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AUTHOR Haney, Joanne D. Hager
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ABSTRACT

The purposes of this study include: (1) determining whether socioeconomic status (SES) or verbal ability (VA) exerts greater influence on childrens' performance of Piagetian tasks; (2) devising an instrument for measuring childrens' level of cognitive development which does not depend on verbal ability alone; and (3) adapting materials for teacher use in assessing childrens' level of intellectual development. The sample was comprised of 160 low and middle SES subjects (K-4) matched for upper and lower VA, to each of whom was administered a battery of Piagetian tasks. Results indicate SES to be a negligible variable, while VA has much stronger discriminative power. Main effects for grade and verbal ability were found for all but one task, though no main effects or higher order interactions were found in connection with sex. The findings support the Piagetian position that culture, schooling, and language have only a limited effect on intellectual development. (Author/TL)

Final Report

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Joanne D. Hager Haney, Ed. D.

P. O. Box 65

Ivanhoe, West Virginia 26227

A COMPARISON OF SOCIOECONOMIC STATUS, VERBAL ABILITY, GRADE LEVEL, AND SEX IN THE PERFORMANCE OF PIAGETIAN-TYPE TASKS

September 1971

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Office of Education

Region III

Regional Research Program

ABSTRACT

The purposes of this study were: (1) to determine whether socio-economic status (SES) or verbal ability (VA) exerts the greater influence on the child's performance of Piagetian tasks in grades K-4; (2) to devise an instrument to measure the level of a child's cognitive development which does not depend on verbal ability alone; (3) to adapt materials which may be constructed easily and used by teachers in the classroom to assess the child's level of intellectual development.

Over 600 children in grades K-4 were rated for SES level and VA and a sample of 160 Ss drawn. The criteria for selection were middle and low SES subjects matched for upper and lower VA at each grade level K-4 with equal numbers of boys and girls. The two schools were rurally oriented and located in southwestern Pennsylvania.

A battery of Piagetian tasks was administered to each subject individually. Special data sheets, devised especially for this study, were used to insure uniformity in testing. Concrete materials were used throughout to minimize or eliminate the need for language on the part of the subject.

SES was found to be a negligible variable. VA was the much stronger discriminating variable. Main effects for grade and verbal ability were found for all but one task. By the fourth grade all groups were performing at comparable levels regardless of social class factors, verbal ability, or sex. No main effects or higher order interactions were found in connection with sex. The findings support the Piagetian position that culture, schooling, and language have only a limited effect on intellectual development.

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U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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CHAPTER I

INTRODUCTION

The renewed emphasis on education has brought about a critical appraisal of the variables that influence intellectual development as it relates to learning. One of the most important problems facing educators today is an understanding of how to promote the intellectual development of each child. The children most in need of help are to be found among the lower socioeconomic status (SES) levels. Educationally, national attention has been turned to the intellectual development of the low SES or culturally deprived child in an effort to break the circle of poverty and help each child become a functioning, productive member of society.

The impact of SES level on intellectual development

The effects of SES level in relation to intellectual development have been studied by several researchers with results generally favoring the middle and upper class child. The lower SES child from a culturally deprived environment has been found to have a deficit in cognitive or intellectual development.

Deutsch (1963) pointed out that the crowded living conditions among the poor severely inhibits the cognitive development of the young child. This type of highly restrictive environment fails to provide the necessary stimulation conducive to intellectual development. These children were also found to have poorer and less systematic ways of ordering and sequencing stimuli deemed important to cognitive growth. Deutsch (1965) found what he called "cumulative deficit phenomena" in language associated with low SES children which occurred during the first five years of life and grew increasingly greater as the children progressed through school. He found a reduced ability to handle syntax and a hesitancy to communicate across class lines as is required in oral classroom presentations. Since language cannot be used as an elaborating form of communication, school loses much of its socializing and teaching capacity, regardless of the content, because the majority of these children have no motivation for learning abilities and strategies required by the school situation. As a result, the negative properties associated with lower class and minority group status are reinforced, and language for these children is restricted to communication with children from their own SES level, an observation made in detail by Hollingshead in Elmtown's Youth.

John (1963) in his study of the intellectual development of slum children concluded that the middle class child has an advantage over lower class children in tasks requiring language facility. The development of abstract, integrative language seems to be hampered by living conditions of lower class children. Opportunities for improving language and the use of categorization are far less prevalent for the lower class.

Blank and Solomon's (1968) study of the effects of a tutorial language program concluded that there is less feedback to the child in the lower SES home and the lack of feedback seriously impairs the intellectual development of the young child, particularly as it relates to the development of language.

Hunt (1963) studied the impact of crowded living conditions on the intellectual development of children and concluded that retardation and apathy on the part of the child resulted from such living conditions. He summarized that during the first year of life the infant from the low SES family may get the normal amount of stimulation, but when he begins to move about by himself, he is likely to get into the way of adults who will restrict his movements and very possibly take punitive action against him. By the time the child is three years old, his continuous questioning is likely to bring more severe rebuffs and little or no response to his verbal activities. This kind of environmental poverty inhibits cognitive development at a time when intellectual development should be progressing at an optimal rate.

Bruner (1961) stated that "not only does early deprivation rob the organism of the opportunity to construct models of the environment, but it also prevents the development of efficient strategies for evaluating information".

The conclusion drawn from a considerable body of literature on the influence of SES levels leads to the inescapable verdict that the advantage lies with the middle and upper class child. These children arrive at school prepared to cope with the environment, while the lower class child is ill prepared to meet the demands the school places upon him.

Research into critical periods for maximal development have been studied in considerable detail over the years. Piaget's theory provides a sound basis for determining the stage of a child's intellectual development and provides procedures to further his development.

Theoretical background of the study

In Piagetian theory the concept of intelligence is viewed as a form of adaptation resulting from continuous interaction between the individual and his environment. Adaptation involves the related processes of assimilation and accommodation. The child assimilates information from the environment through his interaction with it and the information is accommodated within the framework of the existing cognitive structure. New information produces temporary disequilibrium in the organism until it is integrated into the cognitive structure. Each assimilation and accommodation of new information into the cognitive structure results in a higher level of cognitive functioning. The equilibration process serves as a unifying function because it provides a continuity which underlies all of the developmental

processes and provides a new starting point for still higher levels of cognitive development.

The child, during his formative years, carries out innumerable activities which involve space, matter, causality, time, and as he assimilates and accommodates new information from the regularities of his world, old ideas are challenged, changed, and increasingly more complex cognitive structures are formed.

The four factors which influence intellectual development are: maturation, experience, social transmission, and equilibration. These four factors may influence the appearance of periods in Piagetian theory, but not the order of their appearance. (Ripple and Rockcastle, 1964).

According to Piaget (1966) intellectual development proceeds through invariant stages. Intelligence is categorized into two main periods which include the sensori-motor period extending from birth to 2 years and conceptual intelligence extending from 2 years to maturity. The period of conceptual intelligence is further subdivided into pre-conceptual thought (2-4 years), intuitive thought (4-7 years), concrete operational thought (7-11 years), and formal operational thought (11-15 years). Concrete operational thought is heralded by the child's ability to conserve certain properties such as mass, weight, quantity, number, distance, length, area, etc., which remain invariant over irrelevant transformations. In Piagetian theory, conservation is a necessary condition for all subsequent rational activity.

Piaget postulates that for every logical structure there is a corresponding psychological structure. Logical structures subsume intellectual development and are the sine qua non of Piaget's genetic epistemology. The theory also incorporates the idea that the child must actively engage himself with his environment for any intellectual development to take place. Logical thought develops as a result of the individual's interaction with his environment. Logical thought is based on logical operations which constitute the rational means by which the individual manipulates content. It is by means of logical operations that relationships are established and ordered into principles which makes the later abstract formal operations possible. Foresight and hindsight are both brought into play in mental processes. Operations are means by which the individual transforms information about the real world in such a manner that it may be organized and used selectively to solve problems. Operations are viewed by Piaget as the essence of knowledge. Actions that can be carried out directly in the manipulation of objects are called concrete operations. Actions carried out internally where propositions or categories are used are called formal operations.

The four properties of logical thought distinguished by Piaget in the concrete operational period include (1) combinativity or additive composition where elements can be combined to make a class; (2)

identity operation as when a child is asked to compare, contrast, or give an example of something; (3) associativity as when elements can be put together in different ways to achieve the same results; (4) reversibility which is the ability to reverse thought and return to the original starting point. At the level of concrete operations these operations are based on the logic of classes and relations and provide a means for structuring the immediate present into a coherent whole consonant with the past.

Social transmission and intellectual development

Social transmission, one of the four factors involved in intellectual development, includes culture, language, and education. Cultural milieu and language are considered to exert considerable influence on intellectual development and recent research has centered on specific aspects of the child's cultural environment and verbal ability in relation to performance on Piagetian tasks. The influence of SES has also been investigated and as noted the findings favor the upper class child. The research of John (1963) and Deutsch (1965), for example, reports the early arrest of intellectual development in the culturally deprived. The issue in this area currently rests with the question of which factor, SES level or verbal ability, exerts the most pronounced influence upon the developmental lag of the culturally deprived. Some part of mental retardation, previously attributed to genetic and physiological causes, is now known to stem from cultural deprivation. A second issue is the influence of verbal ability in conjunction with SES, both of which have been found to interrelate with logical operations ability. Gordon (1965) found in reviewing characteristics of socially disadvantaged that white children are generally superior to nonwhites in language ability and the use of abstractions which introduces the possibility of racial differences.

While Piaget has admitted that many variables influence the chronological age at which a given stage of functioning dominates, he has done little research to determine the effects of these factors upon the acquisition of conservation. The conventional indices of intelligence in relation to performance of Piagetian tasks have been studied by some investigators and still others have studied the effects of culture and SES, but there is no single study at present that combines SES, verbal ability, and grade level in the attempt to determine which factor, SES or verbal ability, carries the most weight in intellectual development in relation to performance of Piagetian tasks.

Elkind (1968) observes with respect to Piaget's invariant stage formulation that, "Indeed, not only inner-city children, but all children in bush Africa, Hong Kong, and Appalachia attain concrete operations at about the same age as middle class children in Geneva or Boston". It is the purpose of this study to investigate the differences found in cognitive functioning at different SES levels, verbal ability, and grade levels with respect to their impact on performance of Piagetian tasks. The relationship of sex to performance of Piagetian tasks, SES, and verbal ability will also be explored.

CHAPTER II

REVIEW OF RELEVANT LITERATURE

Studies dealing with social transmission may be grouped under three main categories: socioeconomic levels, cultural milieus, and verbal ability. A fourth section on general methodology is included to provide background for Piagetian tasks.

Socioeconomic levels

Almy, Chittenden, and Miller (1967) investigated the validity of the stages postulated by Piaget by means of longitudinal and cross-sectional studies. They sought to establish the relationship between performance on Piagetian tasks and mental ability as measured by traditional tests and academic achievement. The role of experience was studied by drawing the population from two diverse backgrounds of middle and lower class children both with urban residence. Grade levels studied were K-2. The materials used were blocks of two different colors for number conservation, containers of water for conservation of continuous substance, and water and various floating and sinking objects for volume displacement. A standardized question format was used in the testing procedure.

Results of the studies supported the concept of invariant stages over the age range studied. The middle class children showed significantly more conservation at the second grade than the lower class children. The hypothesis that the ability to conserve tends to go along with other measures of mental ability and academic achievement was confirmed in both the longitudinal and cross-sectional studies. The longitudinal study, in accord with Piaget's earlier findings, highlighted the transitional nature of the age range of 5-7 years in relation to conservation ability. Overall it was found that an increasing number of children conserved with increasing age-grade level. Of the middle class children 48% were able to conserve by the second grade, while only 23% of the lower class children conserved on all three tasks. Almy concluded that the reasons why children do not conserve at an earlier age may be associated with their failure to understand what is going on in the classroom; also that middle class children develop a vocabulary early which is adequate to describe their environment and activities accurately whereas lower class children do not. Lower class children can make nonverbal sorts more easily than they could verbally identify the properties of objects. This suggested to the authors that vocabulary training might facilitate logical thinking for these children. The children from these two different SES levels were generally found to have two different "conceptual styles". The middle class children appeared to be more analytical, the lower class more relational-associational in their approach to dealing with conservation tasks.

Wei (1967) did a comparative study of advantaged and disadvantaged children at the kindergarten and second grade levels on classification tasks. Eighty of the Ss were white and one group of twenty Negro children was added to study racial effects. There were twenty low SES white and twenty middle SES white Ss at each level. Ss were tested individually with the same question format. Results indicated that the ability to classify increases with age, that the culturally deprived groups progressed at a slower pace than the middle class groups. There was a significant difference between grade level and social class level in ability to classify. Wei found, contrary to her expectation, two years of schooling for the culturally deprived second graders brought them into closer correspondence with the middle class group. A difference was found between the two social groups in reasoning processes. The deprived groups were not as clear in their explanations as the middle class children and a comparison of answers to tasks on class inclusion and matrices indicated significantly different justification scores between these two SES levels. There were no significant differences found between races and sexes. Wei found general support for Piaget's theory in the sequence of logical operations development and a relationship between stage of development and chronological age. Support was found for Piaget's theory of equilibration stressing the interaction of the individual and the environment. She concluded that opportunities for interaction are often missing or minimal for the culturally deprived which could account for differences in the levels of development.

Sigel, Anderson, and Shapiro (1966) investigated the categorization behavior of lower and middle class Negro preschool children's differences in dealing with representation of familiar objects. This study stemmed from an earlier investigation by Sigel (1954) where boys of ages 7, 9, and 11 were presented stereometric, planometric and verbal stimuli and asked to group materials however they wished. The Ss did not differ significantly in the kind of classification from which he concluded that the meaning of the object transcended its method of presentation and termed this phenomenon "dominance of meaning". This particular finding led to the additional conclusion that at a given point in the life of the child any mode of presentation used will evoke the same kind of classificatory response. Studies of categorization responses with low SES children showed that they had considerable difficulty classifying black and white photographs of familiar items, but they could name the items correctly. This led to the question central to this study of whether the dominance of meaning phenomenon operates in the same manner with lower SES children. Dealing with representational items is closely related to dealing with linguistic and other kinds of symbolic materials including many kinds of intelligence tests.

The study asked the question of whether three dimensional objects and pictures of the objects (pictures reflecting the first level of symbolization or representation of the object) have the same meaning for the child. That is, does he classify items similarly when the mode of presentation varies? Answers were classified in three ways. (1) Descriptive, or seen as similar because of their physical structure;

(2) relational-contextual, or on the basis of use; (3) categorical-inferential, or labeling on the basis of hierarchial classification.

The sample consisted of 20 middle class boys and girls from private nursery schools and 24 lower class boys and girls from a housing project and a settlement house day nursery. Middle and low SES determination was based on the parent's occupation and education. Ages ranged from 3 years 9 months to 5 years 11 months with no significant difference between the ages of the two groups. Tasks used to assess classification behavior included life-sized familiar objects, colored photographs of actual objects, and black and white photographs identical with the colored photographs except for color. The Ss were shown objects and asked "how are they alike" or "which would go together", also "why" in order to see if the child could produce groupings and verbalize his reasons for the groupings. Results indicated no significant difference in tasks for middle class and lower class Ss with actual objects, but a considerable drop for the lower class Ss from objects to colored pictures. The lower class Ss showed a 42% increase in scorable responses on black and white pictures over colored pictures which may indicate an interference effect of color. These data indicated that differences do exist between the lower and middle SES children in their ability to classify. There was found considerable variability in competence for the task with children from both SES levels failing to respond no matter what the conditions. Failure to respond with a verbal explanation does not necessarily mean the children do not understand the task, but may indicate limited verbal competence and lack of ability to objectify these relations verbally. The authors explain that:

> They are perhaps functioning cognitively on what Piaget calls recognitory assimilation, recognizing a relationship to the point of juxtaposing related materials but not being able to explicate the connection into formal language. (Piaget, 1952)

Differences were found between the two groups in the types of categories employed. Lower SES children used groupings based on use and interdependence of items or relational-contextual groupings; middle SES children used more descriptive responses. Categorical-inferential responses were used the least. Low SES Ss had more difficulty in dealing with representations of objects than with actual objects and were less abstract in their classificatory behavior. Middle SES children showed a decline in the use of relational-contextual labels as representation altered and greater use of more abstract descriptive groupings. Middle SES level girls were found to produce more scorable responses than boys and used significantly more descriptive criteria than any of the other groups of both SES levels.

The authors summarize their findings concerning representation with:

> Of more significance in terms of implication for cognitive development and education, is the fact that middle class

> children when able to classify items can transcend the mode of presentation--at least for the conditions of this study. They have a representation of the object and deal with it even with reduced cues; not so, the lower class children. They show less consistency and competence, and hence seem more confused by the pictorial representation of an object even though they can identify the object. This is indeed an intriguing finding--indicating that those children have not acquired the mental representation of the object and thus are unable to deal comparably with its pictoral representation. Lower class children show important differences from their middle class peers--first, less ability to objectify and, second, less ability to deal representationally with material ... lower class children lack the necessary requirements to make adequate transition from the relational--a close approximation of Piaget's sensori-motor behavior--i. e. the egocentric and subjective, to the objective and representational mode of treating objects. (pp. 18, 19)

Baughman and Dahlstrom (1968) studied white and Negro children in a rural community of North Carolina that has remained essentially segregated. One chapter is devoted to the relationship of selected family variables to ability and academic achievement. The family variables studied included father's education, mother's education, father's work, home ownership, telephone service, size of sibship, and ordinal position of the child in the family. Tests of intellectual ability included the Stanford-Binet, Stanford Achievement Test, and Thurstone's Primary Mental Abilities test. Their findings corresponded quite well with the hypothesis that the intellectual proficiency of the children is positively correlated with the socioeconomic status of the family from which they come.

Hooper (1969) investigated the intellectual level of Appalachia children classed as culturally deprived. A battery of standardized tests and Piagetian tasks were administered. The standardized tests included the Peabody Picture Vocabulary Test (PPVT), the results of which indicated below average IQ based on national norms with males showing general superiority to females. The Stanford-Binet results indicated the sample studied to be within the normal range of IQ (90-110) with males performing somewhat better than females. The Frostig Developmental Test of Visual Perceptions showed a considerable number of children with below average perceptual quotients which usually indicates later reading difficulties. The Illinois Test of Psycholinguistic Abilities, which is made up of several subtests, presented a somewhat mixed picture. The cognitive style measures interrelated with fair consistency with other measures of the battery and compared favorably with other research reported. Piagetian task performance was about as expected for the age range of 5½ to 6½ years of age. Males were found to be superior on all conservation tasks at both age levels. Hooper concluded that:

> This initial assessment of the rural Appalachian child reveals a picture of cultural diversity rather than uniform cognitive-intellectual deficits. The children's performance on a global index such as the Stanford-Binet Intelligence Test is generally adequate. The majority of their clearest deficits tend to center upon verbal tasks or those problem settings which demand symbolic representation. In certain cases these deficits appear to increase in severity as the disadvantaged child gets older, thus indicating the pressing need for intervention at the earliest feasible age-level. In contrast, spatial reasoning, auditory and visual decoding, and memory functions do not appear to be noticeably impaired. Adequate Piagetian logical operation skills appear to be significantly inferior as compared to middle-class performances at least for first-grade children. It seems imperative that future research, directed toward the children of this region, which deals with additional comparative behavioral norms or with remedial intervention programs should carefully specify the particular psychological abilities and capacities in question.

Teets (1968) compared two socioeconomic classes on the performance of Piagetian tasks. The sample of 120 children in grades 1-3 with equal boys and girls was drawn from a low SES mining community and a middle SES residential community located in Appalachia regions of West Virginia. The PPVT was administered to determine verbal IQ and a series of Piagetian tasks which included conservation of weight, length, number, surface area, multiplicative classification and seriation were given. Each S was tested individually by a white examiner. Results indicated no significant differences between sexes on the PPVT, consequently, the scores for both sexes were combined in the analyses. No significant differences were found for order of tasks effect. Comparisons for each age-grade level indicated significant positive relationships for performance on Piagetian tasks except for the surface area conservation task. Comparison of within grade levels were found to be significant for the first grade when compared for SES and successful Piagetian task performance; in the second grade significant differences were found for four of the nine tasks; in the third grade only two of the nine tasks showed significant differences. Significant differences were found between Ss performance on Piagetian tasks and SES level in favor of the middle class Ss except for the picture tasks of multiple seriation and multiple classification. Teets speculated that the effects of SES apparently differed across the present age-grade levels. There is, however, another explanation that may account for these findings. The sample was not selected and counterbalanced according to SES and verbal ability. Therefore, it is possible to have a low SES child with high verbal ability and a high SES child with low verbal ability, a condition which could have an effect on these findings. Teets suggested that SES and verbal ability could interact to affect Piagetian task performance since t-tests showed significant comparisons between SES and verbal intelligence as measured by the PPVT. The two

SES levels differed significantly on verbal IQ scores. Even after IQ effects were partialed out, sizable correlations still remained between SES and task performance, but it remained a potential source of confounding due, perhaps, to the fact that each subject was required to give a satisfactory explanation of his answers on the Piagetian tasks. The relationship between SES and Piagetian task performance was especially notable in the first grade, but decreased as grade level increased, so that by the third grade significant differences remained for only the two most difficult tasks of length and area conservation. That finding may indicate that the differences between SES levels and Piagetian task performance may be subject to the leveling effects of schooling rather than age per se.

Zimiles (1968) investigated classification and inferential thinking in children of varying age and social class with a population of 320 Negro lower SES Ss and middle SES white Ss equated on ability and sex in grades K-3 in New York City schools. The study examined two broad questions of how cognitive development changed with age, increasing physical maturation and life experiences, and how cognitive development is affected by variations in the quality of previous life experiences as influenced by SES and ethnicity. The sample contained equal numbers of boys and girls. The materials used consisted of a 44-item Matrix Test devised in order of increasing difficulty by the Research Division of the Bank Street College. The 44 items included perceptual matching, class membership, one-way and two-way classification. All children were tested by white examiners. In the Matrix Test the S may merely point to the answer and is not required to use verbal responses nor to justify his responses. Verbal ability of the Ss was controlled in this way.

Results indicated that lower SES Ss performance declined with increasing difficulty of the items and they were significantly inferior in performance to middle SES white children. The gap widened between Negro and white children with increasing difficulty and age. Zimiles speculated that the failure to classify correctly may be attributed to the child's not having learned the basis for the particular classification. He pointed out that in spite of Negro Ss widespread failure on one-way classification problems they responded to the task in a manner that seemed appropriate to them. Their responses were not random, but based on relational-associational relationships rather than descriptive-classificatory relationships which are of a more abstract nature. The relevant logical principle was available to the low SES Ss, but they failed to it systematically in their responses. These findings are compatible with Sigel (1966) who found essentially the same thing. Jensen (1968) in a study of advantaged and disadvantaged concluded that while there are areas in which the two groups perform similarly, they diverged when the task required the low SES Ss to move from associational responses to more complex mental processes to reach a correct solution.

Asch and Zimiles (1969) did a study of classification behavior in children of varying age and SES background. The Ss were selected from

low and upper SES backgrounds in grades K-3 in two metropolitan public schools. School D was predominantly Negro, low SES; school A was white middle SES Ss. The sample consisted of 320 children with 20 boys and 20 girls at each grade level from each school. The study focused on the aspects of performance which allowed insight into the child's selection of strategies. No notable differences were found between sexes nor in differences in performance as a function of the abstract representational character of the materials used. Perceptual matching was performed easily by the youngest children. Class membership items proved more effective in discriminating between the groups. When the items were familiar, they responded appropriately, but as the items became more abstract, younger Ss responded more arbitrarily; however, performance improved with age. The items are arranged on a continuum from simple-concrete to complex-abstract. Middle class children performed consistently better on these items than lower class children. One-way classification showed steady improvement with age, but the discrepancy between the social classes in performance became substantially greater in favor of the middle class child. Two-way classification items were the most difficult for both groups with the middle class children showing a developing ability to respond correctly whereas the lower class children did not. Both groups showed an increasing ability to cope with the two-way classification problems with increasing age. It appeared that the disadvantaged had trouble holding one dimension in mind while exploring the second dimension of the two-way classification. On the whole the disadvantaged group exhibited the same classic stages of development as the advantaged group, but at a slower rate and at a later age. The youngest of the disadvantaged group responded with equal speed to all of the items, perseverated more, used more positional responses, and generally exhibited more rigid response behavior. The authors attributed at least some part of this behavior to the test situation anxiety, and the desire to escape from it. The most notable finding of this study is that the kindergarten group of School A (advantaged) outperformed even the oldest of the four grades in School D (disadvantaged).

The different kinds of approaches a child may use in selecting an answer ranged from purely guesswork to deducing the correct answer by careful examination of the cell members and alternatives. Between these two extremes are two other approaches which occurred with some frequency. One such approach is demonstrated by the child who chose the alternative which matched the cell adjacent to the empty cell, and the other, more immature in that it disregarded the demands of the task, by the child who made choices based on the position of the alternative. Positional responses were more frequent on more difficult items. The majority of the children who used positional responses chose the alternative closest to the empty cell which indicated a relatively concrete, immature attitude as interpreted by the authors. There was a decrease in positional responses with an increase in age. There were considerably more perseverative, positional responses in the low SES than in the upper SES Ss. Lower and middle SES performance discrepancy widened with increasing item difficulty, although the pattern of

increasing success with age was almost the same as the pattern found for upper SES children.

In summary, it may be said that the disadvantaged shows a definite deficit in abstract thinking. Their ability to perform Piagetian tasks lags behind that of the upper SES level children and their thinking is based on relational-associational relationships rather than descriptive-classificatory relationships. Their ability to move from associational responses to more complex mental processes in generally poorer than the upper SES level children.

Cultural studies

Zimiles and Asch (1969) did a cross-cultural comparison of advantaged and disadvantaged children's ability to classify. Ss were selected from two schools in and near Mexico City. The low SES sample was drawn from a school near the edge of the city in an extremely impoverished area; the middle class sample from a school located on a "normal" school campus in Mexico City. Grades studied were 1-3 with 40 Ss from each grade level in each school with equal numbers of boys and girls. The sample was compared with the previously cited study (Zimiles, 1968). It is to be noted that the New York advantaged sample lived under considerably better conditions than the Mexican counterpart of the sample. The Bank Street Matrix Test was used to test each S individually in his native language. The data gathered from this sample were compared with the data from a previous study of two SES levels, high and low, carried out in New York City. The results indicated substantial differences between the middle and low SES groups in Mexico City. The low SES Ss were often uncertain, exhibited more perseveration, and far more of them fell into the lower end of the distribution of scores. The New York disadvantaged group's performance exceeded that of both the middle and low SES Mexican groups in both class membership and one-way classification. The Mexican children took a longer time to respond without any corresponding improvement in scores, showed more initial confusion at tasks, showed more tendencies to perseverate, and were prone to positional responses. The authors stated:

> Mexican children showed less systematic response patterns. ...In general, the performance of the Mexican children was like that of a slightly younger New York disadvantaged child and like a much younger advantaged child from New York. (p. 11)

On the whole the Mexican group were more positive in their mode of handling the Matrix Test. The New York disadvantaged group were better able to understand the task and respond on a flexible associative basis. The New York disadvantaged group responded less abstractly and flexibly than their advantaged peers.

In a previous analysis of performance differences between the upper and lower SES children from New York, it was concluded that the

major distinguishing characteristic was the ability of the advantaged child to respond to class membership problems in terms of attributes that were less immediately visible or pertinent. The advantaged Ss also had a greater ability to recognize and deal with a form of order dealing with spatial organization which is not necessarily based on the high frequency with which objects classified have occurred together in the past, nor in their individual visually compelling quality. On two-way classification the older age groups indicated increasingly improved ability to engage in multidimensional thinking by classifying objects according to two criteria simultaneously. This suggested that the concept of class or set was better formulated in the advantaged child. In contrast, the New York disadvantaged child tended to perform effectively when the items called for an associative response. Hence classification appeared to depend much more on the degree to which the objects to be classified elicited common associations. There was considerable overlap in performance between the 5-year olds in the K groups and those of the 8-year olds which was particularly true on one-way classification items, the task which produced the greatest variability in performance in the age range studied. The authors suggested that a more refined study of age changes in performance as a function of cognitive content is needed since the 8-year old is very different from the 5-year old cognitively and psychologically.

