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ABSTRACT

This report covers Phase II of a two-phase project concerned with the development of new measures of cognitive variables in elementary school children. The four tasks undertaken in Phase II were: (1) prepare, revise and describe instruments designed to measure the cognitive variables categorized as concept formation, language development, logical thinking, problem solving and response style, and provide a rationale for the particular types of instrumentation developed; (2) administer both the new cognitive measures and the selected achievement tests to the specified populations; (3) present and analyze statistically the data on both the cognitive and achievement measures, and interpret the results; and (4) make recommendations for further development and use of the new measures. Discussions of these four tasks comprise the report proper. In addition, there are 13 appendixes, as follows: I. Listing of Test Materials Submitted with this Report; II. Administration Procedures for the Concept Formation Test; III. Administration Procedures for the Language Development Tests; IV. Administration Procedures for the Logical Thinking Test; V. Administration Procedures for the Problem Solving Test; VI. Administration Procedures for the Response Style Tests; VII, VIII, IX, X, and XI. Statistical Tables; XII. Intercorrelation Matrices: Cognitive Achievement and Intelligence Variables; and XIII. Rotated Factor Structures, Cognitive, Achievement and Intelligence Variables. The Table of Contents lists the contents of the final report of Phase I as well as the contents of this report. (For related document, see ED 060 928, the Phase I report.) (DB)

OE/DCD/FSDS

Final Report of Phase II

Contract No. OEC-0-70-4952

The Development of New Measures of Cognitive Variables in Elementary School Children (Phase II)

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Contents of the Final Report of Phase II

Introduction

The development of new measures of cognitive variables in elementary school children is a task marked by high potentialities for extending our knowledge of how children grow, develop and learn to cope with the problems extant in their environment. In this connection the measurement of cognitive development promises to provide a rich source of data on which to base instructional programs and materials. For example an assessment of differential cognitive functioning between advantaged and disadvantaged children may facilitate the identification of fruitful forms of compensatory instructional programs.

This report covers Phase II of a two phase project. Phase I consisted of three tasks:

1. A review of the literature which pertains directly to cognition, cognitive functioning in children and the measurement of cognitive development. In particular five areas of cognitive functioning are included. They are concept formation, language development, logical thinking, problem solving and response style. For each area this Report includes a critical review of the published and unpublished literature, an annotated bibliography of the five to twenty percent of the references cited which were judged most important to this project and a complete bibliography.

2. A description and rationale for those cognitive processes for which instruments are to be constructed. In addition to the discussion of the processes themselves attention is given to the problems of measurement due to the nature of the cognitive processes, the nature of the various elementary school populations with whom such instruments would be used, and the cost factor attendant to different testing formats.

3. The proposal of a set of achievement measures to be administered together with the tests of cognitive development and a statement of our plans for data collection, statistical analysis and related design considerations.

Phase II consisted of four additional tasks:

4. Prepare, revise and describe instruments designed to measure the cognitive variables categorized as concept formation, language development, logical thinking, problem solving and response style and provide a rationale for the particular types of instrumentation developed.

5. Administer both the new cognitive measures and the selected achievement tests to the specified populations. Report conditions under which the measures were administered, the procedures involved, the particular children who were tested and any other pertinent information. Tell when and where test administration took place; demonstrate the satisfactory fulfillment of the sampling requirements specified. Any special problems encountered during data collection which might result in contamination or invalidation of results should be noted.

6. Present and analyze statistically the data on both the cognitive and achievement measures. Interpret the results in accordance with the theoretical framework and major purposes outlined for the project.

7. Make recommendations for the further development and use of the new measures of cognitive development.

Preparation of Measures of Cognitive Variables

In this section we report the activities which led from the description and rationale for those cognitive processes for which instruments were to be constructed to the issuing of final forms of the various tests. These activities included item production, initial test construction, tryout, pilot studies including item analysis and reliability determination and the revisions which culuminated in the tests used in March and April for the main data collection in Gary, Indiana.

These activities are reported under five heads: concept formation, language development, logical thinking, problem solving and response style.

I. Rationale for the Theoretical Position

The review of the concept formation (CF) literature identified two distinct, complementary approaches to concept formation. These two essentially different views of CF served as the theoretical basis of the test development.

