71-4742

STOKES, Charles Alphonso, 1929-
SOME EFFECTS OF SCHOOLING, AGE, RACE AND SOCIO-ECONOMIC STATUS ON THE COGNITIVE DEVELOPMENT OF PRIMARY SCHOOL BOYS.

The University of Michigan, Ph.D., 1970
Education, general

University Microfilms, Inc., Ann Arbor, Michigan

THIS DISSERTATION HAS BEEN MICROFILMED EXACTLY AS RECEIVED

SOME EFFECTS OF SCHOOLING, AGE, RACE AND SOCIO-ECONOMIC STATUS ON THE COGNITIVE DEVELOPMENT OF PRIMARY SCHOOL BOYS

by
Charles Alphonso Stokes

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in
The University of Michigan
1970

Doctoral Committee:

Professor Warren A. Ketcham, Chairman
Assistant Professor LeVerne S. Collet
Associate Professor John W. Hagen
Associate Professor Jane M. Schwertfeger

Abstract

SOME EFFECTS OF SCHOOLING, AGE, RACE, AND SOCIO-ECONOMIC STATUS ON THE COGNITIVE DEVELOPMENT OF PRIMARY SCHOOL BOYS

By Charles Alphonso Stokes

The primary purpose of this dissertation is to study the effects of age, socio-economic status (SES), and race on the cognitive functioning of primary school-age children and to extend Piaget's research by examining its relevance to the population of this study.

Four basic questions were raised in this study. The first question related to Piaget's contention that conservation, seriation, and classification develop concurrently. Another question was concerned with the possibility of a developmental lag between the two SES groups. Still another question was concerned with a possible developmental lag between the two race groups. Finally, the question of whether or not schooling narrows the developmental gap between SES groups was investigated.

The subjects were 128 midwestern, urban school children from middle and low SES homes. The children ranged in age from five and one-half to eight and one-half years. They were selected from the first and third grades of three elementary schools which were selected on the basis of SES sub-

community location. A third basis for assignment to a group was by race. Two race categories were used: white and black. Thus, a basic two by two by two design resulted--two SES categories, two age levels, and two races. Assignment to groups was by stratified random sampling.

A standardized, individual interview schedule was employed. The schedule was based on Piaget's tasks which were developed in Geneva. Three cognitive areas were included: conservation, seriation, and classification. The Peabody Picture Vocabulary Test (PPVT) was used as a measure of the intellectual maturity of the subjects. Finally, a Personal Data Sheet was used to collect demographic data on each subject. The three instruments were administered to each subject individually in their respective schools.

In the treatment of data, each response was scored 0, 1, or 2. These raw scores were then transformed into standard scores and used in the analyses of variance. The qualitative level of the subjects' explanations were also examined.

Analyses showed that concurrent development of conservation, seriation, and classification was only partially upheld. Results from the analyses of variance indicated a clear significant difference between socio-economic levels as well as grade levels. A less clear but significant difference between race groups was also found.

Results from this study do not support the hypothesis of a wider range of differences between the two SES groups.

Contrary to expectations, the two years of schooling for the third grade children in the low SES groups seem to bring them closer to the middle SES group.

Although no formal statistical tests were performed on the qualitative data, differences in the reasoning process were also noted among the SES and age groups. The low SES and younger children tended to be less clear in their explanations of responses than their respective counterparts.

Implications of the findings for further research were discussed and recommendations were made for improvement of curricula, improvement of instructional and assessment methods, and improvement of programs of teacher training. Finally, it was concluded that Piaget's methods could be fruitfully employed in the type of school setting in which this study was conducted.

ACKNOWLEDGMENTS

The writer is indebted to many persons for their contributions to this study. The constant encouragment, wise guidance, and welcomed resources provided by Dr. Warren Ketcham are deeply appreciated.

A debt of gratitude is also owed to other members of the doctoral committee: Dr. LeVerne Collet, Dr. John Hagen, and Dr. Jane Schwertfeger. Their helpful advise, assistance, and prompt consideration were indispensable to the completion of the project.

Particular gratitude is due Miss Esther Schaeffer, who gave generously both of time and talent when the data were processed; Mrs. Vanessa McDonald, who untiringly assisted in the construction of testing materials; and Mrs. Pearl Ford, who patiently and efficiently performed the secretarial duties.

The writer is grateful to his family for the moral support received throughout the time of his schooling. Thanks go to his mother for her teaching and good example, to his brother, John, for his strong urging and initial financial support toward higher education; and to his wife, Debbie, who endured hardships and made numerous sacrifices for three full years.

TABLE OF CONTENTS

Page

ACKNOWLEDGMENTS ii

LIST OF TABLES vi

Chapter

I. INTRODUCTION 1

Cognitive Development 3

Number Concepts 5

Primary Focus of This Study 11

Statement of Problem 13

Limitations of This Study 15

II. REVIEW OF THE LITERATURE 17

Validation Studies 19

Training Studies 23

Milieu Studies 28

Summary 42

III. METHODOLOGY 44

Setting 44

Instruments and Measures 47

The Cognitive Development Interview Schedule 47

Peabody Picture Vocabulary Test (PPVT) 52

Personal Data Sheet 53

The Selection of Subjects 53

Testing Procedure 55

TABLE OF CONTENTS

Chapter		Page
III.	METHODOLOGY (Continued)	
	Analysis of Data	57
IV.	RESEARCH FINDINGS	59
	Hypothesis 1: Middle SES vs. Low SES	59
	Hypothesis 2: Third Grade vs. First Grade.	63
	Hypothesis 3: Black vs. White Race	64
	Hypothesis 4: Middle SES White vs. Middle SES Black	65
	Hypothesis 5: Low SES Blacks vs. Low SES Whites	67
	Hypothesis 6: Middle SES Blacks vs. Low SES Whites	68
	Hypothesis 7: Middle-White - Low-White) vs. (Middle-Black - Low Black)	70
	Hypothesis 8: (M-1st - L-1st) vs. (M-3rd - L-3rd)	70
	Hypothesis 9: Low SES vs. Middle SES Concerning Concurrent Development	71
V.	EXPLANATIONS AND STRATEGIES OF THE SUBJECTS	74
	Mode of Responses	74
	Comparison Group Composition	75
	Conservation	75
	Seriation	77
	Classification	78
	Summary	79
VI.	DISCUSSION AND IMPLICATIONS	80
	Discussion of Results	81
	The Development of Conservation and Related Abilities	81
	Cognitive Performance of Different SES, Race and Age Groups	82

TABLE OF CONTENTS

Page

Chapter

VI. DISCUSSION AND IMPLICATIONS (continued)

Implications for Education and Research 88

Recommendations for Education 88
Research Implications 93

VII. SUMMARY 95

LIST OF REFERENCES 98

APPENDICES 103

A. Specific Instructions for Administering Test of Cognitive Development 103

B. Record Booklet 108

C. Personal Data Sheet 112

D. Instructions for Scoring Test of Cognitive Development 113

E. Statistical Characteristics of the Test 120

LIST OF TABLES

Table		Page
1.	Comparison of Economic and Living Conditions by Heads of Households in the Two Subcommunities from Which the Sample Was Drawn	45
2.	Demographic Characteristics of SES and Race Subgroups Within Sample	56
3.	Analysis of Variance of Total Cognitive Scores	60
4.	Analysis of Variance of Conservation Scores	61
5.	Analysis of Variance of Seriation Scores	61
6.	Analysis of Variance of Classification Scores	62
7.	Conservation, Seriation, Classification and Total Cognitive Development Scores for Low and Middle SES Groups	62
8.	Conservation, Seriation, Classification and Total Cognitive Development Scores for First and Third Grade Groups	63
9.	Conservation, Seriation, Classification and Total Cognitive Development Scores for Black and White Race Groups	65
10.	Conservation, Seriation, Classification and Total Cognitive Development Scores for Middle-White and Middle-Black Groups	66
11.	Conservation, Seriation, Classification and Total Cognitive Development Scores for Low-Black and Low-White Groups	68
12.	Conservation, Seriation, Classification and Total Cognitive Development Scores for Middle-Black and Low-White Groups	69
13.	Correlation Coefficients for Subtest Comparisons Between SES and Race Groups	72

LIST OF TABLES (continued)

Table		Page
14.	Analysis of Variance for PPVT Scores	73
15.	Methods Employed by the Poorest and Best Performing Groups on Seriation Tasks . . .	78
16.	Degree of Agreement Among Judges for Content Validity Analysis	121
17.	Test-Retest Coefficients for the Cognitive Development Test	122
18.	Scorer Reliability Coefficients for the Cognitive Development Test	123

CHAPTER I

INTRODUCTION

Throughout the United States, school systems have developed elementary and secondary school curricula and programs which appear to work relatively well for a majority of students. Perhaps as many as one-half of the entering students are able to complete these programs successfully. These educational programs have become the determiners of status and economic opportunity, and completion of a secondary school program is rapidly becoming the minimal requirement for successful entry into the larger society. Buckingham (1962) in a symposium on education and automation noted that in the highly developed nations the individual who is not able to complete secondary school is denied admission to an ever increasing sector of the occupational system. In the United States the occupationally successful are increasingly being separated from their unsuccessful counterparts along both socio-economic status and racial lines. While it is true that the rapidly growing urban environment is drawing into close association Negroes and whites in the same occupational classes, such associations are facilitating the assimilation of only the more formal aspects of white culture. Important and distinct racial differences still exist (Frazier, 1939). The United States Riot Commission Report

(1968) and the United States Riot Commission Report One Year Later (1969) both vividly portray the country as an increasingly racially divided one moving toward greater polarization of the races, black on one side and white on the other. Despite the Supreme Court ruling against segregation of the races in schools, defacto segregation is increasing (Coleman, 1967).

Although there is no questioning the wisdom of raising the socio-economic and academic standing of the black child or any other sub-standard group to the point where special norms would have no meaning, at the present time, we have not arrived at this point, and in the place of ideas or fantacies, we need facts; facts which can come only from carefully designed and detailed studies of the situation as it now exists.

For the past several years research evidence has been increasing steadily on those psychological variables which are presumably indicators of performance in school and society. The relatively inferior performance of Negroes as compared with whites on both individual and group intelligence tests, for example, has been documented intensively (Dreger and Miller, 1960; Garrick, 1947; Shuey, 1958; Young and Bright, 1954). However, the rationale for these differences continues to be a controversial topic.

Probably no one has pointed out the serious deficiencies of the great majority of tests for children better that Piaget and Inhelder (1947). Although it is beyond the scope of this study to go into their critiques in detail, it

is proper to discuss their two essential conclusions.

First, the usual tests neglect the structural and functional aspects of intelligence. They illicit an unsubtle numerical result which is very simply the algebraic sum of successes and failures attained by the subject. In other words, these tests are geared almost entirely toward what a person knows instead of how he thinks.

Piaget's and Inhelder's second criticism concerns the specifically genetic character of intelligence. They question whether one can say that the usual intelligence scales truly interpret a natural development, even if the problems concerned in these measurements are distributed according to chronological age. It is well known that in an age scale such as Terman's, a six-year-old child can compensate for failures at the five-year-old level with successes in items localized at seven years. Such a postulate ruins even the sense of the concept of evolution: It makes mental age a simple median performance instead of a true genetic stage and it reduces to a simple compensatory gain the laws of transformation which characterize and explain the successive levels of mental development.

Cognitive Development

In Piaget's system, development is largely a matter of progressive elaboration of cognitive structures in order to deal more and more effectively with the environment. These cognitive structures are schemas undergoing change as a child adjusts himself to his environment and as he adjusts

the environment to himself, i.e., as he assimilates more aspects of his world to his schemas and as he accommodates his schemas to reality constraints of the world. Thus, for Piaget, cognitive development, the gaining of knowledge, involves modification of the organism in response to environmental pressures as has always been emphasized by "nurture theories"; but it also involves adjustment of the environment in line with organismic pressures as has been pointed out by "nature theories." It is Piaget's primary aim to uncover characteristics of the organizing process as they emerge in different stages of development.

According to Piaget, there are three main invariant stages in the development of intellectual structures. These are outlined, among other places, in The Origins of Intelligence in Children (Piaget, 1952), and by Flavell (1963). The earliest stage of sensory motor operations involves mechanisms which are reflexive in orgin but their activities lead to the realization that objects can be permanent. This is followed by another stage of concrete operations. This stage is a period of elaboration and structuration in which age seven is an important milestone. At about age seven the intellectual structure of a child enables him to understand certain basic concepts such as number and space. But such understanding is not yet separated from its concrete content. The final stage, which comes during adolescent years, is characterized by the ability to engage in thoughts that are no longer bound to the situation and objects but which make possible the generation of hypotheses and the deduction of consequences contingent on them.

The period of concrete operations has been widely studied, partly because the new orientation in thinking coincides with the novel learnings and experiences in school. This new method of thinking about problems Piaget maintains is readily observable in the handling of problems involving number and class.

Number Concepts

The Child's Conception of Number (Piaget, 1952) is a theoretical treatise with supporting empirical results which describes in detail the sequence of the development of the number concept. For Piaget, a thorough grasp of the notion of number develops along with an understanding of other logical abilities. Number is regarded as a union of ordering and class. To count the number of elements in a set, in order to arrive at its cardinal value, it is necessary to disregard the properties that make them dissimilar and regard each object as a unit. Thus when a child is required to count the fruits on a table he has to disregard the perceptual distinguishing characteristics pertaining to the orange, the banana, and the pear and think of each as a unit of fruit. In counting them he is classifying and grouping the set of fruits to which he assigned a cardinal number. So, number has a class component. But, the objects so enumerated have an order. To arrive at the correct cardinal value of the fruits the child must realize that having counted the first orange he cannot regard it as equivalent to the other oranges which have not yet been counted. That orange is

different by the treatment, i.e., counting that he has given it. Thus the objects are arranged in a series and given an order as he counts one first, then another, and another. This is an ordination process.

A similar situation arises when a child is dealing mentally with numbers. He has to be able to place "four" in relation to other numbers. It is greater than "three" but less than "five" and also, it is included in "five." For Piaget, then, number has a peculiar status, "It is at the same time a class and an asymmetrical relation, the units of which it is composed being simultaneously added because they are equivalent and seriated because they are different one from another."

A further elaboration states that "number cannot be reduced to class alone but it is a synthesis of class inclusion plus ordering."

A study of such a broadly based concept of number involves Piaget in the study of other logical abilities. These abilities according to Piaget develop concurrently. Without an understanding of one, the child is handicapped in his attempt to deal with the other.

The following sections describe the nature of the abilities related to an understanding of number.

Conservation

Piaget states that prior to age seven the child's ideas of quantity and number are influenced by the appearance of physical properties of objects. Understanding tends

to be largely dependent on perceptual factors. From about age seven onwards there is evidence that a new way of thinking has emerged. The child at this stage is no longer so dependent on appearances for his judgment. He attends to the relations between physical properties of objects and between the objects themselves.

This change in the thinking of the child can be seen in the development of physical concepts, and is reflected in the attainment of "conservation," which Piaget considers a "necessary condition for any mathematical understanding."

Conservation refers to the ability to understand that certain properties of objects, e.g. number, area, and quantity remain invariant in the face of external transformations. For instance, a child who realizes that a given number of beads remain the same whether put into a tall narrow glass or a shallow dish is said to have conserved on that task. The younger child who relies on perceptual cues tends to assert that the beads in the tall glass are more because the contents stand higher than in the shallow glass. He has not grasped the idea that a rearrangement of the two numerically equivalent sets does not alter the original number.

According to Piaget, two distinct strategies are manifested by the conserving and non-conserving child. The non-conserving child's approach entails a "centering" on one dimension of the task at a time. Thus in the example cited the child focuses on the increased height of the glass and forgets the dimension of width. Some others assert that the

number of beads in the shallow dish is more because they concentrate only on the width of the dish. Shortly before attainment of conservation the children in the transitional stage show inconsistent evidence of attention given to both properties. "This transition from a single centering to two successive centerings heralds the beginnings of the operation: Once he reasons with respect to both relations at the same time, the child will in fact deduce conservation" (Piaget, 1960). Alternatively the child in the transitional stage may want to rearrange the objects and reverse the situation to one in which he could more readily accept the equivalents, since he still needs a perceptual confirmation of his judgment.

A conserving child adopts a strategy that coordinates two dimensions of the object. He clearly sees that increases in height compensates for decreases in width, and thus, he reasons with both properties simultaneously. "Thought is no longer tied to particular states of the objects, but is obliged to follow successive changes with all their possible detours and reversals, and it no longer issues from a particular viewpoint of the subject, but coordinates all the different viewpoints in a system of objective reciprocities" (Piaget, 1964).

Seriation and Ordination

Seriation refers to the ability to build objects into a transitive asymmetrical sequence. For instance, a child is given a set of eight blocks varying in size from

the smallest, A, to the largest, H. He is required to seriate these. The problem involves discovering the relationship A < B < C .... < H. The younger child, unable to seriate, groups the small and the large items indiscriminately. A child using the intuitive strategy, has difficulty in conceiving, Piaget believes, both a direct and an inverse relation between objects. For instance, the relationship that block B is both larger than A and smaller than C is not understood. His reaction pattern consists of making comparisons of two objects at a time. Piaget describes the process in an experiment where the children were required to construct a series of sticks from one to ten. He writes, "The child at the second stage does not immediately master the whole set of relations necessary for seriation but discovers them gradually by dint of empirical trial and error. Thus he begins with 9, 10, 8, then measures 10 and 8 against one another, then 9 and 8" (1952).

Ordination refers to the process of recognizing the positions of objects in a series such as that described in the previous paragraph. Piaget discusses an experiment of dolls and sticks in which the child constructed a series according to the order of magnitude with the largest doll being assigned the longest walking stick. He then required the child to match a particular stick to a doll after he disrupted the perceived correspondence.

From their responses the children could be classified into three categories. Some were deceived by the new configuration, others had to rearrange the objects to

convince themselves of the correctness of their intuitive responses; yet others relied on numerical positioning. These realized that the fourth man ought to have the fourth walking stick.

Classification

Piaget discusses the relation between class and number in several sections of The Child's Conception of Number (1952). He believes that notions of class and number develop concurrently. There are two aspects of classification that have direct relevance to an understanding of number; namely, grouping and class inclusion.

Although Piaget discusses many experiments on classes, only the ones on class inclusion are described here. Directly related to number is the notion of "additive composition of classes." This notion refers to a part-whole relationship of sets. To understand number, the child is expected to know that if A+A'=B, the reciprocal relationships B > A and B > A' must follow logically. A typical experiment is presented to the child with brown and white wooden beads. There were obviously more brown beads than white beads. In a series of questions the investigator tried to find out whether the child understood that a string of wooden beads would be longer than a string of brown beads.

The responses fall into three stages again. The main problem of the younger child is that, while he centers his attention on the class of brown beads, he looses sight of the total class of wooden beads, and so, tends to compare

only the class of brown beads with the complimentary class of white beads. "The difficulty is that by centering on A, he destroys the whole, B, so that part A can no longer be compared with the other part A'. So there is again non-conservation of the whole for lack of mobility in the successive centeralizations of thought" (Piaget, 1960). The older children who understood have no difficulty in maintaining the different aspects of the relationships in their minds.