Goodnow (1962) conducted a study in Hong Kong of European, American, and Chinese boys 10-13 years of age. The major question under consideration was whether children from other cultural milieus would demonstrate the same performance patterns as those obtained by Piaget in Geneva. Piaget and Inhelder hold that milieu has only a limited effect and that order and sequence of development remain essentially the same regardless of culture. The sample included high SES European boys, upper class Chinese boys with schooling, low SES Chinese boys with little or no schooling, and two small special groups, one of 24 low SES adult Chinese unskilled workers with no schooling and the other 41 high SES boys from two Chinese schools that did not give a science course in primary school. Raven's Progressive Matrices test was administered and five Piagetian tasks which included conservation of weight, volume, surface area, and a combinatorial problem of three, four, and six colors taken two at a time. Results indicated with a total sample of about 500 European and Chinese boys that similarities across milieus were greater than differences. She found a difference which she termed "odd" in that there was a difference between the combinatorial task which appeared closely related to Raven's Matrices in contrast with the conservation tasks where no such tie-in was found. Compatibility of Goodnow's results with Geneva ranged from fair to good with respect to age of attainment, quality of performance, and the invariant stage sequence. Some milieu effects were identified which were attributed to schooling and social class but were of a relatively minor nature. The perceptual-type conservation tasks do not seem to be affected by intelligence differences but the combinatorial task is considerably affected. Conservation tasks seem to be sensitive to age level and personal characteristics of the Ss. In attempting to reconcile differences found across cultural milieus, Goodnow stated that certain milieus could

supply information that could be either helpful or harmful to task performance and differential socialization patterns may be responsible for such behaviors as the Chinese student's tendency to be unduly influenced by conflicting cues and pseudoscientific bases for their judgments. Certain milieus may also provide differences in the properties used to define concepts and may contribute to differences in intelligence. With respect to chronological age, she stated that:

> Although information about mental age is rarely given with the Geneva results, on at least one occasion Piaget (1931) has made it clear that he is talking about mental rather than chronological age, about average rather than precocious children. (p. 2)

A later study by Goodnow and Bethon (1966) was carried out to further clarify results obtained by Goodnow in her study of children in Hong Kong. She sought to explore further the results obtained with schooled and unschooled children and adults, and further explore the effects of chronological age (CA), and mental age (MA) in relation to Piagetian task performance. The Ss of this experiment were several groups of American school children chosen to permit close matching for either MA or CA and to cover a wide range of IQ. The question under investigation was whether conservation tasks detect lack of schooling and/or lack of intelligence. This question arose from the discrepancy between the conservation and combinatorial tasks in Goodnow's 1962 study. The tasks in this study were essentially the same as those in the previous study. According to Goodnow, results indicated substantiation for Inhelder's (1943) argument that conservation tasks involving amount, weight, and volume will differentiate between dull children and children with about 30 points higher IQ. The combining of the Hong Kong and American results indicated that conservation tasks for weight, volume, and area are not sensitive to lack of schooling. Mermelstein and Shulman (1967) reported similar findings for Negro children in Prince Edward County, Virginia who were deprived of schooling. In contrast, the combinatorial task indicated definite sensitivity to lack of schooling. It appears that skills needed for conservation tasks which require thinking through a problem without benefit of the concrete situation or objects appear to place the disadvantaged child by lack of schooling or wrong type of schooling in an inferior position on this particular task. Goodnow cited another researcher on such preferences as handling and placement of objects in construction tasks which he gave to unschooled African children. He was impressed by the extent to which the Ss consistently estimated length by direct placement of a piece rather than by eye or by a reference length. In short, one of the effects of schooling may be a shift from approach by hand or by direct test to a more abstract approach of visual estimate or the use of measuring instruments. It seems to this writer that the combinatorial reasoning task is more abstract than the clay task in that the child may not manipulate the materials in the combinatorial reasoning task and is required to work out the solution mentally before performing it physically, a task which would seem to be a formal operations task rather than a concrete operations task.

Goodnow (1969) in an article concerning research on culture and thought discussed common results found in a number of cross-cultural studies. One result has been identified as a differential failure to perform tasks requiring "mental imaging," or representational thinking of the consequences of a concrete operation or employing a particular strategy in making a judgment or in solving a problem. The lack of a formal requirement to think, figure out, or visualize a solution or a strategy for obtaining a solution in an environment seemed to be identified with failure in situations requiring mental imaging. The formal school situation and the relative symbolic manner of dealing with tasks were related to success in tasks. She pointed out that experience or activity is important to imaging because it leads to three kinds of familiarity noted by Piaget; familiarity with objects; familiarity with operations; and familiarity with operations as applied to objects. Familiarity serves as the link between activity and imaging. Objects familiar in one culture may be foreign to another, the way an object is used in one culture may differ considerably from another, as well as how the object is regarded and used, all of which could have a bearing on the child's attitude and behavior toward a given object or set of objects.

Price-Williams (1961) did a study concerning concepts of conservation of quantity among children of a primitive tribe. Five groups of nine illiterate West African bush children of the Tiv tribe were tested on questions of conservation using continuous and discontinuous quantities. The techniques employed were similar to those used by Piaget and reported in his book The Child's Conception of Number. Materials used were earth and nuts for continuous and discontinuous quantities, respectively. Results indicated that the progression of the idea of conservation followed that which was found in European and other Western children by previous investigators. Because of the difficulty of precisely determining the absolute age of the children tested, there was some hesitation in claiming that the changeover from a purely perceptual to a conceptual reliance regarding conservation takes place exactly at the age which is found in Western children, but it would seem to be approximately so. The correct responses were greater for discrete than continuous quantity. Price-Williams observed that it was clear that the general sequence from global comparisons to concrete operations occurred in these African children. With respect to cultural experience effects, he stated that:

> ...the Ss of these experiments were familiar with a game, known throughout Africa, concerning the placement of pebbles in two rows of holes....Proper playing of this game entails a good understanding of many of the concepts which are considered under the general category of number.

Price-Williams (1962) conducted a second study on abstract and concrete modes of classification in a primitive society. Past investigations of the cognitive processes of primitive peoples were reviewed with special reference to the continuum of abstract to concrete. It was pointed out that these studies have used Western type tests in

reaching their conclusions. The present study differed in using indigenous materials since the author had lived among the Ss as an anthropologist and spoke the native language. Bush and primary school children living in the same area were compared for their ability to classify and sort models of animals known in the area, and plants found in the neighborhood. Part of the sample of Ss attended a Bush primary school and part attended no school. Ages were estimated, since births are not recorded, and were divided into four classes each of which was approximately 6½, 8, 9½, and 11 years with 20 Ss in each group of literates and illiterates with a total sample of 80 literate Ss and 60 illiterates. The ability to shift from one classification to another and the basis of the classification was investigated.

Results indicated that using familiar materials there were no differences found between the two sets of children of an age range from approximately 6½-11 years. The Tiv children in the sample indicated they could abstract when necessary with less dependence on the concrete as they grew older. Both literate and illiterate groups classified very closely. It was noted that the language of the Tivs is not conducive to classification and culturally they did not use it in this manner per se, but did infer it in their classification. This culture has little interest in forming classifications of objects since there is little need for it. In comparing the classification ability of various age levels, a developmental lag is found in the Tiv child's reaching the concrete operations level in logical thinking. These children showed the classic Piagetian invariant stages of development, but at a later age than those found in upper class children of Europe and the United States. The use of materials indigenous to the area in which the Ss lived probably contributed to the success of these children and the findings would, therefore, be comparable to the findings of other investigators using blocks and designs in other parts of the world where they are a part of the child's cultural background.

Price-Williams, Gordon, and Ramirez (1969) investigated skill and conservation in pottery-making children. The concepts of number, liquid, substance, weight, and volume were investigated in Spanish speaking children ranging in age from 6-9 years. One group of children came from pottery-making families and the other from families engaged in work unrelated to pottery-making. The Ss were matched on age, years of schooling, and SES level. The principle behind the selection of the Ss was the role of experience in pottery-making. The hypothesis predicted that experience in pottery-making would facilitate conservation of substance earlier for Ss from pottery-making families. Transfer from substance to other tasks was used in the design by utilizing the concepts of number, liquid, weight, and volume.

The results were not significant for number, liquid, weight, and volume tasks, but were significant for substance in favor of the pottery-making group of children. On all five tasks the children of potters conserved more frequently, but not significantly more. On the whole there was about one-third more conservation found in the pottery group.

The findings of this study suggested the role of skill gained from experience may be a very important factor in cognitive growth.

Hyde (1959) as cited in Flavell (1963) investigated Piaget's theories of the development of the concept of number. The study was a cross-cultural comparison of children in Aden, i. e., British, Arab, Somali, and Indian children about 8 years of age and all living in the same area. Tests were administered in Arabic, the language used in the schools of that area. Ss responded to number problems in conservation in much the same manner as Piaget's Ss in Geneva. There was general support for stages of development as theorized by Piaget. European children as a general rule performed at a higher level than their non-European peers. Several quantity conservation tasks were used in addition to the number tasks. There was no compelling evidence found for the global quantity, weight, volume décalage found by Smedslund, Elkind, and others. No immediate explanation was offered for this fact, nor for the finding that several Ss conserved out of the predicted order. The suggestion was offered that it might possibly be culturally determined.

Greenfield (1966) studied the effects of culture and conservation with Senegalese children. The sample included bush children, schooled and unschooled, urban schooled children in Dakar, and unschooled adults. Greenfield, of the Harvard group, stresses the role of internalized, culturally transmitted technologies in contrast with the Genevans who do not. The question arises as to how the environment affects growth. The study utilized a culture radically different from our own with the aim of discovering differences in cognitive functioning and the effect of schooling on children in different cultures. The sample was composed of Moslem Wolof children. The task was conservation of continuous quantity using water and beakers for the transformations. There were 9 groups of Ss and three degrees of urbanization and education with three age levels for each group. The urban sample was similar to a Western industrial city; the rural sample was very primitive. Schools in Senegal are based on the French culture and set up on the French system. The results indicated there is a wider gap between schooled and unschooled Wolof children from the same village than between rural and urban schooled children. Nearly all schooled children had achieved conservation by the age of 11-12 whereas only about half of the unschooled children had mastered conservation. The schooled children showed a decline in perceptual cues whereas unschooled children showed a gradual rise in the use of perceptual cues over the same age span. Having unschooled children do the actual pouring transformations themselves reduced their "action-magic" explanations and this action was found to be crucial to the experiment. French-styled Western education seemed to produce "over-perceptualization" in the child. Greenfield concluded that conservation depends on the conceptual task components of identity and equality, but the Senegalese children cannot seem to use identity to integrate conflicting cues and thereby cross-classify the situation according to both appearance and reality. The Senegalese child used identity by

recapitulation, i. e., "the two standard beakers, one now empty, are the same". The American child would say, "It's the same water," which is identity of present phenomenon. Greenfield said:

> If these experiments indicate one thing of special importance, it is the way in which different modes of thought can lead to the same results. It has too often been assumed that different intellectual means must of necessity lead to different cognitive ends. We have shown how an identity schema is crucial to conservation in Senegal as in the United States, but that it can develop by different means. American children make the equality of the past simultaneous with the present inequality of appearance. The Wolof children achieve conservation by establishing identity between the successive states of past and present. (p. 255)

This experiment and others had led Greenfield to suggest that without school intellectual development, defined as any qualitative change, ceases shortly after the age of nine.

The children of bush and town schools yielded the familiar invariant developmental sequence with conservation nearly always attained by the sixth grade.

Greenfield, Reich, and Olver (1966) studied the effects of culture and equivalence using a population of Eskimo and white children. They asked the following questions: to what extent have the Eskimos made the transition from their traditional rural society to the modern urban milieu of Anchorage? Which factors embedded in a given cultural milieu makes a difference in the development of cognitive equivalences? What aspects of equivalence judgments are touched by these influences? The study utilized commonplace objects indigenous to Alaska and asked questions such as, "How are gloves and mukluks alike?" then with a parka added Ss were asked, "How is a parka different from gloves and mukluks?" and then, "How are gloves, mukluks, and parkas all alike?" The procedure was continued until all 8 items of the array were presented. Two different arrays were presented. One consisted of apple-orange and other food products with stone added and the second was gloves-mukluks and other wearing apparel used to keep warm with ice added. The Eskimo and white Ss had very similar educational backgrounds in terms of curriculum and performance standards. Ages ranged from 8.5 to 12.0 with Eskimos averaging a year older than the white Ss. Mean grade placement was about 2.5 for the younger group and 4.3 for the older group with 10 years of age being the dividing line between the groups. The answers to the questions were grouped into two categories: (1) superordinate or likenesses of objects, and (2) complexive or differences among objects. The results indicated the relationship of school and city to the development of the structure and content of concepts. The explicit symbolic representation of the extensive structural properties of superordinates seemed to depend on school for its developmental improvement, whereas grouping operations that were

clearly superordinate, given the action context in which they occur, increased with age in all of the Wolof culture sampled. The findings of this study were compatible with those of other studies cited in this paper.

The study pointed out the early arrest of the process of intellectual growth in unschooled children and the limitations of their verbal ability. The differences between those in school and those out increased with age. This has been a persistent observation concerning the differences between culturally deprived and other American children. It would appear that the conceptual development of lower class American children resembled that of the unschooled Wolof children in this respect. If so, then early intellectual stabilization indicated that full cognitive development is not being attained. In short, it appeared that some cultural environments push cognitive growth longer than others do.

The findings which had a bearing on equivalence were that rural children with no schooling have color oriented concepts; all school children move away from color reliance. Bush children with schooling move toward form; city school children move from form toward function.

The findings of this series of cross-cultural studies indicated support of the comparisons of urban and rural children in the invariant stage sequence formulated by Piaget. It seems to make no difference whether the children studied lived in Mexico, Senegal, Anchorage, Aden, or Africa; the sequence is generally the same with some variations ascribed to cultural differences or artifacts. Rural-urban differences are small and similar in nature to larger differences that separate children who have been to school and those who have not. The difference is described as a difference between abstractness and concreteness. Rural life appears to be less conducive to the development of abstraction. Schooling appears to be the single most powerful factor found in stimulating abstraction. Greenfield, et al. goes on to state:

> ...the first result of schooling is to "perceptualize" a child's approach to conservation. It must be stressed however, that in both conservation and concept formation this perceptual development is a basically conceptual one. Likely as not, this development is also closely tied to language. By conceptual we mean that school is teaching Europe habits of perceptual analysis. An analysis into parts is plainly crucial to concepts based on the multidimensional attribute of form, whereas unitary global perception could suffice for color grouping.

The study discussed the effect of rural-urban residence on cognitive functioning and concluded:

> We believe that the difference between the city child and the rural child derives from a differential exposure to problem solving and communications in situations

> that are not supported by context--as is the case with, for example, most reading and writing, the use of monetary exchange, and schooling. Rural life, it appears, is somewhat less conducive to the development of abstractions. (p. 315)

The results of these cultural studies are in accord with Bruner's (1966) position that socio-cultural differences will make a difference in the child's performance on Piagetian tasks.

Language and verbal ability

While Piaget has not explicitly set down a theory of language, the topic is dealt with in connection with intellectual operations in much of his work. Sinclair (1969) pulled together Piaget's views on language and summarized the two main points in the relationship of language to cognitive development as:

> 1. "The sources of intellectual operations are not to be found in language, but in the preverbal, sensorimotor period where a system of schemes is elaborated that prefigures certain aspects of the structures of classes and relations, and elementary forms of conservation and operative reversibility. In fact, the acquisition of the permanency of objects (elaborated between 6 and 18 months) constitutes a first "invariant". The search for an object which has disappeared is conducted in function of its successive localizations: these localizations depend on the constitution of an elementary groupe de déplacements, in which detours (associativity) and returns (reversibility) are coordinated.
>
> 2. "The formation of representational thought is contemporaneous with the acquisition of language; both belong to a more general process, that of the constitution of the symbolic function in general. This symbolic function has several aspects; different kinds of behaviors, all appearing at about the same time in development, indicate its beginnings. The first verbal utterances are intimately linked to, and contemporaneous with, symbolic play, deferred imitation, and mental images as interiorized imitations." (p. 316)

Piaget does not consider language to be a sufficient condition for the development of intellectual operations. Language itself has logical structure and the quality of reversibility. It is acquired in the same developmental stages as other Piagetian tasks. The results of research with blind and deaf children have confirmed Piaget's view that language is not the source of logic, but on the contrary is structured by logic.

Inhelder (1966) makes a distinction between information which can be conveyed through language and processes which are not influenced by language. With respect to theoretical formulations in conjunction with language she concluded:

> Our general systematic conclusions with respect to the effects of language training are straightforward. First, language training, among other types of training, operates to direct the child's interactions with the environment and thus to "focus" on relevant dimensions of task situations. Second, the observed changes in the justifications given for answers in the conservation task suggest that language does aid in the storage and retrieval of relevant information. However, our evidence offers little, if any, support for the contention that language learning per se contributes to the integration and coordination of "informational units" necessary for the achievement of conservation concepts. (p. 163)

Work by Inhelder indicated that there is parallel development and interrelationship between description and operation, and that the linguistic subsystem alone is not sufficient for the creation of operations. It appears, therefore, that the development of language is analogous to that of intellectual operations and that intellectual development rather than language development takes the principal formative role. The necessity of language in the development of logical operations is denied although it is assigned a facilitative role in logical operations. According to Inhelder and Piaget (1964) a logical type of behavior is apparently involved in the learning of a language. In their view intellectual development is a precursor to language development, i.e. as a result of his activities the child is faced with the necessity of learning a language. In explaining conservation Piaget does not stress the importance of language in the development of logical thought, but does stress the importance of a flexible symbol system, especially during the period of formal operations from 11 to 15 years. He maintains that changes involved in the development of cognitive structure are not directly accomplished by verbal ability. The onset of concrete operations permits more meaningful use of abstract language and not the converse.

Language, according to Bruner et al. (1967), is supposed to be crucial to cognitive development. Bruner (1964) is not in complete agreement with Piaget on the importance of language in the acquisition of conservation. He places paramount importance on linguistic experience and sees cognitive development as a result of the acquisition of techniques of information processing. Bruner holds that information processing techniques form the basis of conservation through an internalization process of three information processing systems: the enactive, the iconic, and the symbolic. These systems represent different levels of cognitive development that are presumably correlated with cognitive development and analogous to Piaget's sensori-motor,

preoperational, and operational intelligence. For Bruner, the mechanism of transmission from iconic to symbolic thought, which is the difference between nonconservation and conservation, is the use of language as a medium for ordering and integrating experience. Bruner stated: "Once language becomes a medium for the translation of experience, there is a progressive release from immediacy." (p. 14) With respect to conservation, the child is freed from the immediate perceptual input, and language is seen as a control on the input. Bruner's position, therefore, postulates that the use of language is an important prior condition for the attainment of conservation. He pointed out also that in conservation there can possibly exist a problem of "verbal semantics" between the adult investigator and the child subject. There are studies which bear out this contention of the child's misinterpretation of the adult's questions. Bruner has suggested that the use of correct terminology probably helps the child in making appropriate comparisons. He noted that nonconservers are likely to use global words such as "big" and "little", while conservers use dimensional words such as "wide", "narrow", "tall", "short", and noted that children who confound global and dimensional terms are not likely to conserve.

Beilin (1965) studied learning and operational convergence in logical thought development in relation to experience and verbal and nonverbal training. An issue in the stage development theory centers on whether it is unitary or nonunitary insofar as response patterns within a given stage are concerned. Beilin studied the unity of conservation performance alone and with training, with the use of reinforcement and nonreinforcement, and with verbal and nonverbal training procedures. The design included pretest, training, and posttesting for conservation of number, length, and area. After the pretest, Ss were matched for age and placed in training or control groups. Training procedures used in the experiment included nonverbal reinforcement (NVR), verbal orientation reinforcement (VOR), verbal rule instruction (VRI), and equilibration (EQ). Training was administered in two sessions. The sample consisted of 131 Ss all of which received a preliminary test to determine whether he had or lacked the language capacities that might affect his success in conservation tasks. It was recognized by the investigator that more than mere vocabulary ability was being sampled. The test assessed the Ss knowledge of equality by testing for his understanding or "same", for inequality with "more" and "less", number production and number equivalence terms.

Results indicated that verbal rule instruction led to the greatest success in conservation. Training in general improved conservation performance, but the improvement was not uniform either for age group or method. Training appeared to be somewhat more effective with older children than it did with younger children. The understanding of "same" appeared to be a better predictor of success in conservation pretests, but it did not preclude success; training seemed to remove pretest differences in such comprehension. While VRI led to significant improvement, it did not transfer to analogous conservation tasks, which was true of the other methods also. Training appeared to help Ss who were in a transitional stage more than those at the global stage. The data

relating to verbal performance success suggested that the ability to give correct verbal conservation responses is not in itself sufficient to insure performance success. With respect to the convergence data resulting from the study, there was relatively little convergence of conservation performance across tasks. Training data showed that training leads to more Ss who showed improved performance, but mostly in the tasks for which they were trained. Beilin summarized:

> Training is not sufficient to make for extensive conservation across all tasks. The acquisition of conservation abilities appears to involve, then, a transaction in which experience, in itself, although contributing considerably to improved performance, does not lead to a generalized conservation capacity... Learning may facilitate convergence but not extensive convergence without, apparently, interaction with maturational processes. (p. 380)

Beilin, Kagan, and Rabinowitz (1966) studied the effects of verbal and perceptual training on water level representation with 152 white and Negro second graders enrolled in a Westchester County New York school. Ages ranged from 6 years 2 months to 8 years 2 months and all Ss were classified according to the father's occupation for SES level which yielded a low and middle SES group. Ss were divided into nine groups and no significant differences were found in age, IQ, race, or SES. The experiment attempted to determine whether language and perceptual experience have a significant function in symbolic imagery. The task used was water levels which involved rotation of straight-sided and round-sided transparent jars partially filled with water. Ss were instructed to copy water levels using line drawings and to anticipate water levels in covered jars tilted at different angles. Previous work indicated that water level representation might be sensitive to social and cultural experiences; therefore, children of differing social and cultural experiences were chosen for study. A pretest-training-posttest-transfer design was used. Perceptual training utilized an anticipation response followed by visual confirmation of the water level in a covered jar. The verbal training phase utilized verbal instruction in horizontality, water principle, or both using programmed instructional materials in booklet form which was read to the Ss. The means of the Perceptual Training groups were the largest and differed significantly from the other groups, except the Verbal Water Level group. No other means were significantly different. On the basis of the posttest and transfer test analyses, it showed that Perceptual Training and the Verbal Water Level training did improve choice of correct water level representations, but this improvement did not generalize or transfer to a Florence flask. The authors pointed out that the data indicated two things: (1) that the Piagetian contention that round-sided flasks are easier for water level determination than straight-sided jars was not confirmed and (2) that training contributed as much to transfer for subjects who are not operational on the pretest but operational on the posttest, as those Ss who were operational on the pretest. This finding differed from a previous finding by

Beilin (1965). Anticipation imagery improved through training. Perceptual training was somewhat more effective than verbal training and yielded significantly larger posttest scores than the controls. Of the two perceptual training procedures, the one using anticipation imagery, motor response to the figural representation, and visual confirmation was more successful than perceptual training without motor response, although the no motor response also led to significant improvement. In general, the greater effectiveness of perceptual training suggested that water level representation is more dependent upon nonverbal than verbal mediational processes. It was pointed out that, "It was shown that the majority of children given the conceptual rule in verbal form were unable as in the present instance, to use it in relevant tasks."

With respect to the influence of SES and race on training, there were significant pretest differences between white and Negro subjects, and between middle and low SES Ss, but when conserving Ss were removed from the sample, there were no significant posttest differences which could be attributed to either SES or race. There was an SES X race interaction that was significant. The gains from training were least for the lower SES Negro Ss, although, on the whole, training was about equally effective for both Negroes and whites.

Beilin and Kagan (1969) studied pluralization rules and the conceptualization of number in order to study a "limited set of linguistic rules and their relation to logically associated conceptual capacities". Two views may be taken with respect to pluralization and conceptualization of number: (1) acquiring and making use of pluralization rules of a language requires the ability to conceptualize number, and (2) the child's knowledge of number is gained by the prior acquisition of pluralization rules because they embody number concepts.

The sample was composed of nearly equal numbers of girls and boys from a private nursery school in New York City. The mean age was 4 years 4 months and the Ss came from essentially middle SES white families. The children were first assessed on their knowledge of noun, possessive, and verb pluralization rules and their ability to conceptualize the numbers 1 and 2. Children who failed the established criterion for verb pluralization and number conceptualization were trained on either verb pluralization or number conceptualization or both.

Results indicated that performance on number concept tasks were superior to language rule knowledge. Training indicated no superiority of pluralization rules over number conceptualization. The authors concluded:

> For language to function with full efficiency, an appropriate conceptual or operational base would appear to be necessary, one that has its origins outside the linguistic rule system itself...The findings are interpreted as demonstrating the prior need of cognitive resources for language

> acquisition as well as the algorithmic function of language. (p. 702)

Beilin and Spontak (1969) studied the relation between linguistic performance involving the active-passive transformation in grammar and preoperational and operational reversibility. Subjects were middle SES children in Nursery-K-1-2 grade levels. The language tasks assessed the children's ability to imitate, comprehend, and produce active and passive sentences. The results of the study showed the active sentence structure ("Mark pushes Susan.") to be well understood by nursery schoolers, whereas the passive sentence structure ("Susan is pushed by Mark.") is not understood or mastered until the second grade level. Beilin summarizes:

> The data of this study that show the relatively late development of understanding of active-passive equivalence, in general, tends to support a contingent relationship between the development of competence in the passive and the development of operational reversibility. The syntactic properties of the child's production of passives suggests the ways he attempts out of his linguistic experience to construct the rules of the active-passive transformation. This is achieved in a series of steps which start with the use of the active sentence itself. Intermediate forms illuminate the child's experiments with the logical and grammatical subject-object relationships. Use of these intermediate forms reach a peak at the kindergarten level, then decline as the passive transformation rules become fully understood. (p. 7)

Several training studies have been concerned with the effects of verbal ability and performance of Piagetian tasks. Beilin (1965) found VRI facilitated the acquisition of conservation. Kohnstamm (1963) stated that the learning of the class inclusion concept was accelerated by an intensive training program involving rule explanation. Gruen's studies (1965, 1966) indicate that a group who were trained on addition-subtraction plus verbal pretraining did significantly better on a conservation of number posttest than the control group which received no verbal pretraining. Sonstroem (in Bruner, et al., 1966) found that the combination of manipulation and verbal labeling to be extremely effective, in producing conservation in children, only when manipulation by the child was combined with correct verbal labeling but neither was very effective when used alone. Smith (1968) studied the effects of addition-subtraction with reinforced practice (feedback) and Beilin's VRI and found that VRI led to significant improvement in the subject's performance both for nonconservers and transitional conservers.

Braine and Shanks (1965a, 1965b) have found in 4½-5½ year olds, several kinds of conservation by using nonverbal assessment methods. The findings of their work suggest that children may be able to perform

a particular task, such as conservation, without having the necessary verbal skills to adequately explain how he arrived at the correct solution.

Wohlwill and Lowe (1962) studied an experimental analysis of the development of conservation of number investigating the relevance of reinforcement, learning set or differentiation, and Piaget's theory of inference in relation to conservation tasks. The design included pretest, training, and posttest. Training sessions were divided into two sessions on two successive days. A verbal pretest was given to determine Ss ability to deal with numbers and conservation, training on a nonverbal test of conservation using a modified stimulus-response format for discrimination learning, training related to number conservation, followed by the repetition of verbal and nonverbal tests of conservation to obtain a measure of change or learning with reference to conservation. The posttest consisted of the same general format as the training series of tasks. The Ss were 72 kindergartners, 35 boys and 37 girls with a mean CA of 5 years 10 months selected from three public schools in Worcester, Massachusetts. SES was designated as lower middle class. Results indicated that none of these procedures was effective in leading to a better understanding of conservation. Continued reinforced practice was expected to yield the most significant and greatest results, but instead showed how ineffective it was. The greatest amount of improvement was obtained in the addition and subtraction group, but virtually no learning occurred in the dissociation group. Wohlwill suggested that nonverbal training led to learning an empirical rule and that little conceptual learning was involved in this type of procedure, and concluded from the predominantly negative outcome of the investigation that future research should focus on covering a wider variety of situations and more generalized experience along with the necessity for a longitudinal study in order to make an intensive analysis of the ontogenesis of conservation.

Goldschmid (1967) studied conservation of substance, weight, continuous and discontinuous quantity, number, area, distance, length, and two and three dimensional space in relation to age, sex, IQ, MA, and vocabulary with first and second graders. The population consisted of normal and emotionally disturbed children. Results were generally in accord with Piaget. Although the emotionally disturbed children were two years older than the normal children, their level of conservation was not higher than that of normal children. The normal older Ss performed significantly better than normal younger Ss even though their age difference was only one year. Boys obtained consistently higher conservation scores than girls and conservation was positively correlated with IQ, MA, and verbal ability. An analysis of nonconservation responses suggested an interaction between the frequency and type of nonconservation on one hand and the particular task configuration of the manipulated object on the other. This is compatible with other studies which found some tasks in a given area easier than others. Results both support Piaget's theory of age-dependent cognitive development for normal subjects and suggest significant individual

differences within a given age group. Conservation of discontinuous quantity and length were found to deviate from Piaget's hypothesized order of acquisition.