Extensive manipulation of variables of CF has taken place in psychological research, usually with adults. Typically, and almost exclusively, this has been of the discriminant response type. Exemplars and nonexemplars are identified followed by a presentation of new stimulus objects to be classified by the subject. This has taken many forms, from attribute cards to wooden blocks. For this type of task, the subject focuses attention on between - thing constancy. Positive and/or negative instances are presented and the subject is asked to identify an instance as positive or negative.

In a second view of CF, Piaget focussed attention on a particular situation. Attributes are systematically varied and the subject's task is to determine if the new situation exemplifies the same object. In studying the concept of number, the child typically is shown two rows of objects such as congruent discs. Attention is directed to the two rows and it is pointed out that there are the same number of discs in each. Then one row of discs is spread out. The child's task is to determine if there are the same number of objects in the two rows. The underlying principle is that the number concept is independent of the arrangement of the objects. Attention is focussed on within - thing constancy. The ability to respond correctly to such a task has been tied into developmental stages of cognitive growth.

Thus, CF is more than just learning the property shared by a set of stimuli, it also involves recognising a constancy in the face of changes in the stimulus objects. It is a matter of within - thing as well as between-thing constancy.

We wished to develop an instrument which would (1) not be biased by reading difficulty; (2) be sufficiently stimulating to capture the attention of children; (3) incorporate both aspects of CF delineated above; (4) have a spread of item difficulty to be appropriate to students of grades 2, 4, and 6; (5) in light of the possible application of such a test, follow a group administration format.

Instrumentation

The instrumentation followed two patterns. Part I of the test measures within-thing CF and Part II between-thing CF. Each of these parts will now be described.

Part I of the instrument

A cine-psychometric approach was chosen as the method most appropriate for this task. It has the advantages of being appealing to students, avoids the reading problem, and lends itself to group administration. Piagetian conservations composed the entire part A. Items on conservation of number, length, area, mass, quantity, weight, and volume were developed. Since these involve movement of objects the cine-psychometric approach is ideal.

An 8mm movie consisting of 21 items was made. Characteristically, the movie showed a set of objects, some transformation was performed, and a pointer indicated the pair of objects or sets to be chosen between. An audio tape was made and synchronized with the film. The tape recorder ran continuously while the projector was turned on and off for each item by cue. The children had three choices on each item; they were to choose which of the objects or sets was greater on some dimension or whether they were the same on that dimension. Three of the twenty-one items were inserted to break the tendency to respond the same as before, since the correct answer on many of the items was "same."

II. Production of the Instrument

A. Motion picture film

Work on the use of the film medium for testing cognitive variables had already been undertaken during the previous year. The decision to use filmed presentation of test items was made on the basis of previous research as well as the known bias against disadvantaged children of traditional paper and pencil tests requiring reading.

For the film portion of the test a list of tasks was delineated based on the work of Piaget and previous experimental work undertaken at Purdue. The test consisted of 18 Piagetian conservation items of number, length, area, quantity, weight and volume. For example, two congruent balls of clay were shown on the screen. Ss were told they had the same amount of clay. Then one ball was slowly rolled between hands to form a sausage shape. With the two forms of clay on the screen the Ss were asked to mark the star if this one has more clay (pointer to left form) and mark the key if this one (pointer to right) form; mark the flower if they both have the same amount of clay. These have been shown to be related to intellectual development. Conservation items are measures of within-thing concept formation. Beginning in December, instructions and sequences of the tasks were designed, filmed, and edited on the basis of quality of film as well as quality of task procedures. Additional footage was shot to complete the test. When all sequences had been edited, they were again edited on the basis of hypothesized order of difficulty. Included with the fundamental sequence of tasks were appropriately spaced items intended to break response patterns which might be formed by the subjects. The test was completed in January 1971 for use in pretesting.

B. Response Booklets

Each page of the response booklet contained a rectangular region subdivided into three squares, each of which contained a drawing of an

object judged to be known and recognized by the prospective subjects. The drawings were of a star, a flower, and a key, in that order. Horizontal placement of the drawings corresponded to horizontal placement of the two sets of objects depicted on the film. Similarly, vertical placement corresponded to vertical placement on the film.