Summary

In Piaget's theory, then, the development of conservation and of the related abilities discussed is essential to the attainment of rational thought. There are generally three stages in the development of these abilities. There is a stage when a child is still intuitive but groping for method, and there is the operational stage when a child fully grasps the relationships that exists between aspects of the problem posed. From about age seven, the children begin to consider these relationships in a systematic manner and discard the dependence on situational, perceptual features. Such changes manifest the structure of concrete operations. The general trend is from one of uncoordinated perceptions to a more complex, flexible but coherent system.

Primary Focus of This Study

The importance of milieu studies in the investigation and adaptation of Piaget's theory of cognitive

development to the field of education should not be underemphasized. In the words of Goodnow (1962), "When we consider cognitive growth or style in different cultures, we are confronted by three requirements. We need to obtain by combining results from several studies some picture of skills common to people from many backgrounds as well as skills that differentiate among them. At the same time we need to find the features of milieu that may account for the similarities and differences in skills. And finally, the thorniest requirement of all, we have to ask as we transpose a task from one culture to another whether the same answer means the same thing in both worlds.... By and large, milieu studies involve so many points of difference both among milieus and among tasks that it is hard to fit the pieces together. The fitting becomes easier as more studies at least use common tasks, a trend helped greatly by the widespread appeal of task developed at Geneva." It is hoped that the present study will make some useful contribution to that ever increasing body of research to which Goodnow refers.

Specifically, this study is an attempt to achieve understanding of the affect of schooling, socio-economic status (SES) and race on the cognitive functioning of young children. It is hoped that the increase in understanding will result in the following outcomes:

1. Increased awareness of the need to establish local norms for the instruments being developed to assess children's cognitive growth.

2. Increased awareness of the need to base curriculum development, teaching and evaluation on individual group differences in children's cognitive development.

3. Expansion of this study and others like it to include additional populations and variables.

There have been several studies of cognitive development in young children which treated one or more of the independent variables which are investigated in the present study but most of them have had serious design problems. In some studies only one race was studied (Etuk, 1967). Others committed the serious design error of confounding social class with race or ethnic character (Melton, etc., 1968: M. Meuron, 1968: M. Almy, 1966). Despite their design problems all of the authors of these studies reported important milieu affects upon the cognitive development of young children.

Statement of Problem

It is important to stress that this is an empirical study designed and executed for practical rather than theoretical reasons. No attempt will be made to answer the question, "What aspects of cognitive ability are innate and what are learned"? Questions with which this study is concerned are as follows:

1. Is Piaget's claim of concurrent development of conservation, seriation and classification structures independent of race and socio-economic status?

2. Is there a developmental lag based on differences in socio-economic status?

3. Is there a developmental lag based on race differences?

4. Does schooling narrow the cognitive development gap, assuming there is one, between low and middle socio-economic status groups of both races?

It is anticipated that between group and within group comparisons of performance on the cognitive development tasks will yield these results:

1. Middle SES children will obtain significantly higher scores than their lower SES counterparts. This has been the finding of the majority of studies which treated SES as an independent variable.

2. Older children will score significantly higher than the younger children. These expectations are also based on findings of previous research studies.

3. The total white sample will obtain significantly higher scores than the total black sample. This result is expected because the independent variables are confounded in this analysis.

4. Middle SES white children will score significantly higher than middle SES black children. Although black and white groups can be equated along SES dimensions, the black child, due to the caste system, is deprived of many cognitively stimulating experiences that his white counterpart is privileged to enjoy.

5. Low SES white and low SES black children will display no significant difference between their performances. The social, psychological and physical environment, and

deprivations are quite similar in these groups and the caste system has less impact under these conditions.

6. Middle SES black children will score significantly higher than low SES white children. The majority of the recent studies investigating the affects of race and socio-economic status on the intellectual performance of children have led to the conclusion that SES is a stronger determiner of intellectual performance than race. It is expected that the same phenomenon will exist in relation to cognitive studies.

7. The difference between performances of the middle SES and low SES groups will be significantly greater between the two white groups than between the two black SES groups. This finding is expected because segregation and in-breeding has resulted in the black race being a more homogeneous group than its less restricted white counterpart.

8. Group differences based on SES will tend to significantly increase with age.

9. The low SES groups of both races will show a stronger trend toward concurrent development of conservation, seriation and classification structures than the middle SES groups. Studies in other areas of development have shown the low SES groups to be more homogeneous in rate of development than the middle SES groups.

Limitations of This Study

The findings of this study are relevant to the sample studied. Only boys were used in the sample because

to control for sex would have made the sample size prohibitive. The investigation is an exploratory study, hence the findings are not treated as conclusive evidence.

CHAPTER II

REVIEW OF THE LITERATURE

During the past fifteen years there has been a rapid growth of research interest in the area of cognitive development. Both the quality and quantity of research have increased, notably in studies of social class and culture differences and of group comparisons, where investigators have attempted to determine the aspects of environment which relate to cognitive development. Because of the large amount of research, any review of the topic must be highly selective and inevitably biased. The selection bias of the present reviewer grows out of a concern with social class, race, and experience differences.

Cognitive theories, as Van de Geer and Jaspers (1966) have pointed out, may vary on a continuum from extensions of stimulus-response (mediation) to phenomenological theories. Between the two extremes lie the theoretical positions probably most influential in present-day research, those which view cognitive growth as the development of increasingly powerful representation systems for dealing with future encounters of the organism with reality. This last approach characterizes in somewhat different ways the points of view of certain of the Soviet psychologists (Zaporozhets, 1965), Bruner's group (Bruner et al., 1966), and the Piagetian

school. Since this study is mainly concerned with Piaget's theory of cognitive development, this review will appropriately reflect the Piagetian position on the continuum of cognitive theories.

Interest in Piaget's theory escalated even more with the increased interest in early experience. When Bloom (1964) amassed his mountain of data to support the argument for the importance of early environmental influences, the structure of intellect and its development finally took its place among the most important psyschological and educational problems. Since Piaget's cognitive theory addresses itself directly to this problem, it was natural and appropriate that it become the central theory of the present study.

The studies selected for review represent diversity of method and motive, and express three crucial issues: (1) replication, in essence, validation studies of the description of cognitive growth, (2) training studies; efforts at modifying the course as charted by Piaget, and (3) cross-cultural studies emphasizing social class and ethnic group differences. Of the three issues listed above, the third is most directly related to the present study; therefore, studies reviewed under that heading will be more numerous and covered in more detail than studies in the other two sections. It is felt that some review of validation studies is essential in establishing construct validity and a review of training studies will help to identify educational implications for Piaget's theory.

Validation Studies

Many studies have been carried out to validate Piaget's stage sequence theory. Only a selected number of studies are reviewed here, but the selection is intended to be representative in regards to findings and conclusions. A comprehensive review of studies based on Piaget's research are to be found in Flavell (1963).

Estes (1956) investigated some mathematical and logical concepts in children using Piaget's number tasks. Besides being one of the first American validation studies, it had another distinction--that of being one of the few studies which concluded that there was no evidence for Piaget's stage development theory. Estes studied 52 American children in the four to six year range, attempting to differentiate between four, five and six-year-old children on the basis of a series of tests suggested by Piaget's work, notably that which concerned itself with the concept of conservation. Estes found no consistent differences between her age groups on these tests. She states that no stages were found in the development of number concept and that if children could count they also possessed the types of ability measured by selection of Piaget's number task. Several investigators have soundly criticized Estes' study. Wohlwill (1960) points out that Estes used a cross-sectional method with a relatively small number of subjects tested. In the face of the well-known individual variation in the rate of development, Dodwell (1960) has commented on the results of

this study and suggests a possible misinterpretation of the aim of Piaget's research. In view of the apparently inadequate methodology used, these results can hardly be taken as conflicting evidence with respect to the reality of Piaget's developmental stages.

Dodwell (1960) used several of Piaget's number tasks to investigate Canadian children's thinking. His subjects were from five to eight-year-old children. In general, Dodwell's results and conclusions concurred with Piaget, particularly on the conservation tasks where he confirms Piaget's three stages. However, Dodwell questioned the concurrent development of conservation, seriation and ordination. In his study the stages in seriation and ordination tasks did not always correspond with that obtained on the conservation task. This finding led to a further exploration of the interrelationship of Piaget's number tasks (1961). The tasks lend themselves to an ordering in the nature of a "quasi-scale." Dodwell concludes that "While Piaget is on the whole co[illegible]c in his description of the child's understanding of number, the pattern of development is neither as neat nor as rigid as he would have us believe."

Pursuing the consistency of ability still further, Dodwell (1962) conducted another study. He found a low correlation between number and classification tasks and he offers the explanation that whereas children receive instruction in the area of number, they receive little specific instruction on the hierarchy of class.

Wohlwill (1960), using Guttman's technique of scalogram analysis, investigated the sequence through which individuals pass in the course of development of the number concept. His subjects were four to seven-year-old children in kindergarten and primary schools in Geneva. The responses of these subjects could be classified into three main categories: a preconceptual, an intermediary, and a final stage which represented number concept in the abstract. These stages correspond with Piaget's categories.

Lovell and Ogilbie (1960) investigated Piaget's claim that in developing the ability to conserve, children pass through three stages: non-conservation, transition and conservation. His subjects were 322 seven to eleven year olds in a North of England school.

The investigators reported some difficulty at times in classifying a child correctly at the transition stage, but they reported the three stages in the development of the concept of conservation were generally found. However, they pointed out that conservation on one task does not necessarily involve the same degree of understanding of other related problems. Such understanding they commented may be highly specific at first, and transfer to other situations increases in depth and complexity with increased experiences and maturation. This observation does not serve as a criticism of Piaget for this is the exact phenomenon that he referred to in discussing his concept of horizonal décalage.

Elkind (1961) studied 80 American children in the four to seven year age range. This study is the first in a series devoted to the systematic replication of his experiments originally performed by Piaget. He investigated the development of conservation of continuous and discontinuous quantity. He found that age is important in understanding quantity and that gross one-to-one correspondence was easier than dealing with the conservation of continuous (liquid) quantity. He therefore concludes that the nature of the task is important in determining the particular stage in which the child falls, and that his overall results agree with Piaget.

From Britain there are reports of confirming studies, some of which have been conducted with mentally handicapped persons. Mannix (1960) studied the number ability of educationally sub-normal children. In spite of individual differences he found that Piaget is generally correct in his description of the type of responses children give. This study is significant in that it is one of the few validation studies based on a sub-normal population.

In another similar study Woodward (1961) used tasks based on Piaget's research. She studied 94 mentally subnormal preadolescents and adults. She reports that responses on three of the four tasks used could be classified according to Piaget's stages. The responses of the subjects were similar to those reported for children in age four to seven years.

Hood (1962) studied a mixed group of normal four to eight year olds, educationally sub-normal ten to fifteen year olds, and mentally retarded adult subjects. Piaget's ideas were confirmed in the main when actual age was considered for the normal group. For the handicapped group, performance on a number task improved with an increase in mental capacity.

As can be seen, these studies have tended to support the sequence of conservation skills but have questioned the particular age-periods specified by Piaget. The failure to confirm the age periods need not be interpreted as a serious weakness in Piaget's total theory. He very reluctantly established the age-for-stage categories only after persistent proding by others, most of whom were in the field of education. He specifically warned against a rigid interpretation of these age periods. Despite the favorable evidence generated from these studies and others, much remains to be done to test the validity of the system. Nonetheless, the evidence indicates that Piaget's theory represents a major contribution to efforts to understand the process of cognitive development.

Training Studies

A second body of literature deals with the modification of the course of intellectual growth. Certain studies attempted to determine whether there is a fixed sequence in time for the acquisition of particular concepts. Investigators

have attempted to modify the child's knowledge and experience thereby influencing the performance with various types of conservation problems.

The training or modification studies included in this review represent a range of methods including direct reinforcement, cognitive-conflict or self-discovery, didactic lessons with demonstrations, and perceptual reorientation.

A group of studies carried out by Smedslund (1961) was designed to accelerate the attainment of conservation using two procedures, external reinforcement and a method involving addition and subtraction of the amount of plasticine used. The second method created a condition of cognitive conflict. Smedslund found that his subjects, age five to seven years, did not respond in the expected direction. Thus he concludes that external reinforcement is an insufficient condition for the attainment of conservation but that conditions creating cognitive conflicts such as presenting competing methods of organized data tend to be more effective.

Wohlwill and Lowe (1962) studied 72 kindergarten children, 35 boys and 37 girls, with a mean CA of five years, ten months. They used four experimental conditions to induce conservation. They were reinforced practice, addition and subtraction, dissociation, and control. Each training series consisted of eighteen trials broken up into two sets of nine which were administered on successive days. Each subject was given a pre-test to reveal their ability to deal with number concepts; a training series on tasks presumed to be

related to number conservation; and finally a repetition of both the non-verbal and verbal tasks of conservation to provide a measure of learning or change with respect to the understanding of this notion. Wohlwill and Lowe found results that were unexpected in that the control group and the one trained on addition and subtraction method showed greater gain than those whose training procedures were based on reinforcement and counting. These results, in effect, support Smedslund's cognitive-conflict hypothesis. Wallach and Sprott (1964) used a similar research design in training children between ages six and seven years. They found that the experimental group reacted to and explained conservation problems much better than the control group.

Piaget (1952) holds that for conservation to appear the child must be able to perform the following operations: multiple classification, multiple relationality, atomism, reversibility, and seriation. Sigel, Roeper, and Hooper (1966) investigated the hypothesis that conservation can be induced if the training procedures embody these prerequisite operations. The subjects were ten children ranging in age from four years, nine months, to five years. They were divided into two groups of five. One group was designated as the training group and the other control. The mean Stanford-Binet IQ's were 149 for the training group and 152 for the control group. Each of the ten children was given conservation tasks of continuous quantity for substance, weight and volume. Post-tests were administered two weeks after the training period. The training focused on multiple

labeling which was followed by multiple classification and multiplicative relations. Reversibility was the final operation to be introduced. In the pre-test four of the five children were able at least to conserve one or more properties. The control group showed no change in conservation ability or verbalization skills, The sequence of development described by Piaget appears in this study with the exception of one subject. The investigators conclude that the basic hypothesis, the training program focusing on prerequisites for relative cognitive operations influenced the resulting cognitive structure, was supported. Besides the extremely small sample size, the investigators themselves supply a rather strong criticism of their study. No pretests were given to determine the exact cognitive stage of the subjects. Therefore, the training subjects could have been at a transitionary or intuitive level. It is reasonable to expect that transitional stage individuals would derive the greatest benefit from the training experiences.

The affects of training upon the rate of conservation obtainment and its transference to other areas of performance were studied by Richards (1968). His subjects were seventeen mentally retarded children of various ages. Subjets found to be non-conservers on pre-test were given conservation and correspondence training using a variety of Piaget task. Following the training experiences the subjects were post-tested using the same measures used for pre-testing with the exception of the number task in which case an alternate form was used. Richards found significant post-test

gains on conservation and number concept scores indicating tentatively that conservation attainment can be accelerated by training with a possible effect on related areas of performance. Scores on an instrument designed to measure internalization of the concepts showed significant gains on post-test. However, post-tests scores on these measures did not correlate significantly with gains on other measures. It is highly likely that using Piaget's task for training purposes was tantamount to teaching the test since the pre-and post-tests were also based on his experimental tasks.

One of the most recent studies investigating the affects of training on the acquisition of conservation skills was conducted by Gelman (1969). She hypothesized that if children could be taught to attend to relevant stimuli (quantitative relations) and not other relational cues, then they should conserve when transferred to standard conservation tests. The subjects were 110 randomly selected kindergarten children in California: 57 girls and 53 boys. Their ages ranged from four years nine months, to six years. Each subject was given a pre-test, training, and post-test. There were three kinds of training: (1) modified learning set with length and number stimuli, (2) experience with the latter problems without feedback, and (3) modified learning set with "junk" stimuli. Conditions (2) and (3) served as controls for the effects of feedback on the learning of length and number concepts. Following training, all subjects were pre-tested on conservation of length, number, mass and liquid, thereby providing tests of specific and

non-specific transfer. The post-test of conservation showed almost perfect specific (length and number), and approximately sixty percent non-specific (mass and liquid amount) transfer of training. Measures taken two or three weeks later suggest that the gains were durable over time. Gelman feels that these findings support the hypothesis that young children fail to conserve because of inattention to relevant quantitative relationships and attention to irrelevant features in classical conservation tests. This hypothesis appears to be worthy of further and more intensive investigation.

The significance of the studies reviewed here rests on their contribution to cognitive development theories as well as to educational practice. They indicate that experiential variables should be considered in any comprehensive evaluation of Piaget's theory. It is evident that no single type of training is equally effective for all kinds of problems. Verbal and non-verbal procedures have differential affects depending upon the class of problem or the subject area in question. A major problem in assessing the effectiveness of training is mutually dependent upon the developmental level of the child, the class of problem, and the kind of training technique used.

Milieu Studies

The studies reviewed below investigate the effects of environment and experience on the cognitive development of children. Specifically, the studies selected for review here dealt with, in varying degrees, the variables of

socio-economic status, race and age; the independent variables of the present study. There are two major groups of studies. The first group consists of cross-cultural studies on non-American populations and the second consists of American studies dealing with the variables of socio-economic status, race and age.

Cross-Cultural Studies

Goodnow (1962) published one of the most comprehensive studies dealing with the impact of cultural differences on Piaget's cognitive development tasks. Her sample of 500 boys was drawn from four milieus. Milieu one covers 148 Europeans mostly from middle class background. Milieu two covers 151 Chinese from high ranking Anglo-Chinese schools. These boys had a middle class background or better. Milieu three covers 80 Chinese school boys with low socio-economic status and normal schooling. Milieu four covers 80 Chinese boys with low socio-economic status and very little schooling. All subjects were given five tests: Raven's Progressive Matrices, judgment of weight, judgment of volume, factorial problem, and judgment of space. In general, milieu differences turned out to be relatively minor and generally followed the age for stage results from Geneva. However, there was an odd difference between the two sets of tasks. The perceptual type or conservation task appeared to be unaffected by wide differences in intelligence, while the combinatorial task was heavily affected. In general, similarities across milieus were more striking than differences.

Price-Williams (1961) conducted an investigation while on field research among the Tiv of Central Nigeria. His aim was to test whether or not the progression of comprehension concerning conservation postulated by Piaget is evident in African children. His subjects, Tiv children, ages five to eight years, were presented with tasks involving a continuous (water) and a discontinuous (nuts) quantity. He found that his subjects made the shift from intuitive to concrete operations at about age seven years. Like Goodnow, Price-Williams also confirmed the ideas of Piaget concerning the three-stage development of conservation structure.

Goodnow and Bethon (1966) compared the performance on conservation task between unschooled Chinese boys and schooled American children. They found that the unschooled Chinese boys could perform the conservation task just as well as the American children and that intelligence scores did not correlate with the performance of their Hongkong subjects. However, these children were markedly inferior in performance on tasks which involved more exacting relational procedures.

Conflicting results were obtained by Greenfield (1966) using a selection of Piaget's test with three groups of Senegalese children. She found that school experience was very significant in obtaining the ability to conserve. However, the Senegalese sample showed a time lag when their performance was compared with that of American children. She also found qualitative differences in the approaches of schooled and unschooled children to the problems of conservation.

