for school (Almy, Chittenden, & Miller, 1966).

A main concern which developed as a result of this study focused on the 5- and 6-year-old groups. Given the varied performance of those two age groups and the distinct possibility that some of these subjects could be placed in the same first grade classroom, the question of the varied levels of readiness for learning needs to be addressed. For if only 50% of the 5-year-old group can solve three or more conservation tasks while 86% of the 6-year-olds perform at the same level, the probability for failure in the 5-year-old group could appear potentially high. Thus, examination of conservation ability might appear as a necessary component in evaluating school readiness.

In addition, program development, especially at the 5-year-old level, should provide for continuous assessment of conservation abilities to anticipate the transition to the readiness stage for academic experiences.

The importance of appropriate preschool programs and the need to evaluate a child on an individual basis appeared reinforced by this study. By failing to recognize the significant cognitive differences which occur at the preschool level and programs appropriate to the differences, one could easily produce a failure situation for a child. The varied learning styles of the 4-, 5-, and 6-year-olds only add credence to the need for programs which follow a developmental progression. Further, the marked variability within the task competences of the 5-year-olds provides additional support for individual evaluations and little credence to the description of the "typical" 5-year-old.

It would seem appropriate at this time to focus not on the development of additional instruments to evaluate preschoolers, but rather to provide professionals with the abilities to understand the children with whom they are involved within the context of Piagetian cognitive development, supplemented by the identity-equivalence theory. It may be possible, from within this framework, to evolve to a readiness level truly based on cognitive abilities and thus preclude the development of later learning problems for many children.

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APPENDIX A

CONCEPT ASSESSMENT KIT

APPENDIX B

PIAGETIAN SCORE SHEET

PIAGETIAN SCORE SHEET

Name_____ Sex_____

DOB_____ Presentation Order_____

Date of Testing_____

Preschool Class_____

I. Introductory Experience

Activity: Pouring from unequal to equal amounts of corn seeds in 2 similar containers.

Criteria: Ability to see the equality in the amounts. Must be aware of terms same and/or equal amounts.

Questions: "What can you tell me about the corn in these two glasses?"

Response:_____

II. Conservation Tasks

A. Quantitative Identity

Activity: S pours corn from one beaker into similar beaker.

Criteria: Recognize same amount of substance.

Questions: "Does this glass have same amount of corn or more corn than this glass had before?"

Trials:	1	2	3	4	5
Response:	_____	_____	_____	_____	_____

Justification:_____

B. Quantitative Equivalence

Activity: Equating 2 glasses with same amount of corn and then corn being moved into 5 smaller glasses.

Criteria: Same amounts of corn in the different containers.

Questions: "Is there as much corn in this one (large glass) as in all of these together, or does one side have more?"

Trials: 1 2 3 4 5

Response: _____ _____ _____ _____ _____

Justification:_____

C. Number Identity

Activity: Five poker chips placed one inch apart.

Criteria: Positioning not affecting amount of substance.

Questions: "Are there the same amount or more chips than before?"

Trials:

1. Lateral Displacement_____
2. Collapsing_____
3. Resubgrouping _____
4. Equal group_____
5. Three subgroups_____

Justification:_____

D. Number Equivalence

Activity: Parallel lines of two different colored chips. One line is compressed while other is extended.

Criteria: Position not affecting amount of substance between substances.

Questions: "Are there as many red chips as white chips, or is there more of one kind?"

Trials: 1 2 3 4 5

Response: _____ _____ _____ _____ _____

Justification: _____

Justification of Responses:

a. Statement of operations performed
b. Addition-subtraction
c. Compensatory relations-proportionality
d. Sameness of materials used
e. Reversibility
f. Counting
g. Reference to previous state of equality

Conservation Task

A. Quantitative Identity _____

B. Quantitative Equivalence _____

C. Number Identity _____

D. Number Equivalence _____