After transformation of one of the two sets of objects on the film, each of the sets was pointed to. If the subject judged the left one (top) to have "more", the star was to be marked while if the right one (bottom) was judged to have "more" the subject was to mark the key. If both were judged to have the same, the flower was to be marked.

Color-coded pages were used in the response booklet for the film portion of the test. This was done in order to avoid requiring knowledge of numerals for subjects in grade two in particular. Master drawings were made of the subdivided rectangle and star, flower, and key.

For the part II of the test, assessing classical concept formation, a pool of possible items was formed as a first step. Each item consisted of three rows of drawings; row one consisting of exemplars, row two consisting of non-exemplars, and row three consisting of four or five drawings from which the subject was to select all of those which were exemplars (one or two of them). There were twelve items in part II of the CF test. For each item, primary type was used on rows one and two of the page to tell whether the drawings represented exemplars or non-exemplars. On row three, the same size type was used to ask which were exemplars. As before, these booklets were produced by use of multilith to obtain clear copy. Two practice items were prepared for presentation by the investigator as instructions for this part of the test.

C. Audio Tape for Film Portion

Upon completion of editing of the film sequences and design of the accompanying response booklet, production was started of the audio tape which was to be used in conjunction with them during the testing procedure. A script was prepared which instructed the subject to mark the star, flower, or key, according to his belief, upon viewing items on the motion picture film. Appropriate pauses had been incorporated during the film preparation to allow for these required taped audio instructions.

Care was taken in the preparation of the film so that the order of instructions given the subject could be varied to control for recency responses. During administration the audio tape ran continuously and the movie projector was turned on and off to achieve synchronization.

III. Pretesting, Item Analysis, Reliabilities and Related Aspects

A. Pretesting

One hundred fifty second, fourth, and sixth grade children considered to be representative of the sample to be used in the final testing served as the pretest sample. Intact classes were tested at each grade level using the instrument produced for this purpose. Total administration time for the test was approximately 45 minutes.

Response booklets were distributed by one team member while two others set up film and audio equipment. Subjects were told that their help was needed in making a better movie by answering questions about it. The film portion of the test proceeded without apparent difficulty. Next, the film-response booklets were collected and those for the second part of the test were distributed. The team leader went through two prepared examples for instruction on marking and the subjects were then instructed to complete their booklets in the same way. After the first class it became apparent that they should be paced through all items and subsequently this was done.

B. Item Analysis

The next step was to transfer responses to mark-sense cards in order to obtain item analysis, test difficulty and interval consistency reliabilities, test difficulty and KR-20 indices are summarized in Table 1.

Table 1
Test Difficulty and Reliability by Subjects' Grade

	Difficulty	KR-20 Reliability
Grade 2		
Part I	.43	.80
Part II	.24	.29
Total	.37	.75
Grade 4		
Part I	.70	.86
Part II	.39	.53
Total	.59	.80
Grade 6		
Part I	.89	.83
Part II	.55	.72
Total	.77	.81
Combined		
Part I	.66	.90
Part II	.38	.69
Total	.57	.90

Correlations between the concept formation test and intelligence and achievement test scores of the subjects are shown in Table 2.

Table 2

Relationships Between Concept Formation and Intelligence and Achievement Measures

	Part I	Part II	Total
1. IQ verbal	.24	.21	.28
2. IQ nonverbal	.10	.01	.30
3. Vocabulary	.26	.23	.30
4. Reading	.14	.13	.15
5. Language	.24	.22	.26
6. Work study	.29	.25	.31
7. Concept Arith.	.10	.05	.19
8. Prob. Solv. Arith.	.16	.15	.14
9. Total Arith.	.15	.11	.21
10. Part I		.71	.97
11. Part II	.71		.85

The results of the pretest suggest that what is being measured by the concept formation test is essentially different from that measured by the pre-existing tests listed. Further, this instrument appeared to have satisfactory internal consistency as judged from the reliability estimates.