Two earlier studies also obtained results which support Piaget's stage theory. Hyde (1959) studied a multiracial group of children in Aden. The subjects were 48 European, 48 Arab, 24 Indian, and 24 Somali children. The age range was from six to eight years. He presented several tasks with local material such as shells and beads and obtained results similar to Piaget's. It was found that tasks involving seriation and class inclusion were difficult for all, although European children performed better than the other groups.

Noro (1961) also studied the development of number concepts in 112 Japanese children aged four to six years. The results obtained were similar to the stages outlined by Piaget.

American Studies

One of the earliest American studies using the theoretical framework of Piaget as a basis was conducted by Jean Deutsche (1943). She investigated children's concepts of causal relations studying age and social class differences. Her subjects were 732 children in grades three to eight from varying social classes. Two types of instruments were employed. Form one consisted of a presentation of experiments like those usually studied in the physical sciences. Form two consisted of a series of questions dealing with natural phenomena, for example, "What causes thunder"? Children's responses were rated on the accuracy of response (explanation). Deutsche found no significant differences in

performance by social class but for all age groups, boys scored significantly higher than girls on form one. The results also indicated that phenomenistic-type explanations decreased with age from thirty-seven percent at eight years, to ten percent at sixteen years. While logical deduction-type explanations increased with age from eleven percent at eight years, to thirty-six percent at sixteen years. The finding of no significant differences between social classes is unique in that subsequent American studies have found social class to be a highly significant independent variable. The descrepancy between the results of this study and subsequent studies may be explained by the fact that when Deusche conducted her study, "social class" was closely tied to social status whereas in later studies "social class" had come to imply economic status.

During the next two decades the majority of research dealing with Piaget's concepts were of the validation and training variety. In the meantime, those who were still conducting cross-cultural studies of cognitive development were becoming increasingly disenchanted with the use of standardized intelligence tests as measures of cognitive growth. The search was intensified for a psychometric instrument which would emphasize the more functional aspect of intelligence and place more emphasis on the process of cognitive growth rather than content.

Siller (1957) was one of the first American researchers in cognitive development to use scores other than those derived from standardized intelligence tests.

The study was designed to relate socio-economic status to conceptual thinking ability. The subjects were 181 white sixth grade New York City public school children in an age range of eight to thirteen years. They were divided into two socio-economic groups; high status and low status. The subjects were tested on the Lorge-Thorndike Intelligence Test and two instruments developed by the examiner, a verbal and non-verbal cognitive development test. Significant findings were (1) the high status children did better than the low status children on all tests of conceptual ability, (2) greater status differences were found on verbal material than on non-verbal material, and (3) when given a choice, high status children more frequently selected abstract answers than did low status children. Siller's study is highly significant in that it is among the first studies to report significant differences among social classes in problem solving process as well as ability.

Semler and Iscoe (1963) also sought to go beyond the usual cross-cultural study which reports existing intellectual differences without regard for the effect of such differences on specific task performance. Their concern was to compare the abilities of Negro and white children on paired-associate learning tasks where previous measurement had determined that the white children had significantly higher IQ's. These investigators expected to find no difference between Negro and white children in paired-associate learning ability. The subjects were 275 white and Negro children from Austin, Texas, public schools, ranging in age from five

through nine years. Each child was first administered a Weschler Intelligence Scale for Children. After approximately a week, each child was administered the pair-associate learning task, having been randomly assigned previously to one of the four experimental conditions. Combinations of the two sets of stimulus pairs (simular versus dissimular) and two degrees of cue presence (concrete versus abstract) were used to establish four experimental conditions. The results suggested that young Negro children have more difficulty than white children in learning new associations, especially when cues are reduced by using photographs rather than actual objects. The results also showed a decreasing difference between races in learning ability across age levels in contrast to continuing significant differences in intelligence. Semler and Iscoe readily admit that in terms of their overall sample of Negro and whites, the Negroes were of lower socio-economic status. They cited the difficult task of equating Negroes and whites on the basis of socio-economic status.

A study of John (1963) examined certain patterns of verbal and cognitive behavior in a sample of Negro children in grades one and three from three social classes. The classes were based largely upon level of education of the parents. Sixty-nine first-grade and 105 fifth-grade children were administered tests which measured use of language. Tasks involving labeling, relating and categorizing were included. Results showed differences between classes on the Peabody Picture Vocabulary Test, Enumeration, Integration, IQ, and WISC Vocabulary were

not significant in grade one, although a trend with class was present. In grade five there were no differences in enumeration but all other tests showed a significant difference in favor of the middle class. On the sorting task, fifth grade lower-class children sorted cards into more piles and gave significantly fewer explicit verbalization of their sorting behavior than did the middle class children. In relational use of language, group differences were small. John concluded that "Acquisition of more abstract and integrative language seems to be hampered by the living condition in the homes of lower-class children. Opportunities for learning to categorize and integrate are rare in the lives of these young children. This type of learning requires specific feedback or careful tutoring." Perhaps a major significance of this study is that it was among the first to point out the possible accumulative affect of environmental deprivation.

The studies reviewed thus far in this section have treated the race and socio-economic status variables singly but have not been concerned with their interaction. Bloom, Whiteman, and Deutsch (1963) conducted a study which attempted to separate out the variables of race and social class in determining social environment. An important conclusion of this study is that social class appeared to be a more potent variable than race in predicting environmental factors. Since this study, few researchers have ventured to address themselves to studying racial differences in cognitive development without at the same time treating the socio-economic status variable and vice versa.

Deutsch (1964) utilized some of his own concepts of race and socio-economic status interaction in studying the role of social class in language development and cognition. This study examined language and cognitive variables on a sample of 292 white and Negro children in grades one and five. Relationships between socio-economic status, race, grade and language variables were studied. Significant correlations with race were found less frequently for the first graders than for the fifth graders. The number of significant comparisons on SES for each grade level was constant. Negroes showed a lower ability in the areas of abstraction, verbalization and enumeration. The lower class of both races showed a dificiency in the abstract and categorical use of language, as opposed to denotative and labeling usage. The author concludes that the data support the cummulative deficit hypothesis which he has advanced. Although there are differences related to SES and race at the first-grade level, they become more marked as the child goes through the early years of school. Deutsch concludes that the tentative support for the accumulative deficit hypothesis raises serious questions as to the adequacy of the schools.

By the mid 1960's evaluation of the fragmentary studies that have been done in different countries as well as in America had led to markedly increased awareness and rather wide acceptance of Piaget's stage theory of mental development. Parallel to this the search was intensified for an instrument to replace the standardized intelligence test; an instrument which would permit the establishment of

a psychological diagnosis of intelligence and not simply an evaluation of its actual functioning. During this same period Flavell (1963) published his excellent critique on Piaget's cognitive development theory. This highly interpretive work put Piaget's theory on a level that even the most inexperienced students of cognitive development can understand and appreciate. As a result, there has been a decided increase in the use of Piaget's experimental tasks as a measure of cognitive developmental level, especially in studies investigating milieu effects on cognitive growth and development.

In June, 1968, the Educational Testing Service in New Jersey published a research memorandum on the cognitive growth in pre-school children (Melton and others, 1968). This memorandum consisted of a group of research reports presented at the Annual Meeting of the American Educational Research Association in Chicago, Illinois, in February, 1968. The symposium was organized to present some preliminary results of an intensive study of the cognitive growth of preschool and kindergarten children. This review will treat three of the six studies reported in this memorandum. They have been selected because they utilized the same Piagetian tasks to measure the dependent variable as were used in the present study. The same subjects and experimental conditions were used for all three studies under consideration.

The basic cross-sectional design of this study was a two by two by eight; two sexes, two socio-economic levels, and eight age groups ranging from four years, three months,

to six years of age. The sample of children was drawn from four public schools and two private nursery schools in New York City. Two of the public schools were in low SES areas of Harlem and Brooklyn and the other two public schools were in middle class areas, Queens and the Bronx. Between four and eight testing sessions were required for each child. Each session lasted from twenty to thirty minutes. Seven tasks were developed to sample from four cognitive areas; classification, time concepts, conservation and language, and the seven tasks were administered to all children in a standard order. A total of 322 children were tested but because of a variety of problems, the investigators used the data for only 259 children. Of the 259 children, 70 did not complete one or more of the tasks but their data were utilized and analyzed for the tasks they completed. In addition to the seven tasks, the Peabody Picture Vocabulary Test was administered to each child as a final performance measure.

Charlesworth (1968) reports on the development of classification skills in the four and five-year-old children of the above studies. The tasks were made up of single and double object clue sorts. For each sort a clue-object was placed on a sheet of white paper and the child was instructed to place from among a group of objects those that belonged with the object already on the paper. The response coding was based on a hierarchy of organizational principles and organizational approaches. Results showed that middle SES children used more logical principles than did the lower SES children. Within each SES group the older children used

more logical principles than the younger ones, thus there was an increase in variety of mature responses and in the percentages of mature responses with higher SES and higher age. The same kinds of trends with respect to social class and age differences appeared for the kinds of organizational approaches used. The universal rule approaches were more frequent for the middle SES children but there were no age differences within social class. A comparison of the combinations of organizational principles and approaches used by each of the four major sub-groups reveal a trend for the more mature principles to combine with more mature levels of approaches; that is, children who use the universal approach usually gave logical principles. An interesting result occurred when the low SES younger children did use a universal rule of approach. Nearly half the time they could not or at least did not give a logical reason. When given a verbal clue the children had less difficulty in sorting appropriate objects than when given an object clue; that is, they had more difficulty when they had to decide on a sorting rule for themselves.

There were clear developmental differences between age groups for the low SES children. These differences were less consistent for the middle SES children. The SES differences for both verbal and non-verbal response items were striking. The low SES children were less confident in their problem solving. They also used fewer higher level principles. Coupled with the result that the immature sorters had lower scores on two language measures, these facts lend

support to the current feeling among educators that young low SES children need compensatory educational programs if they are to compete with their middle class counterparts.

Pike (1968) reported the number conservation ability of four and five-year-old children from this same sample. The tasks used were derived from one of Piaget's eight basic number experiments and involved one-to-one correspondence of equivalent sets of objects.

Middle SES children consistently performed better than lower SES subjects on the number conservation tasks used in this study. There were essentially no age affects among lower SES children but there was a material's affect. One-to-one provoked correspondence was easier for both lower SES younger and older children. The conservation of any quantity item was easier than the conservation of equality items.

Neither of the two above studies treated race and SES as separate variables. Thus, the two were confounded and herein lies the major criticism. The test materials are likely to reflect white middle class biases despite strong efforts to avoid such influences. These biases are difficult to avoid and their impact is difficult to assess unless the problem is dealt with in the design.

After extensive searching, the author could locate only one cross-cultural study using Piagetian tasks which dealt with both variables, socio-economic status and race simultaneously. As mentioned previously, most studies have tended to confound these two important variables. Wei (1966)

studied the differences in classificatory performances of socially disadvantaged children with those of middle class children in kindergarten and grade 2 level. The subjects were 80 white children forming four groups of 20 each; 20 culturally deprived and 20 middle class kindergarten, 20 culturally deprived and 20 middle class second graders. In addition, 20 Negro subjects were chosen for the study of differences between races. The materials used were four classification tasks chosen from Piaget's tasks. They included changing criteria, object classification, class-inclusion, and matrices. The subjects were individually tested and the same standardized form of questioning was used. It was found that the culturally deprived group progressed at a slower rate in classification than children in the middle class groups. The results from this study did not support the hypothesis of an increase in differences between the two social groups with an increase in age. Contrary to expectation, the two years of schooling for the second grade children in the deprived groups appeared to bring them closer to the middle class group.

Significant differences in the reasoning process were also found within the two social groups. The culturally deprived groups tended to be less clear in the justification given for their performances than the middle class children. Differences between races and sexes were not significant. This writer's major criticism of Wei's study is that the inclusion of race as an independent variable in the experimental design appeared to have been an after thought. The

original hypotheses did not involve race as a variable. Also the extremely small N for the Negro sample would necessarily weaken any statistical analysis since that number would have to be spread out among four distinct sub-groups. Despite these weaknesses, the study adds to the findings of previous studies which indicate significant differences in cognitive development among SES groups.

Summary

Despite much variation in methodology and the cultural settings of the studies discussed, there is considerable consistency of findings supporting certain features of Piaget's theories. The sequences, more than the timing of the stages described by Piaget, have received almost unanimous confirmation. Correlation of various Piagetian tasks with other existing measures of mental ability are reported to be low positive. Explanations for these findings as Almy (1966) and many others have commented, refer to the probability that Piaget's theory is based on a different concept of intelligence than those underlying the usual test of mental abilities.

The role of experience in cognitive development has not yet been adequately assessed. Piaget (1964) himself only indicates that experience is important in the development of thinking but offers no further clarification. Approaches that induce cognitive conflicts and that offer direct specific training on the concepts seem to be fruitful. Comparative and training studies may yet throw some light on the

kind of stimulation that aids transition from one level of thought to another. Such information would be useful in planning the education of young children. The content of the curriculum, the timing of concepts taught to the children, and the method of presenting the information are some of the areas that could be affected.

Knowledge of group characteristics as they pertain to cognitive growth and development would also be of immeasurable worth in helping to plan programs and curriculums. The results of cross-cultural studies so far leave no doubt as to the existence of significant differences in rate of cognitive growth based on socio-economic status. But there is a definite scarcity of knowledge about the nature of racial differences in the process of cognitive development in children.

CHAPTER III

METHODOLOGY

The purpose of this chapter is to describe the procedures utilized in the present study. The organization is as follows: (a) the setting of the study, (b) the description of tests used in this study, (c) selection of subjects, (d) the experimental procedure, and (e) the treatment of the data.

Setting

The study was conducted in a large urban school system which is located in the center of a large midwestern metropolitan area. .A recent government survey, Transportation and Land Use Study (TALUS, 1968), shows the population to be one and one-half million, and it is the largest of the forty-six communities included in the survey. The survey statistics show that the total community has a sixty percent to forty percent non-white to white ratio.

Table 1 lists pertinent economic and living conditions characteristic of the two subcommunities from which the sample for this study was drawn. The data point out significant contrasts between the two subcommunities on the characteristics listed in the table. The low SES subcommunity compares unfavorably with the middle SES subcommunity on

TABLE 1

COMPARISON OF ECONOMIC AND LIVING CONDITIONS BY HEADS OF HOUSEHOLDS IN THE TWO SUBCOMMUNITIES FROM WHICH THE SAMPLE WAS DRAWN[a]

	Low SES Subcommunity	Middle SES Subcommunity
Total Population	34,000	43,000
Persons Per Housing Unit	3.1	2.9
Percent Households Non-White	42.4	10.0
Percent Own or Buying Home	42.3	89.1
Percent 1-Family Home	29.0	88.8
Percent Residence 10 Years or More	42.6	51.4
Percent Female Heads of Households	30.7	14.9
Percent 8 Years or Less Schooling	61.8	16.2
Percent High School Graduate	12.0	36.3
Percent College Graduate	1.9	17.6
Percent White Collar	16.1	62.6
Percent Blue Collar	83.9	37.4
Percent Family Income Under $5,000	59.4	18.3
Percent Family Income Over $10,000	4.3	35.2
Median Family Income	$4020	$8600

[a]Data Taken From TALUS (1968)

each of the important SES characteristics listed. In general, the residents of the low SES subcommunity tend to live in more crowded conditions, have less privacy, be more transient, and have more households without a male identification model. In a comparison between educational and occupational characteristics of the two groups, the low SES group compares even worse. More than one-half of the heads of household in the low SES subcommunity have eight years of education or less as compared to about one-sixth of the middle SES group. While only twelve percent of the low SES heads of household have a high school education, thirty-six percent of the middle SES residents are high school graduates. In higher education the gap is even wider. Only two percent of the low SES group are college graduates while seventeen and one-half percent of the middle SES group are college graduates.

The most significant SES variable is family income. A comparison of the family income between the low SES subcommunity and the middle SES subcommunity revealed that the middle SES median family income ($8600) is more than twice that of the lower SES subcommunity median family income ($4020). The data indicate that there are significant socio-economic differences between the two subcommunities.

Approximately 300,000 are enrolled in the public school system. This study was conducted at three elementary schools in the system. One of the schools was located in the low SES subcommunity and two of the schools were located in the middle SES subcommunity. In order to secure an

adequate sample of Negro and white middle SES children it was necessary to use two middle SES schools from the same SES subcommunity; one predominantly white, the other predominantly black.

Instruments and Measures

The Cognitive Development Interview Schedule

Piaget (1929) describes a clinical method of interviewing which he used in his investigations of children's development of cognitive structures. For him the clinical method is one in which the examiners' questions depend on the responses of the child. The examiner is free to follow any interesting leads and to vary the questions to make sure the child understands. Thus the child determines the nature of the question he is being asked. This type of interview required a high level of skill on the part of the interogator. It has not been used widely by other investigators.

Other investigators who have undertaken studies based on Piaget's research have successfully adopted three types of interview methods. Wohlwill (1960) and Braine (1959) have used non-verbal methods. Dodwell (1960) used individual standardized interviews while King (1961) used standardized group tests. A standardized individual interview was selected for this study in order to allow for comparability from one child's interview to another. Also the children's reactions during the interview were noted.

Piaget's clinical method, although inefficient in terms of time, has the advantage of probing further into a

child's responses and allowing the child sufficient opportunities to express what he really understands. Since the standardized interview method loses such flexibility, some researchers have included procedures which assure that the child understands the task or the question being asked. Two of these procedures which were used in the present study are 1) orientation sessions were included to give the children practice with important words and ideas to be used in each of the three parts of the test, and 2) important test questions were rephrased or repeated so that the child understood what was expected of him.

The final tasks were selected after an informal pilot study conducted at the summer session of the University Elementary School. A total of twenty children were informally tested and the results were analyzed during and after the testing session and adjustments were made in the language of the question as well as the tasks themselves. Some tasks were deleted while others were added so that the final selection of tasks represents a consideration of the types of problems that would serve equally well at the different age levels and with different groups of children. Therefore each section contains tasks which according to Piaget present some "simpler situations" as well as some more complex problems.

The complete Cognitive Development Test manual of instructions, along with its detailed account of the materials used and administration procedures for each task, is reproduced in Appendix A, so only a brief description of tasks and their sources are given below.

Also to be found in the Appendices are the following items: Appendix B--a copy of the test protocol; Appendix C--The Personal Data Sheet; Appendix D--Instructions for scoring the test protocol; Appendix E--Statistical characteristics of the test (validity, reliability, objectivity).

Conservation

In an initial orientation session the subjects were requested to compare two rows of blocks that were obviously unequal in number. They were encouraged to make the numbers in the two rows equal. The examiner alternated in making the rows equal or unequal in number of blocks by taking away or adding to one or the other rows. The purpose was to familiarize the subject with the use of the terms "same" and "more." Also during this time the subject was introduced to the non-suggestive question, "What about now"? which was used in later parts of the test.

Task A: The blocks in the interviewer's row were bunched and the child was questioned about the numerical equivalents of the two rows of blocks. The question was rephrased and repeated until the child made a declaration. Then he was asked, "Why do you think so"?

Task B: This task was set up in the same manner as the preceeding one but the questions were asked after the blocks in the child's row were spread out.

Task C: This test was for conservation of area instead of quantity as the preceeding two tasks were. Two eight by

eight green "fields of grass" were placed before the child and a minature horse was placed upon each field. The examiner alternately added "barns" (blocks) to one field or the other and the child was asked to make a judgment as to the equivalence of grass each horse had left to eat. This procedure was repeated until six "barns" were in each of the "fields." In one field the blocks were bunched and in the other they were spread out. The child was then asked, "Which horse has more grass to eat or do they both have the same"? Regardless of his answer he was asked to justify it by the question, "Why"?