Blank and Solomon (1968) studied the effects of a tutorial language program to develop abstract thinking in low SES preschool children. Their centr hypothesis was that intervention limited to the development of language for reflection would play a vital role in cognition and that it would facilitate language and many other aspects of thinking. They devised teaching strategies which included elements of selective attention, categories of exclusion, imagery of future events, relevant inner verbalization and used these methods with 22 low SES children in New York City. Ss ranged in age from 3 years 3 months to 4 years 7 months and were divided into two groups, tutored and untutored, matched for IQ, age, and sex. The first tutored group received individual teaching for 15-20 minutes daily five times a week; the second tutored group received individual teaching three times a week. Each child in the untutored group spent time with the same teacher, but no attempt was made to tutor the child. Results indicated the effectiveness of feedback during the learning process under structured conditions which supported their thesis that deprived children do ot need only more and better words, they need to learn how to use the language they already have as well as any new words they learn to structure and guide their thinking. The mean IQ increased in the tutored groups by 14.5 and 7.0 respectively for the 5-hour and 3-hour per week Ss; in the untutored groups the changes were 2.0 and 1.3 points respectively as measured by the Stanford-Binet scale. Accompanying these changes in IQ, were also dramatic behavioral changes and a very apparent joy in learning. While this tutorial extended over a four month period, they advocated a much longer period of 2-3 years to obtain maximal development to consolidate gains.

Language at its highest level can be divided into two components: semantic and syntactic. The stages of symbolic reference include pointing, labeling, and sentential. Findings by Deutsch (1965) indicated the lower SES child can label, but not use complete sentences. Vocabulary may deal with a single level of generality, i. e. words as words rather than any structural relation among them, or on numbers of levels of generality the word can encode in a language for a particular domain, and, finally, the syntactic properties of language relate to the logical structure of thought. Greenfield et al. (1966) concluded the linguistics analysis with: "In the end we place great stress on the role of linguistic variables in the conceptual growth...

General methodology

Griffiths, Shantz, and Sigel (1967) studied a methodological problem in conservation studies: the use of relational terms. Piagetian tasks used were number, length, and weight, and the relational terms "more", "same", and "less" when making comparisons. They also noted whether the relational terms were given spontaneously by the subjects

or whether they were elicited by questioning. Subjects were 54 children, 33 girls and 21 boys with ages ranging from 49 to 62 months who were attending nursery schools. Three dimensional familiar objects were used as stimuli. One standard object and three comparison objects were used for "more", "same", and "less".

Results indicated the Ss generally had the most difficulty correctly applying the relational term "same". They performed best on all terms with the length task spontaneously, but for number and weight correct use of the terms was most often elicited. The authors noted that the structure of the question asked may influence the use of relational terms in a specific content area and said: "Children may understand the meaning of relational terms but may not use them spontaneously. Thus, it would seem advisable ... to determine whether elicited or spontaneous responses to conservation questions are required, and pretest the appropriate type." (p. 9)

Braine and Shanks (1965a, 1965b) showed that children may interpret "same" to mean "look alike" or similarity of appearance rather than "really alike" a similarity of criterial attributes. "Same" can mean identity or equivalence and Elkind has noted methodological and logical problems involved in asking children about the equality of two objects or the identity of one transformed object with its previous state. Young children note differences before similarities as shown in other experiments and this factor could account for more difficulty with "same". (Long and Welch, 1941; Saltz and Sigel, 1967). The work of Wohlwill (1968) and Ahr and Youniss (1969) showed that children misinterpret the questions asked by the examiner. It points up a need for cross-questioning to be sure the child understands the question and can use the relational terms properly.

Elkind (1964) replicated Piaget's work in discrimination, seriation, and numeration of size and dimensional differences in young children. Discrimination involved simple problems where the child was required to select the smallest and largest of a set of sticks placed before him in disarray. Next the child was asked to build a stairway with a set of sticks, then insert additional sticks. The numeration problem involved placing a doll on the steps and asking the child how many steps the doll had to climb to reach the stair it stood on, and how many more steps it would have to climb to reach the top. Following this the stairway was destroyed and the child was asked the same questions. These problems were structured to determine if a child can coordinate an ordinal position with a cardinal value or the number of stairs climbed. Piaget had found that discrimination problems were passed at the 4-year old level, but the more complex seriation and numeration problems were not attained until the age of 6-7 years. The sample contained 90 Ss with 30 at each age level from 4-6 years of age. Grade levels K-1 were used and were of mixed SES levels and IQ.

The purposes of the study were to determine whether stages similar to those found by Piaget could be identified using standardized

procedures and statistical analysis; to determine whether the perceptibility of size differences in one, two, and three-dimensional stimuli affects the ages at which a given stage appears; to expand and amplify Piaget's findings on the development of seriation and numeration in terms familiar to American psychologists. Results indicated that increased age yielded increased scores on discrimination, seriation, and numeration which were compatible with Piaget's observations. Discrimination, seriation, and numeration were found to be in agreement with Piaget's formulation of order of difficulty. The size of the stimuli data analysis indicated that while the extent of the differences was not great, there was a trend toward more successful performance with an increase in the size of the stimuli which is in agreement with Piaget's views. The analysis of age X test interaction revealed that differences between mean scores on tests of discrimination, seriation, and numeration decreased with age, again in agreement with Piaget. The age X materials interaction showed that, in keeping with Piaget, "perceptibility of size differences affects absolute score differences, but not relative score differences between age groups on different materials." The tests X materials interaction brought an unexpected result which indicated that the effects of the dimensionality of the materials was greatest for discrimination and numeration and least for seriation. Further study of this point was suggested. The age X test X material interaction yielded no significant results which Elkind interpreted to mean that the effects of the combination of any one material and any one test does not vary with age level.

Bruner (1964) reported on certain Piagetian type tasks in his article on the course of cognitive growth. The task we are concerned with is that of multiple seriation which involved the use of a 3 x 3 matrix of plastic glasses with varying diameters and heights. The subjects of the experiment were children ranging in age from 5 to 7 years of age. The glasses were set before the child in the properly arranged matrix and to acquaint him with the task first one, then two, then three glasses were removed and the child asked to replace them. The child was asked how the glasses in the columns and rows were alike and how they differed. The glasses were then scrambled and the child asked to make something like was there before. Following this, the glasses were all removed and the glass that was in the southwest corner was moved to the southeast corner and the child asked to make something like was there before.

The results showed no difference between the ages of 5, 6, and 7 with respect to their ability to complete all but the last task. Older children rebuild the original matrix faster. On the last task, most of the 7-year-olds successfully completed the task, but hardly any of the youngest children were able to complete the task. Bruner analyzed the three linguistic modes used by the Ss in describing how the glasses were alike and different with:

> One was <u>dimensional</u>, singling out two ends of an attribute--for example, "That one is higher, and that one is shorter."

> A second was global in nature. Of glasses differing only in height the child says, "That one is bigger and that one is littler." The same words could be used equally well for diameter or for nearly any other magnitude. Finally, there was confounded usage: "That one is tall and that one is little," where a dimensional term is used for end of the continuum and a global term for the other. Children who used confounded descriptions had the most difficulty with the transposed matrix. Lumping all ages together, the children who used confounded descriptions were twice as likely to fail on the transposition task as those who used either dimensional or global terms. But the language the children used had no relation whatsoever to their performance in reproducing the first untransposed matrix. Inhelder and Sinclair in a recent communication also report that confounded language of this kind is associated with failure on conservation tasks in children of the same age... (p. 5)

Rothenberg (1969) investigated conservation of number among 4-5 year olds of low and middle SES levels. She focused on the language ability of the children, e.g. the problems of their understanding of "same" and "more", careful structuring of questions to be sure they were understood by the Ss, and whether justification of the answer was required or not. The major purposes of the study were to investigate conservation of number using prior assessment of key terms and a questioning format to reduce the possibility of confounding of responses due to language ability, and to study the effects of different types and numbers of transformations on conserving ability; also with the need for including justifications by the child. Unique pairs of objects such as dogs, vases, etc. were used, rather than functionally related objects such as eggs and egg cups, and blocks which were designated as homogeneous materials. The schools from which the sample was selected were predominantly middle and low SES with the middle SES mostly white with 4% Negroes. White women tested the middle SES Ss and Negro women tested the low SES Ss. The Peabody Picture Vocabulary Test (PPVT) was given to determine verbal intelligence and results indicated higher verbal IQ for middle SES than for low SES children.

Results indicated no significant differences in the conserving status of groups A and B in the test for materials effect. Pairs of uniquely matched toys did NOT facilitate conservation to a greater extent than homogeneous materials. Simplification of the question format produced a greater percentage of correct responses and when only one justifying answer was required showed a greater percentage of conserving answers than when both questions "same" and "more" were required. The middle SES Ss performed better on these questions than the lower SES Ss. Conservation of inequality produced more conserving responses than conservation of equality in both classes. Generally, the lower class children had fewer conserving, and inconsistent nonconserving responses, than the middle class children. Rothenberg concluded: "The true conservation status of a child appears not to be

reliably determined on the basis of one or even two types of transformations." (p. 399). In the subject's justifications of conservation judgments there was a clear social class difference in the number of Ss who gave adequate explanations. It was pointed out that even when complete conservers are considered, only three out of every four correct conservation judgments were adequately justified. Other findings included differences in total conservation scores attributable to age, but not to sex among the lower class Ss, but no significant main effects for age or sex. There was a social class effect, but no significant age effect; a significant age X social class interaction for the total sample showed an age increase among the lower class Ss but not for the middle class on the total conservation scores possibly due to the similarity in language understanding between the two middle class age groups as found on the PPVT. A strong correlation was found between the PPVT raw score and conservation of number (.52, $p < .001$, $N = 70$), but a much lower correlation (.17, $p < .02$) between CA and conservation, probably due at least in part to lack of age differences in the total score for the middle class sample. It should be noted that all children in the study were between the ages of 5-7, the stage of transition, which may explain some of the seemingly inconsistent findings. The major findings of the study suggested the question format using more than one question about each transformation and possibly varying the order of the questions asked, and the inclusion of a variety of transformations measuring conservation of both equality and inequality. The explanations of the subjects judgments should be probed more deeply and extensively when possible. Rothenberg thought deeper probing advisable since the low SES child with lower verbal ability is most likely to be incorrectly assessed on conservation ability.

Experimental work by Piaget, Inhelder, and Szeminska (1960) in the realm of surface area conservation indicated that this ability is not acquired until about the age of 9 years. Surface area conservation is associated with the child's construction of geometrical two-dimensional space. Conservation of volume, a three dimensional space concept, is not acquired until still later. The Piagetian format for this task involves the use of representational materials which include a green field, a grass eating animal, a farmer, and barns. These materials are used to effect certain transformations with respect to the amount of grass which the animal has left to eat. The child has reached a state of conservation when he can conserve surface area over irrelevant transformations.

Sex differences

Significant sex differences have not been reported by the majority of previous research studies; however, sex differences have been found in a number of recent studies which have dealt with Piagetian task performance. These include studies by Elkind (1961), Furth (1964), Goldschmid (1967), Hooper (1969), King (1961), Shantz and Sigel (1970), and Tuddenham (1967). A study not concerned with Piagetian tasks, but

which found consistent significant sex differences, is that by Baughman and Dahlstrom (1968).

STATEMENT OF THE PROBLEM

Two areas in which an increasing amount of attention has become focused are the effects of SES levels and VA as they relate to intellectual development of young children, particularly the culturally deprived. Piagetian theory takes the position that social transmission, which includes culture, schooling, and language, has only a limited effect on intellectual development. Research indicates that SES levels and VA are positively and significantly correlated with intelligence as defined by current IQ testing methods.

Braine and Shanks (1965a, 1965b) found, using nonverbal assessment techniques, several kinds of conservation in $4\frac{1}{2}$-$5\frac{1}{2}$ year olds. This suggests that children may be able to perform a given operation without having the verbal ability to adequately explain how he arrived at the solution. Beilin (1965) has suggested in several places that the ability to give correct verbal conservation responses is not in itself sufficient to insure successful performance on Piagetian tasks. This circumstance introduces the need for an instrument that would combine objective and verbal responses in the assessment of basic intellectual ability in order to get a clearer picture of a child's potential. Differences between Bruner and other Piagetian investigators arise from Bruner's not requiring verbal justifications whereas Piagetians do.

The central question is whether commonly used standardized tests based on verbal ability will show the same basic intellectual ability as a nonverbal Piagetian battery based on manipulation of concrete materials? Will children who perform Piagetian tasks successfully be able to justify objective responses verbally? Does SES or VA exert the greater influence on the intellectual development of the young? Is VA a determinant in the performance of Piagetian tasks?

A need exists for a simple procedure which would minimize the necessity for language and tap the child's basic intellectual schema by nonverbal means. Such an instrument has been devised and used in this study. (See Appendix B).

The developmental aspects of the present study are explicit in the utilization of five different age-grade levels (K-4). Specifically the analyses focus on Piagetian task performances as they relate to differing SES levels in conjunction with differing levels of VA.

HYPOTHESES

The hypotheses to be evaluated are as follows:

1. There will be significant differences in Piagetian task performances in favor of the middle SES over low SES subjects combined across grade levels K-4.

2. There will be significant differences in Piagetian task performances in favor of high over low verbal ability subjects combined across grade levels and at each grade level considered separately.

3. The range of differences between middle and low SES groups will be: (a) greater at the first grade than at the fourth grade for number conservation tasks and verbal justifications, and (b) greater at the fourth grade level than at the first grade for surface area conservation tasks and verbal justifications.

4. Subjects from middle SES levels with low verbal ability combined across grade levels K-4 will: (a) perform significantly better on number conservation tasks and verbal justifications than subjects from low SES levels with low verbal ability, and (b) perform significantly better on surface area conservation tasks and verbal justifications than subjects from low SES levels with low verbal ability.

5. SES will be a significantly greater discriminating variable than verbal ability on Piagetian task performances combined across grade levels K-4.

6. It is not predicted that any main effects or higher order interactions will be associated with the sex dichotomy.

7. If there is a correlation between the Piagetian task objective scores, verbal justification scores, and the standardized Gates-MacGinitie test scores, they will be of a relatively small magnitude.

CHAPTER III

METHODS AND PROCEDURES

General characteristics of the subject sample

The subject sample was taken from two elementary schools located in Fayette County, Pennsylvania which were used by arrangement with the Albert Gallatin School District. Fairchance Elementary School is located in a rurally oriented small town and has a school population rated as middle class SES. Friendship Hill Elementary School is located outside of Point Marion and draws its school population from scattered rural hamlets and farms about the surrounding countryside with a social class SES level essentially falling into the low range.

Over 600 children in grades K-4 were rated for SES level and verbal ability and a sample of 160 Ss was drawn. The criteria for selection were middle and low SES subjects matched for high and low verbal ability at each grade level K-4 with equal numbers of girls and boys. (See Figure 1). The sample of 160 Ss was matched as closely as possible for SES, verbal ability, and age from the pool of approximately 600 children.

Middle and low SES levels were determined by using the Warner Scale for rating social class (Warner, 1960, pp. 140-141). The dividing line between middle and low SES was set at 60 on the Warner Scale. The numerical range of 54-62 includes the upper-lower class, (see Appendix A) and in a few cases it was necessary to include subjects from this group in order to fill the cells with the required number of subjects. Low SES subjects were used from the lower-lower class pool insofar as it was possible. The characteristics of lower-lower class families differ considerably from those of the upper-lower class who are more like the lower-middle class than the lower-lower class. The area where lower-middle and upper-lower meet at the dividing point of 60 may introduce enough variability within groups to affect results dealing with low-middle SES effects. The items included on the Warner Scale were (1) occupation, (2) source of income, (3) type of dwelling, and (4) area of dwelling. The investigator added "any funds received from governmental sources" to include social security and unemployment compensation under (2) source of income, category 7. (See Appendix A).

Verbal ability was determined using the Gates-MacGinitie Reading Tests for vocabulary and comprehension for grades 1-4. A Readiness Test was used for kindergarteners, which included more than vocabulary and comprehension, and for this reason the verbal ability scores, shown in Table 1, are not directly comparable with other grade levels because of the numerical inequality of the scores. The scores were combined for each grade level and the median used as the breaking point for high and low verbal ability. The Gates-MacGinitie tests have been correlated with the Lorge-Thorndike Intelligence Test (1964) Multilevel edition and yielded an r of .60 at the fourth grade level.

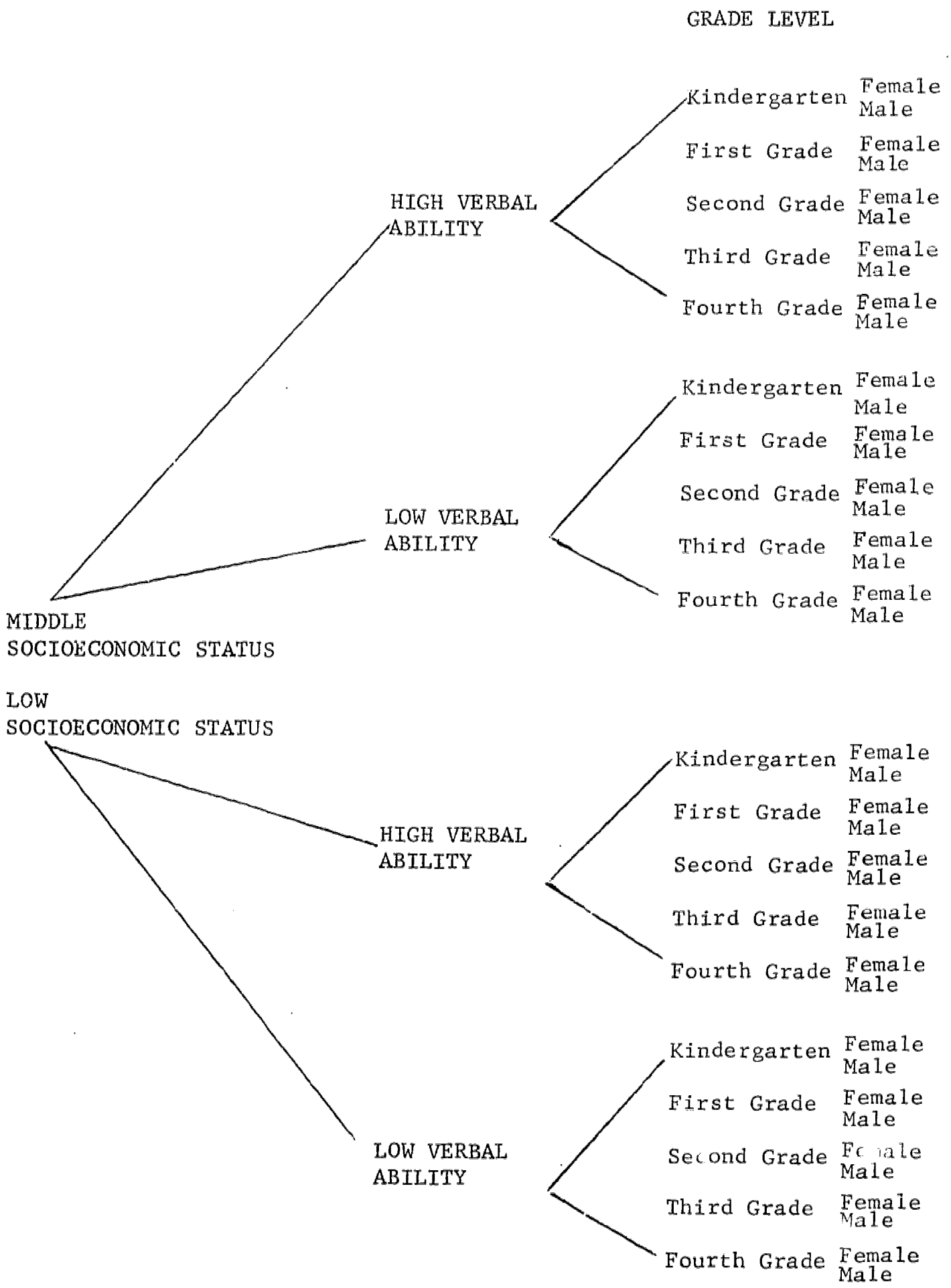

Fig. 1. Schematic diagram for study on SES and verbal ability in grade levels K-4.

TABLE 1

Means and Standard Deviations for Socioeconomic Status (SES), Verbal Ability (VA), and Age for Each Grade Level of the Subject Sample

	Age in Mos.*		SES		Verbal Ability	
	Mean	S. D.	Mean	S. D.	Mean	S. D.
Kindergarten**						
LSES/LVA	71.00	7.17	68.00	9.00	25.12	4.96
LSES/HVA	70.50	4.81	68.62	5.31	46.87	8.28
MSES/LVA	70.75	2.86	57.75	3.41	38.37	6.75
MSES/HVA	69.75	2.65	55.62	5.42	51.75	5.89
First Grade						
LSES/LVA	88.25	12.24	73.37	7.63	12.75	3.53
LSES/HVA	82.12	4.18	71.00	6.18	28.25	2.25
MSES/LVA	79.50	5.31	51.75	7.32	12.87	3.72
MSES/HVA	83.87	6.66	48.12	6.79	29.12	2.16
Second Grade						
LSES/LVA	99.25	7.02	72.75	8.25	17.12	1.24
LSES/HVA	97.62	3.92	71.00	8.46	31.50	4.03
MSES/LVA	92.00	4.07	54.62	6.20	17.62	1.68
MSES/HVA	93.12	3.83	52.37	5.09	31.50	4.03
Third Grade						
LSES/LVA	109.50	7.46	70.37	5.31	21.12	3.39
LSES/HVA	109.00	4.03	70.12	5.30	38.37	2.82
MSES/LVA	106.37	5.37	53.87	5.41	20.87	2.64
MSES/HVA	104.50	4.47	50.37	7.74	38.25	2.65
Fourth Grade						
LSES/LVA	122.25	7.70	69.37	7.48	21.12	1.55
LSES/HVA	118.00	6.63	69.37	6.92	30.87	2.74
MSES/LVA	120.62	5.28	49.25	5.80	19.87	1.72
MSES/HVA	117.87	4.48	47.62	8.15	31.87	2.41

* Age in May 1970

**Kindergarten subjects were administered a readiness test which resulted in numerically higher scores than for grades 1-4 which had vocabulary and comprehension tests. Therefore, test scores for verbal ability at the kindergarten level and other grade levels are not directly comparable. Fifty points were subtracted from each Kindergarten VA score.

General administration procedures

The test battery consisted of (1) Relational Terms Pretest to assess each subject's understanding of the relational terms "more", "less", and "same"; (2) Provoked Correspondence Tasks; (3) Provoked Correspondence Verbal Justification; (4) Unprovoked Correspondence Tasks; (5) Unprovoked Correspondence Verbal Justification; (6) Single Seriation-Height Tasks; (7) Single Seriation-Width Tasks; (8) Multiple Seriation Tasks; (9) Surface Area Conservation Tasks; and (10) Surface Area Conservation Verbal Justification. The Piagetian tasks were selected to assess number conservation. To rule out differences in representational abilities all stimulus materials were concrete objects which could be manipulated by the subjects. Verbal Justification responses to the tasks were scored separately since justification was not a part of the pass-fail criteria.

One of four trained white examiners tested each subject individually in a room set aside for test administration purposes. All but one examiner were teachers with several years of classroom experience. The reamining examiner was a minister who had experience working with children in church and church-related activities. Each examiner tested children at all grade levels in the various classifications. The total test battery of Piagetian tasks required about one hour testing time per subject which was completed in one testing session. The total testing period covered a span of three weeks. The Piagetian task battery was arranged in order of easy to difficult.

Examiners chatted with each subject to get acquainted. Subjects were told they were going to play some games and that the nature of the games were to be a secret between the examiner and the subject until all of the subjects had been tested. Subjects were asked to promise that they would not discuss the games with anybody else in an effort to prevent contamination of results from children who had taken the Piagetian task battery with those who had not until the total sample had been tested. As a motivational device, subjects were told that they would score one point for each correct answer given, but for each wrong answer the examiner would get the point which called upon the subject to do his best in order to win out over the adult examiner. Correct answers were reinforced verbally with remarks such as, "Good", "Right", and the like. Incorrect answers received a verbal reply of "Interesting". In no cases were corrective feedback supplied to subjects by examiners. Subjects were told they would be asked three questions about each task and that the second and third questions did not mean that the first answer was wrong, but only that the examiner wanted to be absolutely sure the subject really understood the task. Standardized data sheets were prepared and used in the present study. (See Appendix B).

Task specific procedures

Relational Terms Pretest. A pretest was used based on a modified version of Griffiths, Shantz, and Sigel's (1967) test of relational

terms. Three dimensional objects familiar to children were used for number and height. A standard sized object was used for comparison with four other objects; one object to form the comparison of "same", one for upward comparison of "more", one for downward comparison of "less", and two for more extreme differences. Number comparisons were represented with four sets of suckers utilizing a standard set of 3 suckers and comparison sets of 4, 3, 2, and 1 suckers. Each set of suckers was attached to a 5" x 8" card.

The second relational terms pretest task was discrimination of height. This task was adapted from Piaget (1964), Elkind (1964), and Bruner (1964). The purpose was to assess the subject's ability to discriminate differing heights and ability to respond appropriately using the terms "shorter", "taller", and "middle". The materials used were four sticks and a holder. The set of sticks consisted of one stick 4" in height for "shorter", two sticks 6" in height for "middle" and "same", and one 8" stick for "taller". The sticks were placed in disarray before S who was required to pick out the three dimensions and place them in their proper order. (See Appendix B)

Conservation of number: provoked and unprovoked correspondence. The format for these two tasks was adapted from Rothenberg (1969). She found using one part questions more effective than multiple part questions typically used in the Piagetian questioning procedure. She found no significant differences between performance on provoked and unprovoked correspondence. Other investigators, using functionally related objects such as eggs and egg cups, doll and doll beds, found provoked correspondence occurring somewhat earlier than unprovoked correspondence which utilized homogeneous materials such as wooden blocks. Rothenberg used unique pairs of objects (such as 2 vases, 2 boots, etc.) rather than functionally related objects and found no significant difference between provoked and unprovoked correspondence. It is possible that unique pairs of objects presents a different problem to the young child than functionally related objects and may, therefore, be considered a different task. Zimiles (1965) found in his study of differentiation and conservation of number that smaller aggregates of objects produced more correct responses by younger subjects than larger aggregates. The present study utilized aggregates not exceeding five objects for these two tasks, with unique pairs of objects (dolls, cups, spoons, horses, blocks) for provoked correspondence, and wooden blocks for unprovoked correspondence. Transformations used in the present study were identical with those used by Rothenberg. The present study utilized three one-part questions, whereas Rothenberg utilized two one-part questions. Both studies asked for verbal justification of objective responses. There was one warm-up item followed by five trials for both tasks. An 18" x 24" sheet of masonite, one side painted blue, and the other side yellow with a white line down the center, served as a background for transformations which avoided any reference to "my side" or "your side" by either the examiner or the subject. Objective answers and verbal justifications were scored and considered separately.

Single Seriation - Height and width. According to Inhelder and Piaget (1964), operational seriation does not develop much earlier than operational classification in young children. The two main differences between seriation and classification are: (1) a relation can be seen while a class as such can't, and (2) serial configuration constitutes "good form" perceptually. In seriation size alone may be sufficient for a child to choose between elements of a series. Serial configuration is not a primary datum but is itself influenced by the child's activities. Serial operations are an internalized result of previous activities and have their origins in the sensorimotor period. Stated another way, seriation arises from the child's activities as a whole, not from his perceptions alone. Once the child finds a systematic method of seriation, it may be easily generalized.

Single seriation for height and width was adapted from Piaget (1964), Elkind (1964), and Bruner (1964). The purpose of these tasks was to assess the child's ability to discriminate differing heights and widths and his ability to respond appropriately with relational terms. The child most often discriminates height or verticality before width or horizontality. The task for single seriation in height utilized a set of five sticks with a holder. Each stick was 1" in diameter with heights of 2", 4", 6", 8", and 10". Each subject saw the array in its proper order, then the order was disarrayed and S required to choose the shortest, tallest and middle sized sticks, then insert the remaining two sticks in their proper place. Single seriation for width utilized a set of five wooden cylinders all 2" high, but with diameters of 1", 1½", 2", 2½", and 3". All materials were natural wood color. No verbal justifications were required for either of the single seriation tasks.