IV. Revision of Instrument

Part one. Four items were revised prior to final testing. Item 8 showing rods of different sizes was refilmed so that the pointer indicated top rod first as in all other items of a vertical orientation. Item 11 on discontinuous quantity (beans in tumblers) was changed to use a tall thin container instead of a short flat container to provide variety. Item 21 and 22 on volume with cubes were revised to provide more perceptual contrast between initial and terminal states as effected by the transformation.

Though it was not necessary to do these revisions on the basis of the item analysis, it was felt that the result would give a more accurate account of the conceptual ability of the subjects and result in a higher quality instrument.

Part two. Observation of subjects during testing indicated that results might be confounded by a lack of reading ability on the part of many students due to a lack of familiarity with the printed mediating terms used in the response booklets. A second problem was related to the number of correct alternatives on some items. Often, one successful choice appeared to satisfy subjects' need for success and consequently their search for a

second alternative did not take place. The third problem, indicated by the item analysis, was that some items were too difficult and more easy items were desired. In retrospect these changes were not necessary.

Thus a comprehensive revision of the Part II of the test was undertaken. It was decided to place the instructions for this portion of the test on film, then continue with audio instructions only for the test proper. The revisions included:

1. graded difficulty of items as judged by the investigator,
2. selection of five new items of varying difficulty, and
3. revision of ten items used on the pretest.

Revision of the pretest items included:

1. having just one correct alternative and
2. changing the number of possible alternatives from four to five to help control for guessing.

All items were reproduced on colored paper to continue the booklet format used in the film portion of the test.

V. The final form of the CF test

The final form of the CF test, like the preliminary form, consisted of two parts. Part I was a test of conservation, within-thing concept formation; part II was a discriminante response, between-thing concept formation task. Part I was changed only superficially since the pretesting identified no problems. It consisted of twenty-one items measuring conservation of number, length, quantity, mass, area, and volume. The administration time for part I was 30 minutes. Directions were presented via tape by a female voice and the visual component consisted of an 8mm color motion picture. The tape recorder ran continuously during the administration, while the projector was turned off and on by cues on the audio tape. The pupil response booklet was made of varying colored paper. All 23 pages were printed identically except for the horizontal or vertical orientation of the response boxes to correspond to the form of the visual stimuli. Each page contained three squares; one containing a star, one a flower and one a key. The pupils were to mark exactly one of the boxes with an x. There were two practice items. Table 3 shows the concept being assessed in each item.

Table 3
Item types in Part I of the Concept Formation Test

Item	Type of Conservation
1, 3, 4	number
2	(more) response breaker

Table 3 continued

Item	Type of Conservation
5, 7	length
6	response breaker
9, 11	discontinuous quantity
10	inequality of quantity
12, 13	mass
14, 15	continuous quantity
16, 17, 18	area
19, 20, 21	volume

Part II was revised extensively on the basis of pretest data. The words were removed from the page since they seemed to be a distractor. On each item there were four shapes in the top row (positive exemplars), four shapes in the second row (negative instances) and five shapes on the bottom row. The subject was to choose one shape on the bottom row which was like the ones in the top row. The nature of the items can best be seen by referring to the response booklet for part II.

There were two practice items presented by movie and tape recorder. The 13 test items were presented via test booklet and tape recorded instructions, with the pupils marking response booklets and receiving directions from the tape recorder only.

Thus the final form of the test consisted of 34 items with four practice items. The total testing time was 45 minutes.

Word Association

The word association task which was chosen was one which already existed; however, word association as a task is not one which appears on standardized achievement tests, and, consequently, measures a level of language development which is not ordinarily measured by those instruments. Children's free associations are highly related to word comprehension and ability to place words in appropriate contexts (Riegel, et al., 1964); to semantic measures (DiVesta, 1966); and to correct usage of nonsense words after exposure to the nonsense words in syntax (Brown & Berko, 1960).

The Berko & Brown list was chosen because it contains very common words which prevents it from being a traditional vocabulary test. Moreover, it avoids words which contain potential dialectal differences in morphology. Also data exist on middle class children in the first three grades. In addition, the list is much shorter than Entwisle's (1966) 96-word list, though percentage scores permit comparison with her data on disadvantaged first, third, and fifth graders.