Seriation and Ordination

The orientation section was designed to give the children practice in arranging objects in order of size. The subjects were given five "houses" of uniform variation in height and asked to arrange them according to size. Assistance was given when the subject needed it.

Task A: Each subject was required to arrange seven "houses" according to their size.

Task B: The subjects were required to seriate two sets of objects, dolls and "packages," such that the tallest doll carried the largest "package" and the smallest doll carried the smallest "package."

Task C: After arranging the dolls and packages the subjects were asked a series of questions based on the arrangement. The questions were designed to investigate the subjects'

understanding of the numerical order they assigned the objects when they counted them previously. According to Piaget (1952) ordinal numeration is a more complex task than cardination (counting). In order to ordinate, the subject is forced to hold the relationship of each individual object to the rest of the objects in the group. The subjects were asked in turn to identify the fourth man, the three smallest packages, and the second largest man.

Classification

Again there was an orientation section that was designed to introduce the children to the activity of grouping.

Task A: The child was given a collection of animals of varying colors and size and asked to sort them into groups that were alike and then asked to explain the criterion for their grouping.

Task B: This was also a sorting task. Here the child was asked to sort the animals again into groups that were alike but to use a different scheme than that used in Task A. This was a task to ascertain whether or not the child was able to attend to more than one attribute of an object.

Task C: This task measured the child's understanding and ability to work with the concept of hierarchy of classification in both ascending and descending order. This was the only completely verbal task in the entire test.

Task D: This task tested the subjects' understanding of part-whole relationships as well as the subjects' understanding of the shared attribute of objects.

Order of Presentation

The tasks were presented in the same order to all subjects. The testing started with the conservation problems A and B, followed by C. The seriation tasks were next presented and the classification problems ended the test. This arrangement was maintained so that a non-verbal response section (seriation and ordination) separated the two verbal parts of the test on conservation and classification.

Peabody Picture Vocabulary Test (PPVT)

The Peabody Picture Vocabulary Test (PPVT) was chosen to serve as a second dependent variable and also to provide an assessment of the subjects' intellectual maturity. The selection was made because it is conveniently used with a group of children who may not be able to read and it is relatively easy to administer and score. The PPVT can be administered in fifteen minutes to young children by relatively untrained personnel.

The PPVT was standardized on 4,012 cases: 92 at the two-six level; 92 at the three-zero level; 119 at the three-six level; 110 at the four-zero level; 122 at the four-six level; and 133 at the five-year level. According to Dunn (1965), who contributed the test, it appears to have congruent validity, or validity defined as the extent to which the PPVT score compares with scores on other vocabulary

and intelligence test scores. Correlations arranging from .82 to .86 with a median of .83 have been obtained with mental ages obtained on the 1963 Binet. The highest correlations were obtained when children over a wide age range across the full range of intellectual ability served as subjects.

In that the children were not routinely tested for intellectual ability, the PPVT provided the only measurement for comparison of intellectual functions.

Personal Data Sheet

A personal data sheet (see Appendix C) was used to collect broad and general information about the type of home, family interactions, and culture experiences of each subject. The information sought was the kind that could be supplied by the school records or the subjects themselves. When these sources proved inadequate, contact was made with the parents by phone. In a few cases the parent was contacted by means of written communication.

The Selection of Subjects

The sample of children was drawn from three elementary public schools in Detroit. One of the public schools was in a low SES area and two of the schools were in a middle SES area. As stated earlier, it was necessary to use two middle SES schools in order to get sufficient numbers of both black and white subjects.

The SES status of the groups were determined from

data resulting from the TALUS (1966) study. The population was considered to be a self-defined one. The definition of Negro was determined by the community and the subjects and their parents. The sample population was further restricted to children in attendance at school at the time of the study. As previously mentioned, only boys were used in the sample.

The basic cross-sectional design was a two by two by two--two SES levels, two races, and two grade (age) groups. Lists of all first and third grade boys were obtained from the teachers in each of the three schools. All grade repeaters were eliminated. It was also decided at this time to eliminate all subjects who scored under 70 or over 130 on the PPVT. It was unnecessary to eliminate any subjects because of this criteria. A total of 20 subjects (16 original and 4 alternates) were randomly assigned to each of the eight groups using a stratified random sampling procedure. The list of names were stratified along the dimensions of the three independent variables: class, race and grade.

The eight groups formed were as follows:

1. Low SES, white, first graders (LW1)
2. Low SES, white, third graders (LW3)
3. Low SES, black, first graders (LB1)
4. Low SES, black, third graders (LB3)
5. Middle SES, white, first graders (MW1)
6. Middle SES, white, third graders (MW3)
7. Middle SES, black, first graders (MB1)
8. Middle SES, black, third graders (MB3)

A total of 128 subjects (8 groups of 16 each) were tested by two examiners; one black, the author of this paper, and one white. An equal number of children from each SES, race, and grade group was tested by each of the examiners. In addition, there was counterbalancing to control for time-of-day testing affects as well as an increase in examiner skill effects.

Table 2 lists some demographic characteristics of SES and race sub-groups within the sample. There were highly significant differences between the low SES and middle SES groups which supports the use of subcommunity residency as the major basis of assignment of subjects to SES categories.

Because during the original sampling procedure, allowance was made for loss or disqualification of subjects by providing alternates for each sub-group, an equal N was maintained throughout. Nine alternates were used due to some subjects' families moving from the school district. The alternates were taken in turn as listed on the alternate list.

Testing Procedure

Each of the two examiners were supplied with lists of names of subjects each was to test in the three buildings. The lists were divided into morning and afternoon sessions. The examiners alternated among the three buildings, the same examiner returning to the same building about every fourth school day. During mornings the examiners took the subject at the top of his morning list and during afternoons he took

TABLE 2

DEMOGRAPHIC CHARACTERISTICS OF SES AND RACE SUBGROUPS WITHIN SAMPLE

Subgroup	N	Head of House-Hold's Educ.	% of Heads of House-Holds in Top 4 Occups.	% on Wel-fare	No. of Younger Sibs.	No. of Older Sibs.	Total No. of Sibs.	Person To Room Ratio	% With No Male Model	Child's Age in Months
White	64	11.1	37.1	6.3*	1.2	1.9	3.1	1.0	9.4	90.1
Black	64	11.0	38.3	18.8*	1.3	2.0	3.9	1.1	18.8	88.7
Middle SES	64	12.4	66.1**	0.0**	1.0	1.5	2.5	0.9	1.9**	88.3
Low SES	64	9.8	6.1**	25.0**	1.6	2.4	3.8	1.2	26.6**	89.9
White Middle	32	12.5	66.7	0.0	1.0	1.5	2.6	0.9	3.1	89.8
Black Middle	32	12.3	78.2	0.0	0.9	1.5	2.3	0.8	0.0	87.8
White Low	32	9.8	9.4	12.5*	1.4	2.2	3.7	1.1	15.6*	90.5
Black Low	32	9.7	3.0	37.5*	1.7	2.7	4.0	1.3	37.5*	89.5
Total Sample	128	11.1	37.7	12.5	1.3	1.9	3.1	1.0	14.1	89.4

*Significant at .05 level.
**Significant at .01 level.

the subject at the top of his afternoon list. Testing was done individually in a private room. Only one session was required for each subject. The time involved ranged from thirty-five to forty-five minutes. The tests were administered in the same order by both examiners.

The personal data sheet was completed first. This served the dual purpose of getting the desired information from the subjects as well as establishing rapport before testing.

Administering the PPVT followed the completion of the personal data sheet. This helped to establish rapport in that the subject received no negative feedback when he failed items on the PPVT.

The last instrument to be administered was the cognitive development instrument. After this task was completed, the child was thanked for his cooperation and returned by the examiner to his classroom. The total testing of 128 subjects was completed within a one-month period.

Analysis of Data

In all cases of data analysis involving individual subjects, raw scores were used. In those cases of analysis involving the total Cognitive Development Score, a mean standard score derived from the standard scores of the three subtests was used. The use of standard scores provided for the equal weighting of the three subtests despite an unequal number of items.

In those cases dealing with the PPVT measures, the derived intelligence quotient was used.

The characteristics of reliability, validity and objectivity of the cognitive development scale were determined by using samples of the previously tested population. These results are reported in Appendix E.

CHAPTER IV

RESEARCH FINDINGS

The general plan of this chapter is to present the findings related to each hypothesis in the order in which they are listed in Chapter I. The procedure is as follows: (a) List the hypothesis by number, followed by the groups under comparison; (b) state the hypothesis in null form, when appropriate; and (c) present the results. Examination of the data has in some instances proceeded beyond that needed to test the original hypotheses. These results are presented in a separate section at the end of the chapter.

For hypothesis testing, the investigator has chosen a three-choice decision -- rejection, acceptance, or suspended judgment. If the deviation is significant at the .05 level or better, the null hypothesis is rejected; if the deviation is smaller than the boundary of the critical region at the .10 level, H_o is not rejected. Between the two levels, .10 and .05, judgment is suspended.

Hypothesis 1: Middle SES vs. Low SES

The null hypothesis states in this case that there is no difference in cognitive test scores between middle SES children and low SES children.

An analysis of variance shows a significant difference in test scores between the two SES groups. ($F = 29.11$, $F_{.01} = 6.94$ for 1 and 120 degrees of freedom.) These results, along with the main effect results of Grade and Race, are listed in Table 3.

Subtest analysis of variance results for Conservation, Seriation and Classification subtests are listed in Tables 4, 5, and 6 respectively. Table 4 shows there is a significant difference in conservation skills between the two SES groups. ($F = 6.23$, $F_{.05} = 3.92$ for 1 and 120 degrees of freedom.) Table 5 shows there is a significant difference in seriation scores between the two SES groups. ($F = 22.59$, $F_{.01} = 6.94$ for 1 and 120 degrees of freedom.) Table 6 shows a significant class effect for classification ability. ($F = 18.34$, $F_{.01} = 6.94$ for 1 and 120 degrees of freedom.)

TABLE 3

ANALYSIS OF VARIANCE OF TOTAL COGNITIVE SCORES

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F	p
Class	1062.26	1	1062.26	29.11	.01
Grade	2363.80	1	2363.80	64.79	.01
Race	153.27	1	153.27	4.20	.05
Class X Grade	35.01	1	35.01	< 1	ns.*
Class X Race	8.70	1	8.70	< 1	ns.
Grade X Race	5.60	1	5.60	< 1	ns.
Class X Grade X Race	109.56	1	109.56	3.00	ns.
Between	4378.22	120	36.49		

*Not significant

TABLE 4

ANALYSIS OF VARIANCE OF CONSERVATION SCORES

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F	p
Class	32.00	1	32.00	6.22	.05
Grade	112.50	1	112.50	21.89	.01
Race	0.28	1	0.28	< 1	ns.*
Class X Grade	1.53	1	1.53	< 1	ns.
Class X Race	15.12	1	15.12	2.94	ns.
Grade X Race	0.13	1	0.13	< 1	ns.
Class X Grade X Race	11.28	1	11.28	2.20	ns.
Between	616.63	120	5.14		

*Not significant

TABLE 5

ANALYSIS OF VARIANCE OF SERIATION SCORES

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F	p
Class	45.13	1	45.13	22.59	.01
Grade	91.13	1	91.13	45.61	.01
Race	9.03	1	9.03	4.52	.05
Class X Grade	9.03	1	9.03	4.52	.05
Class X Race	1.13	1	1.13	< 1	ns.*
Grade X Race	0.00	1	0.00	< 1	ns.
Class X Grade X Race	7.03	1	7.03	3.52	ns.
Between	239.75	120	2.00		

*Not significant

TABLE 6

ANALYSIS OF VARIANCE OF CLASSIFICATION SCORES

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F	p
Class	52.53	1	52.53	18.34	.01
Grade	91.13	1	91.13	31.81	.01
Race	15.13	1	15.13	5.28	.05
Class X Grade	2.53	1	2.53	< 1	ns.*
Class X Race	5.28	1	5.28	1.84	ns.
Grade X Race	0.50	1	0.50	< 1	ns.
Class X Grade X Race	0.31	1	0.31	< 1	ns.
Between	343.75	120	2.86		

*Not significant

Table 7 was prepared to demonstrate the direction of difference between the two SES groups.

TABLE 7

CONSERVATION, SERIATION, CLASSIFICATION AND TOTAL COGNITIVE DEVELOPMENT SCORES FOR LOW AND MIDDLE SES GROUPS

Group	Subtest Scores*						Total Test Scores**	
	Conservation		Seriation		Classification			
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Low	4.64	2.37	5.73	2.04	5.95	2.05	47.13	8.42
Middle	5.64	2.53	6.92	1.23	7.23	1.75	52.88	6.41

*Raw scores
**T-scores

Table 7 shows that for the three subtests and the total score the mean differences are in favor of the middle SES group. Thus, null hypothesis 1 is rejected. The middle SES children scored significantly higher than the low SES children.

Hypothesis 2: Third Grade vs. First Grade

The null hypothesis states that no difference exists between the means of the populations of first and third graders from which the samples were drawn.

Table 3 shows a statistically significant grade (age) effect for total cognitive score ($F = 64.79$, $F_{.01}$ for 1 and 120 degrees of freedom = 6.94.) Tables 4, 5, and 6 show statistically significant grade (age) effects ($F = 21.89$, $F_{.01}$ for 1 and 120 degrees of freedom = 6.94), ($F = 45.61$, $F_{.01}$ for 1 and 120 degrees of freedom = 6.94), and ($F = 91.13$, $F_{.01}$ for 1 and 120 degrees of freedom = 6.94) for conservation, seriation and classification respectively.

Table 8 was constructed to show the direction of difference between the two age groups.

TABLE 8

CONSERVATION, SERIATION, CLASSIFICATION AND TOTAL COGNITIVE DEVELOPMENT SCORES FOR FIRST AND THIRD GRADE GROUPS

Group	Subtest Scores*						Total Test Scores**	
	Conservation		Seriation		Classification			
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
First	4.21	2.40	5.48	1.91	5.75	1.92	45.71	7.30
Third	6.08	2.21	7.17	1.13	7.44	1.73	54.30	6.17

*Raw scores **T-scores

Table 8 shows that for the three subtests and the total score the statistically significant grade effects are in favor of higher scores for the older group. Thus, Hypothesis 2, postulating no difference in mean scores between the two groups, is rejected.

Hypothesis 3: Black vs. White Race

The null hypothesis states that there is no difference in cognitive test scores between black children and white children.

Table 3 shows a statistically significant race effect for total cognitive score ($F = 4.20$, $F_{.05}$ for 1 and 120 degrees of freedom = 3.92). Table 4 shows that an analysis of variance of conservation subtest results produced no statistically significant race effect ($F = 0.05$, $F_{.05}$ for 1 and 120 degrees of freedom = 3.92). Tables 5 and 6 show statistical significant race effects ($F = 4.52$, $F_{.05}$ for 1 and 120 degrees of freedom = 3.92), and ($F = 5.28$, $F_{.05}$ for 1 and 120 degrees of freedom = 3.92) for seriation and classification respectively.

Table 9 was prepared to demonstrate the direction of difference between the two race group means.

Table 9 shows that for two out of three subtests and the total score, the statistically significant race effects are in favor of higher scores for the white group. Even in the case of conservation, which did not reach statistical significance, the direction of difference is the same. Thus,

TABLE 9

CONSERVATION, SERIATION, CLASSIFICATION AND TOTAL COGNITIVE DEVELOPMENT SCORES FOR BLACK AND WHITE RACE GROUPS

Group	Subtest Scores*						Total Test Score**	
	Conservation		Seriation		Classification			
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Black	5.09	2.35	6.06	1.74	6.25	2.15	48.91	8.01
White	5.18	2.65	6.59	1.79	6.94	1.80	51.11	7.85

*Raw scores
**T-scores

on the basis of the analysis of variance results for the total score, Hypothesis 3 is rejected. That is, one may conclude that the white children on the whole made significantly higher cognitive test scores than did the black children.

Hypothesis 4: Middle SES White vs. Middle SES Black

The null hypothesis states that there is no difference in cognitive test scores between middle SES white and middle SES black children.

A t test of a difference between means was applied to the data. The results for total cognitive score are inconclusive (t = 1.79, $t_{.10}$ for 120 degrees of freedom = 1.67). On the basis of this result, judgment concerning Hypothesis 4 is suspended. Despite a definite trend toward higher cognitive performance for white middle SES children, it cannot be concluded that white middle SES children scored

significantly higher than black middle SES children on the total Cognitive Development Test.

A t test was also performed on each of the three sets of subtest data. Significant difference between means was found for seriation and classification (t = 2.04, $t_{.05}$ for 120 degrees of freedom = 1.98) and (t = 2.07, $t_{.05}$ for 120 degrees of freedom = 1.98) respectively. Thus, it may be concluded that white middle SES children scored significantly higher than black middle SES children on both the seriation and classification tasks.

Analysis of difference between means for conservation supports the null hypothesis of no difference (t = 1.38, $t_{.05}$ for 120 degrees of freedom = 1.98).

Table 10 was prepared to demonstrate the direction of difference between means of the middle SES black and white groups.

TABLE 10

CONSERVATION, SERIATION, CLASSIFICATION AND TOTAL COGNITIVE DEVELOPMENT SCORES FOR MIDDLE-WHITE AND MIDDLE-BLACK GPS.

Group	Subtest Scores*						Total Test Scores**	
	Conservation		Seriation		Classification			
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
M-White	6.03	2.60	7.28	0.92	7.38	1.64	54.24	5.78
M-Black	5.25	2.45	6.56	1.39	7.09	1.87	51.53	6.80

*Raw scores
**T-scores

Table 10 shows that for each comparison, higher mean scores in favor of middle SES white children exists.

Hypothesis 5: Low SES Blacks vs. Low SES Whites

The null hypothesis states that there is no difference in cognitive test scores between low SES black and low SES white children.

A t test of a difference between means was applied to the data. The results show no significant difference between means for total cognitive score (t = 1.10, $t_{.05}$ for 120 degrees of freedom = 1.98). It can be concluded from this result that either there is no difference in test performance between the two groups or the difference is quite small.

A t test was also performed on each of the three sets of subtest data. No significant difference between means of middle SES black and white subjects was found for conservation (t = 1.05, $t_{.05}$ for 120 degrees of freedom = 1.98) and seriation (t = 0.97, $t_{.05}$ for 120 degrees of freedom = 1.98). Analysis of difference between means of the Conservation subtest fails to support the null hypothesis of no difference (t = 2.59, $t_{.05}$ for 120 degrees of freedom = 1.98).

Table 11 was prepared to show the direction of difference between means of the low SES black and white groups. Table 11 reveals that for seriation, classification and total score, the higher means are in favor of the low SES

whites. For conservation, the higher mean favors the low SES blacks.