Multiple seriation. The format for the task is adapted from Bruner (1964). Multiple seriation is seen by the Genevans as an additive arrangement of asymmetrical transitive relations, or the ability of the child to view and assess two or more dimensions simultaneously and place them in correct correspondence based on an underlying principle. The materials used for this task were wooden cylinders with diameters of 1", 1½", and 2" with heights of 2", 3", and 4" arranged on a 3 x 3 matrix made of masonite 12" x 12" painted green with white lines. Cylinders were all natural wood color. The cylinders were arranged in proper order on the 3 x 3 matrix before Ss. The varying heights and diameters were discussed. Subjects were required to replace cylinders removed by the examiner, to rebuild the original matrix, then to build the original matrix in reverse. Children below the age of 7 are seldom able to reverse the original matrix successfully. (See Appendix B).

Conservation of surface area. Research by Piaget, Inhelder, and Szeminska (1960) indicates that conservation of surface area is not acquired by most children until about the age of 9 years. This task is associated with the child's construction of two-dimensional geometric space. Conservation of volume, which concerns three-dimensional space is not acquired until still later.

Conservation of surface area was assessed by utilizing a format similar to that used by Piaget et al. The materials consisted of a piece of masonite 18" x 24" painted green to represent grass with a white line down the center to represent a fence. A grass eating toy animal was placed in each field and various transformations were effected using wooden blocks to represent barns. The underlying logical formula is B - A = A' where B represents the entire surface area of a field, A represents the area occupied by barns, and A' the remaining surface area of grass which the animal has to eat. Subjects were asked three questions using the terms "more", "less", and "same". Verbal justifications of objective responses were also recorded and scored separately. The exact transformations and questioning procedures are given in detail on the data sheets for surface area conservation. (See Appendix B). Transformations varied from sameness to extreme differences with respect to number and placement of barns on each field because of Piaget's findings that some transitional conservers conserve only with minimal illusion and fail to conserve with strong illusions. Other investigators have found some trials on the same task of different difficulty.

Scoring procedures

Examiners recorded objective answers on the data sheets immediately opposite each trial. Verbal justification responses were scored separately and rated as adequate or inadequate. The passing criterion for each trial was correct answers or performance on all questions. When all questions and/or performances were correct for a given trial, a score of one was assigned for the trial; a single incorrect response resulted in a zero score for the trial. Each of the ten separate tasks had five trials, the trials ranging from easy to difficult on a given task. A perfect performance on the entire task battery would be reflected in a score of 55 which would include objective responses and verbal justifications.

Treatment of data

Parametric statistics were used throughout for data analysis. Four-way analysis of variance and Student's t-tests for independent groups were used.

CHAPTER IV

RESULTS

Table 2 presents the means and standard deviations for middle and low SES, high and low verbal ability subsamples by task[1] for each sex at grade levels K-4. Other means and standard deviations may be found in Appendix C. Factorial analyses of variance (see Appendix D) across grade levels K-4 indicate the following: (1) SES was not significant for any task. (2) Verbal ability (see Table 7) was significant at the .05 level for single seriation-width, multiple seriation, and surface area justification; at the .01 level for provoked correspondence tasks and verbal justifications, and surface area tasks. The relational terms pretest and unprovoked correspondence tasks both approached significance at the .05 level. In every case the high verbal ability group performances were superior to that of the low group. (3) Grade level was significant at the .05 level for relational terms pretest and at the .01 level for provoked correspondence tasks and verbal justifications, unprovoked correspondence tasks and justifications, single seriation-width, multiple seriation, surface area tasks and verbal justifications, or a total of 8 out of 10 tasks. Performance scores favored upper grades over the lower ones. The main effect of age-grade level was not significant for single seriation-height task. (4) Only one task out of ten, the relational terms pretest, was significantly different with girls outperforming boys.

The only interactions occurred in relation to one task, single seriation-height, which indicated significant interactions at the .05 level for grade x sex x verbal ability; grade x SES x verbal ability; sex x SES x verbal ability; and grade x sex x SES x verbal ability.

The possibility of type I and II errors should be considered. Several significant t-tests were found throughout these results. Significant t's will be found by chance alone 5% of the time with an alpha level of .05 and 1% of the time with an alpha level of .01.

Hypothesis 1. There will be significant differences in Piagetian task performances in favor of the middle SES over low SES subjects combined across grade levels K-4.

This hypothesis was not supported. Factorial analyses of variance across grade levels K-4 indicated that SES was not significant for any task. Table 3 showing t-test results indicates no significant differences for each test battery item except provoked correspondence tasks which was significant at the .05 level favoring the middle SES group. These results indicate that SES has little, if any, influence on any task of the battery.

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[1]Definitions of tasks may be found in Methods and Procedures section under Task Specific Procedures.

TABLE 2

Mean and S.D. for Middle and Low SES, High and Low Verbal Ability by Task for Each Sex at Each Grade Level*

		Low SES				Middle SES			
		Low Verbal		High Verbal		Low Verbal		High Verbal	
Grade	Sex	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
1. Relational Terms									
K	Female	9.00	1.41	9.75	0.50	10.00	0.00	9.75	0.50
K	Male	9.75	0.50	8.25	2.87	8.75	1.50	10.00	0.00
1	Female	10.00	0.00	9.75	0.50	9.50	0.57	9.75	0.50
1	Male	9.00	1.41	9.75	0.50	8.00	2.70	9.50	0.57
2	Female	9.25	0.95	10.00	0.00	9.25	0.95	10.00	0.00
2	Male	8.75	2.50	8.25	1.50	10.00	0.00	10.00	0.00
3	Female	10.00	0.00	10.00	0.00	9.25	1.50	10.00	0.00
3	Male	9.75	0.50	10.00	0.00	10.00	0.00	10.00	0.00
4	Female	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00
4	Male	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00
2. Provoked Correspondence Justifications									
K	Female	1.00	1.41	2.25	2.21	3.00	1.82	2.50	1.91
K	Male	2.00	1.82	2.25	2.63	2.75	1.70	3.75	1.89
1	Female	3.00	2.16	4.50	1.00	2.50	1.73	3.50	2.38
1	Male	2.00	0.81	4.00	0.81	2.75	2.63	3.50	1.73
2	Female	3.75	1.89	4.75	0.50	4.25	1.50	5.00	0.00
2	Male	4.25	1.50	4.00	1.41	5.00	0.00	4.75	0.50
3	Female	4.25	0.95	5.00	0.00	4.75	0.50	5.00	0.00
3	Male	5.00	0.00	5.00	0.00	4.50	0.57	5.00	0.00
4	Female	4.75	0.50	5.00	0.00	4.75	0.50	5.00	0.00
4	Male	4.50	1.00	5.00	0.00	4.50	1.00	5.00	0.00

* N = 4

TABLE 2 (continued)

Grade	Sex	Low SES				Middle SES			
		Low Verbal		High Verbal		Low Verbal		High Verbal	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
3. Provoked Correspondence Tasks									
K	Female	1.00	1.41	2.25	2.21	3.00	1.82	2.00	1.15
K	Male	1.50	1.73	2.75	2.21	3.00	1.82	3.75	1.89
1	Female	2.25	2.21	4.50	1.00	2.50	1.73	5.00	0.00
1	Male	2.50	1.91	3.75	1.25	2.75	2.63	3.75	1.89
2	Female	4.75	0.50	4.75	0.50	4.00	1.41	5.00	0.00
2	Male	4.00	1.41	4.00	1.41	4.75	0.50	4.75	0.50
3	Female	4.50	0.57	5.00	0.00	4.75	0.50	5.00	0.00
3	Male	5.00	0.00	5.00	0.00	4.50	0.57	5.00	0.00
4	Female	4.75	0.50	4.50	0.57	5.00	0.00	5.00	0.00
4	Male	4.50	1.00	5.00	0.00	4.50	1.00	5.00	0.00
4. Unprovoked Correspondence Justifications									
K	Female	2.00	1.41	4.25	0.95	3.50	2.38	2.25	0.50
K	Male	2.00	1.82	2.75	2.21	2.50	2.38	4.00	2.00
1	Female	3.25	3.36	3.75	1.50	4.25	0.95	4.25	1.50
1	Male	2.75	2.06	4.50	0.57	2.75	2.63	4.25	1.50
2	Female	4.75	0.50	5.00	0.00	4.75	0.50	5.00	0.00
2	Male	4.75	0.50	4.25	1.50	5.00	0.00	5.00	0.00
3	Female	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00
3	Male	4.75	0.50	5.00	0.00	4.75	0.50	5.00	0.00
4	Female	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00
4	Male	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00

TABLE 2 (continued)

Grade	Sex	Low SES				Middle SES			
		Low Verbal		High Verbal		Low Verbal		High Verbal	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
5. Unprovoked Correspondence Tasks									
K	Female	1.75	1.70	4.00	1.41	3.50	2.38	2.25	1.25
K	Male	2.00	1.41	2.75	2.63	2.75	2.63	3.75	2.50
1	Female	3.75	2.50	4.25	1.50	4.25	0.95	4.25	1.50
1	Male	3.00	1.82	4.50	1.00	3.00	2.44	4.25	1.50
2	Female	4.75	0.50	5.00	0.00	4.75	0.50	5.00	0.00
2	Male	5.00	0.00	4.25	1.50	5.00	0.00	5.00	0.00
3	Female	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00
3	Male	4.75	0.50	5.00	0.00	4.75	0.50	5.00	0.00
4	Female	4.75	0.50	5.00	0.00	5.00	0.00	5.00	0.00
4	Male	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00
6. Single Seriation - Height									
K	Female	4.50	1.00	5.00	0.00	5.00	0.00	2.75	2.63
K	Male	4.25	0.95	5.00	0.00	4.75	0.50	5.00	0.00
1	Female	3.75	1.25	5.00	0.00	4.50	0.57	5.00	0.00
1	Male	5.00	0.00	4.50	1.00	4.25	1.50	4.50	1.00
2	Female	4.50	1.00	4.75	0.50	5.00	0.00	4.50	1.00
2	Male	4.50	0.57	2.75	1.50	3.50	1.73	5.00	0.00
3	Female	4.75	0.50	5.00	0.00	4.00	1.41	5.00	0.00
3	Male	5.00	0.00	4.75	0.50	4.25	0.95	3.75	1.25
4	Female	5.00	0.00	4.75	0.50	5.00	0.00	4.75	0.50
4	Male	5.00	0.00	4.75	0.50	5.00	0.00	5.00	0.00

TABLE 2 (continued)

Grade	Sex	Low SES				Middle SES			
		Low Verbal		High Verbal		Low Verbal		High Verbal	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
7. Single Seriation - Width									
K	Female	3.00	1.63	4.25	1.50	3.50	1.91	4.50	0.57
K	Male	4.25	0.95	4.25	1.50	3.75	1.25	2.00	2.16
1	Female	3.75	1.25	3.75	1.50	3.75	0.95	5.00	0.00
1	Male	3.50	1.73	4.25	0.95	3.00	1.82	5.00	0.00
2	Female	5.00	0.00	5.00	0.00	4.00	2.00	4.25	0.95
2	Male	4.00	1.15	5.00	5.00	3.50	1.73	4.50	1.00
3	Female	4.50	0.57	4.25	1.50	4.00	1.41	5.00	0.00
3	Male	5.00	0.00	4.25	0.95	3.75	1.50	4.75	0.50
4	Female	4.75	0.50	4.75	0.50	5.00	0.00	4.75	0.50
4	Male	4.00	1 41	4.25	0.95	5.00	0.00	5.00	0.00
8. Multiple Seriation Tasks									
K	Female	1.50	1.00	1.00	1.41	1.75	1.70	1.50	1.91
K	Male	3.00	0.81	2.25	2.63	1.50	1.91	1.25	1.50
1	Female	2.25	0.50	2.75	1.50	1.50	0.57	2.25	2.63
1	Male	2.50	1.29	3.25	1.25	0.75	0.50	3.75	1.25
2	Female	3.00	1.82	4.25	0.95	3.00	1.63	4.00	0.81
2	Male	2.75	0.50	3.25	2.06	4.00	0.81	3.75	1.50
3	Female	3.75	0.95	5.00	0.00	4.00	0.81	4.50	0.57
3	Male	3.75	1.25	4.00	1.41	4.50	1.00	4.75	0.50
4	Female	4.00	0.81	4.50	0.57	4.50	1.00	4.75	0.50
4	Male	3.50	1.91	3.75	1.50	4.75	0.50	4.50	1.00

TABLE 2 (continued)

Grade	Sex	Low SES				Middle SES			
		Low Verbal		High Verbal		Low Verbal		High Verbal	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
9. Area Justification									
K	Female	0.75	0.95	2.50	1.29	1.25	0.95	0.75	0.95
K	Male	2.25	2.21	1.75	2.36	1.25	0.95	1.25	2.50
1	Female	2.50	1.73	3.75	1.50	2.75	0.95	2.50	1.73
1	Male	1.75	2.36	1.75	1.25	1.00	1.41	3.00	1.41
2	Female	3.00	0.81	4.00	1.15	3.25	1.70	3.25	2.36
2	Male	4.50	1.00	3.75	1.89	4.75	0.50	00	1.15
3	Female	2.25	1.70	4.25	1.50	3.50	1.29	4.00	1.41
3	Male	3.00	1.82	4.50	1.00	2.50	1.00	4.75	0.50
4	Female	4.75	0.50	3.75	1.89	3.00	1.41	4.00	1.41
4	Male	4.50	1.00	5.00	0.00	4.50	1.00	4.00	1.15
10. Area Tasks									
K	Female	1.25	0.95	2.50	1.29	1.25	0.95	2.00	1.63
K	Male	2.75	1.70	2.25	2.06	1.50	1.29	2.00	2.16
1	Female	2.00	1.41	3.75	1.50	2.75	0.95	2.50	1.73
1	Male	2.25	0.95	2.75	0.50	1.00	1.41	3.25	1.50
2	Female	3.00	1.41	4.50	1.00	3.25	1.70	3.50	1.91
2	Male	4.00	1.15	3.75	1.89	4.75	0.50	4.00	1.15
3	Female	2.25	1.70	4.25	1.50	3.25	0.95	4.25	1.50
3	Male	3.00	1.82	4.50	1.00	2.50	1.00	4.75	0.50
4	Female	5.00	0.00	3.75	1.89	3.75	1.50	4.75	0.50
4	Male	4.50	1.00	5.00	0.00	4.75	0.50	4.00	1.15

TABLE 3

t-test Results for Comparisons of Low and Middle SES Groups on All Tasks

Tasks	Low SES Mean	Low SES S.D.	Middle SES Mean	Middle SES S.D.	t-Value*
1. Relational terms pretest	9.56	1.10	9.68	0.89	0.82 ns
2. Provoked correspondence justification	3.81	1.68	4.08	1.50	1. ns
3. Provoked correspondence tasks	3.81	1.67	4.15	1.43	1.72 sig.
4. Unprovoked correspondence justification	4.18	1.44	4.36	1.37	0.85 ns
5. Unprovoked correspondence tasks	4.22	1.47	4.37	1.39	0.75 ns
6. Single seriation-height	4.62	0.80	4.52	1.05	0.73 ns
7. Single seriation-width	4.28	1.09	4.20	1.30	0.49 ns
8. Multiple seriation	3.20	1.52	3.26	1.77	0.28 ns
9. Surface area conservation justification	3.21	1.79	2.96	1.74	1.08 ns
10. Surface area conservation tasks	3.35	1.59	3.18	1.65	0.77 ns

*one-tailed test. $t_{.05,158df} = 1.645$ $t_{.01,158df} = 2.326$

N = 80 for each subsample

Hypothesis 2. There will be significant differences in Piagetian task performances in favor of high over low verbal ability subjects combined across grade levels and at each grade level considered separately.

The results of analysis of variance across grade levels K-4 (see Table 4) indicates support for this hypothesis. Results of t-test comparisons by grades shown in Table 4 indicates no significant differences for any task at the kindergarten level. At grade one, significant differences favoring the high VA's were found for provoked correspondence tasks, single seriation-width, multiple seriation, and surface area conservation tasks. At the second grade levels no significant differences were found for any task. At the third grade level significant differences were found for provoked correspondence tasks and verbal justifications, multiple seriation, and surface area tasks and verbal justifications all favoring the high verbal ability group. At the fourth grade level differences were found for provoked correspondence tasks favoring the high verbal ability group and single seriation-height favoring the low verbal ability group.

Hypothesis 3. The range of differences between middle and low SES groups will be: (a) greater at the first grade than at the fourth grade for number conservation tasks and verbal justifications, and (b) greater at the fourth grade than at the first grade for surface area conservation tasks and verbal justifications.

This hypothesis was not supported. The results of t-tests shown in Table 5 indicates no significant difference attributable to low or middle SES levels on any of the tasks examined for either the first or fourth grade levels.

In every case the fourth graders did better than first graders on both number conservation tasks and verbal justifications, and surface area conservation tasks and verbal justifications. (See Figs. 2-7). There were no significant differences for verbal justifications between the two groups, although surface area justifications approached the level of significance at the .05 level favoring the low SES fourth graders.

Hypothesis 4. Subjects from middle SES levels with low verbal ability combined across grade levels K-4 will:

(a) perform significantly better on number conservation tasks and verbal justifications than subjects from low SES levels with low verbal ability, and

(b) perform significantly better on surface area conservation tasks and verbal justifications than subjects from low SES levels with low verbal ability.

TABLE 4

t-test Comparisons of High and Low Verbal Ability
at each Grade Level K-4

Tasks	Low Verbal Mean	Low Verbal S.D.	High Verbal Mean	High Verbal S.D.	t-Value*
Kindergarten					
1. Relational Terms Pretest	9.37	1.08	9.43	1.50	0.01 ns
2. Provoked Correspondence Justification	2.18	1.72	2.68	2.05	0.83 ns
3. Provoked Correspondence Tasks	2.12	1.78	2.68	1.85	0.88 ns
4. Unprovoked Correspondence Justification	2.50	1.93	3.33	1.66	1.28 ns
5. Unprovoked Correspondence Tasks	2.50	2.00	3.18	1.97	0.45 ns
6. Single Seriation Vertical	4.62	0.71	4.43	1.54	0.44 ns
7. Single Seriation Horizontal	3.62	1.40	3.75	1.75	0.23 ns
8. Multiple Seriation	1.93	1.43	1.50	1.78	0.76 ns
9. Area Conservation Justification	1.37	1.36	1.56	1.82	0.33 ns
10. Area Conservation Tasks	1.68	1.30	2.18	1.64	0.96 ns
First Grade					
1. Relational Terms Pretest	9.12	1.58	9.68	0.47	1.56 ns
2. Provoked Correspondence Justification	2.56	1.78	3.87	1.50	0.18 ns
3. Provoked Correspondence Tasks	2.50	1.93	4.25	1.23	3.04**sig.
4. Unprovoked Correspondence Justification	3.25	1.98	4.18	1.22	1.44 ns
5. Unprovoked Correspondence Tasks	3.50	1.89	4.31	1.25	1.43 ns
6. Single Seriation Vertical	4.37	1.02	4.75	0.68	1.22 ns
7. Single Seriation Horizontal	3.50	1.36	4.50	0.96	2.39**sig.
8. Multiple Seriation	1.75	1.00	3.00	1.67	2.55**sig.
9. Area Conservation Justification	2.00	1.67	2.75	1.52	1.33 ns
10. Area Conservation Tasks	2.00	1.26	3.06	1.34	2.32**sig.

TABLE 4 (continued)

Tasks	Second Grade Low Verbal Mean	S.D.	High Verbal Mean	S.D.	t-Value*
1. Relational Terms Pretest	9.31	1.35	9.56	1.03	0.57 ns
2. Provoked Correspondence Justification	4.31	1.35	4.62	0.80	0.80 ns
3. Provoked Correspondence Tasks	4.37	1.02	4.62	0.80	0.77 ns
4. Unprovoked Correspondence Justification	4.81	0.40	4.81	0.75	0.00 ns
5. Unprovoked Correspondence Tasks	4.87	0.34	4.81	0.75	0.30 ns
6. Single Seriation Vertical	4.37	1.08	4.25	1.23	0.33 ns
7. Single Seriation Horizontal	4.12	1.40	4.68	0.70	1.45 ns
8. Multiple Seriation	3.18	1.27	3.81	1.32	1.36 ns
9. Area Conservation Justification	3.87	1.25	3.75	1.57	0.20 ns
10. Area Conservation Tasks	3.75	1.34	3.93	1.43	0.38 ns
	Third Grade				
1. Relational Terms Pretest	9.75	0.77	10.00	0.00	1.25 ns
2. Provoked Correspondence Justification	4.62	0.61	5.00	0.00	2.45**sig.
3. Provoked Correspondence Tasks	4.68	0.47	5.00	0.00	2.61**sig.
4. Unprovoked Correspondence Justification	4.87	0.34	5.00	0.00	1.47 ns
5. Unprovoked Correspondence Tasks	4.87	0.34	5.00	0.00	1.47 ns
6. Single Seriation Vertical	4.50	0.89	4.62	0.80	0.42 ns
7. Single Seriation Horizontal	4.31	1.07	4.56	0.89	0.72 ns
8. Multiple Seriation	4.00	0.96	4.56	0.81	1.78* sig.
9. Area Conservation Justification	2.81	1.42	4.37	1.08	3.49**sig.
10. Area Conservation Tasks	2.75	1.34	4.43	1.09	3.88**sig.

TABLE 4 (continued)

Tasks	Fourth Grade				
	Low Verbal		High Verbal		
	Mean	S.D.	Mean	S.D.	t-Value*
1. Relational Terms Pretest	10.00	0.00	10.00	0.00	0.00 ns
2. Provoked Correspondence Justification	4.62	0.71	5.00	0.00	2.09* sig.
3. Provoked Correspondence Tasks	4.68	0.70	4.87	0.34	0.96 ns
4. Unprovoked Correspondence Justification	5.00	0.00	5.00	0.00	0.00 ns
5. Unprovoked Correspondence Tasks	4.93	0.25	5.00	0.00	0.99 ns
6. Single Seriation Vertical	5.00	0.00	4.81	0.40	1.86* sig.
7. Single Seriation Horizontal	4.68	0.79	4.68	0.60	0.00 ns
8. Multiple Seriation	4.18	1.16	4.37	0.95	0.50 ns
9. Area Conservation Justification	4.18	1.16	4.18	1.27	0.00 ns
10. Area Conservation Tasks	4.50	0.96	4.37	1.14	0.33 ns

*One-tailed test
$t_{.05,\ 30\ df} = 1.69$

**$t_{.01,\ 30\ df} = 2.45$

N = 16 for each subsample

TABLE 5

t-test Comparisons of Selected Tasks at the
First and Fourth Grade Levels
for Low and Middle SES Groups

Tasks	Low SES Mean	Low SES S.D.	Middle SES Mean	Middle SES S.D.	t-Value*
First Grade					
2. Provoked Correspondence Justification	3.37	1.54	3.06	1.98	0.49 ns
3. Provoked Correspondence Tasks	3.25	1.77	3.50	1.93	0.38 ns
4. Unprovoked Correspondence Justification	3.56	1.71	3.87	1.71	0.52 ns
5. Unprovoked Correspondence Tasks	3.87	1.71	3.94	1.61	0.01 ns
9. Surface Area Justification	2.43	1.78	2.31	1.49	0.20 ns
10. Surface area Tasks	2.68	1.25	2.37	1.54	0.52 ns
Fourth Grade					
2. Provoked Correspondence Justification	4.81	0.54	4.81	0.54	0.00 ns
3. Provoked Correspondence Tasks	4.75	0.57	4.87	0.50	0.66 ns
4. Unprovoked Correspondence Justification	5.00	0.00	5.00	0.00	0.00 ns
5. Unprovoked Correspondence Tasks	5.00	0.00	5.00	0.00	0.00 ns
9. Surface Area Justification	4.50	1.06	3.87	1.20	1.56 ns
10. Surface Area Tasks	4.61	1.09	4.31	1.02	0.81 ns

*One-tailed test. $t_{.05,30df} = 1.69$

N = 16 for each subsample

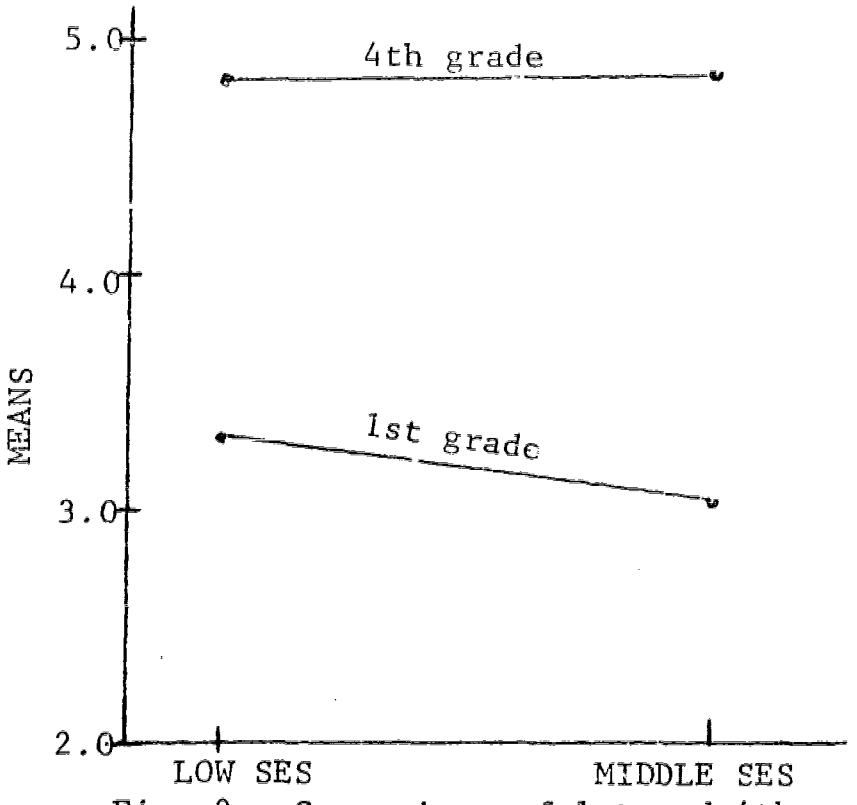

Fig. 2. Comparison of 1st and 4th grade means for provoked correspondence justifications.

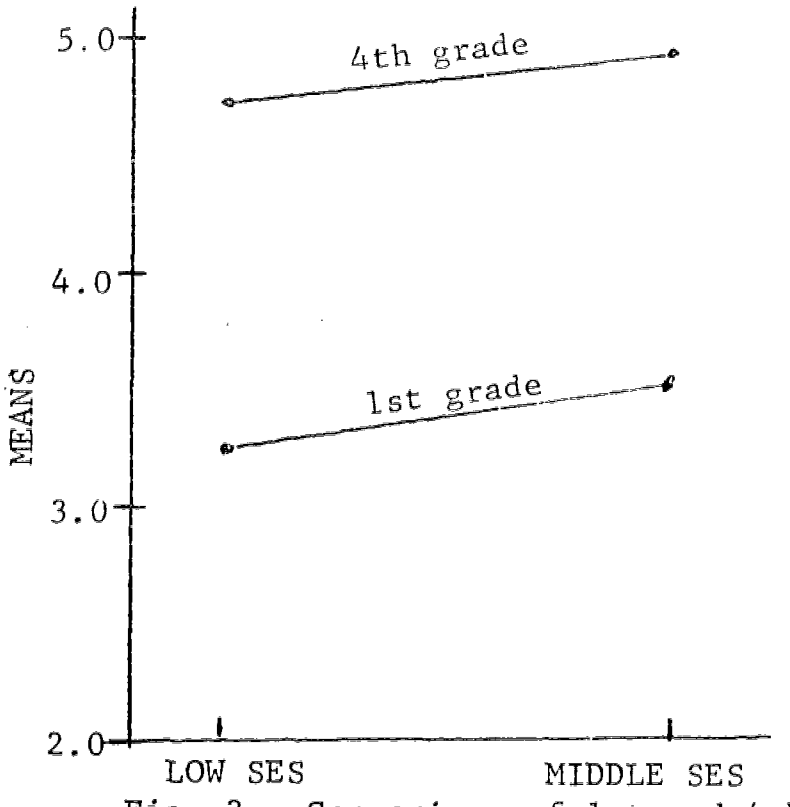

Fig. 3. Comparison of 1st and 4th grade means for provoked correspondence tasks.