The cognitive variable measured by this instrument is one level of language development; that is, the rate of paradigmatic responding (same form class as given) indicates the extent to which the child is coding words according to form class. The Brown & Berko list contains 36 words: six of each of six form classes. There are two types of nouns (mass and count); two types of verbs (transitive and intransitive); adjectives; and adverbs.

Cost factors include the production of the response form but more importantly test administration. Ease of administration varies. The list was administered in two ways: an "aural/oral" individually administered version, and a "read and write" group administered version. The aural/oral version took from five to seven minutes to administer and maintained the children's close attention throughout. The read and write version ranged from ten to thirty minutes to administer and, of course, some children were distracted during the session.

Preliminary tryouts and revisions were not necessary because there are no "floor or ceiling" problems. It was essential that the list remain intact for the comparisons indicated in the first paragraph of this section. Subjects in all 18 cells were involved in both the individual (aural/oral) and the group (read and write) administrations. There is a representative sample of overlap to permit a direct comparison of both types of administration.

Samples of the two response forms used are listed in Appendix I and are included in the packet of test materials accompanying this Report. The longer one with the scoring grid at the bottom is the one used for individual aural/oral administration. The second form, consisting of 2 sheets with the words in primary type, was used for group administration. Directions for administering and scoring each version are included in Appendix III.

Scoring of the Word Association Test involves assigning response words to a part-of-speech. On the Free Association Test those response words that were marked with characteristic suffixes (adjectives and adverbs) or with the to of the verbal infinitive could be confidently classified. With most potentially doubtful responses membership in one part-of-speech is so much more common than membership in another that it was safe to assign the word this primary membership. Where there was some doubt, however, the experimenter asks the child to use the response word in a sentence and, in doing so, the child revealed the part-of-speech he had in mind. It was necessary for the experimenter to score the responses mentally as they were elicited so that he could resolve scoring problems where necessary.

There were 36 stimulus words on the Free Association Test, six words for each of six parts-of-speech. Each of the 36 response words (or phrases) was scored as homogeneous or heterogenius with reference to its stimulus word, and so for every subject there was a possible maximal score of six homogeneous responses for each of six parts-of-speech.

Samples of Written Language Production

A second approach to assessing language development was through the use of written productions. Aronfreed's (1971) field review of the Phase 1 report suggested that analysis of active language manipulation should provide an additional dimension in understanding any verbal deficiencies in disadvantaged children.

To obtain written productions from children, two drawings were presented with the request that the children make up a story about each picture. One picture, "the wall:, shows four men scaling a wall. The second picture, "rich man-poor man", shows a well dressed man looking at a dejected figure sitting in a street or alley The forms used are in the test materials packet.

No attempt was made to analyze the thematic content of the two stories. Rather, each story was analyzed to yield the following information.

1. Total number of words used
2. Number of sentences
3. Number of commas
4. Punctuation other than commas
5. Average sentence length
6 Standard deviation of sentence length
7. Average word length

The use of these indices is suggested by the work of Page (no date) who found substantial correlations between overall quality of essays as judged by teachers and length of essays in words (.32), average word length (.51), standard deviation of word length (.53) and number of commas (.34).

While these indices are relatively gross and do not represent the more sophisticated transformational analyses first outlined by Chomsky (1957), there is evidence that language maturity is related to the total production of words elicited in controlled interviews (Loban, 1963), sentence length (Riling, 1965; Hunt, 1965; and O'Donnell, Griffin and Norris, 1967) and sentence complexity (Strickland, 1962).

The indices employed in the present study were generated entirely by computer analysis. To obtain this analysis all essays were keypunched into IBM cards and a computer program was written for scanning the essays and generating the designated statistics.

Before statistical analysis, essays without periods were removed from the sample. Since these were essentially one sentence essays, removal of these cards eliminated spuriously high average sentence lengths.

The "Make A Story" test was administered following the word association test. Instructions stated that the story should be completed on the front side of the paper. No time limit was set on the production of the stories, although some teacher's may have limited the time available in order to end the testing session.