TABLE 11

CONSERVATION, SERIATION, CLASSIFICATION AND TOTAL COGNITIVE DEVELOPMENT SCORES FOR LOW-BLACK AND LOW-WHITE GROUPS

Group	Subtest Scores*						Total Test Scores**	
	Conservation		Seriation		Classification			
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
L-Black	4.94	2.27	5.56	1.92	5.41	2.09	46.29	8.36
L-White	4.34	2.46	5.91	2.18	6.50	1.88	47.96	8.54

*Raw scores
**T-scores

Hypothesis 6: Middle SES Blacks vs. Low SES Whites

The null hypothesis in this case is that there is no difference between means of cognitive test scores for middle SES blacks and low SES whites.

A t value was computed for difference between means. The results indicate a significant difference between means for total cognitive score (t = 2.37, $t_{.05}$ for 120 degrees of freedom = 1.98). Thus, the null hypothesis is rejected. That is, one may with ninety-five percent confidence conclude that the middle SES black group scored significantly higher than the low SES white group on the total cognitive scale.

The significance test for difference between means on the three sets of subtest data yielded mixed results.

For seriation, the results are inconclusive ($\underline{t}$ = 1.86, $\underline{t}_{.10}$ for 120 degrees of freedom = 1.67). For conservation and classification, the difference between means of the middle SES black and low SES white groups approaches significance but does not reach it ($\underline{t}$ = 1.60, $\underline{t}_{.05}$ for 120 degrees of freedom = 1.98) and ($\underline{t}$ = 1.40, $\underline{t}_{.05}$ for 120 degrees of freedom = 1.98) respectively.

Table 12 was prepared to demonstrate the direction of difference between means of the middle SES black and low SES white groups.

TABLE 12

CONSERVATION, SERIATION, CLASSIFICATION AND TOTAL COGNITIVE DEVELOPMENT SCORES FOR MIDDLE-BLACK AND LOW-WHITE GROUPS

Group	Subtest Scores*						Total Test Scores**	
	Conservation		Seriation		Classification			
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
M-Black	5.25	2.45	6.56	1.39	7.09	1.87	54.24	5.78
L-White	4.34	2.46	5.91	2.18	6.50	1.88	47.96	8.54

*Raw scores
**T-scores

Table 12 shows that for each comparison, the middle SES black group mean is greater than the low SES white group's.

Hypothesis 7: (Middle-White - Low-White) vs. (Middle-Black - Low Black)

In this case, the null hypothesis is that there is no difference in the difference between means of the two SES

groups when within race comparisons are made.

The t test for significant difference of a difference between means was performed. No significant difference was found ($t = 0.49$, $t_{.05}$ for 120 degrees of freedom = 1.98). Thus, Hypothesis 7 is not rejected. That is, one can with ninety-five percent confidence assert that the difference in means resulting from a within race comparison of the difference between performance of the two SES groups is equal or else very small.

A t test was also performed on each of the three sets of subtest data. No significant difference between differences was found for seriation and classification ($t = 0.75$, $t_{.05}$ for 120 degrees of freedom = 1.98) and ($t = 1.36$, $t_{.05}$ for 120 degrees of freedom = 1.98) respectively. Analysis of Conservation subtest data yielded results contrary to the results for seriation, classification and total score ($t = 1.72$, $t_{.10}$ for 120 degrees of freedom = 1.67). Thus, for conservation, judgment is suspended.

Hypothesis 8: (M-1st - L-1st) vs. (M-3rd - L-3rd)

In this case the null hypothesis states that there is no difference in the difference between means of the two SES groups when within grade comparisons are made.

Hypothesis 8 predicted a greater difference between middle and low SES means at the third-grade level than at the first-grade level. It is evident by mere inspection that the difference occurred in reverse of the direction predicted. However, a t test for the significance of the

difference between differences of means was performed to determine whether the reverse difference was significant. The result led to the null hypothesis not being rejected (t = 0.98, $t_{.05}$ for 120 degrees of freedom = 1.98).

A confidence interval and confidence limits were computed. As a result, it can be stated with ninety-five percent confidence that the population difference of a difference between means lie in a range from 2.15 when (M3 - L3) $>$ (M1 - L1) to 6.33 when (M3 - L3) $<$ (M1 - L1). From this result it can be expected, by chance, for the largest difference between SES groups to occur more frequently at the first-grade level than at the third. Thus, one can conclude that SES group differences in cognitive test performance do not increase with age. Instead, the trend points toward a decrease in differences with age.

Analysis of subtest data also revealed a trend of smaller differences between means in favor of the older group. However, only in the case of seriation was the difference of a difference significant (t = 2.13, $t_{.05}$ for 120 degrees of freedom = 1.98). Thus, for seriation, the null hypothesis is rejected.

Hypothesis 9: Low SES vs. Middle SES Concerning Concurrent Development

The null hypothesis states that no difference between correlation coefficients will result from subtest comparisons.

Because of the relatively small sample size, a non-parametric test for significance of the difference between correlation coefficients was employed.

Table 13 was prepared to demonstrate the direction of difference between each of the six comparisons of SES groups. The binomial model was applied to the data and a probability value for the likelihood of all six comparisons differing in the same direction by chance was obtained ($.01 < p < .02$). Thus, the null hypothesis of no difference is rejected. That is, we can be at least ninety-eight percent certain that the low SES group of either race show a stronger trend toward concurrent development of cognitive skills than their middle SES counterparts.

TABLE 13

CORRELATION COEFFICIENTS FOR SUBTEST COMPARISONS BETWEEN SES AND RACE GROUPS

Group	Subtest Comparisons					
	Consv. vs. Ser.		Consv. vs. Class.		Ser. vs. Class.	
	Black	White	Black	White	Black	White
Middle	.44	.36	.29	.16	.24	.37
Low	.54	.54	.48	.40	.54	.51

Analysis of Variance for PPVT

Although no hypotheses were offered involving PPVT scores, an analysis of variance was performed on the data. The result of the analysis is reported in Table 14.

As can be seen, only the main effect of class reached statistical significance.

TABLE 14

Analysis of Variance for PPVT Scores

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F	p
Class	6917.82	1	6917.82	46.04	.01
Grade	6.57	1	6.57	<1	ns.*
Race	239.26	1	239.26	1.59	ns.
Class X Grade	17.26	1	17.26	<1	ns.
Class X Race	21.95	1	21.95	<1	ns.
Grade X Race	122.07	1	122.07	<1	ns.
Class X Grade X Race	13.13	1	13.13	<1	ns.
Between	18030.81	120	150.26		

*Not significant

In addition, a correlation coefficient for the relationship between the PPVT and Cognitive Development Test was computed. They were found to be moderately correlated ($r = .39$). Correlation coefficients for the relationship between the PPVT and each subtest; Conservation, Seriation and Classification, were computed. Coefficients of .30, .39 and .25 respectively were obtained.

CHAPTER V

EXPLANATIONS AND STRATEGIES OF THE SUBJECTS

The general purpose of this chapter is to describe the different approaches to problem solving used by assorted groups of subjects. An attempt will be made to examine the main qualitative differences in the performance of the younger subjects and their older counterparts. In addition, similar comparisons will be made between the two SES groups.

Mode of Responses

As mentioned earlier in this study, Piaget postulates that young children have two basic approaches to problem solving, the intuitive and the operational. The intuitive child depends largely on perceptual attributes of the problem and centers on only one aspect of the problem at a time. In contrast, the operational child, who is capable in varying degrees of conserving, seriating and classifying, is not only less dependent on perceptual properties of an arrangement, but is able to go beyond the "givens" of the situation, and analize and sythesize different relationships of the problem.

In this chapter the responses are described as they progress from perceptually based strategy to the internalized, synthesizing style of problem solving.

Comparison Group Composition

In order to illustrate the important differences in the approach of the intuitive and operational subjects, they have been divided into two groups; the poorest performers (Group P) and the best performers (Group B). Group P is composed of the eight poorest performing first-grade subjects and the eight poorest performing third-grade subjects. Group B is composed of the eight best performing first-grade subjects and the eight best performing third-grade subjects. There is a total of sixteen subjects in each group. In that all but one of the sixteen subjects in Group P are in the low SES category, and all but two of the subjects in Group B are in the middle SES category, the comparison by performance level is also, in effect, a comparison of SES groups.

In order to avoid redundancy, this qualitative analysis of responses is restricted to representative tasks from each of the three subtests.

Conservation

On Task A the subjects were required to determine the numerical equivalence of two sets of blocks after one row of blocks had been bunched.

Three distinct levels of responses were considered. At a very intuitive level, some subjects were unable to focus on aspects of the problem necessary for its solution. Instead, their comments tended to be irrelevant to the solution. Responses such as "they both have a lot" and "I just

know," along with those responses describing some perceptual quality of the object (color, etc.), are examples of the irrelevant response. Four children used such explantions, three first graders and one third grader, all from Group P.

At a more advanced level, responses were still perceptual but more specific about aspects of the array or action that was relevant to the problem. Such responses as "because this one is longer," used to express non-equivalence, or "because you only pushed yours together," denoting equivalence, are examples of perceptual or action-bound responses. A total of seventeen subjects, eleven in Group P and six in Group B, used the types of explanations described in this paragraph. Only one of the eleven from Group P used this type of explanation to support a correct response while five out of six Group B subjects solved the problem correctly using perceptual explanations.

The most advanced strategy used by the subjects was when they were able to relate two or more aspects of the problem. Some subjects related a past and a present state: "They're the same because they were equal when you arranged them before." Another set of responses compared appearance and reality, and still another went beyond the problem situation, realizing that some features of the objects, for example, number, could not be altered by rearrangements. They had, according to Piaget, internalized and coordinated their observations. Eleven subjects used explanations in this category, and all but one of them are in Group B. Only three of the eleven successful ones are first graders.

Seriation

In Tasks A and B the subjects were required to arrange houses, dolls and packages according to size. Since the Seriation subtest is mainly non-verbal, the subjects' actions rather than their explanations are described in this section.

The main difference between the two groups could be seen in the methods employed during the comparisons of objects. Table 15 shows the number of subjects from each group using the different methods. Five subjects, all from Group P, attempted to solve the problem with random movement of the objects. Four of the five were first graders and one was a third grader. Another six of the Group P subjects, equally divided between first and third graders, tried unsuccessfully to use two-at-a-time comparisons. They tended to compare A and B, then E and F without considering how the latter pair related to A and B. A total of fourteen subjects, four in Group P and ten in Group B, utilized the two-at-a-time method successfully. The ten Group B subjects were equally divided by grade but all four of the Group P subjects were from the third grade.

Six out of the seven subjects who seriated using mental comparisons were in the group of best performers. They were equally distributed between the two grades. The one performer using the mental comparison method was a third grader.

TABLE 15

METHODS EMPLOYED BY THE POOREST AND BEST PERFORMING GROUPS ON SERIATION TASKS

Group	Methods Employed							
	Random Movement		Two-at-a-Time (U)*		Two-at-a-Time (S)**		Mental Comparison	
	1st	3rd	1st	3rd	1st	3rd	1st	3rd
Poorest Perfor.	4	1	3	3	0	4	0	1
Best Performers	0	0	0	0	5	5	3	3
Total	4	1	3	3	5	9	3	4

*Unsuccessful
**Successful

Classification

Task A: In this sorting task the subjects were given a collection of animals and asked to group them on the basis of "sameness," or "likeness." Eight subjects, unable to maintain one criterion in the task, used mixed attributes of the animals, thereby failing the task. Only one of the eight was from Group B, and that one was a first grader. The seven poor performers who failed this task were almost evenly distributed between the two grades.

Fifteen of the sixteen best performers (Group B) gave explantions indicating that the groups were constructed on the basis of shared attributes. Responses such as "these are all ducks, these are all chickens, etc." and "there are four groups for the four different kinds of animals" were given.

Another interesting difference in the performance of the two groups was that three out of ten Group P subjects, all third graders, sorted on the basis of color, whereas none of the subjects in Group B sorted by color.

Task B: On this task the subjects were asked to "put the animals in groups that are alike in some other way." Eight of the nine poorest performers who sorted correctly in Task A failed Task B. They were evenly divided between first and third graders. In contrast, only four of the fifteen best performers who solved Task A failed to solve Task B. All of these were first graders. The subjects' responses and explanations suggested that they had difficulty decentering from the attribute which was used in Task A.

Task D: This task proved to be the most difficult on the test and it consequently had a very high discrimination factor, discriminating between the poorest and best performers. Only one subject in Group P solved this task, whereas nine subjects in Group B solved it.

Summary

In the comparison of intuitive and operations responses Piaget's descriptions have been upheld. The younger subjects were more intuitive in their explanations and responses than the older subjects. Low SES subjects were more intuitive than middle SES subjects. Some subjects offered operational explanations for easy tasks and regressed to intuitive explanations on difficult tasks such as the class inclusion problem.

CHAPTER VI

DISCUSSION AND IMPLICATIONS

Discussions in this chapter are based on the results reported in Chapters IV and V. Emphasis is placed on relating the results to the two basic purposes of the study. Those purposes were stated in the first chapter and are restated below:

1. Test the validity of Piaget's claim of concurrent development of conservation, seriation and classification structures for the population from which the sample of this study was drawn.

2. Provide some description of cognitive skills common to children from different SES, race, and age groups, as well as skills that differentiate among them.

The study deviated from the classical studies of Piaget in that a standardized, individual interview schedule was used instead of his flexible, clinical method of inquiry. Also, the analyses of data have been based on quanitative scoring of performance on a series of tasks rather than on the kind of depth of understanding shown in one of Piaget's experiments. The basic assumption behind the scoring procedure used in this study is that a subject who successfully completed conservation tasks A, B, C and D was necessarily a

"better" conserver than one who performed only tasks A and B or tasks C and D.

The remainder of this chapter is divided into two major parts. The first part is a general discussion of results along the lines outlined above. The second part of this chapter deals with some implications for education as well as further research which are indicated by the results and their interpretation.

Discussion of Results

The Development of Conservation and Related Abilities

According to Piaget's theory, the ability to conserve, seriate and classify develops simultaneously. The results of this study show that Piaget's claim is upheld in a general sense but that attainment of a particular level in one area does not presuppose a corresponding degree of ability in the others. The most developed of the three cognitive areas studied was seriation. The least developed was conservation. This finding is an expected one considering that maturation allows for the cognitive capacity essential for the attainment of these concepts to develop, and of the three areas studied, conservation appears to be most under the influence of the forces of maturation and least affected by experience, including formal education.

This result is in line with the finding reported by Sigel and Mermelstein (1966). They concluded that the disadvantaged milieu contributes differentially to cognitive

deficit, and that performance in classification skills is affected more adversely than is performance on conservation tasks.

The results of this study also indicate that conservation and the logical abilities of seriation and classification develop at various rates within different groups of children. The investigator hypothesized a stronger trend toward concurrent development of conservation, seriation and classification in favor of the low SES groups of both races. The hypothesis was supported. It was clearly evident that different race subjects of the same SES were more alike in rate of development than same race subjects of different SES. Apparently, the disadvantaged milieu, associated with low SES, results in that group being more homogeneous in rate of development than the middle SES group.

In conclusion, it can be said that conservation, seriation and classification may develop concurrently if the requisite experiences are provided by the environment. Also, the increased heterogeneity of the requisite experiences among middle SES children appears to lead to a decrease in concurrent development of cognitive skills for that group.

Cognitive Performance of Different SES, Race and Age Groups

Significant differences in performance on the cognitive tasks were found between the two SES groups, the two race groups, and the two age groups. The disparity in performance cannot be completely explained on the basis of superior intellectual maturity of one group or the other,

especially since intelligence was only minimally related to performance on the Cognitive Development Test. Experiential factors at home and in school are evidently responsible for part of those differences. The remainder of this section is devoted to relating some of these experiential factors and the cognitive performance of different age, race and SES groups.

Age Differences

The performance of older children was superior to that of their younger counterparts. This finding was not unexpected since all validation studies, except one (Estes, 1956), which were reported in Chapter II, found consistent differences between age groups on Piaget's cognitive tasks. This finding provides support for the validity of Piaget's stage theory of development.

In the comparison of qualitative differences in responses, Piaget's descriptions are also upheld. The younger children were more intuitive in their explanations and responses than the older children.

It is difficult to determine whether the older children perform better because of an advanced maturational level or due to enriched experiences. In Hypothesis 8 it was predicted that group differences based on SES would tend to increase with age. This hypothesis was not supported and, indeed, the trend was toward decreased differences with age. The fact that two years of schooling serves to narrow or at least arrest the widening of the gap between performance of

the two SES groups points to the possibility of differences in experiences as at least partly responsible for the original gap. It may be that school provides an enriched environment for the low SES children.

Race and SES Differences

The performance of white children was superior to that of their black counterparts. This main effect finding was not surprising in that, for this analysis, the race variable was confounded with SES and age variables. Other studies which confounded the two variables of race and SES (Semler and Iscoe, 1963 and John, 1963) reported similar results.

In addition to the race differences, the performance of middle SES children was superior to that of their low SES counterparts. This main effect finding was also hypothesized and is in agreement with several studies reviewed in Chapter II (Siller, 1957), (John, 1963), (Deutsch, 1964), and (Charlesworth, 1968).

There were no significant interaction effects between race and SES but since additional hypotheses were formulated in advance, the testing of these is justified.

Within the middle SES group, the performance on cognitive tasks by white children was not significantly different from that of black children. However, there appears to be some evidence of a trend toward differences in favor of the white children. The latter result was predicted by the investigator.

The rationale for that prediction was that although black and white groups can be equated along SES dimensions, the black children, due to the caste system, are deprived of many cognitively stimulating experiences that their white counterparts are privileged to enjoy. Such reasoning places the cause of performance differences heavily on experiential factors rather than maturational ones.

The outcome of the anlysis of individual subtest scores appears to support the above line of reasoning. It was found that for seriation and classification the white children's performance was superior but, for conservation, no significant difference was found. The study by Sigel and Mermelstein (1966) is relevant here. In this study, black children who had been deprived of schooling for four years were compared with black academically-experienced children on conservation and classification tasks. It was reported that deprivation of schooling did not produce significant differences in performance of the two groups on the conservation tasks. However, the opposite was true of the classification tasks. Thus, it would appear that since the significant differences between the two middle SES race groups are in those cognitive tasks which are most affected by experiential factors, enrichment of the black children's experiences, in school and at home, should prove quite fruitful.

No difference or, at the most, a relatively slight difference exists in cognitive performance between black and white children within the low SES group, except for classification skills, where the performance of low SES white

children was superior to that of their black SES counterparts. So, it would seem that the deprivations found in the low SES environment have an equally debilitating effect on black and white children, except in the case of classification skills, where the black children evidently suffer more.

Whiteman, et al., (1967) reported a high positive correlation between level or language development and classification skills. This result seems to indicate that a fruitful area to search for possible explanations for discrepancy in performance between the two race groups on classification tasks may well be the area of language development.

Deutsch (1964) studied relationships between SES, race, grade and language variables. He concluded that although the lower SES children of both races showed a deficiency in the abstract and categorical use of language, Negroes showed a lower ability in the areas of abstraction, verbalization and enumeration.

Deutsch noted that even when subjects are equated for SES, the Negroes tend to be poorer than whites. This fact may mean that the Negro is sequentially disadvantaged. Thus, they may have a double dose of cultural deprivation. One set of deprivations is accrued from his low SES membership and another by virtue of his caste.

Table 2 of this study shows that within the low SES group, the blacks are indeed poorer, have more peer group language models, have fewer adult language models, and live in more crowded conditions, all of which have negative effects upon language development and, consequently, upon acquisition of classification skills.