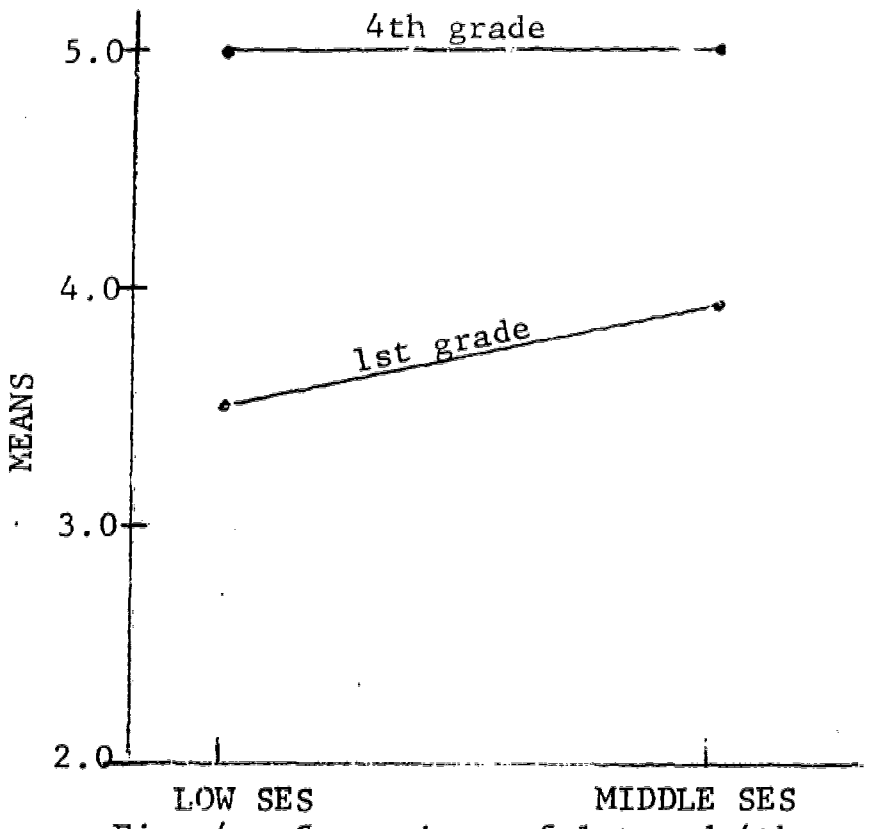

Fig. 4. Comparison of 1st and 4th grade means for unprovoked correspondence justifications.

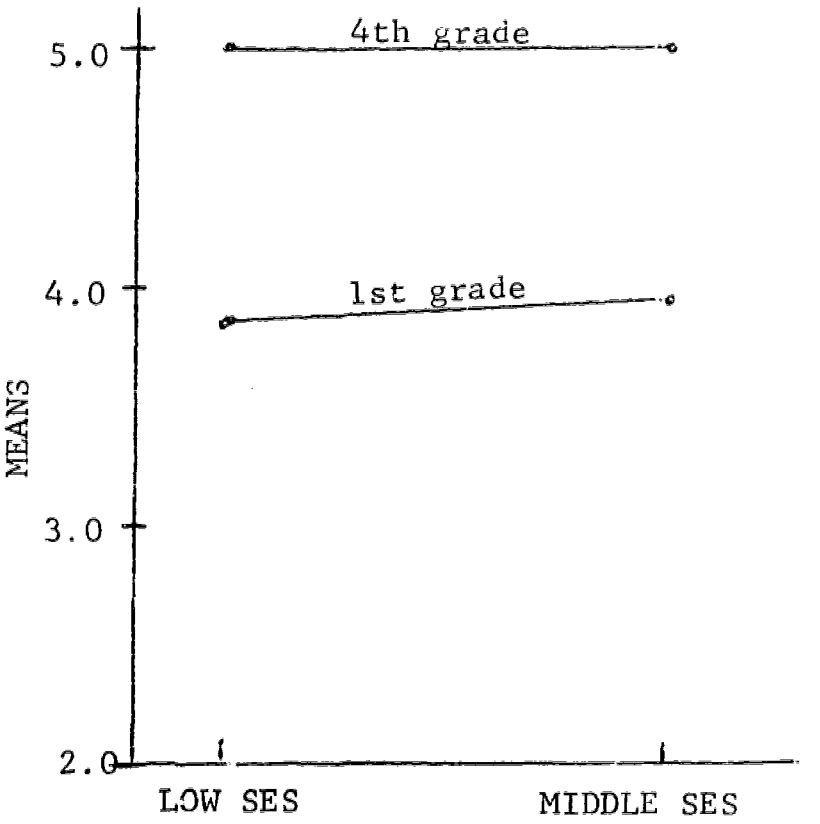

Fig. 5. Comparison of 1st and 4th grade means for unprovoked correspondence tasks.

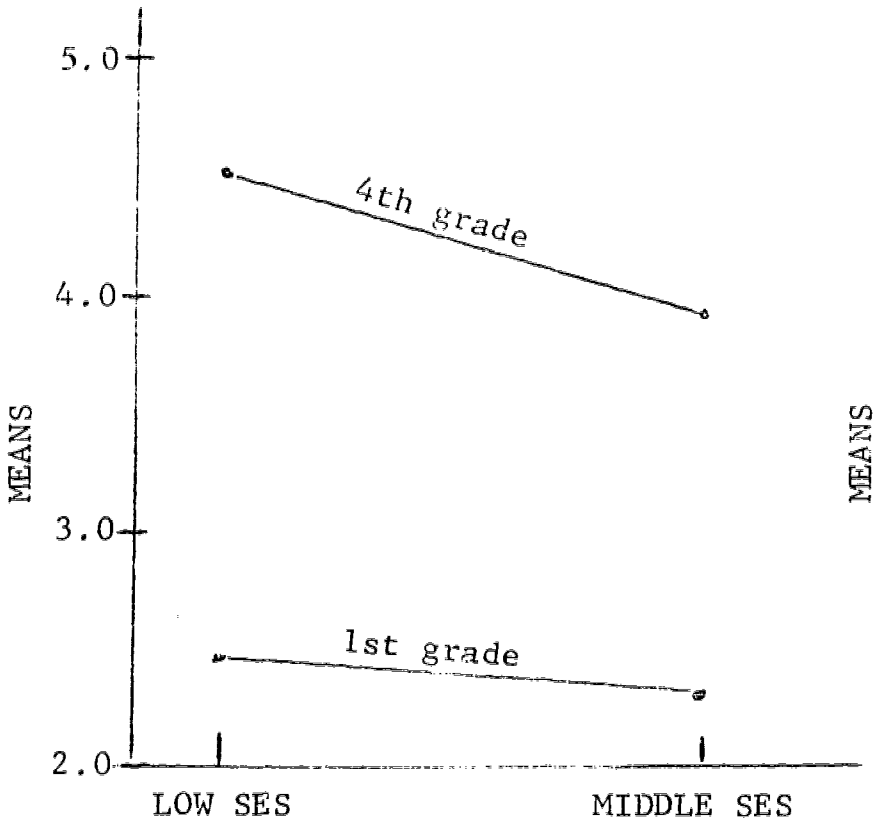

Fig. 6. Comparison of 1st and 4th grade means for surface area justifications.

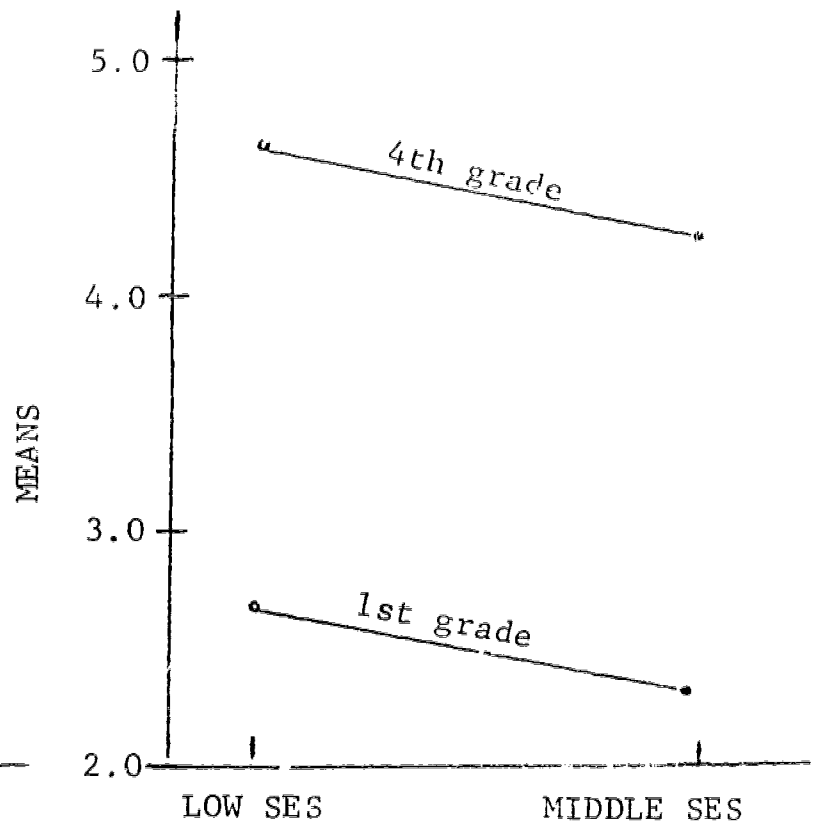

Fig. 7. Comparison of 1st and 4th grade means for surface area tasks

(a) This hypothesis received only very weak support. t-test results shown in Table 6 indicate no significant differences in task scores for low and middle SES groups both with low verbal ability, except for unprovoked correspondence justifications which indicates a difference attributable to SES in favor of middle SES subjects.

(b) Subjects from middle and low SES groups, both with low verbal ability, did not perform significantly different on surface area tasks. Surface area justifications approaches significance at the .05 level in favor of the middle SES subjects.

Hypothesis 5. SES will be a significantly greater discriminating variable in Piagetian task performance than verbal ability combined across grade levels K-4.

This hypothesis was not supported. The provoked correspondence tasks without justification was the only one which significantly differed between the two SES groups and favored the middle SES subjects. (See Table 3). Analysis of variance across grade levels for individual tasks for SES and verbal ability are shown in Table 7 and indicates that verbal ability is the stronger discriminating variable. The effects of SES are negligible. Significantly different performances are attributed to verbal ability at the .01 level for provoked correspondence justifications, provoked correspondence tasks, and surface area tasks; at the .05 level for single seriation-width, multiple seriation, and surface area justifications. The relational terms pretest, unprovoked correspondence justifications, and unprovoked correspondence tasks approach significance at the .05 level. Single seriation-height was not significant with regard to the verbal ability dichotomy.

Hypothesis 6. It is not predicted that any main effects or higher order interactions will be associated with the sex dichotomy.

This hypothesis was supported. Main effects or interactions were not found to be attributable to sex combined across grade levels or at each individual grade level, except in the case of the relational terms pretest, i.e., results combined across grade levels indicate a significant difference between the sexes in favor of girls over boys. There are no significant interactions with the other variables except for single seriation-height. Table 8, showing t-test results combined across grade levels, indicates no significant differences between the sexes except for relational terms pretest as noted. Table 9, showing t-test results for girls and boys at each grade level for all tasks, shows no significant differences at the kindergarten level. At the first grade level there is one significant difference on relational terms pretest favoring girls. At the second grade level, single seriation-height favored girls and surface area conservation justifications favored boys. At the third and fourth grade levels there were no significant differences favoring either group.

TABLE 6

t-test Comparisons of Selected Tasks Combined
Across Grades K-4 for Low and Middle
SES Groups with Low Verbal Ability

Tasks	Low Verbal Ability				t-Value*
	Low SES		Middle SES		
	Mean	S.D.	Mean	S.D.	
2. Provoked Correspondence Justification	3.48	1.69	3.78	1.73	0.85 ns
3. Provoked Correspondence Tasks	3.47	1.85	3.87	1.51	1.07 ns
4. Unprovoked Correspondence Justification	3.97	1.17	4.47	1.26	1.82 sig.
5. Unprovoked Correspondence Tasks	3.92	1.38	4.25	1.55	1.00 ns
9. Surface Area Justification	2.92	1.85	3.50	1.87	1.44 ns
10. Surface Area Tasks	2.97	1.59	2.95	1.66	0.06 ns

*One-tailed test. $t_{.05,78df} = 1.665$

N = 80 for each subsample

TABLE 7

Analyses of Variance Comparisons for SES and Verbal Ability
Across Grade Levels K-4 by Tasks

Tasks	SES				Verbal Ability			
	DF	S.S.	Err. M.S.	F Ratio	DF	S.S.	Err. M.S.	F Ratio
1. Relational Terms Pretest	1	0.62	0.92	ns	1	2.02	0.92	2.20 ns
2. Provoked Correspondence Justifications	1	3.02	1.77	ns	1	13.22	1.77	7.47 sig.
3. Provoked Correspondence Tasks	1	4.55	1.54	ns	1	15.00	1.54	9.80 sig.**
4. Unprovoked Correspondence Justifications	1	1.22	1.37	ns	1	5.62	1.37	3.37 ns
5. Unprovoked Correspondence Tasks	1	0.89	1.55	ns	1	4.22	1.55	2.72 ns
6. Single Seriation Height	1	0.39	0.72	ns	1	0.00	0.72	0.00 ns
7. Single Seriation Width	1	0.30	1.31	ns	1	6.00	1.31	4.61 sig.*
8. Multiple Seriation	1	0.56	1.73	ns	1	7.65	1.73	4.43 sig.*
9. Surface Area Justifications	1	2.49	2.11	ns	1	9.02	2.11	4.27 sig.*
10. Surface Area Tasks	1	1.05	1.78	ns	1	17.55	1.79	9.81 sig.**

N = 80 for each subsample

*$F_{.05,\ 1,120\ df} = 3.92$

**$F_{.01,\ 1,120\ df} = 6.85$

TABLE 8

t-test Comparison of Sex Combined Across Grade Levels K-4 for All Tasks

Tasks	Female Mean	Female S.D.	Male Mean	Male S.D.	t-Value*
1. Relational Terms Pretest	9.76	0.62	9.48	1.26	1.81* sig
2. Provoked Correspondence Justification	3.92	1.64	3.97	1.55	0.22 ns
3. Provoked Correspondence Tasks	3.97	1.58	3.98	1.55	0.02 ns
4. Unprovoked Correspondence Justification	4.35	1.27	4.20	1.52	0.73 ns
5. Unprovoked Correspondence Tasks	4.36	1.33	4.23	1.53	0.63 ns
6. Single Seriation Height	4.62	0.93	4.52	0.94	0.75 ns
7. Single Seriation Width	4.33	1.11	4.15	1.28	1.04 ns
8. Multiple Seriation	3.18	1.66	3.27	1.64	0.42 ns
9. Surface Area Justification	2.98	1.65	3.18	1.87	0.87 ns
10. Surface Area Tasks	3.17	1.62	3.36	1.63	0.89 ns

*One-tailed test. $t_{.05,\ 158df} = 1.645$

N = 80 for each subsample

TABLE 9

t-test Comparisons of Sex for All Tasks
at Each Grade Level K-4

Tasks	Female Mean	Female S.D.	Male Mean	Male S.D.	t-Value*
Kindergarten					
1. Relational Terms Pretest	9.62	0.80	9.18	1.64	0.98 ns
2. Provoked Correspondence Justification	2.18	1.83	2.68	1.95	0.75 ns
3. Provoked Correspondence Tasks	2.06	1.69	2.75	1.91	0.08 ns
4. Unprovoked Correspondence Justification	3.00	1.63	2.81	2.04	0.27 ns
5. Unprovoked Correspondence Tasks	2.87	1.82	2.81	2.19	0.08 ns
6. Single Seriation Height	4.31	1.57	4.75	0.57	1.07 ns
7. Single Seriation Width	3.81	1.47	3.56	1.67	0.45 ns
8. Multiple Seriation	1.43	1.41	2.00	1.78	0.99 ns
9. Surface Area Justification	1.31	1.19	1.62	1.92	0.55 ns
10. Surface Area Tasks	1.75	1.23	2.12	1.70	0.71 ns
First Grade					
1. Relational Terms Pretest	9.75	0.44	9.06	1.56	1.85* sig.
2. Provoked Correspondence Justification	3.37	1.85	3.06	1.69	0.50 ns
3. Provoked Correspondence Tasks	3.56	1.82	3.18	1.86	0.58 ns
4. Unprovoked Correspondence Justification	3.87	1.54	3.56	1.86	0.48 ns
5. Unprovoked Correspondence Tasks	4.12	1.54	3.68	1.74	0.81 ns
6. Single Seriation Height	4.56	0.81	4.56	0.96	0.00 ns
7. Single Seriation Width	4.06	1.12	3.93	1.43	0.28 ns
8. Multiple Seriation	2.18	1.47	2.56	1.54	0.72 ns
9. Surface Area Justification	2.87	1.45	1.87	1.66	1.65 ns
10. Surface Area Tasks	2.75	1.43	2.31	1.35	0.91 ns

TABLE 9 (continued)

Tasks	Second Grade Female Mean	Female S.D.	Male Mean	Male S.D.	t-Value
1. Relational Terms Pretest	9.62	0.71	9.25	1.52	0.89 ns
2. Provoked Correspondence Justification	4.43	1.20	4.50	1.03	0.01 ns
3. Provoked Correspondence Tasks	4.62	0.80	4.37	1.02	0.07 ns
4. Unprovoked Correspondence Justification	4.87	0.34	4.75	0.77	0.48 ns
5. Unprovoked Correspondence Tasks	4.87	0.34	4.81	0.75	0.31 ns
6. Single Seriation Height	4.68	0.70	3.93	1.38	1.92* sig.
7. Single Seriation Width	4.56	1.09	4.25	1.18	1.01 ns
8. Multiple Seriation	3.56	1.36	2.43	1.31	0.03 ns
9. Surface Area Justification	3.57	1.50	4.25	1.18	1.82* sig.
10. Surface Area Tasks	3.56	1.50	4.12	1.20	0.92 ns
	Third Grade				
1. Relational Terms Pretest	9.81	0.75	9.93	0.25	0.58 ns
2. Provoked Correspondence Justification	4.75	0.57	4.87	0.34	0.74 ns
3. Provoked Correspondence Tasks	4.81	0.40	4.87	0.34	0.06 ns
4. Unprovoked Correspondence Justification	5.00	0.00	4.87	0.34	1.48 ns
5. Unprovoked Correspondence Tasks	5.00	0.00	4.87	0.34	1.48 ns
6. Single Seriation Height	4.68	0.79	4.43	0.89	0.84 ns
7. Single Seriation Width	4.43	1.03	4.43	0.96	0.00 ns
8. Multiple Seriation	4.31	0.79	4.25	1.06	0.19 ns
9. Surface Area Justification	3.50	1.54	3.68	1.44	0.45 ns
10. Surface Area Tasks	3.50	1.54	3.68	1.44	0.48 ns

TABLE 9 (continued)

Tasks	Fourth Grade Female Mean	Female S.D.	Male Mean	Male S.D.	t-Value
1. Relational Terms Pretest	10.00	0.00	10.00	0.00	0.00 ns
2. Provoked Correspondence Justification	4.87	0.34	4.75	0.68	0.69 ns
3. Provoked Correspondence Tasks	4.81	0.40	4.75	0.68	0.21 ns
4. Unprovoked Correspondence Justification	5.00	0.00	5.00	0.00	0.00 ns
5. Unprovoked Correspondence Tasks	4.93	0.25	5.00	0.00	0.99 ns
6. Single Seriation Height	4.87	0.34	4.93	0.25	0.62 ns
7. Single Seriation Width	4.81	0.40	4.56	0.89	1.02 ns
8. Multiple Seriation	4.43	0.72	4.12	1.31	1.12 ns
9. Surface Area Justification	3.87	1.40	4.50	0.89	0.91 ns
10. Surface Area Tasks	4.31	1.25	4.56	0.81	0.64 ns

*One-tailed test

$t_{.05,\ 30\ df} = 1.69$

$^{**}t_{.01,\ 30\ df} = 2.45$

N = 16

Hypothesis 7. If there is a correlation between the Piagetian task objective scores, verbal justifications scores, and the standardized Gates-MacGinitie test scores, it will be of a relatively small magnitude.

This hypothesis was supported. Table 10 indicates a high correlation between the Piagetian task objective scores and the verbal justification scores, whereas the correlations between the Piagetian scores and the Gates-MacGinitie scores are quite low. The product moment correlation indicates only three of ten correlations were statistically significant. Of the three that were statistically significant, the coefficients of determination were less than 50% indicating the significant correlations to be of little practical value.

TABLE 10

Product Moment Correlation Coefficients for Piagetian Task Objectives Scores, Verbal Justifications Scores, and the Standardized Gates-MacGinitie Test Scores for Each Grade Level

	Piagetian Task Scores	Verbal Justifications Scores	Gates-MacGinitie Scores
Kindergarten*			
Piagetian Task Scores	1.00	0.82	0.26
Verbal Justifications	0.82	1.00	0.25
Gates-MacGinitie Scores	0.26	0.25	1.00
First Grade*			
Piagetian Task Scores	1.00	0.76	0.65
Verbal Justifications	0.76	1.00	0.36
Gates-MacGinitie Scores	0.65	0.36	1.00
Second Grade*			
Piagetian Task Scores	1.00	0.69	0.26
Verbal Justifications	0.69	1.00	0.08
Gates-MacGinitie Scores	0.26	0.08	1.00
Third Grade*			
Piagetian Task Scores	1.00	0.73	0.60
Verbal Justifications	0.73	1.00	0.64
Gates-MacGinitie Scores	0.60	0.64	1.00
Fourth Grade*			
Piagetian Task Scores	1.00	0.42	0.07
Verbal Justifications	0.42	1.00	0.26
Gates-MacGinitie Scores	0.07	0.26	1.00
Overall**			
Piagetian Task Scores	1.00	0.85	0.03
Verbal Justifications	0.85	1.00	-0.10
Gates-MacGinitie Scores	0.03	-0.10	1.00

* N = 32
** N = 160

CHAPTER V

DISCUSSION

SES did not prove to be a significant variable for any task combined across grade levels K-4. The results of t-tests between low and middle SES subjects indicated only one task, provoked correspondence, which revealed significantly different performances favoring the middle SES group. There is, therefore, no clear-cut superiority for one SES group over the other. Comparisons for low verbal ability for middle and low SES groups indicates only weak support for the middle SES low verbal ability group on task performances and verbal justifications. Unprovoked correspondence justifications was significant at the .05 level in favor of the middle SES low verbal ability group, while surface area justifications approached significance at the .05 level. Means are slightly higher for middle SES low verbal ability group on all but surface area tasks which slightly favors the low SES low verbal ability group. (See Table 5).

In contrast, the high verbal ability group shows significantly different performances from the low verbal ability group on a number of comparisons across grade levels. The means for the high verbal ability group are, in most instances, higher than those for the low verbal ability group. At kindergarten, first, and third grades the high verbal ability group consistently did better than the low verbal ability group, but at the second and fourth grades the low verbal ability group's means are somewhat higher than the high verbal ability group's means, although not significantly so. Comparisons of SES and verbal ability on Piagetian task performances indicate that verbal ability is a very strong discriminating variable whereas SES is weak to negligible. (See Table 6). There were no main effects for sex and significant interactions associated with sex were found on only one task, single seriation-height, which lends strong support to the position that sex exerts little differential effect on Piagetian task performances.

Several studies which were cited earlier have found definite SES effects, whereas the present study has not. Some factors which may have influenced these findings are noted by Asch and Zimiles (1969) in their study of classification abilities. They assessed low and middle SES subjects and found no differences between the two SES groups when actual objects were used, but a considerable drop for lower SES subjects when they changed from actual objects to colored pictures, which represent a lower level abstract presentation. The present study utilized actual objects, suggesting that low and middle SES subjects are operating at comparable intellectual levels or have equivalent basic intellectual schemas upon which to build insofar as concrete media are concerned. Due to the limitations of the materials used, no statement may be made as to the differences or similarities regarding representational or more abstract levels of cognitive development between these two SES groups. Jensen's (1968) study of low and middle SES

children concluded that there are areas in which the two groups perform similarly, but they diverge when task requirements move from the lower level of associational responses to more complex mental processes and abstract levels.

Beilin et al. (1966) in a training study found no significant posttest differences which could be attributed to SES and said "with respect to SES.. on training, there were significant pretest differences ...between middle and low SES, but when conserving subjects were removed from the sample, there were no significant posttest differences which could be attributed to ...SES..."

Teets (1968), with a sample comparable on middle and low SES from the same general region as the present study, found sizable differences on Piagetian task performances which she attributed to SES effects. She found high verbal ability intercorrelations with Piagetian task performances as well. Her study utilized concrete objects and representational materials, i.e., picture, whereas the present study utilized only concrete objects. Surface area conservation is the only task common to both studies. The format differs between the studies on questioning procedures and verbal justifications as well as the number of trials for each task. The Teets study used verbal justifications as a part of the pass-fail criterion, while the present study examined objective responses in relation to verbal justifications on three selected tasks. The covariance analysis, using the Peabody Picture Vocabulary Test as the covariate, found significant SES main effects for all five conservation tasks used by Teets, including surface area tasks with justifications. Thus, the findings of the Teets study and the present study appear to be in opposition to each other. The findings of the present study are in line with Piagetian theory which postulates that social transmission, which includes culture, education, and language have only a limited effect on the acquisition of conservation abilities. Social transmission may affect the rate of acquisition, but not the order or sequence according to the stage theory.

In consideration of Piaget's equilibration model and the relative importance of other factors, Flavell (1963) states that this "model is conceived as a very general affair which presupposes the causal contributions of maturation and learning, but subsumes them." The foregoing statement makes it clear that maturation, experience and social transmission (which includes SES, culture, and education) combine to produce a limited effect upon cognitive development.

The lack of SES effects may be related to the variability within the low and middle SES groups resulting from the arbitrary dividing point used in conjunction with the Warner Scale in rating SES levels of subjects. By using 60 as a cut off point between low and middle SES groups, the upper-lower group and the lower-middle group were closer together than the lower-lower group and the upper-middle group.

Previous studies which have found SES differences utilized subjects drawn from urban environments whereas the present study used subjects

from a primarily rural region of Appalachia. There is some evidence of differences between rural and urban school populations noted by Greenfield et al. (1966). Hooper (1969) points out in his study of low SES children from the same general region that rural Appalachian children reveal "cultural diversity rather than uniform cognitive-intellectual deficits." He points out the clearest deficits are in verbal tasks and the more abstract symbolic representations. It is quite likely that differences due to cultural variations exist between children from urban centers of the United States and those from rural Appalachia which may account for the lack of differences found between low and middle SES subjects.

Price-Williams et al. (1969) found that children from pottery-making families conserved substance significantly more frequently than children from families engaged in work unrelated to pottery-making. This suggests that the role of skills gained through experience may be a very important factor in cognitive growth. That is, children from rural areas, who are familiar with farm life, have a different set of experiences and cultural values from which to draw upon than children from urban settings. Goodnow and Bethon (1966) concluded that skills needed for conservation tasks, which require thinking through a problem representationally without benefit of concrete objects, appear to place the low SES child, by reasons of lack of schooling or nonappropriate types of schooling, in a distinctly inferior position.

If SES were a strong discriminating variable, it would be expected that the range of differences between low and middle SES groups on given tasks would be greater at the first grade on low level tasks and greater at the fourth grade level on higher level tasks. The prediction was based on Teets' findings and that of other investigators which indicated the developmental priority of number conservation over surface area conservation. Number conservation is usually acquired by the age of 7 years whereas surface area conservation is not usually acquired until about the age of 9 years in normal children of average ability. Examination of Table 5 indicates no significant difference between the two SES groups at the first or fourth grade levels. Figures 2-7 indicated that the fourth graders consistently outperformed the first graders on every task. The range of differences between the low and middle SES groups is fairly consistent for all six tasks. The widest range of differences, favoring the middle SES subjects, appeared on surface area justifications which approached significance at the .05 level. Comparison of means (see Table 5) and SES levels of performance (Figures 2-7) indicates no significant differences attributable to SES.

The age range for the fourth grade sample was 9 years 4 months to 11 years 1 month with an overall mean age of 9 years 9 months. Conservation of surface area is generally acquired around the age of 9 years by about 30% of the subjects. The older ages may account for some portion of the higher percentage of subjects showing surface area conservation. Data was gathered near the end of the school year which

resulted in the higher age ranges than if it had been gathered at the beginning of the school year. It was also found that both schools from which the sample was drawn were currently using a new series of mathematics textbooks which stressed "correspondences" with considerable time spent in teaching principles with practice on problems similar to surface area conservation. These principles learned through classroom instruction and practice may well have generalized to the surface area conservation tasks and justifications.