Statistics were computed for each story separately, then combined for each student. The figures for each essay were added together to obtain the variables Total Words Used, Number of Sentences, Number of Commas, and Number of Other punctuations. The figures for each essay were averaged to obtain the variables Mean Sentence Length, Standard Deviation of Sentence Length, Mean Word Length, and Standard Deviation of Word Length.

Finally in order that the communicative and cognitive aspects of language ability enter as a variable in this study, a sample of sixth grade essays was drawn from two of the disadvantaged schools and read independently by two judges. All mechanics of written language were disregarded and scores were generated for the following aspects of the essays:

A. Unity — The central plot or thread of the story can be identified. The sequence of events is clear, and appropriate connections exist among the elements of the story.

B. Development — Concrete details are added which lend specificity and richness to the people, places and events which are introduced.

C. Imagination — The story goes beyond simple description and brings in elements not present in the picture. The theme of the story shows uniqueness and originality.

The essays were rated on a five point scale for each of the three characteristics described above, and an overall quality score generated by adding the scores obtained on the three parts.

The ratings of the two judges were combined to obtain the scores reported and analyzed. Thus, a student's score on any aspect of the essay could range from 2 through 10. The overall quality score could range from 6 to 30.

The quality of essay scores entered into the correlational analysis only.

I. Summary of Cognitive Variables

As outlined in the project report of October 15, the skills to be assessed through the test of logical thinking originally consisted of those skills involving multiple classification, seriation, and relational and syllogistic type logic. These particular aspects of logical thinking were selected on the basis of evidence of other researchers who have found that each of them (especially multiple classification) are exemplary of the development of cognitive growth through several age levels and that the growth of these particular skills may be effected by factors of race and socio-economic status. It has also been shown that the development of these skills is not adequately assessed by standardized intelligence tests, and that there is a relationship between their development and measures of school achievement.

The construction of a group test involving these factors marked a new direction in test development for a number of reasons. First, no single instrument had previously attempted to include each of these parameters in a comprehensive test for even a single age level and no similar instrument had been designed for a range of ages. Second, most researchers measuring the growth of these cognitive skills had relied upon a clinical approach in which the test items were administered to individual subjects. Further, these individual tests usually involved the manipulation of concrete objects rather than conventional paper and pencil forms of testing. Hence the development of an instrument which could be administered to groups of children was a departure from previous studies. Third, the incorporation of movie film and synchronized tape recorded instructions was another innovation which had never before been applied to these measures of cognitive growth.

II. The Production of the Instrument

Based on a comprehensive review of the literature, the following parameters were judged to be indicative of logical thinking and were included in the Belmont Elementary Logical Classification Hierarchy.

1. Multiple classification skills were measured through the use of 4 x 4 matrices involving problems of one and two attributes and by means of row and column intersections (a variation of a 4 x 4 matrix in which the upper left section of nine elements was removed) consisting of one and two attribute problems. The attributes involved were those of size, shape, color, and pattern.

2. Seriational and relational items were measured through problems in which the subjects were asked to respond to situations which required them to consider the relationships among a series of people or objects.

3. The measures of formal logic were presented in a series of five kinds of syllogistic logic problems using the if-then type format. The five categories chosen, based upon the work of Ennis, were those of basic understanding, inversion, conversion, contraposition, and transitivity.

The final version of the test is the result of a number of revisions, trials and adaptations which were designed to pretest and refine each of the elements before it was accepted for the final form. The most important of these preliminary versions will be described, not only because they are necessary for a complete understanding of the end result, but also because the reasons underlying the decisions reflected in the final product should be of interest to those who wish to replicate or extend these procedures.

The initial format of the test consisted of four subtests, matrices, row and column intersections, relations, and syllogistic logic. Each matrix was a four by four pattern of 16 spaces containing a combination of up to four variables. One element of each matrix was left blank. The instructions asked the subject to select the correct element from among four choices. The format of the test consisted of five matrices which could be solved by attending to one attribute, followed by a second set of five matrices each of which could be solved by attending to two attributes simultaneously.

The number of attributes involved in each matrix was defined to be the minimum number to which a subject would have to attend in order to solve the problem.

The row and column subtest consisted of problems in the format of the intersection of a four element row and a four element column. The point of intersection was left blank and the subject was to select from among four choices, the element which correctly filled the blankintersection. Five one attribute problems and five two attribute problems were included in this subtest.