Another conclusion which can be made as supported by statistical evidence is that the performance of middle SES black children was superior to that of low SES white children. Thus, it appears that the accrued advantages gained by the middle SES black child by virtue of his higher SES overshadow the disadvantages associated with belonging to the black race.

This speculation is compatible with the conclusions of Bloom, Whiteman and Deutsch (1963), following a study in which they attempted to separate out the variables of race and social class in determining social environment. The important conclusion of this study was that social class appeared to be a more potent variable than race in predicting environmental factors.

Because of inconclusive evidence, the question of whether or not the black subjects are a more homogeneous group with respect to cognitive performance than the white subjects will have to go largely unanswered in this study. However, the fact that the black group proved to be more homogeneous with respect to conservation ability than the white group may in itself be quite significant. It has been previously assumed in this study that, of the three cognitive areas tested, conservation is the cognitive ability least determined by experiential factors, and most dependent on maturational factors. This assumption and the investigator's rationale that segregation and in-breeding has resulted in the black race being more homogeneous than the white race appear to compliment each other.

Implications for Education and Research

In this study, as in many others, Piaget's stage dependent theory of cognitive development has been generally upheld. In addition, this study has demonstrated that Piaget's theories can be fruitfully employed in examining the development of young children's thinking. The remainder of this section suggests ways that findings and conclusions of this study can be used in further research and in the education of young children.

Recommendations for Education

This study, and many others like it, have shown that children make a transition from an intuitive to an operational mode of thinking in problem solving. This study has quite conclusively shown that the pace of transition is slower in the black sample than in the white and slower in the low SES sample than in the middle SES sample. Almy, et al.,(1966) reported that the ability to conserve and classify is related to reading readiness and other aspects of school achievement. Therefore, the advantages of helping children to make the shift from intuitive to more mature forms of thinking are suggested but further testing is needed.

It is the contention of this investigator that three major factors mitigate against present research findings in education and psychology being translated into classroom practice. First, there appears to be both a conscious and unconscious resistance to change on the part of teachers. Second, the unavailability of many important research findings

makes the chances for their implementation by the classroom teacher remote. Third, and perhaps most important, the relevance of the research to the classroom is often questioned by teachers, either because there is no relevance or because the results can not be readily interpreted in classroom terms. An attempt has been made in the present research to cope with this third factor and the recommendations that follow are designed to add to that attempt.

Teacher Behavior

A modification in instructional methods can help the experientially disadvantaged children (those who show a serious cognitive development lag) to make the transition from intuitive to operational thought more efficiently. In their book written about the disadvantaged child, Crow, Murray and Smythe (1966) cite inadequate schooling along with shortcomings in the home environment as the major contributors to the disadvantaged child's continued low achievement level.

According to Piaget, and contrary to the emphasis of some writers of compensatory programs, additional perceptual training is not "the" answer to increasing logical thinking. In Piaget's theory, the action of the individual is crucial to the development of operational thinking. Therefore, teachers should make provisions for individual experimentation and direct manipulation of materials. Unfortunately, too many primary school teachers still use formal classroom methods which seriously restrict the child's active

involvement in classroom activities. This practice is especially true of low SES schools where it is common practice to restrict movement and activity by the children for the sake of maintaining strict classroom control and discipline. The extreme reserve of some children during the interviews, particularly the low SES children, may well have been an outgrowth of the above-described mode of training. It should also be mentioned that the middle SES children tend to have greater freedom of expression at home and in their schools.

According to Piaget, children need to be given the opportunity to discover, explore and manipulate concrete objects so as to learn about their different properties. The teacher can satisfy this need by making available to the children a wide assortment of different objects, most of which are inexpensive and easy to procure. The children could use such materials to practice sorting, grouping and serial ordering, sometimes with help from the teacher, sometimes without.

It must not be forgotten that in addition to limitations in their thinking, the low performers displayed serious deficiencies in expressive ability. Although Bernstein (1960) has shown that children using a "restricted" language code comprehend more than they communicate, communicating the solution to others is an essential part of problem solving. Koch (1954) has found that the child with the greatest proficiency in verbal skills tends to be the one with access to a good adult vocal model. In the case of the disadvantaged

child, it is often the teacher who must fill this role. Such methods as the extended response exercise, which force the child to extend his verbalizations, should prove fruitful.

Curricula

Piaget's notion of stage sequencing was supported in this study and it has relevance for what children ought to be taught. The importance of what should be taught in the different grades and classes has long been deep concerns of educators. Hunt (1961) spoke of "the problem of the match," referring to the pedagogically difficult problem of determining when the child is ready to move from one level of organizing information to another.

In the large urban classrooms, it would be difficult for the teacher to present material at precisely the time when each child is ready to make the shift, even if she did know when it occurred. The next best thing for the teacher to do is organize the class in small, flexible groups on the basis of careful assessments of cognitive abilities and rates of cognitive ability within the class. The teacher who arms himself with some of Piaget's tasks has at his disposal useful tools for assessing the progress of the pupils. In addition, his particular emphasis would more likely be on improving the children's approach to problem solving rather than the popular practice of teaching specific details and content.

Testing Programs

It is a well known axiom in educational circles that

a change in curricula and instructional procedures necessitates a change in the testing program. If the classroom teacher changes his emphasis from content teaching to teaching the process of problem solving, he must change his tests too. His test should no longer be constructed to assess what the children know, but how they think. Piaget's tasks, and variations of them, lend themselves well to just this kind of performance assessment.

An added advantage of a Piaget type test is that it allows the teacher to assertain the individual differences in rates of development among his pupils without the accompanying feelings of failure and defeat which generally follow a poor performance on a content oriented test.

Training of Teachers

It is unrealistic to expect to effect meaningful change in teacher behavior in the classroom without also changing some aspects of teacher training. Consider the recommendations that have been made for utilizing some of Piaget's concepts in the classroom. The academic background of many teachers, especially in slum schools, is inadequate. Thus, it may be difficult for them to read Piaget's accounts and select and use appropriate tasks. Such teachers obviously need some measure of training and help with the theory and practical application of the suggested methods. Part of this training necessarily involves a way of looking at children, realizing that they are different from adults not only in size but in their approach to problems.

In conclusion, Piaget's notions can be used as the basis for planning more developmentally appropriate curricula, improving instructional procedures, and assessing children's cognitive and problem solving abilities.

Research Implications

To be contributory, research must raise as well as answer questions. While it is true that some answers have resulted from this study, it is also true that further questions have been raised. The general purpose of this chapter is to point up those questions which have been raised as a result of the study.

An obvious line of inquiry is presented by the pattern of individual differences in each group. Just what are the factors that contribute to the high performance of some low SES children and to the low performance of some high SES children? An investigation along these lines might provide key information for an action program. While some high performance low SES children may be particularly well endowed, others may have had key experiences which contributed to their superior performances. If such experiences could be identified, they might provide important leads for an action program. Similar questions could be asked about the performance of the two race groups.

Another important aspect which was only partially treated in the present study has to do with inter-task consistency.

Are the children who do well in one task likely to

do well in other tasks? The most meaningful way to look at this question would seem to be within age, race, and SES categories. Some interesting interactions may be revealed. For example, relatively poor cultural experiences may prove to be sufficient for adequate performance in some task areas but not in others, whereas somewhat more enriched nonspecific experiences may have more general effects.

Finally, Piaget's contention that conservation and other logical abilities develop concurrently has only been partially upheld in this study. It was suggested that maturation allows for the capacity, and experiences influence the level of development of each ability. If such is the case, adequate training should smoothen out the unevenness in level of understanding of the different abilities.

CHAPTER VII

SUMMARY

The primary aims of this study were to examine the effects of age, socio-economic status (SES), and race on the cognitive functioning of primary school-age children and to extend Piaget's research by examining its relevance to the population of this study.

Piaget's theory of cognitive development, and particularly number concept, were discussed. It was noted that Piaget's main aim is to uncover characteristics of mental structures in different stages of development and at the same time describe the process by which those structures are formed. There are four such stages; namely, the sensori-motor stage, the pre-operational stage, the stage of concrete operations, in which age seven is an important milestone, and the period of formal operations during which thought is most mobile and systematic.

It was pointed out that Piaget regards the logical abilities of seriation and classification as being essential for a true understanding of number. These are said to develop side by side. In dealing with the problems which test their understanding of these concepts, children manifest two distinct strategies. The intuitive approach entails a centering on one aspect of the problem and a reliance on

perceptual features. The operational child, on the other hand, considers relationship between objects.

The present study employed a standardized, individual interview schedule based on Piaget's tasks to investigate a series of questions in a group of urban American children.

Subjects were 128 midwestern, urban school children from middle and low SES homes, which were selected on the basis of the subcommunities in which they lived. The children were five and one-half to eight and one-half years old, from the first and third grades of three elementary schools. The schools were selected on the basis of SES subcommunity location. A third basis for assignment to a group was race. Two race categories were used: white and black. Thus, a basic two by two by two design resulted; two age levels, two SES categories, and two races. Assignment to groups was by stratified random sampling.

The Peabody Picture Vocabulary Test (PPVT) was used as a measure of the intellectual maturity of the subjects. A Personal Data Sheet was used to collect demographic data on each subject. The three instruments were administered to each subject individually in their schools.

Four basic questions were raised in this study. The first question related to Piaget's contention that conservation, seriation and classification develops concurrently. Another question was concerned with the possibility of a developmental lag between the two SES groups. Still another question was concerned with a possible developmental lag between the two race groups. Finally, the question of

whether or not schooling narrows the developmental gap between SES groups has been investigated.

There were a total of ten tasks; three on conservation, three on seriation and ordination, and four on classification problems. In addition, each of the three subtests began with an orientation task which was also scored. Data were analyzed on the basis of a quantitative scoring system.

Analyses showed that the concurrent development of conservation, seriation and classification was only partially upheld. Older children, middle SES children, and white children performed better than younger children, low SES children, and black children respectively. Although the results were not conclusive, there was a trend toward schooling resulting in a narrower gap between the performance of the two SES groups.

The results have been discussed in relation to the relative effect of maturation and experience on cognitive development, and in relation to the different backgrounds of the children from middle SES and low SES homes. Children's explanations were also examined.

Implications of the findings for research have been discussed and recommendations were made for improvement of curricula, instructional and assessment methods, and teacher training programs. Finally, it was concluded that Piaget's methods could be fruitfully employed in the type of school setting in which this study was conducted.

LIST OF REFERENCES

Almy, Millie; Chittenden, E.; and Miller, P. Young Children's Thinking: Some Aspects of Piaget's Theory. New York: Teachers College Press. Teachers College, Columbia University, 1966.

Bernstein, Basil. "Social Structure, Language and Learning." Educational Research. III, (1961). 163-76.

Bloom, Benjamin S. Stability and Change in Human Characteristics. New York: John Wiley & Sons, 1964.

Bloom, R.; Whiteman, M.; and Deutsch, M. "Race and Social Class as Separate Factors Related to Social Environment." American Journal of Sociology. LXX (4), 471-76.

Braine, M. D. S. The Ontogeny of Certain Logical Operations: Piaget's Formulations Examined by Nonverbal Methods. Psychological Monograms, LXXIII (1959).

Bruner, Jerome S., et al. Studies in Cognitive Development. New York: John Wiley & Sons, Inc., 1966.

Charlesworth, Rosalind, "Classification Skills." Research Memorandum 66-9. Princeton N. J.: Educational Testing Service, (June, 1968).

Coleman, J. S., et al. "Equality of Educational Opportunity." United States Department of Health, Education, and Welfare. Washington D. C.: United States Government Printing Office, 1966.

Crow, L. D.; Murray, W. I.; and Smythe, H. H. Educating the Culturally Disadvantaged Child. New York: David McKay Company, Inc., 1966.

Deutsche, Jean M., The Development of Children's Concepts of Causal Relations. Minneapolis: University of Minnesota Press, 1943.

Deutsch, Martin. "The Role of Social Class in Language Development and Cognition." American Journal of Orthopsychiatry, XXXV (1965), 78-88.

Dodwell, P. C. "Children's Understanding of Number and Related Concepts," Canadian Journal of Psychology, XIV (1960), 191-205.

Dodwell, P. C. "Children's Understanding of Number Concepts: Characteristics of an Individual and of a Group Test." Canadian Journal of Psychology, XV (1961), 29-36.

Dodwell, P. C. "Relations Between the Understanding of the Logic of Classes and of Cardinal Number in Children." Canadian Journal of Psychology, XVI (1962), 152-160.

Elkind, D. "The Development of Quantitative Thinking: A Systematic Replication of Piaget's Studies." Journal of Genetic Psychology, XCVII (1961), 37-46.

Estes, Betsy W. "Some Mathematical and Logical Concepts in Children." Journal of Genetic Psychology. LXXXVIII (1956), 219-222.

Etuk, Elizabeth E. "The Development of Number Concepts: An Examination of Piaget's Theory with Yoruba-speaking Nigerian Children." Unpublished Ph.D. dissertation, Columbia University, 1967.

Flavell, J. H. The Developmental Psychology of Jean Piaget. Princeton, N. J.: D. Van Nostrand Co., Inc., 1963.

Frazier, E. Franklin. The Negro Family in the United States. Chicago: University of Chicago Press, 1939.

Garrett, H. E. "Negro-White Differences in Mental Ability in the United States." Scientific Monthly, LXV (1947) 329-333.

Gelman, Rochel. "Conservation Acquisition: A Problem of Learning to Attend to Relevant Attributes." Journal of Experimental Child Psychology. VII (1969), 167-187.

Goodnow, Jacqueline. "Milieu Differences." Psychological Monograms. LXXVI (1962, No. 36, (Whole no. 555).

Goodnow, Jacqueline J., and Bethon, Gloria. "Piaget's Tasks: The Effects of Schooling and Intelligence." Child Development. XXXVII (1966), 573-582.

Greenfield, Patricia M. "On Culture and Conservation." In Jerome S. Bruner et al. Studies in Cognitive Growth. New York: John Wiley & Sons, Inc., 1966, 225-256.

Hood, Blair. "An Experimental Study of Piaget's Theory of the Development of the Concept of Number." British Journal of Psychology, LIII (1962), 273-286.

Hunt, J. McV. Intelligence and Experience. New York: Ronald Press, 1961.

Hyde, D. M. "An Investigation of Piaget's Theories of the Development of the Concept of Number." Unpublished Ph.D. dissertation, University of London, 1959.

John Vera P. "The Intellectual Development of Slum Children: Some Preliminary Findings." American Journal of Orthopsychiatry. XXXIII (1963), 813-822.

Kerlinger, Fred N. Foundations of Behavioral Research. New York: Holt, Rinehart and Winston, Inc., 1966.

King, W. H. "The Development of Scientific Concepts in Children." British Journal of Educational Psychology. XXX (1960) 170-171.

Koch, Helen. "The Relation of Primary Mental Abilities in Five and Six Year Olds to Sex and Characteristics of Siblings." Child Development. XXV (1954), 209-223.

Lovell, K. and Ogilvie, E. "A Study of Conservation of Substance in the Junior School Child." British Journal of Educational Psychology, XXX (1960) 180-118.

Mannix, J. B. "The Number Concepts of a Group of Educationally Subnormal Children." British Journal of Educational Psychology. XXX (1960) 180-181.

Melton, R. S., et al. "Cognitive Growth in Preschool Children." Research Memorandum: Educational Testing Service, Princeton, N. J. (June, 1968).

Meuron, Mirelle de and Auerswald, E. H. "Cognition and Social Adaptation." Paper presented at the Forty-Fifth Annual Meeting of the American Orthopsychiatric Association, Chicago, Illinois, March, 1968.

Noro, Sho. "Development of the Child's Conception of Number." Japanese Journal of Educational Psychology. 1961, 230-239 (Child Development Abstract, XXXVIII 115).

Piaget, Jean. The Child's Conception of the World. New York: Harcourt & Brace, 1929.

Piaget, Jean. The Origins of Intelligence in Children. Patterson, N. J.: International University Press, 1952a.

Piaget, Jean. The Child's Conception of Number. London: Routledge & Kegan Paul Ltd., 1952b.

Piaget, Jean. "Development and Learning." In Richard E. Ripple & Verne N. Rockcastle (Eds.). Piaget Rediscovered: A Report of the Conference on Cognitive Studies and Curriculum Development. Ithaca: School of Education, Cornell University, March, 1964, 21-32.

Piaget, Jean. The Psychology of Intelligence. Patterson, N. J.: Littlefield, Adams & Company, 1960.

Piaget, Jean and Inhelder, Barbel. "Diagnosis of Mental Operations and Theory of Intelligence." American Journal of Mental Deficiency, LI (1947), 401-406.

Pike, Lewis W. "A Study of Number Conservation in Young Children, Under Two Materials Conditions." Research Memorandum: Cognitive Growth in Preschool Children. 66-9, Princeton, N. J.: Educational Testing Service, (June, 1968).

Price-Williams, D. R. "A Study Concerning Concepts of Conservation of Quantities Among Primitive Children." Acta Psychologica, XVIII (1961), 297-305.

Richards, Hyrum E. "Variations on Piaget's Pre-Number Development Tests Used as Learning Experiences." Unpublished Ph.D. dissertation, Utah State University, 1968.

Semler, Ira J., and Iscoe, Ira. "Structure of Intelligence in Negro and White Children." Journal of Educational Psychology, LVII (1963), 326-336.

Sigel, I. E., and Mermelstein, E. "Effects of Nonschooling on Piagetian Tasks of Conservation." Detroit: Merrill-Palmer Institute, 1966 (Mimeographed).

Sigel, I. E., Roeper, Annemarie, and Hooper, Frank H. "A Training Procedure for Acquisition of Piaget's Conservation of Quantity." British Journal of Educational Psychology, XXXVI (November, 1966), 301-311.

Siller, Jerome. "Socio-economic Status and Conceptual Thinking." Journal of Abnormal Social Psychology, LV (1957), 365-371.

Smedslund, J. "The Acquisition of Transitivity of Weight in Five to Seven Year Old Children." Journal of Genetic Psychology, CII (1963), 245-255.

Shuey, Audrey M. The Testing of Negro Intelligence. Lynchberg: Bell Publishing Co., 1958.

Transportation and Land Use Study: A Profile of Southeastern Michigan. Irving J. Rubin, Director, 1248 Washington Boulevard, Detroit, Michigan 48226, 1967.

United States Riot Commission Report: Report of the National Advisory Commission on Civil Disorders. Governor Otto Kerner of Illinois, Chairman, 1968.

United States Riot Commission Report: One Year Later. A Follow-up Report of the National Advisory Commission on Civil Disorders, New York: Bantam Books, 1969.

Van de Geer, John P., and Jaspars, Joseph M. "Cognitive Functions." Annual Review of Psychology. (Edited by Paul R. Farnsworth, Olga McNemar, and Quinn McNemar.) Palo Alto, California: Annual Reviews, XVII (1966), 145-149.

Wallach, Lise and Sprott, R. L. "Inducing Number Concept in Children." Child Development, XXXV (1964) 1057-1071.

Wei, Tam. "Racial and Social Class Differences on Piaget's Classification Tasks: Differences at Five and Seven Years of Age." Unpublished Ph.D. dissertation, University of Illinois, 1966.

Whiteman, M., Brown, B., and Deutsch, M. "Some Effects of Social Class and Race on Children's Language and Intellective Abilities." In Martin Deutsch et al., The Disadvantaged Child. New York: Basic Books, 1967.