The present study replicates, in part, Rothenberg's (1969) study of conservation of number of 4-5 year old children. Her sample included subjects drawn from an urban setting whereas the subjects in the present study were drawn from an essentially rural environment. Rothenberg's sample ranged in age from 4 years 3 months to 5 years, while the age range of the kindergarteners in the present study ranged from 5 years 4 months to 6 years 11 months. Low and middle SES subjects and essentially the same materials were used in both studies. Rothenberg used two questions following each presentation, while the present study used three one-part questions. Both studies obtained verbal justifications of objective answers and identical transformations were used. Rothenberg's study used seven categories of answers, whereas the present study recorded verbal justifications as appropriate versus inappropriate.

Rothenberg found no significant differences between the homogeneous materials (blocks) and unique pairs of objects (vases, dogs, boots, women, beads). The present study with an older age group showed 47% correct responses and justifications for provoked correspondence with unique pairs of objects and 59% correct responses with verbal justifications for homogeneous blocks. On the provoked correspondence tasks, the middle SES subjects had 49 correct answers with 46 correct justifications; the low SES subjects had 35 correct answers with 30 correct justifications. On the unprovoked correspondence tasks, the middle SES subjects had 49 correct responses with 49 correct justifications; the low SES subjects had 49 correct answers with 42 correct justifications. No sex differences were found in either study.

Rothenberg found a SES effect favoring the middle SES subjects. However, the subjects in her study were not matched for high and low verbal ability in relation to SES, although she found a high intercorrelation between the Peabody Picture Vocabulary Test for verbal IQ and conservation ability. The middle SES subjects in the present study tended to outperform the low SES subjects, but not significantly so. Rothenberg found a total of 6% conservers in her sample of 210 children. The present study found 18% of the 32 subjects in the kindergarten sample conserving on provoked correspondence tasks with verbal justifications and 31% of 32 subjects conserving on unprovoked correspondence with verbal justifications. The higher percentage of conserving subjects found in the present study is hardly surprising considering the age differences between the two samples.

The prediction that no main effects or higher order interactions would be associated with the sex dichotomy was strongly supported. Analyses of variance for sexes across grades K-4 show no significant differences, except for the relational terms pretest which favored girls over boys. Table 9 showing t-test results for girls and boys at each grade level for all tasks shows no significant differences at the kindergarten level, one significant difference at the first grade level on relational terms pretest favoring girls. At the second grade single seriation-height favored girls and surface area conservation justifications favored boys. There were no significant differences favoring either sex at the fourth grade level. Main effects were found for grade and verbal ability for every task in the battery except single seriation-height which showed no main effects for either grade or verbal ability. No interactions were found for any task of the battery except single seriation-height; therefore, it is believed these interactions are not true interactions but chance ones. (See Appendix D). The present findings are in general agreement with Piagetian theory and the majority of previous replication studies which indicate that girls and boys perform Piagetian tasks with comparable success at each age-grade level.

Examination of Figures 2-7 suggests that some tasks are more dependent upon nonverbal than verbal mediational processes as suggested by Beilin et al, (1966), e.g., the ability to give correct verbal conservation responses is not in itself sufficient to insure success in Piagetian task performances. There were instances in the present study where subjects responded correctly to objective questions, but were unable to give adequate verbal justifications. Conversely, there were subjects who were unable to correctly answer objective questions, but gave what appeared to be adequate verbal justifications. The former may very well indicate the presence of adequate cognitive development to perform the tasks, but insufficient verbal skills to adequately explain the justifications; the latter could possibly be due to semantic confusion and/or test anxiety on the part of the child.

It was predicted that an effect for low-middle SES would be found between the two low verbal ability groups. Again SES influences proved to be very weak. On only one task out of six did the differences prove to be significant. Unprovoked correspondence justifications favored the middle SES over the low SES groups combined across grade levels K-4. Although there was only one instance of significantly different performances which is attributed to SES, an examination of the means and standard deviations for both groups shows a definite trend for higher means for the middle SES group with low verbal ability.

The data indicate that the low verbal ability groups perform Piagetian tasks successfully with a similar degree of regularity regardless of SES level. The difference between SES levels, verbal ability, and successful Piagetian task performances is such that only a tentative statement may be considered; subject to the limitations of the present study, SES appears to have a very limited effect on Piagetian task

performances and associated verbal justifications. It is pointed out that previous studies which found clear-cut SES effects were drawn from urban centers, primarily in the northeastern section of the United States whereas the sample for this study was drawn from a rural section of Appalachia located in southwestern Pennsylvania. These sample differences may relate to schooling, cultural effects and/or life experiences. As expected from previous normative studies, at the earlier grade levels there are considerably more children which would be classified as global or transitional as opposed to the later grades where more children would be classified as conservers on the overall task battery.

Analyses of variance for SES and verbal ability across grade levels K-4 (see Table 7) for all tasks indicated that verbal ability is more discriminating than SES in relation to performance of Piagetian tasks. Of a total of ten tasks, six indicated significant differences in favor of the high verbal ability subjects. The six tasks which show significant differences were provoked correspondence tasks and verbal justifications, single seriation-width, multiple seriation, surface area conservation tasks and verbal justifications. The four tasks on which the two verbal ability groups performed comparably were relational terms pretest, unprovoked correspondence tasks and verbal justifications, and single seriation-height.

There is generally strong overall support for the position that high verbal ability subjects outperform low verbal ability subjects at each grade level. The results of t-test comparisons by grades shown in Table 4 indicate no significant differences between high and low verbal ability at the kindergarten level. It should be noted that kindergarten subjects were given a readiness test, whereas grades 1-4 were administered a vocabulary and comprehension test scaled to the individual grade level; hence, the results of kindergarten tests and grades 1-4 tests are not directly comparable.

At the first grade level, four measures (provoked correspondence tasks, single seriation-width, multiple seriation, and surface area tasks) showed significant differences between low and high verbal ability subjects, each favoring the high verbal ability group. At the second grade-level there were no significant differences or clear-cut trends. At the third grade-level five tasks, provoked correspondence tasks and verbal justifications, multiple seriation, surface area tasks and verbal justifications indicated significant differences favoring the high verbal ability group with the remaining five tasks indicating a definite trend toward the high verbal ability group. At the fourth grade level, only two out of ten tasks, provoked correspondence justifications and single seriation-height, were significantly different favoring the high verbal ability group. Again, a definite trend can be seen in favor of the high verbal ability group on the remaining eight tasks.

These findings seem to indicate that kindergarten subjects selected on the basis of verbal ability are not significantly different with

respect to Piagetian task performance. Kindergarten subjects are generally at either the global or transitional stage in the acquisition of conservation abilities. At the first grade level there is considerable variability in task performance, which suggests that many of these children are conservers, while others are still in the stage of transition. By the second grade they are performing at comparable levels again; that is, the transitional children of the first grade become conservers in the second grade. At the third grade level considerable differences are found, which suggests that low verbal ability children are lagging behind high verbal ability children in some areas. By the fourth grade, only two out of ten tasks show significant differences, which indicates closer correspondence between the two verbal ability groups. Provoked correspondence verbal justifications favored the high verbal ability group and single seriation-height favored the low verbal ability group at the fourth grade. The means and standard deviations for the fourth grade are the closest for any grade level and suggests the leveling effect of schooling and/or operational convergence of logical operations and verbal ability. Considering the conventional developmental norms, with increasing grade level all differences attributed to verbal ability should eventually diminish for this task battery.

Bruner (1967) views language as crucial to cognitive development and an important prior condition for the acquisition of conservation. While Bruner is not in complete agreement with Geneva on the point of the importance of language, the two viewpoints are not irreconcilable. For example, when a child is engaged in an activity, he is simultaneously handling materials, making perceptual observations, receiving sensory input; thus, intellectual schemas are being formed. Cognitive development is taking place on a preverbal sensorimotor or iconic level. The young child discovers differences and similarities in his environment, but true order and comparability are lacking until appropriate verbal labels are attached to the objects and experiences. The correct linguistic terminology which the child learns to use in connection with his activity and sensory input is the means by which he stores, associates, abstracts, and retrieves information. This view explains why teaching children to "parrot" rules without the accompanying activity and sensory input has had such limited effects on intellectual development. These activities form the foundation for later abstractions. Bruner states that "Once language becomes a medium for the translation of experience, there is progressive release from immediacy." In short, the young child must build the foundations of logical operations through interaction with his environment accompanied by language development in order to be able to manipulate language in its more abstract aspects at the level of formal operations. In view of these considerations, the role of language must be looked upon as potentially very powerful.

The product moment correlations for the Piagetian task objective scores and the verbal justifications ranged from .85 at the first grade level to .42 at the fourth grade which seems to indicate the lessening effect of language with increase in age-grade level. In other words, the child's basic intellectual development continues to grow in

relation to concrete media irrespective of comparable growth in verbal ability. The ability to manipulate materials correctly increases whether the ability to describe such manipulations more abstractly with language within acceptable limits increases or not.

The correlations between the Piagetian task objective scores, and verbal justifications scores on the one hand, and the Gates-MacGinitie test scores on the other hand, range from -.10 to .65 with the majority of the correlations falling considerably below .60. These correlations would seem to indicate the lack of relationship between the standardized Gates-MacGinitie test scores and the child's intellectual development reflected in the Piagetian task objective scores. Briefly, these findings indicate verbal ability is not an accurate indicator of intellectual development, and are in line with Piagetian theory that verbal ability is not the determining factor in intellectual development.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of this study was to investigate the effects of SES levels and verbal ability by matching middle and low SES subjects on high and low verbal ability at grade levels K-4 using equal numbers of girls and boys in each cell. Each subject was tested by a trained white adult examiner. A battery of ten Piagetian tasks was used. Three of the tasks required verbal justifications of objective responses which were scored separately for the purpose of comparing objective responses with verbal justifications. All tasks were concerned with number conservation. The task battery employed three-dimensional materials which were manipulated by the subjects.

The following hypotheses were tested:

1. There will be significant differences in Piagetian task performances in favor of middle SES over low SES subjects combined across grade levels K-4.

2. There will be significant differences in Piagetian task performance in favor of high over low verbal ability subjects combined across grade levels and at each grade level considered separately.

3. The range of differences between middle and low SES groups will be: (a) greater at the first grade than at the fourth grade for number conservation tasks and verbal justifications, and (b) greater at the fourth grade level than at the first grade for surface area conservation tasks and verbal justifications.

4. Subjects from middle SES levels with low verbal ability combined across grade levels K-4 will: (a) perform significantly better on number conservation tasks and verbal justifications than subjects from low SES levels with low verbal ability, and (b) perform significantly better on surface area conservation tasks and verbal justifications than subjects from low SES levels with low verbal ability.

5. SES will be a significantly greater discriminating variable than verbal ability on Piagetian task performances combined across grade levels K-4.

6. It is not predicted that any main effects or higher order interactions will be associated with the sex dichotomy.

7. If there is a correlation between the Piagetian task objective scores, verbal justifications scores, and the standardized Gates-MacGinitie test scores, they will be of a relatively small magnitude.

The subjects were 160 children matched for middle and low SES, high and low verbal ability in grades K-4 with equal numbers of females and males.

The tasks included: Relational Terms Pretest, Provoked Correspondence Tasks, Provoked Correspondence Justifications, Unprovoked Correspondence Tasks, Unprovoked Correspondence Justifications, Single Seriation-Height, Single Seriation-Width, Multiple Seriation, Surface Area Conservation Tasks, and Surface Area Conservation Justifications.

The subjects were tested individually. The tasks were presented in the order given above with the same standardized questioning format.

Subjects scored one point for each transformation when all three questions were answered correctly. Factorial analysis of variance, t-tests, and Pearson's product moment correlations were used for data analyses.

It was found that SES effects were negligible. Verbal ability was the much stronger discriminating variable. Main effects for grade and verbal ability were found for all tasks except Single Seriation-Height which proved to be the easiest task of the battery. Interactions occurred in connection with Single Seriation-Height, but were believed to be chance occurrences rather than true interactions. By the fourth grade all groups were performing at comparable levels regardless of social class factors, verbal ability, or sex. No main effects or higher order interactions were found in connection with sex.

Piagetian theory advances the notion that social transmission, which includes culture, education, and language, has only limited effects on the acquisition of conservation abilities. The present study supports this theory. While verbal ability was found to be a stronger discriminating variable than SES, most differences in performances between high and low verbal ability groups disappeared or were no longer clearly in favor of the high verbal ability group at the fourth grade level. In line with Piagetian theory, there was strong support for consistently better performances with increased age-grade levels irrespective of social class factors, culture, or verbal ability. Product moment correlations of Piagetian task objective scores, verbal justifications, and the standardized Gates-MacGinitie test scores indicate verbal ability is not an accurate indicator of intellectual development in line with Piagetian theory that verbal ability is not the determining factor in intellectual development.

The following recommendations are suggested: 1. Further research of different social classes utilizing samples from upper-middle class SES levels and lower-lower class SES levels with less variability within groups than this study was able to obtain. 2. Inclusion of grades 5-6 to determine if differences between middle-low SES, and high-low verbal ability groups completely disappear. 3. Inclusion

of additional tasks utilizing representational materials to study possible SES and verbal ability differences between groups in relation to more abstract materials.

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APPENDIX A

WARNER SCALE FOR RATING SOCIAL CLASS

SOCIAL CLASS EQUIVALENTS

Weighted Total of Ratings	Social Class Equivalents
12-17	Upper-Upper Class
18-22	Upper class probably, with some possibility of Upper-Middle Class
23-24	Indeterminate: either Upper or Upper-Middle Class
25-33	Upper-Middle Class
34-37	Indeterminate: either Upper-Middle or Lower-Middle Class
38-50	Lower-Middle Class
51-53	Indeterminate: either Lower-Middle or Upper-Lower Class
54-62	Upper-Lower Class
63-66	Indeterminate: either Upper-Lower or Lower-Lower Class
67-69	Lower-Lower Class probably, with some possibility of Upper-Lower Class
70-84	Lower-Lower Class

WARNER SCALE FOR RATING SOCIAL CLASS

Occupation

1. Professional which includes lawyers, doctors, dentists, engineers, judges, high school superintendents, veterinarians, ministers (graduated from divinity schools), chemists with postgraduate training, proprietors and managers of businesses valued at $75,000. and over. Businessmen such as regional and divisional managers of large financial and industrial enterprizes. Certified public accountants and gentleman farmers.

2. Professionals such as high school teachers, registered/trained nurses, chiropodists, chirapractors, undertakers, ministers with some college, newspaper editors, librarians with graduate work. Proprietors and managers of businesses valued at $20,000. to $75,000. Businessmen such as assistant managers and office and department managers of large businesses, assistants to executives, etc. Accountants, salesman of real estate and insurance, postmasters, large farm owners with large cash producing crops.

3. Professionals such as social workers, grade school teachers, optometrists, librarians (not graduated), undertaker's assistants, ministers with no training. Proprietors and managers of businesses valued at $5,000. to $20,000. Minor officials of businesses. Automobile salesmen, bank clerks, cashiers, postal clerks, secretaries to executives, supervisors of railroad, telephone, etc., justice of the peace. Contractors who own and operate businesses.

4. Proprietors and managers who operate businesses valued at $2,000. to $5,000. Stenographers, typists, bookkeepers, rural mail clerks, railroad and bus ticket agents, sales people in dry goods store, etc. Factory foremen, electricians, plumbers, carpenters, watchmakers, dry cleaners, butchers who own own business. Sheriffs, railroad engineers and conductors, bus drivers, etc. Small farm owners.

5. Proprietors and managers of businesses valued at $500. to $2,000. 5 & 10 clerks, hardware salesman, beauty operator, telephone operator, apprentice carpenters, plumbers, electricians, timekeeper, lineman, radio or television repairman, appliance serviceman, barbers, fireman, butcher's apprentice, practical nurses, policeman, seamstress, cook in restaurant, bartender. Tenant farmer.

6. Proprietors and managers of businesses valued at less than $500. Moulders, semi-skilled workers, assistants to carpenters, baggage man, night policeman, watchman, taxi driver, truck driver, bus station attendant, waitresses, small tenant farmers, miners.

7. Heavy labor, odd job man, migrant worker, janitor, custodian, cleaning personnel, newsboys, migrant farm laborer, unemployed.

WARNER SCALE FOR RATING SOCIAL CLASS (continued)

Source of Income

1. Inherited wealth.
2. Earned wealth.
3. Profits and fees.
4. Salary (fixed weekly, monthly, annual).
5. Wages (based on hours worked or production).
6. Private assistance.
7. Public assistance. (Includes funds received from any governmental source such as Social Security, Workman's Compensation, etc.).

House Type

1. Large house in good condition with landscaped grounds.
2. Large house in medium condition; medium house in good condition.
3. Large house in poor condition.
4. Medium house in medium condition; apartment in regular apartment building.
5. Small house in good condition; small house in medium condition; dwelling over store or business.
6. Medium sized house in poor condition; small house in poor condition.
7. House in very poor condition; house not intended originally for home (a store or business converted to dwelling).

Dwelling Area

1. Very high income area with excellent houses.
2. High, the better area of town and the better suburbs, apartment house areas, houses with spacious yards and landscaping.
3. Above average; area all residential, larger than average space around houses; apartment area in good condition.
4. Average; residential neighborhoods, no deterioration in the area.
5. Below average; area is not quite holding its own and is beginning to run down; businesses are moving in.
6. Low; considerably run down and in need of repairs.
7. Very run down and old with great amount of work needed.

Status Characteristic	Weights to be used if all ratings avail.	Weights to be used if ratings on one characteristic is missing.			
		Occupation Missing	Source of Income	House Type	Dwelling Area
Occupation	4	-	5	5	5
Source of Income	3	5	-	4	4
House Type	3	4	4	-	3
Dwelling Area	2	3	3	3	-

USE TO COMPUTE SOCIAL CLASS

Status Characteristic	Rating	X	Weight	Product
Occupation	_____	X	_____	_____
Source of Income	_____	X	_____	_____
House Type	_____	X	_____	_____
Dwelling Area	_____	X	_____	_____
		Weighted Total		_____

APPENDIX B

TASK BATTERY

GENERAL INFORMATION

PIAGETIAN TASK BATTERY - CONSERVATION OF NUMBER

Read carefully

The task battery is made up of seven units relating to conservation of number. These seven units are:

1. Relational terms pretests 1 and 2.
2. Single seriation - height
3. Single seriation - width
4. 1:1 provoked correspondence and verbal justifications
5. 1:1 unprovoked correspondence and verbal justifications
6. Multiple seriation
7. Area conservation and verbal justifications

The individual task data sheets with five trials per task are arranged in the order of easy to difficult. The Haney data sheets have been specially designed to administer, score, and interpret performances on these tasks based on age for normal children of average ability.

Preliminary steps

The examiner should put the child at ease before actual testing begins by chatting with him about school, family, friends, pets, etc. After a few moments, move on to explain to the subject these particular points:

1. The examiner and child are going to play some games. If several children are to be tested from the same class or school, the child should be encouraged to keep the nature of the games a secret until all the children have been tested. This is to prevent a child who has taken the battery from priming classmates prior to their taking the battery.
2. Explain very carefully that there are no tricks in these games.
3. Encourage the child to handle the testing materials and take his time answering.
4. The child will be allowed to correct self-discovered errors and will get credit for these corrections. The examiner should NEVER supply corrective feedback to the child.
5. The child will get a point for each correct answer, but for each incorrect answer, the examiner gets the point. This motivates the child to do his best to win over the examiner.
6. Very slowly and carefully tell the child that some of the games will require him to answer three questions. Be sure the child understands the later questions do not mean his first answers were wrong, only that you want to be sure he really knows the game. Be sure to remind the child about the three questions at the beginning of these particular tasks. NOTE TO EXAMINER is included at the heading of these task sheets as a reminder.

Special instructions to the examiner

1. Reinforcement. A correct answer may be reinforced verbally with responses of "Good", "Right", "Correct", "Yes", and the like.
2. Examiner should NEVER give corrective feedback to the child by showing, telling, or indicating by facial expression.
3. If a child is uncertain about an answer and asks the examiner whether the answer is right or not, the examiner should reply by telling the child his answer is "Interesting".
4. DO NOT SUPPLY CORRECTIVE FEEDBACK AT ANY POINT. THIS IS AN ASSESSMENT BATTERY, NOT A TRAINING SCHEDULE.
5. Testing area. Keep all materials off the table and out of sight except for those being used for a given task. A table cluttered with testing materials for other tasks often acts to distract subjects.
6. Some children will try to read the expression on the examiner's face to determine the quality of their performance. Avoid frequent or continuous eye contact with the child. Keep your eyes on the testing materials and the subjects will do the same.
7. REMEMBER to do your scoring as you go along. Double check at the end of each task to be sure you have completed your scoring.
8. Children will often ask how they are doing. If they are doing well, tell them so. If they are doing poorly, give a non-commital answer such as "How do you think you're doing?" or the like.

Verbal justifications

Four tasks require verbal justifications by the children. These four tasks are:

1. Relational terms pretest 1
2. 1:1 provoked correspondence
3. 1:1 unprovoked correspondence
4. Area conservation

For an answer to be considered adequate, it should fall into one of the following categories.

1. Reference to a previous state: "It's no different than it was", or a variation.
2. Identity statements or reference to sameness of objects or area before and after transformations.
3. Reversibility: "You can put it back the way it was."
4. Addition-subtraction: "We didn't add any or take any away".
5. Compensatory relations or proportionality statements: "This line is longer, but the blocks are closer together in this one, so there's still the same number of blocks."
6. Statement of operations performed: "We just moved it."
7. Counting correctly: "There are still six blocks here", or simply, "I counted."
8. Reciprocal action: "You can do the same thing to the other one (side)."

Unacceptable answers would include: "My mother told me", "I just know!", "Because", and other such responses.

Assessment of performance

In learning any new task, there are three stages of intellectual development. These stages are:

Stage 1 - Global Stage. At this state the child meets a new experience. He knows nothing whatever about it since he has had no interaction or experience with it. It is an unknown quantity to him. His explorations are uncertain, haphazard, and perplexing. An example of the global stage would be a child's first meeting with the sets of pennies on cards in the relational terms pretest. The very young child would not know what they were, nor would you be able to get a correct answer to any question. The child's manipulation of the materials would be random because he has not yet developed discrimination of single discrete objects, has no sense of height or width, number, and no special vocabulary to deal with the questions. As a child manipulates, interacts, and gains experience he notes attributes such as differences and similarities among and between objects. Playing with a set of five objects familiarizes him with them and he gains experience through his play. He also begins to learn to imitate sounds and speak words. As experience and language converge in intellectual development, he moves into the next stage.

Stage 2 - Stage of Transition. The stage of transition emerges when the child, through manipulation, interaction, and experience with his environment, begins to note differences and similarities in his environment. He has begun to acquire words that go along with and describe his environment and experiences. Intellectual development is a form of adaptation resulting from continuous interaction between the individual and his environment. Adaptation involves the related processes of assimilation and accommodation. The child assimilates information from the environment through his interaction with it and the information is accommodated within the framework of the existing cognitive structure. New information produces temporary disequilibrium in the organism until it is integrated into the cognitive structure. Each assimilation and accommodation of new information into the cognitive structure results in a higher level of cognitive functioning and increasingly more complex cognitive structures are formed. Playing with a set of five objects leads to familiarization with the numbers 1-5 and certain characteristics about them. He can answer some questions, knows some things are invariant, but still makes mistakes because he has not mastered the numbers 1-5 and their various transformations. He can be misled by perceptual cues.

Stage 3. Conservation. The stage of conservation may be most simply defined as the ability of the child to overcome perceptually misleading cues with reason and logic, or the ability to perceive invariance over irrelevant transformations. An example would be the child's mastery of the numbers 1-5 and his ability to use them easily, flexibly, and correctly in any situation.

Every individual, whether child or adult, when faced with a totally new situation, must move through these three stages which are a part of the ongoing process of learning and intellectual development.

Final notes

Normal children of average ability acquire the ability to perform the tasks of this battery without training and regardless of schooling, cultural background, or verbal ability. The tasks of this battery should not be taught per se. To do so would nullify results. However, children may be taught similar tasks based on the same general principles which may or not generalize to this task battery depending on the child's developmental stage.

The tasks of this battery are arranged from easy to difficult, or the order in which most children, according to intellectual development, would be able to perform them. The easiest tasks should be completed by most 5-year olds, the most difficult by most 9-year olds. Only a very bright 6-year old would be able to complete the entire battery correctly.

The purpose of this task battery is to detect children with adequate basic intellectual ability, but who are nonverbal. Often lower socioeconomic level children are thought to be lacking intellectually when, in fact, they are merely nonverbal. The tasks are designed in such a way that objective responses may be made by manipulating the materials, pointing, nodding, or the use of monosyllables; hence, little or no verbalization is required by the child. The pruden examiner will allow the child time to make his verbal justifications and ask additional questions to help the child clarify his answers. It should be borne in mind that one may know how to do something, but when asked to explain his actions, there is momentary perplexity while the mind searches for a reason and the vocabulary to communicate before formulating a satisfactory answer. Thus, one must consider the plight of the relatively inexperienced child and allow him time for thoughtful consideration.

Current research indicates that mentally retarded children, as well as emotionally disturbed children, lag behind normal children about two years or more in the performance of Piagetian tasks. If there is any question as to whether a child is retarded or emotionally disturbed, he should be referred to proper personnel for evaluation to determine his proper classification.

It is usually a good idea to go through the battery a few times with another person acting as the "child" before you begin in the classroom. A few practice sessions make it much easier and smoother.

RELATIONAL TERMS PRETEST 1

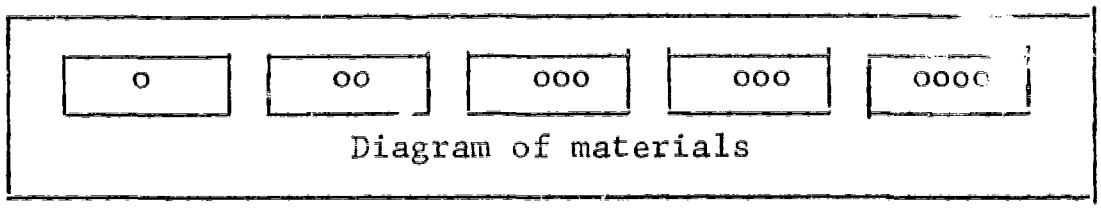


Diagram of materials

Materials

The materials for relational terms pretest 1 consist of five 3"x5" cards with pennies attached as shown in the diagram above. Buttons, lollipops, counters, seeds, circles cut from paper or any other discrete but identical objects may be used instead of pennies. Use your imagination for other possibilities.

Administration procedure

1. Remove all materials from the testing area except those currently in use.
2. Place data sheets and pencil beside you.
3. Explain you are going to play some games with the child and that there are no tricks.
4. Encourage the child to handle the materials.
5. Score answer after each trial. Score one for each correct answer and zero for each incorrect answer. Remind the child the examiner will get the point for each item he answers incorrectly.

Interpretation of results

The purpose of this task is to determine correct usage of the terms relating to the concepts of "more", "less", and "same". The first question of each trial is to see if the child can spontaneously use these terms or whether responses must be elicited by questioning. Children generally have the most difficulty with correctly applying the relational term "same". Young children note differences before similarities and this factor probably accounts for more difficulty with "same". Children may also interpret "same" to mean "look alike" or similarity of appearance rather than "really alike" a similarity of criterial attributes. It is not unusual for children to misinterpret the questions asked which point up the need for cross-questioning to be sure he understands the question and can use relational terms properly. Some children will give incorrect objective responses but are able to indicate the correct answers by pointing to cards with more/less/same objects when asked "Show me". Semantic confusion and test situation anxiety should always be taken into account. Therefore, the child should be given the opportunity to note his discrepancies and correct them for the examiner to get a clear picture of intellectual capabilities. Take it easy with him.

Normal children of average ability have usually mastered the usage of these terms by the age of 4-5 years. Children who cannot use these terms correctly should not be tested further until comprehension is achieved.

The child who correctly completes all five trials has attained concept and word mastery of the relational terms and would be classified Stage 3 - Conservation. The child who gets some answers right would be Stage 2 - Transitional. The child who gets no answers correct, or one by chance, would be Stage 1 - Global.

RELATIONAL TERMS PRETEST 1

Materials: Five 3"x5" cards with 1, 2, 3 (2), and 4 pennies taped to each card.