The third subtest concerned the relationships among series of objects presented to the subject. The relationships were ones of size for inanimate objects and factors such as speed or age for animate objects. For example, a subject was shown three shapes A, B, and C in pairs while the taped voice established a relationship between the pairs as follows: "A=B, B=C, does A=C?" The response format offered three choices: "Yes, No and Can't Tell." The subject was to select the correct answer. There were 10 items in thesubtest.

The fourth subtest involved syllogistic type logic. The syllogism was presented on the screen and in the test booklet while the taped voice read it for the subjects. The subject was then asked to decide whether the first two statements made the third one true and to respond by circling the correct answer in the test book. The choices were: "Yes, No and Can't Tell." A total of 15 syllogisms were presented.

III. The Pilot Studies

This first form of the test was individually administered to a pilot study group of thirty subjects, ten per grade level for grade two, four and six in a predominately white, middle class school in a small neighboring town. Following the pilot, minor changes were effected in the script and timing of the items and ambiguous items were redesigned.

The second pilot study with the revised instrument was after the first pilot study, the presentation of the times was committed to 8mm color movie film and the instructions and timing of the test were put on audio tape. A pupil response and a fifty page pupil response booklet was printed. For each type of item, the subject was presented with a practice item in his book and on the screen while the taped instructions described the item, how it could be solved and how the response was to be marked in the booklet. The items were presented at 25 second intervals for the entire test. Including the time for the five practice items, this made a total time required for the administration of this form of the test was approximately fifty minutes. This includes the time required for passing out materials and setting up the equipment.

The second pilot study of this form of the test was administered to a sample of 151 subjects in Lincoln School in Gary, Indiana in February. These subjects were of the same grade levels, socioeconomic status and came from the same ethnic strata as were the subjects to be tested in the major testing program. The results of the pilot study were subjected to rigorous analysis in the form of both item analysis and the computation of Kuder Richardson reliabilities and a review of the clinical observations made by the testing team, teachers, school administrators and school board officials.

The time required to administer this form of the test including time necessary for passing out materials and setting up equipment was approximately 50 minutes. This was longer than the authors had anticipated and it was felt that interest flagged especially in the lower grades as the test progressed. This was partially due to the length of the test and to the fact that the syllogistic items which were hardest for the primary age children came at the end of the test batteries.

The item analysis yielded discrimination indices in the form of item correlations for each item with the subjects total score and a measure of item difficulty in terms of the percentage of subjects choosing each item and its alternative responses. In addition, Kuder-Richardson formula 20 reliabilities were computed. The reliability for the total test for the grade two subjects was .63; for the fourth grade subjects, .59 and for the sixth grade subjects it was .60. The overall reliability for all grade levels was .71.

IV. Revisions made due to pretesting and final analyses

The information generated by the two pilot studies resulted in a number of changes and improvements in the final form of the test. These changes were based on a number of factors, among them being the item analyses of the pilot, clinical observations made by the testing team during the testing situation, critiques by the Belmont project staff and suggestions offered by the Belmont National committees and the Washington staff.

The major changes were the adoption of a new format for the test, and the deletion of the subsections pertaining to relations and syllogistic type thinking. The section dealing with relations was removed from the test for the following reasons:

1. The items seemed to be too easy for the upper grade children and not difficult enough for the lower grade level subjects.

2. There were not enough items to measure adequately the subjects' abilities to understand and operate with relationships among three elements. The inclusion of four or more elements in each item might have rendered a more accurate measure, however, this would have lengthened the section of the test substantially.

3. This portion of the test did not add significantly to the subjects scores for the total test.

4. The mechanics of administering this section of the test required the subjects to pay close attention to the image on the screen while at the same time, it was crucial that the tape recording be exactly synchronized with the film projector.

The subtest dealing with syllogistic logic was removed from the test for the following reasons:

1. The subjects' scores on these items were inconsistent across the grade levels and it was felt that the response format in which the subject was to select one of three possible answers encouraged guessing which confounded the results.

2. Observations by the testing team and the school officials led to the conclusion that only the upper elementary grade subjects were applying themselves to these items. Lower grade subjects tended to choose responses at random.