Wohlwill, J. F. "A Study of the Development of Number Concept by Scalogram Analysis." Journal of Genetic Psychology, XCVII (1960), 345-377.

Wohlwill, J. F., and Lowe, R. C. "Experimental Analysis of the Conservation of Number." Child Development. XXXIII (1962), 153-169.

Woodward, Mary. "Concepts of Number of the Mentally Subnormal Studies by Piaget's Method." Journal of Child Psychology, II (1961), 249-259.

Appendix A

SPECIFIC INSTRUCTIONS FOR ADMINISTERING TEST OF COGNITIVE DEVELOPMENT

PART I - CONSERVATION

1. Orientation

MATERIAL: One box of twelve 1-inch green cubes and one box of twelve 1-inch red cubes.

PROCEDURE:

(A) (Child's name), here are some blocks. I am going to put them on the table...like this (place eleven red blocks 1/2 inch apart in row in front of child. That (Point) is your row of blocks. (The one remaining red block should be put IMPERCEPTIBLY out of sight.) Now, here are some more blocks. I am going to put them on the table too. (Take eight green blocks from the box on the table and form a second row so that there is a one-to-one correspondence between the two rows with the three remaining blocks in the child's row being to his right. There should be about a 6-inch space between the two rows.) These are my blocks (Point). ARE THERE AS MANY BLOCKS IN MY ROW AS IN YOUR ROW? (Push box with remaining green blocks toward child.) (Child's name), please take some more blocks and make my row have as many blocks as your row. (If child hesitates, reword directions until some attempt is made. If child is unable to complete the task the E should complete it.)

(B) Now, watch what I do. (Remove one block from child's row and place it in the box.) WHAT ABOUT NOW? ARE THERE AS MANY BLOCKS IN YOUR ROW AS THERE ARE IN MY ROW? IS THERE A ROW THAT HAS MORE BLOCKS?

(C) (Return the one block.) WHAT ABOUT NOW? ARE THERE JUST AS MANY BLOCKS IN THE TWO ROWS? IS THERE ANY ROW THAT HAS MORE BLOCKS?

(D) (Remove two blocks from interviewer's row.) WHAT ABOUT NOW? ARE THERE JUST AS MANY BLOCKS IN THE TWO ROWS? IS THERE ANY ROW THAT HAS MORE BLOCKS?

(E) (Return the two blocks.) WHAT ABOUT NOW?

2. Tests

MATERIAL: One set of twelve 1-inch green cubes and one set of twelve 1-inch red cubes. Two 8x8 fields of "grass" and two horses, one brown, one black.

PROCEDURE:

(A) Now, (child's name), watch what I do to my blocks. (The interviewer bunches his row of blocks by pushing the two end blocks in his row toward the center until all eleven blocks are touching.) WHAT ABOUT NOW? HAVE I GOT JUST AS MANY BLOCKS AS YOU HAVE? HOW DO YOU KNOW? (Match both rows of blocks again.)

(B) Watch what I do this time. (Spread out blocks in child's row so that they are about one inch apart.) WHAT ABOUT NOW? IS THERE ANY ROW THAT HAS MORE BLOCKS? (If the child answers "yes" or indicates they are not the same, ask WHICH HAS MORE?) WHY DO YOU THINK SO? (Remove all except eight green blocks from the table.)

(C) Now, let us look at two farms. (Place the two pieces of green paper in front of child. There should be a three-inch space between papers. Place a black horse in one "pasture" in the upper right hand corner and a brown horse in the other pasture.) This is Mr. Black's field (point to field with brown horse). DOES MR. BLACK'S HORSE HAVE MORE GRASS TO EAT THAN MR. BROWN'S HORSE OR DO THEY HAVE THE SAME? (E should help S establish "same" concept.) Mr. Black decides to build a barn on his field. (Place a red block in upper left hand corner.) NOW, DO BOTH HORSES HAVE THE SAME AMOUNT OF GRASS OR DOES ONE HAVE MORE? WHY? Mr. Brown decides to build a barn also. (Place a red block in upper left hand corner of Mr. Brown's field.) NOW, WHICH HORSE HAS MORE GRASS OR DO THEY HAVE THE SAME? (The process of alternately adding barns one by one is repeated until each field has 3 barns. The last placement is three at a time on each field making a total of six. The barns on Mr. Black's field should form a neat row across the top with each barn touching. Mr. Brown's barns after the first placement are placed in a random fashion over the field.) Now, all of the barns have been built. WHICH HORSE HAS MORE GRASS TO EAT OR DO THEY BOTH HAVE THE SAME? WHY?

PART II - SERIATION

1. Orientation

MATERIAL: Five 2-inch wide blocks ranging in height from 2 to 4 inches at 1/2 inch intervals and with painted designs giving them a house appearance.

PROCEDURE:

(A) (Place five blocks randomly on table.) Look at these blocks. They are like houses. They all look alike but some are bigger than the others. (Place blocks #2 and #4 in front of the child.) Let us look at these two. They look alike but one is bigger than the other. CAN YOU TELL ME WHICH ONE IS BIGGER? (If the child hesitates encourage him to slide the blocks together. After child has given his answer, put the two blocks in front of child placing them about 10 inches apart.)

(B) (Hand block #3 to the child.) Where should this one go? IS IT THE BIGGEST ONE AND GOES HERE, OR THE SMALLEST ONE AND GOES HERE, OR DOES IT GO HERE IN THE MIDDLE? (E should point to the various positions as he asks the question. Block #1 and #5 are similarly presented.) WHERE DO THESE GO? (If child is unable to correctly place the blocks, E assists him.) Now we have arranged (put) them from smallest (littlest) to largest (biggest).

2. Tests

MATERIAL: Seven dolls ranging in heights from 6 inches to 9 inches at 1/2-inch intervals; seven 2-inch wide blocks (packages) ranging in height from 1 to 4 inches at 1/2-inch intervals; seven seriated "houses," 2-5 inches.

PROCEDURE:

(A) Simple one row seriation: (Randomly place seven houses on the table in front of the child.) NOW I WANT YOU TO PUT THE HOUSES IN ONE LINE, LIKE WE DID JUST NOW. PUT THEM FROM THE SMALLEST TO THE LARGEST ONE. REMEMBER, THE LITTLEST TO THE BIGGEST. (Do not assist the child farther.)

(B) Matched seriation: (Place seven dolls on the table in a random fashion.) NOW I WANT YOU TO ARRANGE THESE PEOPLE (DOLLS) THE SAME WAY THAT YOU ARRANGED THE HOUSES, FROM SMALLEST TO LARGEST. You may put the littlest one here and the biggest one over

there. (If S fails to correctly perform this task E corrects him imperceptibly. After dolls are correctly arranged, E places the seven "packages" randomly before the S.) Each of these persons must carry one of these packages. YOU PUT ONE PACKAGE AT THE FEET OF EACH OF THESE PEOPLE. REMEMBER, THE BIGGEST MAN CARRIES THE BIGGEST PACKAGE AND THE SMALLEST MAN CARRIES THE SMALLEST PACKAGE. (E should give S verbal support but not the solution. If S does not arrange them correctly, the E assists him imperceptibly.)

(C) Ordination: Let us count and make sure that there are still seven men and seven packages. (Encourage the child to count.) I WANT YOU TO PUT YOUR FINDER ON THE HEAD OF THE FOURTH MAN. NOW, GIVE ME THE THREE SMALLEST (LITTLEST) MEN"S PACKAGES. NOW, SHOW ME THE SECOND LARGEST MAN.

PART III - CLASSIFICATION

1. Orientation

MATERIAL: 3 circular, 3 triangular, and 3 rectangular blocks; two of each are red while the third block in each set is white.

PROCEDURE:

(A) Here are some blocks different in color and shape. Some are red, some are white; some are like boxes, some are round as the moon, and some are like tents. I WANT YOU TO PUT ALL THOSE THAT ARE ALIKE TOGETHER. (Encourage the child to handle and sort the blocks but do not assist him.)

(B) (Remove the rectangular blocks.) Look at the blocks that are still on the table. ARE THERE MORE WHITE BLOCKS, MORE RED BLOCKS, OR ARE THERE THE SAME NUMBER OF EACH COLOR? You may count them if you want to. (If necessary, encourage the child to separate the white and red blocks.)

2. Tests

MATERIAL: Three pigs, three chickens, three ducks and three horses; one of each group is painted in the following colors: brown, black, white. One small cardboard box containing ten small wooden beads; two blue and eight yellow.

PROCEDURE:

(A) (Place the twelve animals on the table in front of the child in a random fashion.) Here are some animals that you know. NOW, I WANT YOU TO PUT ALL THOSE ANIMALS THAT ARE ALIKE TOGETHER. (After the child has arranged the animals, say) WHY HAVE YOU PUT THEM IN THESE (number of groups) GROUPS? (If the child fails Test A, to to Test C.)

(B) GOOD! NOW, I WANT YOU TO MAKE DIFFERENT GROUPS THIS TIME. CAN YOU THINK OF SOME OTHER WAY THE ANIMALS GO TOGETHER. THAT IS NOT LIKE THE FIRST GROUPS? PUT ALL OF THE ANIMALS TOGETHER THAT ARE ALIKE IN SOME OTHER WAY. (After the child has arranged the animals, say) WHY HAVE YOU PUT THEM IN THESE (number of groups) GROUPS?

(C) (Remove all animals.) Ask: IF ALL THE DUCKS IN THE WORLD SHOULD DIE, WOULD THERE BE ANY ANIMALS LEFT? WHY? HOW, IF ALL THE ANIMALS IN THE WORLD SHOULD DIE, WOULD THERE BE ANY DUCKS LEFT? WHY?

(D) (Give the child the box containing the ten beads. He is allowed to, or if necessary, helped to familiarize himself with the beads.) Here are some wooden beads. Some are yellow and some are blue. See, they have holes in them so that a necklace could be made. IF YOU MAKE A NECKLACE WITH ALL THE BEADS MADE OF WOOD, AND I MAKE A NECKLACE OF ALL THE YELLOW BEADS, WHO CAN MAKE THE LONGER NECKLACE? (Repeat the question until child understands.) WHICH WOULD MAKE THE LONGER NECKLACE, ALL THE WOODEN BEADS OR ALL THE YELLOW BEADS? WHY?

Appendix B

RECORD BOOKLET

TEST OF COGNITIVE DEVELOPMENT

Name_____ Code_____

School_____ Grade_____

Examiner_____ Date and Time_____

	Year	Mo.	Day		
Date Tested	____	____	____	Conservation	_____
Date of Birth	____	____	____	Seriation	_____
Age	____	____	____	Classification	_____
				Total Score	_____

NOTES

_____
Examiner

PART I - CONSERVATION

____ Orientation

Child understood throughout_____

Child partially understood (needed some help)_____

Child failed to grasp idea even with help_____

Other_____

_____

Tests

_____A. (bunched blocks)

What about now?_____

As many?_____

How do you know?_____

_____

Other_____

_____

_____B. (blocks spread out)

What about now?_____

More?_____ Which row?_____

How do you know?_____

_____

_____C. (Area)

More_____ Same_____ (no barns)

More_____ Same_____ Why?_____(uneven #)

More_____ Same_____ Why?_____(same #)

More_____ Same_____ Why?_____(6 barns each)

PART II - SERIATION

____ Orientation

Child understood throughout_____

Child partially understood (needed some help)_____

Child failed to grasp idea even with help_____

Other_____

_____

Tests

_____A. (one row seriation)

Arrangement of dolls by number (order of size, 1 to 7)_____

Description of method used_____

_____

_____B. (matched seriation)

Number of dolls correct_____ Method_____

Number of packages correct____ Method_____

_____C. (ordination)

Fourth man_____ Three smallest packages_____

Second largest man_____

PART III - CLASSIFICATION

____ Orientation

Child understood throughout_____

Child partially understood (needed some help)_____

Child failed to grasp idea even with help_____

Other_____

_____

Tests

_____A. (animal grouping)

Number of groups_____ Scheme_____

Consistent of mixed grouping_____

Why?_____

_____B. (shifting groups)

Number of groups_____ Scheme_____

Consistent or mixed grouping_____

Why?_____

_____C. (hierarchical classification)

If all ducks die? Yes____ No____ Why?_____

_____

If all animals die? Yes____ No____ Why?_____

_____

_____D. (inclusive relations)

Longer necklace?_____

Why?_____

_____

Appendix C

PERSONAL DATA SHEET

Name_____ Race_____

Address_____

Date of Birth_____ Age_____

School_____ Grade_____

Kindergarten Experience?___ Head Start?___ Nursery?_____

Education of Mother_____

Education of Father_____

Occupation of Main Support_____

Presence of Father in Home_____

No. of Older Siblings_____ No. of Younger Siblings_____

No. of Adults in Home Besides Parents_____

No. of Rooms in Home_____

Persons Present at Evening Meals: Father_____ Mother_____

Siblings_____ Others_____ Alone_____

Conversation at Meal Time: None_____ Little_____ Much_____

Have you ever been to the

Zoo?	Yes_____	No_____	How Many Times?____	With Whom?___
Museum?	Yes_____	No_____	How Many Times?____	With Whom?___
Movie?	Yes_____	No_____	How Many Times?____	With Whom?___
Farm?	Yes_____	No_____	How Many Times?____	With Whom?___
Greenwich Village?	Yes_____	No_____	How Many Times?____	With Whom?___
Out of Town Trip?	Yes_____	No_____	How Many Times?____	With Whom?___

Appendix D

INSTRUCTIONS FOR SCORING TEST OF COGNITIVE DEVELOPMENT

PART I - CONSERVATION

Orientation

Understood throughout	2
Partially understood (needed help)	1
Failed to understand (even with help)	0

Tests A & B (Score Separately)

In A and B, does the child maintain the notion that a rearrangement of blocks does not alter the original number and equivalence of the two sets of blocks? Can he adequately explain why this is so?

Definitely Conserving 2

Child whose record indicates a "same" response is put in this group except his explanation falls into the "g" and "h" categories, in which case, he is classified with the partial conservers.

Categorize explanations as follows:

a. use of counting and number, e.g., "because there are 11 here and 11 there."

b. reference to previous correspondence, e.g., "because they were equal before you (bunched them." (spread them out."

c. reference to observed action or present arrangement, e.g., "because you didn't take any away," "you only bunched yours."

d. reference to reversed situation, e.g., "if you arrange these in the same way, they will be the same."

e. reflecting appearance vs. reality, e.g., "it looks longer but they are really the same."

f. reference to two dimensions of the problem, e.g., "this is merely bunched and the other is spread out."

Partially Conserving 1

Child who initially indicates that there are "more" or that the two sets of blocks are "not the same" on the first question but shifts to "same" when asked to identify which is more.

Also, child who gives "same" response to "what about now" question, does not shift on the second question but whose explanation does not show that he really understands that this is so.

Categorize explanations as follows:

g. expressing conviction, e.g., "I know that they are equal" or simply "they are equal," without indicating why they are equal.

h. expressing inability to explain, "I don't know," "no reason."

For other explanations, look under categories for conservers and nonconservers.

Definitely Not Conserving 0

Child's response indicates that he thinks the two sets of blocks have become different in number, "they are not the same," "I have more," and orientation section record shows that he understood. In response to the "why" question, child's explanation relates to the appearance of things generally.

Categorize explanations as follows:

a. use of counting and number, e.g., "because there are 13 here and 11 there."

b. reference to observed action or present arrangement, e.g., "two were taken out of mine," "you took some of yours," "you put nine together."

c. "mine is longer," "yours is shorter."

d. merely expressing conviction, e.g., "I don't know," "no reason," "nothing."

Test C

Definitely Conserving 2

Child whose record indicates a "same" response to the last question is put in this group except his explanation

falls into the "g" or "h" categories, in which case, he is classified with the partial conservers.

Categorize explanations as follows:

a. use of counting and number, e.g., "because they both have 6 barns.

b. reference to previous correspondence, e.g., "because they were the same before and you did the same to both."

c. reference to equal size of blocks, e.g., "they are the same size so they cover the same amount of grass."

d. reference to reversed situation, e.g., "if you arrange these like those they would be the same."

e. reflecting appearance vs. reality, e.g., "it looks as if the black horse has more but they really have the same."

f. reference to two dimensions of the problem, e.g., "this is just spread out and these are bunched together."

Partially Conserving 1

The child who initially indicates that one or the other horse has "more" or "does not have the same" but shifts when asked why? or how do you know"?

Also, child who gives "same" response to "what about now" question, does not shift on the second question but whose explantion does not show that he really understands.

g. expressing conviction, e.g., "I know that they have the same," or simply "they have the same," without indicating why they are the same.

h. expressing inability to explain, "I don't know," "no reason."

Definitely Not Conserving 0

Child's response indicates that he thinks the two horses have different quantities of grass to eat, e.g., "the brown horse has more," "the black horse has more," "I have more," etc.

PART II - SERIATION AND ORDINATION

Orientation

Understood throughout 2
Partially understood (needed help) 1
Failed to understand (even with help) 0

Test A

Definitely Seriating 2

Child makes no misplacements irrespective of method used.

Partially Seriating 1

Child makes two misplacements, e.g., two adjacent objects are interchanged.

Definitely Not Seriating 0

More than two misplacements irrespective of method used. (Interchange of two adjacent objects is counted as two misplacements.)

Test B

Definitely Match Seriating 2

Child makes no misplacement on the man row nor the package row.

Partially Match Seriating 1

Child makes two misplacements, e.g., two adjacent objects are interchanged in either or both of the two rows.

Definitely Not Match Seriating 0

Child makes more than two misplacements in either or both rows.

Test C

Definitely Ordinating 2

All responses correct.

Partially Ordinating 1

Last response and one other correct. Last response incorrect but other two responses correct.

Definitely Not Ordinating 0

Last response and one other incorrect.

PART III - CLASSIFICATION

Orientation

Understood throughout 2
Partially understood (needed help) 1
Failed to understand (even with help) 0

Test A

Definitely Able to Sort 2

Child uses a single, observable criterion to group objects, e.g., color, type, size. Whatever the criterion, the sorting must be consistent with only that criterion. Also, for explanation, child shows an understanding that members of each group share a similar property, e.g., "these are all the same color," or "there are ducks here, horses here, chickens here, and pigs here." Partially correct explanations, e.g., "they are the same," or "there are three in each group," are included here.

Partially Able to Sort 1

a. Child who is unable to sort without help but can complete a sorting scheme and give a logical affirmation for it.

b. Child who is able to sort but cannot adequately verbalize the basis for sorting, e.g., "you asked me to do it."

c. Sorting scheme not quite clear but reason is explicit, e.g., "they are different animals in each group."

Definitely Unable to Sort 0

Child responds but makes no observably logical groups and does not give what seems like a logical reason for action, or gives no reason at all.

Test B

The idea here is to test the child's ability to shift his focus from one common attribute of objects to another. Tests A and B are scored separately but the scoring criterion are the same for both.

Test C

Definitely Understands Hierarchical Classification 2

Child answers first question "yes" and gives an explanation which indicates that he understands ducks to be a part of the total category of animals, e.g., "other animals didn't die," "there are still pigs, horses, etc." Also, child answers second question "no" and gives an explanation which indicates that he understands that chickens are included in the category "all animals," e.g., "because there are no more animals left," or "chickens are animals too."