TASK	DIRECTIONS TO EXAMINER	INSTRUCTIONS TO CHILD	SCORE
Trial 1	Place 2 cards of 3 pennies side by side. Explain each card is a **SET**...Then ask.....	What can you tell me about these sets of pennies?	____
ooo			
ooo	Score answer. If child can explain the correct answer on this and subsequent first answers, to go next trial. If not, ask child.....	Are the two sets the same?	____
	Score answer, ask child.....	Does one set have more? Show me.	____
	Score answer, ask child.....	Does one set have less? Show me.	____
	Score answer		
Trial 2	Place cards of 2 & 3 pennies side by side, then ask child..	What can you tell me about these two sets of pennies?	____
oo	Score answer, then ask.....	Does one set have more? Show me.	____
ooo	Score answer, then ask.....	Does one set have less? Show me.	____
	Score answer, then ask.....	Are both sets the same?	____
	Score answer		
Trial 3	Place cards of 4 & 3 pennies side by side, then ask child..	What can you tell me about these two sets of pennies?	____
oooo	Score answer, then ask.....	Does one set have less? Show me.	____
ooo	Score answer, then ask.....	Are both sets the same? Show me.	____
	Score answer, then ask.....	Does one set have more? Show me.	____
	Score answer		
Trial 4	Place cards of 2 & 4 pennies side by side, then ask child..	What can you tell me about these two sets of pennies?	____
oooo	Score answer, then ask.....	Are both sets the same?	____
	Score answer, then ask.....	Does one set have less? Show me.	____
oo	Score answer, then ask.....	Does one set have more? Show me.	____
	Score answer		
Trial 5	Place card of 1 & 4 pennies side by side, then ask child..	What can you tell me about these two sets of pennies?	____
oooo	Score answer, then ask.....	Does one set have more? Show me.	____
o	Score answer, then ask.....	Does one set have less? Show me.	____
	Score answer, then ask.....	Are both sets the same?	____
	Score answer.		

RELATIONAL TERMS PRETEST 2

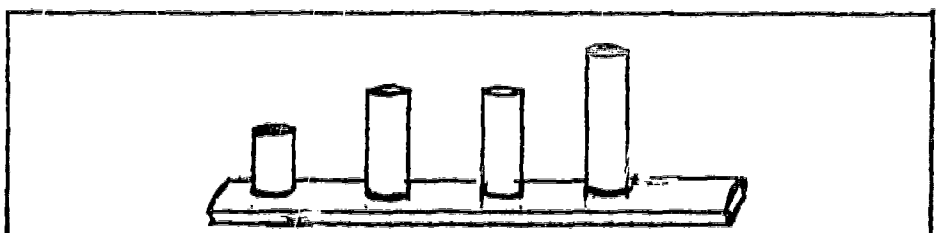


Diagram of Materials

Materials

The materials for relational terms pretest 2 consist of a set of four sticks and a holder. (These materials are also used for single seriation-height). Each stick is 1" in diameter. One stick is 4" long, two sticks 6" long, and one stick 8" long. The dimensions of the holder are 12" long, 1½" wide, 1" thick. Wooden dowels may be cut to the specified lengths. The holder is a piece of wood of the specified dimensions with five holes evenly spaced to hold the dowels in an upright position. A simpler substitute may be constructed using cardboard cylinders from inside rolls of wax paper, plastic wraps, aluminum foil, etc. The holder may be constructed from a piece cut from an ordinary cardboard box with circles drawn or holes cut to indicate the spacing of the cylinders.

Administration procedure

1. Follow instructions under "Administration procedure" for relational terms pretest 1, items 1-5.
2. The warm up item indicates the child's ability to verbalize spontaneously so watch this one and make a note below the "Score" space as to his performance on this item.

Interpretation of results

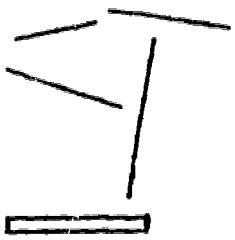
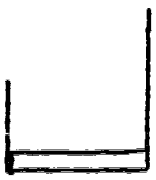
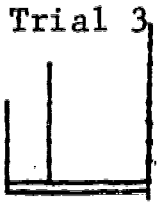
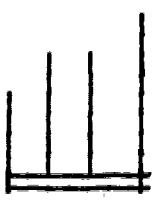
The purpose of this task is to assess the child's mastery of the concepts and related terms of "shorter", "taller/longer", and "middle/same". Young children generally have the most difficulty with the "middle/same" terms and concept.

Normal children of average ability master the usage of these terms by the age of 4-5 years. Children who cannot use these terms correctly should not be tested further until comprehension is achieved.

The child who correctly completes all five trials has achieved concept mastery of the relational terms and would be classified as Stage 3 - Conservation. The child who gets some answers right, some wrong would be Stage 2 - Transitional. No answers correct, or one by by chance, would be Stage 1 - Global.

RELATIONAL TERMS PRETEST 2

Materials: Holder and sticks 4", 6" (2), and 8" long.

TASK	DIRECTIONS TO EXAMINER	INSTRUCTIONS TO CHILD	SCORE
Warm up 	Place sticks in disarray before child, then ask.....	What can you tell me about these sticks? How are they different? How are they alike?	X
	If child can correctly state differences in length, and sameness of diameter go to Trial 1. If not, point out differing heights and diameters, then go to Trial 1.		
Trial 1 	With sticks in disarray before child, ask child....	Show me the shortest stick. Put it in the hole (or on the circle)	____
	Score answer		
Trial 2 	With 1 stick in place, say to child.....	Show me the longest stick. Put it in the hole (or on the circle)	____
	Score answer		
Trial 3 	With 2 sticks in place, ask child.....	Show me a middle-sized stick. Put it in the hole (or on the circle)	____
	Score answer		
Trial 4 	With one middle-sized stick remaining before child, ask.....	What can you tell me about the stick that is left? Is it short, tall, or middle-sized? Put it in the hole (or on the circle)	____
	Score answer		
Trial 5 	With all sticks in place, ask child.....	Which of these sticks are middle-sized? Show me.	____
	Score answer, then ask child	Which stick is longest or tallest? Show me.	____
	Score answer, then ask child	Which stick is shortest? Show me.	____
	Score answer		

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Haney Data Sheet - Revised 1971

SINGLE SERIATION - HEIGHT

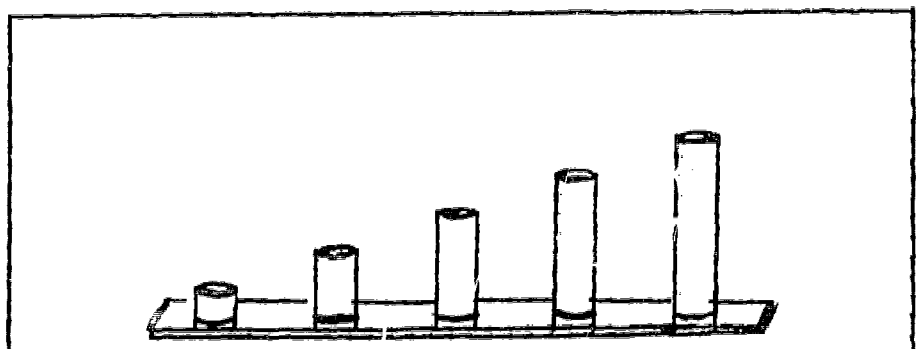


Diagram of materials

Materials

The basic materials for this task are the same as those for relational terms pretest 2, except that five sticks are used with heights of 2", 4", 6", 8", 10". The same holder may be used with the addition of the 2" and 10" sticks to the three 4", 6", and 8" ones used previously. The same substitution of materials may be made in this task as relational terms pretest 2.

Administration procedure

1. Follow instructions under "Administration procedure" for relational terms pretest 1, items 1-5.
2. The warm up item indicates the child's ability to verbalize spontaneously. Make a note on his performance on this item in the space below "Score", then compare this with his objective responses on Trials 1-5.

Interpretation of results

This task is designed to assess the child's ability to discriminate height. Discrimination of height usually precedes discrimination of width and is mastered at about 4 years of age by normal children of average ability. It is one of the easiest tasks for young children to learn probably because every stick is of a differing height, and children discriminate differences before they note similarities.

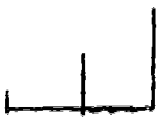
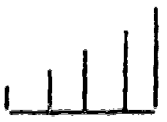
Children who correctly complete all trials have achieved mastery of gross height discrimination with small numbers of objects. Children who cannot correctly complete the task need work in the area of visual discrimination and accompanying language description.

Young children discriminate only one dimension at a time and are unable to coordinate two or more dimensions until single dimensions have been mastered.

The child who correctly completes all five trials would be classified as Stage 3 - Conservation; some answers correct, some wrong would be Stage 2 - Transitional; no answers correct or one by chance would be Stage 1 - Global.

SINGLE SERIATION - HEIGHT

Materials: Holder and set of five sticks 1" diameter, 2", 4", 6", 8", 10" long

TASK	DIRECTIONS TO EXAMINER	INSTRUCTIONS TO CHILD	SCORE
Warm up 	Place sticks in disarray before child, then ask.....	What can you tell me about these sticks? How are they all different? How are they all alike?	X
	If child can correctly state they are all different in length, height, but the same in diameter, go to Trial 1. If not, point out the differing heights and same diameter, then go to Trial 1.		
Trial 1 	With sticks in disarray, ask child.....	Show me the shortest stick. Put it in the hole (or on the circle).	____
	Score answer.		
Trial 2 	With remaining sticks in disarray, ask child.....	Show me the longest stick. Put it in the hole (or on the circle).	____
	Score answer.		
Trial 3 	With remaining sticks in disarray, ask child.....	Show me the middle-sized stick; the one that goes in the middle hole (or on the middle circle).	____
	Score answer		
Trial 4 	With remaining 2 sticks before child, point to the hole (circle) between the longest and middle sticks and ask child.....	Which stick goes here? Put the stick in the hole (or on the circle).	____
	Score answer		
Trial 5 	With remaining stick, point to space between the shortest and middle sticks and ask child.....	Which stick goes here? Put the stick in the hole (or on the circle).	____
	Score answer		

Haney Data Sheet - Revised 1971

SINGLE SERIATION - WIDTH

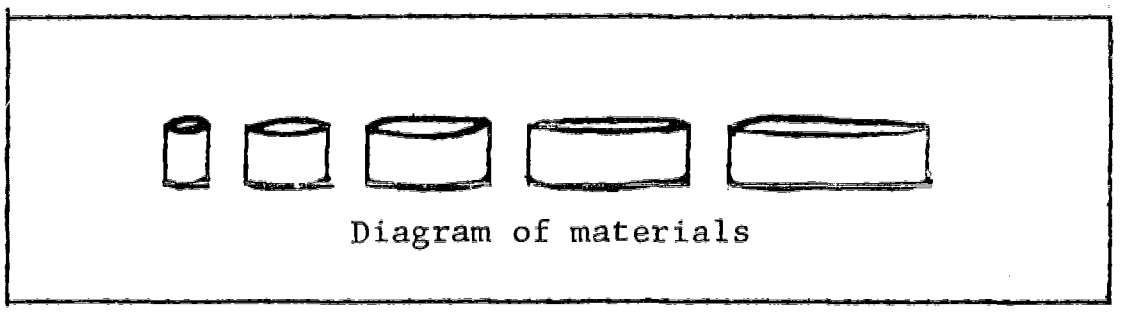


Diagram of materials

Materials

The materials for this task are cylinders 2" high with diameters of 1", 1½", 2", 2½", 3". The easiest way of making this set of materials is to use paper with some substance such as oak tag which will bend easily and still retain a cylindrical shape. Cut strips of oak tag 2" wide and of these lengths: 3.60", 5.20", 6.75", 8.35", 10.40". These lengths allow about one-half inch overlap which should be stapled or taped together to form the cylinders of the required height and width.

Administration procedure

1. Follow instructions under "Administration procedure" for relational terms pretest 1, items 1-5.
2. The warm up item indicates the child's ability to verbalize spontaneously. Note his performance on this item, then compare it with his objective responses on Trials 1-5.

Interpretation of results

This task is designed to assess the child's ability to discriminate width. Discrimination of width usually follows the child's ability to discriminate height and occurs at about the age of 4-5 years. This is one of the easier tasks for young children to learn probably because it involves discrimination of differences.

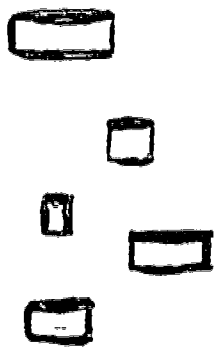
Children who correctly complete all trials have mastered gross width discrimination involving small numbers of objects. Children who cannot correctly complete the task require work in the area of visual discrimination and accompanying language description.

Young children learn to discriminate a single dimension at a time and cannot coordinate two or more dimensions until the single ones have been acquired.

The child who correctly completes all five trials would be classified Stage 3 - Conservation; some answers correct, some wrong would be Stage 2 - Transitional; no answers correct or one by chance would be Stage 1 - Global.

SINGLE SERIATION - WIDTH

Materials: Cylinders 2" high with diameters of 1", 1½", 2", 2½", 3".

TASK	DIRECTIONS TO EXAMINER	INSTRUCTIONS TO CHILD	SCORE
Warm up 	Place cylinders in disarray before child, then ask.....	What can you tell me about these cylinders? How are they different? How are they alike?	X
	If child can state differences in diameter and sameness of height, go to Trial 1. If not, point out differing diameters and same heights before going to Trial 1.		
Trial 1	With cylinders in disarray before child, ask..... (Indicate placement)	Show me the **smallest** cylinder. Put it here.	____
	Score answer		
Trial 2	With remaining 4 cylinders in disarray, ask..... (Indicate placement)	Show me the biggest cylinder. Put it here.	____
	Score answer		
Trial 3	With remaining 3 cylinders in disarray, ask.....	Show me the middle-sized cylinder. Put it where it belongs.	____
	Score answer		
Trial 4	With remaining 2 cylinders point to space between the largest and middle sized cylinders and ask.....	Which cylinder goes here? Put it there.	____
	Score answer		
Trial 5 	With remaining single cylinder, point to space between the smallest and middle sized cylinders and ask.....	Which cylinder goes here? Put it there.	____
	Score answer		

Haney Data Sheet - Revised 1971

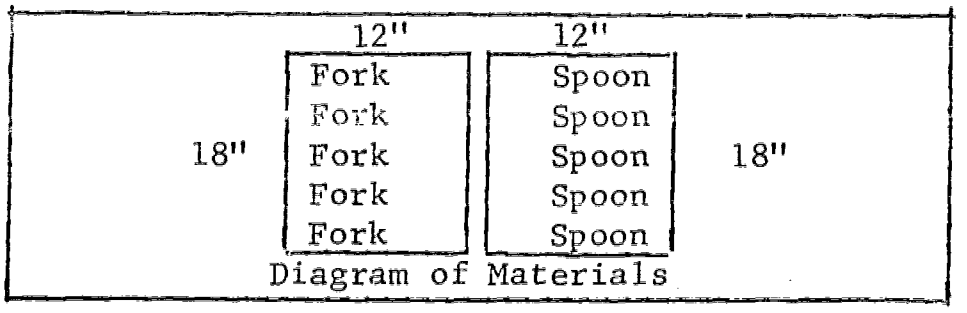


Diagram of Materials

Materials

The materials for provoked correspondence tasks and verbal justifications consist of two sheets of different colored paper 12" x 18" each, five forks and five spoons. The forks and spoons are the small plastic variety. Other materials which may be substituted are flowers and vases, dolls and doll beds, eggs and egg cups. Other functionally related materials may be used depending on the child's cultural background.

Administration procedure

1. Follow instructions under "Administration procedure" for relational terms pretest 1, items 1-5.
2. Verbal justifications are included for the purpose of comparing the child's objective responses with his adequacy in verbally justifying or explaining his objective answers.
3. Be sure to use the "Note to Examiner" on this task to remind the child he will be asked three questions for the reason for it.

Interpretation of results

The purpose of this task is to compare objective responses, elicited by questioning, with verbal justifications (see General Information, "Verbal Justifications"), and the child's ability to conserve number.

Normal children of average ability can usually make correct objective responses by the age of 6-7 years. Verbal children can justify their answers, the nonverbal children cannot. Look, therefore, at the objective responses separately from the verbal justifications to determine whether the child possesses adequate basic intellectual development. Verbal justifications tell you the obvious--that the child has learned how to use language to communicate his understanding of concepts. When a child makes the correct objective responses, but is unable to verbalize his justifications or reasons, it means he has not had the required basic instruction and practice in communication skills. Nonverbal children are often assessed low in IQ by teachers and standardized tests when, in fact, the child's intellectual ability is adequate, even above average in some cases. This is quite often the case with low socioeconomic children, but by no means confined to them. Correct objective responses with poor verbal justifications usually indicates the need for individualized work in language and speech practice.

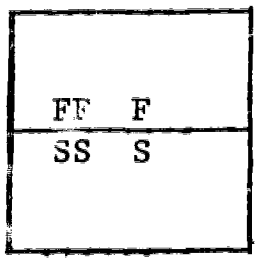
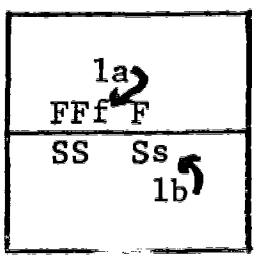
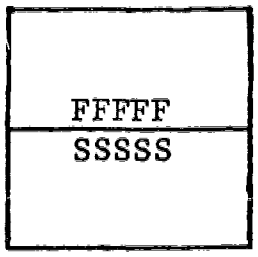
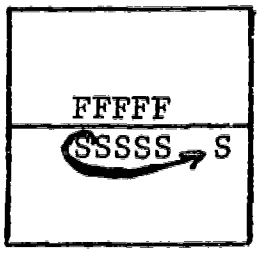
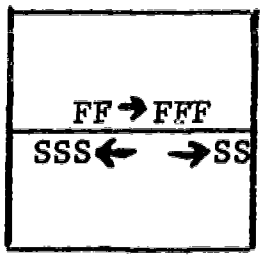
Children who get all trials correct would be classed as Stage 3 - Conservers; those with some correct would be Stage 2 - Transitional; those with none correct would be classified Stage 1 - Global.

PROVOKED CORRESPONDENCE TASKS AND VERBAL JUSTIFICATIONS

Materials: 2 sheets of different colored paper 12"x18", 5 forks, 5 spoons.

NOTE TO EXAMINER: Remind child he will be asked three questions. Be sure he understands the later questions do not mean his first answers were wrong.

TASK	DIRECTIONS TO EXAMINER	INSTRUCTIONS TO CHILD	SCORE
Warm up	Place blue and green sheets of paper before child with 3 forks on one sheet and 3 spoons on the other sheet, then ask.....	Are there the same number of forks as spoons?	X
FFF / SSS	Remove one spoon, then ask...	Are there the same number of forks as spoons now?	X
		Does one side have more? Show me the side with more.	
FFF / SS		Does one side have less? Show me the side with less.	X
	For verbal justification ask..... Write brief answer here.....	How can you tell? _____	
Trial 1	(Conservation of inequality) Place 3 forks and spoons in 1:1 correspondence as shown, then ask.....	Are there the same number of forks and spoons on each side?	
F F F / S S S	Score answer, then give child 2 more forks and 1 more spoon, then tell him.....	Put one fork here (1a), and one fork here (1b). Now put the spoon here (1c).	
1a 1b Ff Ff F / S S Ss 1c	With all items as indicated in diagram, ask.....	Are there the same number of forks and spoons on both sides?	
	Score answer, then ask.....	Are there more on one side? Show me the side with more.	
	Score answer, then ask.....	Are there less on one side? Show me the side with less.	
	Score answer, then ask..... Write brief answer here.....	How can you tell? _____	
Trial 2	(Collapsing) Place 5 forks and spoons in 1:1 correspondence, then ask.	Do both sides have the same number of forks & spoons now?	
F F F F F / S S S S S	Score answer, then tell child	Push all the spoons close together so they are touching. Does each side still have the same number?	
	Score answer, then ask.....	Does one side have more? Show me the side with more.	
F F F F F / → SSSSS ←	Score answer, then ask.....	Does one side have less? Show me the side with less.	
	Score answer, then ask..... Write brief answer.....	How can you tell? _____	

TASK	DIRECTIONS TO EXAMINER	INSTRUCTIONS TO CHILD	SCORE
Trial 3	(Equal addition) Place 3 forks and 3 spoons in 1:1 correspondence, then ask.....	Are there the same number of things on both sides?	X
	Give child 1 fork and 1 spoon, then tell him.....	Put the fork here (1a). Put the spoon here (1b).	
	Now ask.....	Are there the same number of things on both sides?	____
	Score answer, then ask.....	Are there less on one side? Show me.	____
	Score answer, then ask.....	Are there more things on one side? Show me.	____
	Score answer, then ask..... Write brief answer here.....	How can you tell? _____	
Trial 4	(Conservation of equality) Place 5 forks and 5 spoons in 1:1 correspondence, then ask.....	Are there the same number of forks and spoons on both sides?	X
	Indicate and instruct child..	Take the spoon at the end and move it here. Does each side still have the same number of forks & spoons?	____
	Score answer, then ask.....	Does one side have less? Show me the side with less.	____
	Score answer, then ask.....	Does one side have more? Show me the side with more.	____
	Score answer, then ask..... Write brief answer here.....	How can you tell? _____	
Trial 5	(Resubgrouping) Place 5 forks and 5 spoons in 1:1 correspondence, then ask	Are there the same number of forks & spoons on both sides	X
	Indicate and instruct child..	Move three forks here (Indicate). Now move three spoons this way. (Indicate) Move two spoons this way. (Indicate).	
	Now ask.....	Does each side still have the same number of forks and spoons?	____
	Score answer, then ask.....	Does one side have less? Show me the side with less.	____
	Score answer, then ask.....	Does one side have more? Show me the side with more.	____
	Score answer, then ask..... Write brief answer here.....	How can you tell? _____	

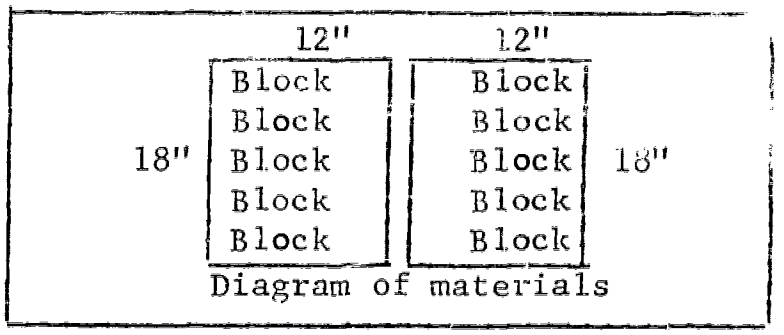


Diagram of materials

Materials

The materials for unprovoked correspondence tasks and verbal justifications consist of two sheets of different colored paper each 12" x 18" and ten blocks. Other materials may be substituted for blocks providing they are all identical in size. Paper cups, small animals, or other such homogeneous materials may be used.

Administration procedure

The administration procedure is exactly the same as for provoked correspondence tasks and verbal justifications.

Interpretation of results

Children usually conserve on 1:1 provoked correspondence tasks before they conserve 1:1 unprovoked correspondence. For this reason provoked correspondence tasks precede unprovoked correspondence in this task battery.

Interpretation of results is the same as for 1:1 provoked correspondence, except that some children may exhibit conserving responses on the provoked correspondence task prior to unprovoked correspondence. When evaluating the performance of young children, note the task where he goes from conserving responses to transitional or global behavior. This change denotes the level of intellectual development at the time the battery is administered, and indicates the direction future work should take. For example, if a child completes the provoked correspondence task, but fails to complete the unprovoked correspondence task, he is lacking in his ability to discriminate and understand differences among like objects over irrelevant transformations.

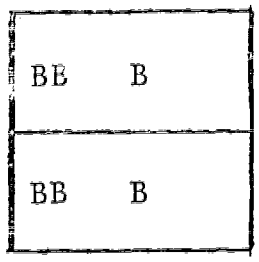
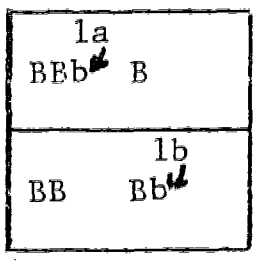
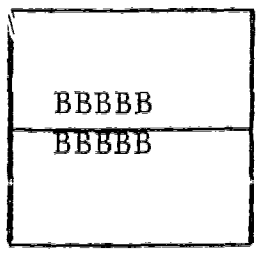
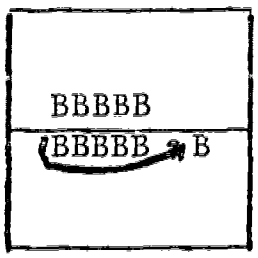
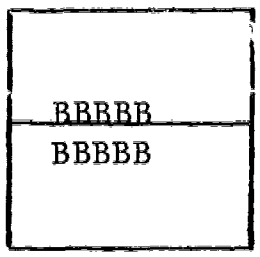
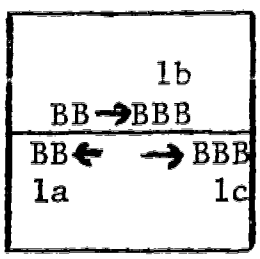
The child who gets all trials correct would be classified as Stage 3 - Conservation; some answers correct, some incorrect would be Stage 2 - Transitional; no answers correct or one by chance would be Stage 1 - Global.

UNPROVOKED CORRESPONDENCE TASKS AND VERBAL JUSTIFICATIONS

Materials: 10 wooden blocks, 2 sheets of different colored paper 12"x18" each.

NOTE TO EXAMINER: Remind child he will be asked three questions. Be sure he understands the later questions do not mean his first answers were wrong.

TASK	DIRECTIONS TO EXAMINER	INSTRUCTIONS TO CHILD	SCORE
Trial 1	(Conservation of inequality) Place 2 sheets of different colored paper side by side before child. Place three blocks in 1:1 correspondence, then ask.....	Are there the same number of blocks on both sides?	____
B B B B B B	Score answer, then give child 3 more blocks, and tell him..	Put one block here (1a). Put one block here (1b). Put one block here (1c).	
1a 1b Bb Bb B 1c B B Bb	With all blocks as indicated at left, ask.....	Are there the same number of blocks on both sides?	____
	Score answer, then ask.....	Are there more blocks on one side. Show me.	____
	Score answer, then ask.....	Are there less blocks on one side? Show me.	____
	Score answer, then ask..... Write brief answer here.....	How can you tell?	____
Trial 2	(Collapsing) Place 5 blocks on each sheet in 1:1 correspondence, then ask.....	Are there the same number of blocks on both sides?	____
B B B B B B B B B B	Score answer, then tell child	Push all the blocks together on one side. Does each side still have the same number of blocks?	____
	Score answer, then ask.....	Does one side have more blocks? Show me.	____
B B B B B	Score answer, then ask.....	Does one side have less blocks? Show me.	____
→BBBBB←	Score answer, then ask..... Write brief answer here.....	How can you tell?	

TASK	DIRECTIONS TO EXAMINER	INSTRUCTIONS TO CHILD	SCORE
Trial 3	(Equal addition) Place 6 blocks in 1:1 correspondence, then ask.....	Are there the same number of blocks on both sides?	X
	Give child 2 more blocks, then tell him.....	Put one block here (1a), and one block here (1b).	
	Then ask.....	Are there the same number of blocks on both sides?	____
	Score answer, then ask.....	Are there less blocks on one side? Show me.	____
	Score answer, then ask.....	Are there more blocks on one side? Show me.	____
	Score answer, then ask..... Write brief answer here.....	How can you tell?_____	
Trial 4	(Conservation of equality) Place 10 blocks in 1:1 correspondence, then ask.....	Are there the same number of blocks on both sides?	X
	Indicate and instruct child..	Take the block at the end and move it here.	
	Then ask.....	Does each side still have the same number of blocks?	____
	Score answer, then ask.....	Does one side have less blocks? Show me.	____
	Score answer, then ask.....	Does one side have more blocks? Show me.	____
	Score answer, then ask..... Write brief answer here.....	How can you tell?_____	
Trial 5	(Resubgrouping) Place 10 blocks in 1:1 correspondence, then ask.....	Are there the same number of blocks on both sides?	X
	Indicate and instruct child..	Move two blocks here (1a). Move three blocks here (1b). Move three blocks here (1c).	
	Then ask.....	Does each side have the same number of blocks?	____
	Score answer, then ask.....	Does one side have more blocks? Show me.	____
	Score answer, then ask.....	Does one side have less blocks? Show me.	____
	Score answer, then ask..... Write brief answer here.....	How can you tell?_____	

Haney Data Sheet - Revised 1971

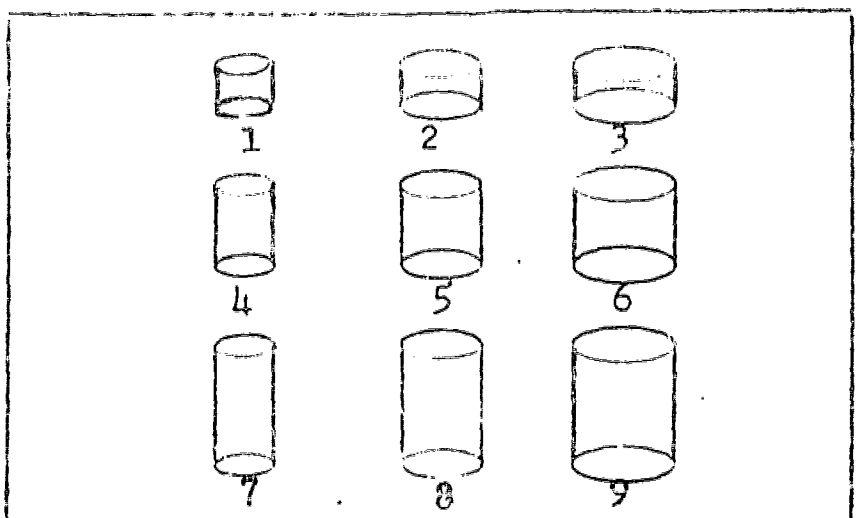


Diagram of materials

Materials

The basic materials for this task are a 3 x 3 matrix measuring 12" x 12", which may be constructed from a sheet of paper marked off as for tic-tac-toe. Cylinder numbers 1, 4, 7, are about 1" diameter with heights of 2", 3", and 4". Cylinder numbers 2, 5, 8 are about 1½" in diameter with heights of 2", 3", 4". Cylinder numbers 3, 6, 9 are about 2" in diameter with heights of 2", 3", 4". These cylinders may be constructed from oak tag paper which will bend easily but still retain a cylindrical shape. Strips should be cut 2" wide and 3.60", 6.75", and 10.40" long for cylinders 1, 4, and 7. For cylinder numbers 2, 5, and 8, strips should be cut 3" wide and 3.60", 6.75", and 10.40" long. The third set of cylinders should be cut 4" wide and 3.60", 6.75", and 10.40" long. These lengths allow about one-half inch overlap which should be stapled or taped together to form the cylinders of the required height and width. If you have a better idea, use it!

Administration procedure

1. Follow instructions under "Administration procedure" for relational terms pretest 1, items 1-5.
2. The warm up item indicates the child's ability to verbalize spontaneously. Note his performance on this item, then compare it with his objective responses on Trials 1-5.

Interpretation of results

This task is designed to determine operational convergence of single seriation height and width, i.e., the child must be able to handle height and width simultaneously.

Normal children of average ability usually complete all trials of this task by the age of 7. Younger children can usually complete trials 1-4, but it is not until about the age of 7 years that they can successfully reverse the matrix as required in Trial 5.

This task is a very good indicator of the child's ability to manipulate materials with no verbalization required, except for the warm up item. Again, note his performance on the warm up and trials 1-5 to compare spontaneous verbalizations with his objective responses.

Children who get all trials correct would be classified as Stage 3 - Conservers; some correct, some incorrect would be Stage 2 - Transitional; no answers correct or one by chance would be classified Stage 1 - Global.

Materials: 3x3 matrix and 9 cylinders of varying heights and diameters.

TASK	DIRECTIONS TO EXAMINER	INSTRUCTIONS TO CHILD	SCORE
Warm up 1 2 3 4 5 6 7 8 9	Arrange 9 cylinders on matrix as shown, then ask.... If child can state differences and sameness in heights and diameters, go to Trial 1. If not, point out differing heights and diameters before going to Trial 1.	What can you tell me about these cylinders? How are they different? How are they alike?	X
Trial 1 _ 2 _ _ _ _ _ _ _	Remove cylinder no. 2, then ask..... Score answer	Can you put this cylinder back where it belongs? Put it back.	
Trial 2 _ _ 3 _ 5 _ 7 _ 9	Remove cylinder nos. 3, 5, 7, 9, then ask..... Score answer	Can you put these cylinders back where they belong? Put them back.	
Trial 3 1 2 _ 4 _ 6 _ 8 9	Remove cylinder nos. 1, 2, 4, 6, 8, 9, then ask..... Score answer	Can you put these cylinders back where they belong? Put them back.	
Trial 4 _ _ _ _ _ _ _ _ _	Remove ALL cylinders from matrix, disarray them, then ask child..... (Rebuilding matrix) Score answer	Can you put all the cylinders back the way they were? Put them back.	
Trial 5 _ _ 1 _ _ _ _ _ _	Remove ALL cylinders from matrix, disarray them, then place cylinder no. 1 in the upper right hand corner, then say..... (Reversing matrix) Score answer	I'm moving this one cylinder from the upper left corner to the upper right corner. Can you make something like was there before, but leave this one cylinder here? Go ahead.	

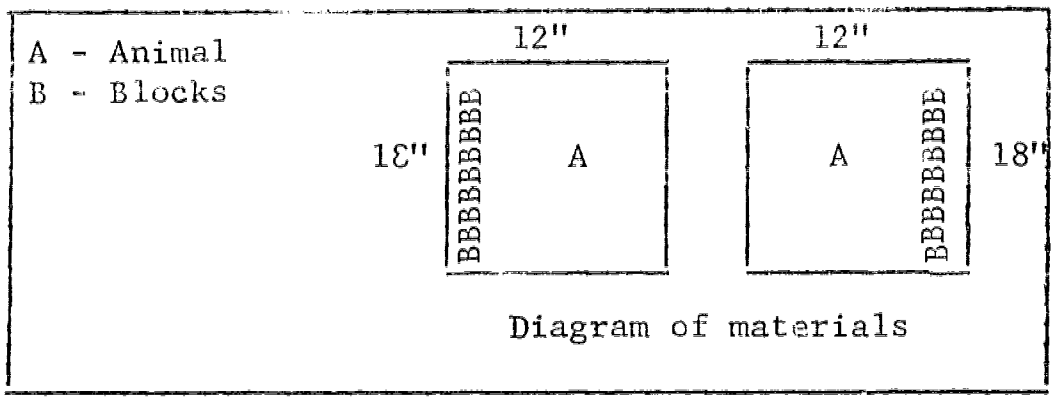


Diagram of materials

Materials

The materials for this task consist of two sheets of green paper 12" x 18", two toy animals to represent grass eating animals such as horses, sheep, cows, etc., which are identical, and eighteen wooden blocks all the same size. Bags of plastic animals may be purchased at toy departments. The wooden blocks may be purchased or a mill can cut the blocks from material 1½"x1½"x1½" for a nominal sum. If you are handy with tools you can cut them yourself. The blocks must be square on all sides.

Administration procedure

1. Follow instructions under "Administration procedure" for relational terms pretest 1, items 1-5.
2. The warm up item is to acquaint the child with the materials and format of this task.
3. Be sure to use the "Note to Examiner" on this task to remind the child he will be asked three questions and the reason for it.

Interpretation of results

The purpose of this task is to assess the child's ability to conserve area by objective responses elicited by questioning with verbal justifications. (See General Information, Verbal Justifications).

The underlying logical formula for this task is B-A=A' or the total amount of surface (B), minus the area covered by blocks (A), equals the amount of surface area or grass (A').

Normal children of average ability usually master this task at about nine years of age. Some children can verbally justify their objective responses, whereas, others cannot. It is necessary to consider objective responses separately from verbal justifications to determine whether the child possesses adequate basic intellectual development. Verbal justifications tell you the obvious--that the child has learned how to use language to communicate his understanding of these concepts. When a subject makes the correct objective responses, but is unable to verbalize his justifications, it means he is lacking in communication skills, not in basic intellectual development. Nonverbal children are often assessed a low IQ by standardized tests and teachers when, in fact, the child's intellectual ability is adequate, even above average in some cases. This is quite often the case with low socioeconomic children, but by no means confined to them.

Correct objective responses with poor verbal justifications usually indicates the need for individualized work in communication skills, i.e., language and speaking.

Children who get all trials correct would be classified as Stage 3 - Conservers; those with some correct would be classified Stage 2 - Transitional; those with none correct would be termed Stage 1 - Global.

VERBAL JUSTIFICATIONS

Materials: Two sheets green paper 12"x18" each, two toy animals, 18 wooden blocks.

NOTE TO EXAMINER: Remind child he will be asked three questions. Be sure he understands the later questions do not mean his first answers were wrong.

TASK	DIRECTIONS TO EXAMINER	INSTRUCTIONS TO CHILD	SCORE
Warm up H H	Superimpose two sheets of green paper so child can see they are identical in size. Place the two sheets side by side and put a toy animal on each sheet of paper, then tell child.....	These are two fields of grass the same size, and these are two animals that eat grass. Does each animal have the same amount of grass to eat?	____
	Score answer, then ask.....	Does one have more grass? Show me.	____
	Score answer, then ask.....	Does one have less grass? Show me.	____
	Score answer, then ask..... Write brief answer here.....	How can you tell? _____ _____	
Trial 1	With an animal in each field tell child.....	The farmers who own these fields want to build some barns.	
BBB H H BBB	Place 6 barns before child and tell him.....	Put 3 barns in a row in the corner of each field.	
	Indicate placement of barns, then ask.....	Does each of these animals have the same amount of grass to eat? Show me.	____
		Does one animal have more grass to eat? Show me.	____
		Does one animal have less grass to eat? Show me.	____
BBB H B B H B	Indicate one field and tell child.....	The farmer who owns this field decided to move his barns around. You move the barns around.	
	When barns are scattered ask child.....	Do the two animals have the same amount of grass to eat now? Show me.	____
	Score answer, then ask.....	Does one animal have more grass to eat? Show me.	____
	Score answer, then ask.....	Does one animal have less grass to eat? Show me.	____
	Score answer, then ask..... Write brief answer here.....	How can you tell? _____ _____	

Haney Data Sheet - Revised 1971

AREA CONSERVATION TASKS AND VERBAL JUSTIFICATIONS (continued)

TASK	DIRECTIONS TO EXAMINER	INSTRUCTIONS TO CHILD	SCORE
Trial 2	Place 12 blocks (barns) before child, then indicate and instruct him.....	Put 6 barns in the corner of each field.	
BBBBBB H	Then ask.....	Does each animal have the same amount of grass to eat?	____
H BBBBBB	Score answer, then ask.....	Does one have more grass? Show me.	____
	Score answer, then ask.....	Does one have less grass? Show me.	____
	Score answer, then ask.....	How can you tell? _____	
	Write brief answer here.....		
BBBEBB H	Tell child and indicate.....	The farmer that owns this field decided to move his barns about. Scatter the barns over the field.	
B B E B H B B	Ask child.....	Does each animal still have the same amount of grass to eat? Show me.	____
	Score answer, then ask.....	Does one animal have less grass to eat? Show me.	____
	Score answer, then ask.....	Does one animal have more grass to eat? Show me.	____
	Score answer, then ask.....	How can you tell? _____	
	Write brief answer here.....		
Trial 3	Align 6 blocks (barns) in the corner of each field, then ask child.....	Does each animal have the same amount of grass to eat?	____
BBBBBB H	Score answer, then ask.....	Does one have more grass to eat? Show me.	____
H BBBBBB	Score answer, then ask.....	Does one have less grass to eat? Show me.	____
	Tell child and indicate.....	Take 2 barns away from this field.	
	Ask child.....	Does each animal still have the same amount of grass to eat? Show me.	____
BBEBBB H	Score answer, then ask.....	Does one animal have more grass to eat? Show me.	____
H BBBB	Score answer, then ask.....	Does one animal have less grass to eat? Show me.	____
	Score answer, then ask.....	How can you tell? _____	
	Write brief answer here.....		

Haney Data Sheet - Revised 1971

TASK	DIRECTIONS TO EXAMINER	INSTRUCTIONS TO CHILD	SCORE
Trial 4	Align 6 blocks (barns) in the corner of each field, then ask child.....	Does each animal have the same amount of grass to eat?	____
BBBBBB H	Score answer then ask.....	Does one animal have less grass to eat? Show me.	____
H BBBBBB	Score answer, then ask	Does one animal have more grass to eat? Show me.	____
	Score answer, then tell child and indicate.....	Take ONE barn from this field. Take FIVE barns from this field.	
B B B H B B	Indicate field with 5 barns and tell child.....	Take all the barns on this field and scatter them all around.	
H B	Show child how to scatter blocks if necessary, then ask	Does each animal have the same amount of grass to eat?	____
	Score answer, then ask.....	Does one animal have more grass to eat? Show me.	____
	Score answer, then ask.....	Does one animal have less grass to eat? Show me.	____
	Score answer, then ask.....	How can you tell?	____
	Write brief answer here.....		
Trial 5	Align 9 blocks (barns) in the corner of each field, then ask child.....	Does each animal have the same amount of grass to eat?	____
BBBBBBBBB H	Score answer, then ask.....	Does one animal have more grass to eat? Show me.	____
H BBBBBBBBB	Score answer, then ask.....	Does one animal have less grass to eat? Show me.	____
	Score answer, then tell child and indicate.....	The farmer that owns this field decided to move his barns about. Scatter the barns over the field.	
BBBBBBBBB H	Show child if necessary, then ask.....	Does each animal have the same amount of grass to eat?	____
	Score answer, then ask.....	Does one animal have less grass to eat? Show me.	____
B B B B B B B H B B	Score answer, then ask.....	Does one animal have more grass to eat? Show me.	____
	Score answer, then ask.....	How can you tell?	____
	Write brief answer here.....		

APPENDIX C

TABLES: MEANS AND STANDARD DEVIATIONS

Overall means and standard deviations for all tasks across SES levels, verbal ability levels and grades K-4.

TASKS	N	MEAN	S. D.
1. Relational Terms Pretest	160	9.62	1.00
2. Provoked Correspondence Justifications	160	3.95	1.59
3. Provoked Correspondence Tasks	160	3.98	1.56
4. Unprovoked Correspondence Justifications	160	4.27	1.40
5. Unprovoked Correspondence Tasks	160	4.30	1.43
6. Single Seriation - Height	160	4.57	0.93
7. Single Seriation - Width	160	4.24	1.20
8. Multiple Seriation	160	3.23	1.65
9. Surface Area Justifications	160	3.08	1.76
10. Surface Area Tasks	160	3.26	1.62

Means and standard deviations for low and middle SES by tasks across grade levels K-4.

TASKS AND SES LEVELS	MEAN	S. D.
1. Relational Terms Pretest		
Low SES	9.56	1.10
Middle SES	9.68	0.89
2. Provoked Correspondence Justifications		
Low SES	3.81	1.68
Middle SES	4.08	1.50
3. Provoked Correspondence Tasks		
Low SES	3.81	1.67
Middle SES	4.15	1.43
4. Unprovoked Correspondence Justifications		
Low SES	4.18	1.44
Middle SES	4.36	1.37
5. Unprovoked Correspondence Tasks		
Low SES	4.22	1.47
Middle SES	4.37	1.39
6. Single Seriation - Height		
Low SES	4.62	0.80
Middle SES	4.52	1.05
7. Single Seriation - Width		
Low SES	4.28	1.09
Middle SES	4.20	1.30
8. Multiple Seriation		
Low SES	3.20	1.52
Middle SES	3.26	1.77
9. Surface Area Justifications		
Low SES	3.21	1.79
Middle SES	2.96	1.74
10. Surface Area Tasks		
Low SES	3.35	1.59
Middle SES	3.18	1.65

N = 80 for each subsample.

Means and standard deviations for verbal ability comparisons for tasks across SES levels and grades K-4.

TASKS AND VERBAL ABILITY	MEAN	S.D.
1. Relational Terms Pretest		
Low VA	9.51	1.12
High VA	9.73	0.85
2. Provoked Correspondence Justifications		
Low VA	3.66	1.68
High VA	4.23	1.46
3. Provoked Correspondence Tasks		
Low VA	3.67	1.71
High VA	4.28	1.34
4. Unprovoked Correspondence Justifications		
Low VA	4.08	1.60
High VA	4.46	1.15
5. Unprovoked Correspondence Tasks		
Low VA	4.13	1.57
High VA	4.46	1.27
6. Single Seriation - Height		
Low VA	4.57	0.85
High VA	4.57	1.01
7. Single Seriation - Width		
Low VA	4.05	1.28
High VA	4.43	1.08
8. Multiple Seriation		
Low VA	3.01	1.53
High VA	3.45	1.74
9. Surface Area Justifications		
Low VA	2.85	1.72
High VA	3.32	1.78
10. Surface Area Tasks		
Low VA	2.93	1.61
High VA	3.60	1.57

N = 80 for each subsample.

Means and standard deviations for sex by tasks across grade levels K-4.

TASKS AND SEX	MEAN	S. D.
1. Relational Terms Pretest		
Female	9.76	0.62
Male	9.48	1.26
2. Provoked Correspondence Justifications		
Female	3.92	1.64
Male	3.97	1.55
3. Provoked Correspondence Tasks		
Female	3.97	1.58
Male	3.98	1.55
4. Unprovoked Correspondence Justifications		
Female	4.35	1.37
Male	4.20	1.52
5. Unprovoked Correspondence Tasks		
Female	4.36	1.33
Male	4.23	1.53
6. Single Seriation - Height		
Female	4.62	0.93
Male	4.52	0.94
7. Single Seriation - Width		
Female	4.33	1.11
Male	4.15	1.28
8. Multiple Seriation		
Female	3.18	1.66
Male	3.27	1.64
9. Surface Area Justifications		
Female	2.98	1.65
Male	3.18	1.87
10. Surface Area Tasks		
Female	3.17	1.62
Male	3.36	1.63

N = 80 for each subsample.

Means and standard deviations for low and middle SES groups for each task at the first grade level.

TASKS AND SES LEVELS FIRST GRADE	MEAN	S.D.
1. Relational Terms Pretest		
Low SES	9.63	0.81
Middle SES	9.18	1.47
2. Provoked Correspondence Justifications		
Low SES	3.37	1.54
Middle SES	3.06	1.98
3. Provoked Correspondence Tasks		
Low SES	3.25	1.77
Middle SES	3.50	1.93
4. Unprovoked Correspondence Justifications		
Low SES	3.56	1.71
Middle SES	88	1.71
5. Unprovoked Correspondence Tasks		
Low SES	3.88	1.71
Middle SES	3.94	1.61
6. Single Seriation - Height		
Low SES	4.56	0.89
Middle SES	4.56	0.89
7. Single Seriation - Width		
Low SES	3.81	1.28
Middle SES	4.18	1.28
8. Multiple Seriation		
Low SES	2.68	1.14
Middle SES	2.06	1.77
9. Surface Area Justifications		
Low SES	2.44	1.79
Middle SES	2.31	1.49
10. Surface Area Tasks		
Low SES	2.69	1.25
Middle SES	2.37	1.54

N = 16 for each subsample.

Means and standard deviations for Grades K-4 combined across SES and verbal ability levels.

GRADE	RELATIONAL TERMS PRETEST Mean	S. D.	PROVOKED CORRESPOND. TASKS Mean	S. D.	PROVOKED CORRESPOND. JUSTIFICATIONS Mean	S. D.
K	9.40	1.29	2.40	1.81	2.43	1.88
1	9.40	1.18	3.37	1.82	3.21	1.75
2	9.43	1.18	4.50	0.91	4.46	1.10
3	9.87	0.55	4.84	0.36	4.81	0.47
4	10.00	0.00	4.78	0.55	4.81	0.53
	UNPROVOKED COR. TASKS		UNPROVOKED COR. JUSTIFICATIONS		SINGLE SERIATION WEIGHT	
K	2.90	1.82	2.90	1.82	4.53	1.19
1	3.71	1.68	3.71	1.68	4.56	0.87
2	4.81	0.59	4.81	0.59	4.31	1.14
3	4.93	0.24	4.93	0.24	4.56	0.84
4	5.00	0.00	5.00	0.00	4.90	0.29
	SINGLE SERIATION WIDTH		MULTIPLE SERIATION		SURFACE AREA TASKS	
K	3.68	1.55	1.71	1.61	1.93	1.47
1	4.00	1.27	2.37	1.49	2.53	1.39
2	4.40	1.13	3.50	1.31	3.84	1.37
3	4.43	0.98	4.28	0.92	3.59	1.47
4	4.68	0.69	4.28	1.05	4.43	1.01
	SURFACE AREA JUSTIFICATIONS					
K	1.46	1.58				
1	2.37	1.62				
2	3.81	1.40				
3	3.59	1.47				
4	4.18	1.20				

N = 32 for each subsample.

APPENDIX D

ANALYSIS OF VARIANCE

SUMMARY

ANALYSIS OF VARIANCE
SUMMARY

	df	S. S.	M. S.	F ratio	df	S. S.	M. S.	F ratio
	Relational Terms Pretest				Provoked Correspondence Justifications			
1. Grade	4	10.68	2.67	2.90* .05	4	146.53	36.63	20.69**
2. Sex	1	3.02	3.02	3.29* .05	1	0.09	0.09	ns
3. SES	1	0.62	0.62	ns	1	3.02	3.02	ns
4. VA	1	2.02	2.02	2.20 ***	1	13.22	13.22	7.46**
5. Grade x sex	4	3.53	0.88	ns	4	2.96	0.74	ns
6. Grade x SES	4	7.06	1.76	ns	4	10.41	2.60	ns
7. Grade x VA	4	1.53	0.38	ns	4	5.58	1.39	ns
8. Sex x SES	1	0.89	0.89	ns	1	0.22	0.22	ns
9. Sex x VA	1	0.09	0.09	ns	1	0.22	0.22	ns
10. SES x VA	1	1.59	1.59	ns	1	0.89	0.89	ns
11. Gr x sex x SES	4	4.41	1.10	ns	4	2.08	0.52	ns
12. Gr x sex x VA	4	4.83	1.20	ns	4	2.71	0.67	ns
13. Gr x SES x VA	4	0.96	0.24	ns	4	1.16	0.29	ns
14. Sex x SES x VA	1	1.22	1.22	ns	1	0.89	0.89	ns
15. Gr x sex x SES x VA	4	6.46	1.61	ns	4	3.03	0.75	ns
16. Error	120	110.50	0.92	ns	120	212.50	1.77	
17. Mean	1	14822.50	-.--		1	2496.39	-.--	
	Provoked Correspondence Tasks				Unprovoked Correspondence Justifications			
1. Grade	4	144.03	36.00	23.53**	4	109.96	27.49	20.07**
2. Sex	1	0.00	0.00	ns	1	0.89	0.89	ns
3. SES	1	4.55	4.55	2.95 ***	1	1.22	1.22	ns
4. VA	1	15.00	15.00	9.80**	1	5.62	5.62	3.37***
5. Grade x sex	4	5.46	1.36	ns	4	0.41	0.10	ns
6. Grade x SES	4	5.78	1.44	ns	4	0.83	0.20	ns
7. Grade x VA	4	13.58	3.39	ns	4	6.81	1.70	ns
9. Sex x SES	1	0.05	0.05	ns	1	0.22	0.22	ns
9. Sex x VA	1	0.05	0.05	ns	1	1.22	1.22	ns
10. SES x VA	1	0.15	0.15	ns	1	0.89	0.89	ns
11. Gr x sex x SES	4	2.91	0.72	ns	4	4.33	1.08	ns
12. Gr x sex x VA	4	5.91	1.47	ns	4	3.96	0.99	ns
13. Gr x SES x VA	4	4.18	1.04	ns	4	3.28	0.82	ns
14. Sex x SES x VA	1	0.05	0.05	ns	1	2.49	2.49	ns
15. Gr x sex x SES x VA	4	2.41	0.60	ns	4	6.68	1.67	ns
16. Error	120	184.75	1.53		120	165.00	1.37	
17. Mean	1	2536.05	-.--		1	2924.09	----	

ANALYSIS OF VARIANCE
SUMMARY

		df	S. S.	M. S.	F ratio	df	S. S.	M. S.	F ratio
		Unprovoked Correspondence Tasks				Single Seriation - Height			
1.	Grade	4	109.59	27.39	17.67**	4	5.78	1.44	ns
2.	Sex	1	0.62	0.62	ns	1	0.39	0.39	ns
3.	SES	1	0.89	0.89	ns	1	0.39	0.39	ns
4.	VA	1	4.22	4.22	2.72 ***	1	0.00	0.00	ns
5.	Grade x sex	4	1.22	0.28	ns	4	6.16	1.54	ns
6.	Grade x SES	4	0.97	0.24	ns	4	4.66	1.16	ns
7.	Grade x VA	4	5.02	1.25	ns	4	1.93	0.48	ns
8.	Sex x SES	1	0.22	0.22	ns	1	0.09	0.09	ns
9.	Sex x VA	1	0.39	0.39	ns	1	0.09	0.09	ns
10.	SES x VA	1	1.22	1.22	ns	1	0.00	0.00	ns
11.	Gr x sex x SES	4	1.89	0.47	ns	4	4.58	1.14	ns
12.	Gr x sex x VA	4	3.34	0.83	ns	4	7.71	1.92	2.67*
13.	Gr x SES x VA	4	4.64	1.16	ns	4	8.56	2.14	2.97*
14.	Sex x SES x VA	1	2.49	2.49	ns	1	4.89	4.89	6.79*
15.	Gr x sex x SES x VA	4	4.87	1.21	ns	4	7.28	1.82	2.53*
16.	Error	120	186.00	1.55		120	86.50	0.72	
17.	Mean	1	2958.39	----		1	3348.89	----	
		Single Seriation- Width				Multiple Seriation			
1.	Grade	4	20.14	5.03	3.85**	4	169.53	42.38	24.58***
2.	Sex	1	1.40	1.40	ns	1	0.30	0.30	ns
3.	SES	1	0.30	0.30	ns	1	0.56	0.56	ns
4.	VA	1	6.00	6.00	4.61*	1	7.65	7.65	4.43*
5.	Grade x sex	4	0.49	0.12	ns	4	4.28	1.07	ns
6.	Grade x SES	4	8.72	2.18	ns	4	10.18	2.54	ns
7.	Grade x VA	4	5.14	1.28	ns	4	12.31	3.07	ns
8.	Sex x SES	1	1.05	1.05	ns	1	0.30	0.30	ns
9.	Sex x VA	1	0.05	0.05	ns	1	0.30	0.30	ns
10.	SES x VA	1	1.05	1.05	ns	1	0.05	0.05	ns
11.	Gr x sex x SES	4	7.47	1.86	ns	4	9.28	2.32	ns
12.	Gr x sex x VA	4	10.84	2.71	ns	4	5.91	1.47	ns
13.	Gr x SES x VA	4	8.72	2.18	ns	4	4.41	1.10	ns
14.	Sex x SES x VA	1	0.15	0.15	ns	1	0.50	0.50	ns
15.	Gr x sex x SES x VA	4	1.12	0.28	ns	4	1.96	0.49	ns
16.	Error	120	156.75	1.30		120	207.25	1.72	
17.	Mean	1	2881.50	----		1	1670.55	----	

ANALYSIS OF VARIANCE
SUMMARY

	df	S. S.	M. S.	F ratio	df	S. S.	M. S.	F ratio
	Surface Area Conservation Justif.				Surface Area Conservation Tasks			
1. Grade	4	163.83	40.95	19.40**	4	131.78	32.94	18.38**
2. Sex	1	1.59	1.59	ns	1	0.40	0.40	ns
3. SES	1	2.49	2.49	ns	1	1.05	1.05	ns
4. VA	1	9.02	9.02	4.27*	1	17.55	17.55	9.81**
5. Grade x sex	4	16.71	4.17	ns	4	4.56	1.14	ns
6. Grade x SES	4	4.81	1.20	ns	4	2.53	0.63	ns
7. Grade x VA	4	15.41	3.85	ns	4	16.66	4.16	2.31 ***
8. Sex x SES	1	0.22	0.22	ns	1	0.15	0.15	ns
9. Sex x VA	1	0.39	0.39	ns	1	0.75	0.75	ns
10. SES x VA	1	0.39	0.39	ns	1	0.56	0.56	ns
11. Gr x sex x SES	4	2.33	0.58	ns	4	2.81	0.70	ns
12. Gr x sex x VA	4	5.53	1.38	ns	4	6.08	1.52	ns
13. Gr x SES x VA	4	2.53	0.63	ns	4	2.16	0.54	ns
14. Sex x SES x VA	1	4.22	4.22	ns	1	1.80	1.80	ns
15. Gr x sex x SES x VA	4	13.21	3.30	ns	4	14.28	3.57	ns
16. Error	120	254.00	2.11		120	215.75	1.79	
17. Mean	1	1525.22	----		1	1709.55	----	

* F value for 1,120 df at .05 level is 3.92
** F value for 1,120 df at .01 level is 6.85
*** F approaches significance at the .05 level

*F value for 4,120 df at .05 level is 2.45
**F value for 4,120 df at .01 level is 3.48