Partially Understands Hierarchical Classification 1

a. Child gives correst "yes" or "no" answer to only one of the two questions along with a logical explanation.

b. Child gives correct "yes" or "no" answer to both questions but one or both explanations are faulty, e.g., "I just know," "there would be nothing for the chickens to eat," and "I don't know."

Definitely Does Not Understand Hierarchical Classification 0

a. Child gives incorrect "yes" or "no" answer to both questions.

b. Child gives correct "yes" or "no" answer to one of the two questions but is unable to give a logical explanation for the correct answer--gives no explanation at all.

Test D

Definitely Understands Inclusive Relations 2

Child indicates correctly without vacillating, which necklace would be the longer and gives explanation indicating that there are more wooden beads than yellow beads.

Partially Understands Inclusive Relations 1

a. Child vacillates between which is more, the wooden beads or the yellow beads, irrespective of explanation given.

b. Child on second trial following "more yellow than blue" response gives correct answer and explanation.

c. Child indicates correctly which necklace would be longer but fails to give an explanation, e.g., "I just know," etc.

Definitely Does Not Understand Inclusive Relations 0

a. Child is unable to decenter from color attribute even upon restatement of question, e.g., "more yellow than blue."

b. Child indicates that the yellow necklace is longer and explains the answer either incorrectly, e.g., "more yellow beads than wooden beads" or is unable to explain at all.

Appendix E

STATISTICAL CHARACTERISTICS OF THE TEST

Scales and Norms

In this study, both raw and derived scores were reported. A T-Score was computed for each of the three subtests and total score. The standard scores are linear transformations of raw scores.

Validity

Content validity was measured using a method reported by Kerlinger (1966). The judges were all active university professors and holders of doctorate degrees in educational psychology. Each judge possessed a teaching knowledge of Piaget's theory of cognitive development. The directions under which the judges made their judgments are included in this section, beginning on page 126.

Table 16 shows the results of the procedure, listing percent of agreement for each of the ten individual items (orientation items were not included in this procedure), each subtest, and for total cognitive score. The 95.7 percent agreement for total cognitive scores indicates that the test does have some validity.

Reliability

One form of estimating reliability, test-retest, is best understood as temporal stability. It functions as an answer to the question: How stable are the scores over a given period of time?

TABLE 16

DEGREE OF AGREEMENT AMONG JUDGES FOR CONTENT VALIDITY ANALYSIS

Judgment	Cognitive Test Item						
	Task A Conservation	Task B Conservation	Task C Conservation	Task A Seriation	Task B Seriation	Task C Seriation	Task A Classification
Agree	7	6	7	7	7	7	7
Disagree	0	1	0	0	0	0	0
Percent Agreement	100	85.7	100	100	100	100	100

Judgment	Cognitive Test Item			Cognitive Subtest			Total Cognitive Test
	Task B Classification	Task C Classification	Task D Classification	Conservation	Seriation	Classification	
Agree	7	6	6	20	21	26	67
Disagree	0	1	1	1	0	2	3
Percent Agreement	100	85.7	85.7	95.2	100	92.9	95.7

Twenty children from the previously tested sample were selected by stratified random sampling to be retested. Each of the subjects were retested in the same manner six to ten days later by the same examiner. All retested subjects were elated to be selected a second time.

A Pearson product moment correlation coefficient was calculated on each of the three subtests and total score distributions. The derived coefficients ranged from a low of .63 on classification to a high of .95 on conservation. The coefficient for the total score was .89. All of the derived coefficients were significant at the .01 level of confidence where the critical level was .56.

Table 17 provides the coefficients for each of the subscales and total scale.

TABLE 17

TEST-RETEST COEFFICIENTS FOR THE COGNITIVE DEVELOPMENT TEST (N=20)

Scale	Test-Retest Coefficient[a]
Conservation	0.951
Seriation	0.752
Classification	0.628
Total Score	0.889

[a]Critical level was .561 at .01 level

Objectivity

One form of objectivity is scorer reliability which is concerned with the degree of agreement between two independent scorers of the same test protocol.

Thirty-two children were randomly (stratified) selected from the previously tested total sample and the three subtests and total score distributions were subjected to analysis with a Pearson product moment correlation. All of the derived coefficients were significant at the .01 level of confidence.

Table 18 provides the coefficients for each of the subscales and total scale.

TABLE 18

SCORER RELIABILITY COEFFICIENTS FOR THE COGNITIVE DEVELOPMENT TEST (N=32)

Scale	Coefficient
Conservation	0.991
Classification	0.996
Seriation	0.956
Total Score	0.992

Degree of examiner effects on performance is another concern when determining the objectivity of a test. In this study, examiner effects were controlled by counterbalancing. A one-way analysis of variance was performed on the two-score distributions (two examiners). The null hypothesis of no significant difference between the means of the two

distributions was tested. The null hypothesis was supported ($F=0.60$. $F_{.05} = 3.92$ for 1 and 120 degrees of freedom).

Charles A. Stokes
Ph.D. Candidate
University of Michigan
Ann Arbor, Michigan

January, 1970

Dear Colleague,

As you probably know, I am presently engaged in writing a dissertation. In collecting data it was necessary to develop a measuring instrument based on some Piaget concepts. It is my intent to establish content validity for the instrument and this is where your help is needed.

The following is a paragraph from Foundations of Behavioral Research, (Kerlinger, 1966. p. 447):

> Content validation, then is vasically judgmental. The items of a test must be studied, each item being weighed for its presumed representativeness of the universe. This means that each item must be judged for its presumed relevance to the property being measured, which is no easy task. In many cases, other "competent" judges must also judge the content of the items. The universe of content must, if possible, be clearly defined; that is, the judges must be furnished with specific directions for making judgments, as well as with specification of what they are judging. Then, some method for pooling independent judgments must be used.

Enclosed you will find a short review of the four concepts to be judged. Also, the ten test items each of which measures one of the four above concepts. All four concepts might or might not be represented among these tem items.

Thank you in advance for your prompt consideration. It is greatly appreciated.

Yours truly,

Charles A. Stokes

A SUMMARY OF THE FOUR PIAGET CONCEPTS INVOLVED IN CONTENT JUDGMENT EXERCISES

1. Conservation

Piaget states that prior to age seven the child's ideas of quantity and number are influenced by the appearance and physical properties of objects. Understanding tends to be largely dependent on perceptual factors. From about age seven onwards there is evidence that a new way of thinking has emerged. The child at this stage is no longer so dependent on the appearance for his judgment. He attends to the relations between physical properties of objects and between the objects themselves.

This change in the thinking of the child can be seen in the development of physical concepts, and is reflected in the attainment of "conservation," which Piaget considers a "necessary condition for any mathematical understanding" (1952). Conservation refers to the ability to understand that certain properties of objects, e.g., number area, and quantity remain invariant in the face of external transformations. For instance, a child who realizes that a given number of beads remain the same whether put into a tall narrow glass or a shallow dish is said to have conserved on that task. The younger child who relies on perceptual cues tends to assert that the beads in the tall glass are more because the contents stand higher than in the shallow glass. He has not grasped the idea that a rearrangement of the two numerically equivalent sets does not alter the original number.

2. Seriation and Ordination

Seriation refers to the ability to build objects into a transitive asymmetrical sequence. For instance, a child is given a set of eight blocks varying in size from the smallest, A to the largest, H. He is required to seriate these. The problem involves discovering the relationship $A < B < C < \ldots < H$. The younger child, unable to seriate, groups the small and the large items indiscriminately. A child using the intuitive strategy, has difficulty in conceiving, Piaget believes, both a direct and an inverse relation between objects. For instance, the relationship that block B is both larger than A and smaller than C is not understood. His reaction pattern consists of making comparisons of two objects at a time. Piaget describes the process in an experiment where the children were required to construct a series of sticks from one to ten. He writes, "The child at the second stage does not immediately master the whole set of relations necessary for seriation but discovers them gradually by dint of emperical trial and error. Thus he begins with 9, 10, 8, then measure 10 and 8 against one another, then 9 and 8." (1952)

Ordination refers to the process of recognizing the positions of objects in a series such as that described in the previous paragraph. Piaget discusses an experiment of dolls and sticks in which the child constructed a series according to the order of magnitude with the largest doll being assigned the longest walking stick. He then required

the child to match a particular stick to a doll after he disrupted the perceived correspondence.

From their responses the children could be classified into three categories. Some were deceived by the new configuration, others had to rearrange the objects to convince themselves of the correctness of their intuitive responses; yet others relied on numerical positioning. These realized that the fourth man ought to have the fourth walking stick.

3. Classification

Piaget discusses the relation between class and number in several sections of The Child's Conception of Number (1952). He believes that notions of class and number develop concurrently. There are two aspects of classification that have direct relavence to an understanding of number; namely, grouping and class inclusion.

Although Piaget discusses many experiments on classes, only the ones on class inclusion are described here. Directly related to number is the notion of "additive composition of classes." This refers to a part-whole relationship of sets. To understand number, the child is expected to know that if A + A' = B, the reciprocal relationships of $B > A$ and $B > A'$ must follow logically. A typical experiment presented the child with brown and white wooden beads. The brown beads were obviously more in number than the white ones. In a series of questions the investigator tried to find out whether the child understood that a string of

wooden beads would be longer than a string of brown beads.

The responses fall into three stages again. The main problem of the younger child is that, while he centers his attention on the class of brown beads, he looses sight of the total class of wooden beads, and so, tends to compare only the class of brown beads with the complimentary class of white beads. "The difficulty is that by centering on A, he destroys the while, B, so that part A can no longer be compared with the other part A'. So there is again non-conservation of the whole for lack of mobility in the successive centralizations of thought." (Piaget, 1960) The older children who understood have no difficulty in maintaining the different aspects of the relationships in their minds.

4. Time and Speed

Finally, let us review the operations involved in the structuration of speed and of time. In accordance with the initial primacy of topological and ordinal structures, the notion of speed does not make its first appearance in a metrical form (V = s/t), which is not arrived at until ten or eleven, but in an ordinal form. One moving object is faster than another if it overtakes it; that is, if it was behind it at a previous moment and is in front of it at a later moment. At a preoperatory level, the child generally considers only the points of arrival (and fails to understand that more speed is required just to catch up and arrive at the same time); then he structures anticipated overtakings

as well as observed overtakings in an operatory manner; later he notes the increasing or decreasing size of the intervals (hyperordinal level); and finally comes to relate duration with distance covered.

The notion of time is based, in its completed form, on three kinds of operations: (1) a seriation of events, which constitutes the order of temporal succession; (2) an inclusion of the intervals between events occurring at a certain point of time, which is the source of the notion of duration; and (3) temporal metrics (already at work in the system of musical units, well before any scientific elaboration) analogous to spatial metrics. However, whereas the ordinal structuration of speeds is independent of duration (but not, of course, of temporal order), duration, like simultaneity, depends on speed. Indeed, the preceding operations (1-3) remain independent of the greater or lesser rapidity of the passage of time and teach the subject nothing about the cadence of this passage itself, because the cadence depends on the physical or psychological content of the duration, from which the duration is inseparable. The child begins to judge duration only in terms of this content, forgetting speed (as we often do ourselves in intuitive evaluations). Thus the child estimates that a moving object has been in motion longer if it has gone farther. Later, this content is seen in relation to speed, which then constitutes time as an objective relation and provides a grasp of the passage of time as such. This is evident in the measurement

of time (the speed of the movement of the clock). In young subjects, however, such points of references are useless, for these children imagine that the hands of a watch or the sand in an hourglass moves at variable rates of speed depending on the content to be measured.

After reviewing Piaget's description of the structuration of the constructs conservation, seriation and ordination, classification, and time and speed, compare them with each of the following 10 items. Make a judgment as to which of the constructs each item measures. Circle the number of your selection.

Item I

Material: Three pigs, three chickens, three ducks, and three horses; one of each group is painted in the following colors: brown, black, white, e.g. one brown chicken, one black chicken, one white chicken.

(Place the twelve animals on the table in front of the child in a random fashion.) Here are some animals that you know. NOW I WANT YOU TO PUT ALL THOSE ANIMALS THAT ARE ALIKE TOGETHER. (After the child has arranged the animals, say) WHY HAVE YOU PUT THEM IN THESE (number of groups) GROUPS?

This item measures the structuration of:

1. Conservation
2. Seriation and ordination
3. Classification
4. Time and speed

Item II

Material: One set of twelve 1-inch green cubes and one set of twelve 1-inch red cubes.

(Place eleven red blocks 1/2 inch apart in row in front of child.) That (point) is your row of blocks. Now, here are some more blocks. (Take eleven green blocks from the box on the table and form a second row so that there is one to one correspondence.) ARE THERE AS MANY BLOCKS IN MY ROW AS IN YOUR ROW? (If necessary, aid child in establishing the fact of equality of the two rows.) Now, watch what I do to my blocks. (The examiner bunches his row of blocks (the green row) by pushing the two end blocks in his row toward the center until all eleven blocks are touching.) WHAT ABOUT NOW? HAVE I GOT JUST AS MANY BLOCKS AS YOU HAVE? HOW DO YOU KNOW?

This item measures the structuration of:

1. Conservation

2. Seriation and ordination

3. Classification

4. Time and speed

Item III

Materials: None

Ask: IF ALL THE DUCKS IN THE WORLD SHOULD DIE, WOULD THERE BE ANY ANIMALS LEFT? NOW, IF ALL THE ANIMALS IN THE WORLD SHOULD DIE, WOULD THERE BE ANY CHICKENS LEFT?

This item measures the structuration of:

1. Conservation

2. Seriation and ordination

3. Classification

4. Time and speed

Item IV

Materials: Seven dolls ranging in heights from 6 inches to 9 inches at 1/2 inch intervals; seven 2-inch wide blocks (packages) ranging in height from 1 to 4 inches at 1/2 inch intervals.

(Place seven dolls on the table in a random fashion.) NOW I WANT YOU TO ARRANGE THESE PEOPLE (DOLLS) . . . . FROM SMALLEST TO LARGEST. YOU MAY PUT THE LITTLEST HERE AND THE BIGGEST ONE HERE. (If S fails to correctly perform this task, E corrects him inperceptibly. After dolls are correctly arranged, E places the seven "packages" randomly before the S.) Each of these persons must carry one of these packages. YOU PUT ONE PACKAGE AT THE FEET OF EACH OF THESE PEOPLE. REMEMBER THE BIGGEST MAN CARRIES THE BIGGEST PACKAGE AND THE SMALLEST MAN CARRIES THE SMALLEST PACKAGE. (E may give S verbal support, but not the solution.)

This item measures the structuration of:

1. Conservation

2. Seriation and ordination

3. Classification

4. Time and speed

Item V

Materials: Twelve 1-inch red blocks. Two horses; one brown, one black. Two 8-inch square pieces of green paper.

Now let's look at two farms. (Place the two pieces of green paper in front of child. There should be about a 3-inch space between papers. Place a black horse in one "pasture" in the upper right hand corner and a brown horse in the other pasture.) This is Mr. Black's field (point to field with black horse) and this is Mr. Brown's field (point to field with brown horse). DOES MR. BLACK'S HORSE HAVE MORE GRASS TO EAT THAN MR. BROWN'S HORSE OR DO THEY HAVE THE SAME? (E should help S establish "same" concept.) Mr. Black decides to build a barn on his field. (Place a red block in upper left hand corner.) NOW DO BOTH HORSES HAVE THE SAME AMOUNT OF GRASS OR DOES ONE HAVE MORE? WHY? Mr. Brown decides to build a barn also. (Place a red block in upper left hand corner of Mr. Brown's field.) NOW, WHICH HORSE HAS MORE GRASS OR DO THEY HAVE THE SAME? (The process of alternately adding barns one by one is repeated until each field has three barns. The last placement is three at a time on each field making a total of six. The barns on Mr. Black's field should form a neat row across the top with each barn touching. Mr. Brown's barns after the first placement are placed in a random fashion over the field.) Now, all of the barns have been built. WHICH HORSE HAS MORE GRASS TO EAT OR DO THEY BOTH HAVE THE SAME? WHY?

This item measures the structuration of:

1. Conservation
2. Seriation and ordination
3. Classification
4. Time and speed

Item VI

Materials: One small cardboard box containing ten small wooden beads with a hole through the center of each. There are two blue and eight yellow ones.

(Give the child the box containing the ten beads. He is allowed to, or if necessary, helped to familiarize himself with the beads.) Here are some wooden beads. Some are yellow and some are blue. See, they have holes in them so that a necklace could be made. IF YOU MAKE A NECKLACE WITH ALL THE BEADS MADE OF WOOD, AND I MAKE A NECKLACE OF ALL

THE YELLOW BEADS, WHO CAN MAKE THE LONGEST NECKLACE? (Repeat the question until child understands.) WHICH WOULD MAKE THE LONGEST NECKLACE, ALL THE WOODEN BEADS OR ALL THE YELLOW BEADS? WHY?

This item measures the structuration of:

1. Conservation
2. Seriation and ordination
3. Classification
4. Time and speed

Item VII

Material: Seven dolls ranging in heights from 6 inches to 9 inches at 1/2 inch intervals; seven 2-inch wide blocks (packages) ranging in height from 1 to 4 inches at 1/2 inch intervals.

Let's count and make sure that there are still seven men and seven packages. (Encourage the child to count.) I WANT YOU TO PUT YOUR FINGER ON THE HEAD OF THE FOURTH MAN. NOW, GIVE ME THE THREE SMALLEST (LITTLEST) MEN'S PACKAGES. NOW, SHOW ME THE SECOND LARGEST MAN.

This item measures the structuration of:

1. Conservation
2. Seriation and ordination
3. Classification
4. Time and speed

Item VIII

Material: 12 1-inch red cubes. 12 1-inch green cubes.

(Place blocks in two rows about 1/2 inch apart. Put blocks in one to one correspondence.) Watch what I do this time. (Spread out blocks in child's row so that they are about one inch apart.) WHAT ABOUT NOW? IS THERE ANY ROW THAT HAS MORE BLOCKS? (If child answers yes or indicates they are not the same, ask WHICH IS MORE?) WHY DO YOU THINK SO?

This item measures the structuration of:

1. Conservation

2. Seriation and ordination

3. Classification

4. Time and speed

Item IX

Material: Seven 2-inch-wide blocks (houses) ranging in height of 2 to 5 inches at 1/2 inch intervals.

(Randomly place seven "houses" on the table in front of the child.) NOW, I WANT YOU TO PUT THE HOUSES IN ONE LINE, LIKE WE DID JUST NOW. PUT THEM FROM THE SMALLEST TO THE LARGEST ONE. REMEMBER THE LITTLEST TO THE BIGGEST. (Do not assist the child farther.)

This item measures the structuration of:

1. Conservation

2. Seriation and ordination

3. Classification

4. Time and speed

Item X

Materials: Three pigs, three chickens, three ducks, and three horses; one of each group is painted in the following colors: brown, black, white.

(Place the twelve animals on the table in front of the child in a random fashion.) GOOD: NOW, I WANT YOU TO MAKE DIFFERENT GROUPS THIS TIME. CAN YOU THINK OF SOME OTHER WAY THE ANIMALS GO TOGETHER THAT IS NOT LIKE THE FIRST GROUPS? PUT ALL THE ANIMALS TOGETHER THAT ARE ALIKE IN SOME OTHER WAY.

This item measures the structuration of:

1. Conservation

2. Seriation and ordination

3. Classification

4. Time and speed