3. The syllogistic format of the items seemed too advanced for most subjects. That is, the first pilot study with small groups of subjects in individual testing situations proved that young subjects can attend to this type of problem, but they seem to respond better when asked to state their answers verbally or to justify their response.

4. There was some question as to whether the language used in the syllogisms (even though they were read for the subjects) was appropriate for all ages and socioeconomic backgrounds.

The method of administration was altered from the first versions in which each item was shown on the film and remained in view while the tape recorded instructions were heard. The item had continued in view during the time the subject responded to it, hence the pacing of the subjects was standardized by both the film and the tape recording. After the administration of the second pilot study, this method was judged unsatisfactory for the following reasons:

1. Once the subjects had proceeded past the practice items, there seemed little justification in having them divide their attention between the image on the screen and the test booklet on their desk. In fact, as soon as the subjects became familiar with the format of the test, they seldom looked at the screen except for the practice items.

2. Showing the item on the screen for the duration of the time required for the child to respond to it, required a considerable amount of film which added to the cost of the instrument.

3. Running the film and the tape recorder simultaneously and attempting to maintain perfect coordination between the two proved to be a very difficult task due to temporary power surges and the degree to which the machines had warmed up to their peak operating speeds. While this problem could have been remedied by the use of a professionally produced sound film, this did not seem feasible at this time. In addition, the testing team was dissatisfied with this method of pacing the subjects through the test. It is interesting to note that this pacing was considered necessary for a variety of reasons, the two most important being that, 1) presenting the items for a given amount of time for each subject served to standardize the test for all the subjects and 2) that where the team experimented with allowing the subjects to proceed at their own pace, it was found that a serious loss of data resulted from the fact that subjects tended to race through the test and to spend an insufficient amount of time on each item.

The new method of administration for the test was a refinement of the first method with these changes:

1. More practice items were included in the test so that the subject was taken step-by-step through two practice items for the matrix problems (one practice item for the two attribute problem and one practice item for the three attribute problem), one practice item for the row and column intersections (by this time, the subjects were familiar with the response book format, the requirements of the testing situation and with two and three attribute problems), and two practice items for the shape and color intersection items.

2. Only the practice items were presented on film. The tape recorded instructions were synchronized with the film, but after the subjects had completed the practice items, the test administrator turned the film projector off. The tape recorder continued to run and the voice processed to tell the subjects when to turn to the next page, thus pacing the subjects through the test at a speed of 20 seconds per item.

A new series of items was included in the final form of the test at this time. These items have been termed "Shape and Color Intersections" since they were comprised of the intersections of various shapes and colors. These items are found on pages 41 to 55 of the test book. Each item required the subject to decide which, if any, of the five choices presented to him, would "fit" in the space marked with an X. In order to decide this, the subject had to take several classes in to account simultaneously. Here again, the definition of criterial attributes was applied to these items with the result that the latter were ranked according to the minimum number of attributes to which a subject had to attend to solve the item. Thus, the items represented one, two and three attribute problems.

The final change from the pretest format was the inclusion of another response choice for each item. That is, instead of having four boxes at the bottom of the page (three figures and a "none of these" choice) an additional figure was included. This allowed for an increase in the order of difficulty for each item.

These changes resulted in a standardized format for the entire test, a similarity among the three subsections of items and in the form of the responses required of the subjects. It also resulted in a test of fewer items, greater ease of administration and clarity of directions and a shortening of the time required for the test.

V. The Final Test

The final form of the test contains 55 items plus five practice items. It should be noted that the statistical analysis of the test was done on 46 items, nine items having been deleted on the basis of the item analysis using the larger, final sample.

The format of the test, its subsections, the criterial attributes of the items and the location of the practice items.

Items	Description	Number of Attributes
	First practice item, 4 x 4 matrix	2
	Second practice item, 4 x 4 matrix	3
1 to 10	4 x 4 matrices	2
11 to 20	4 x 4 matrices	3

Items	Description	Number of Attributes
	Third practice item, row and column intersection	2
21 to 30	row and column intersections	2
31 to 40	row and column intersections	3
	Fourth practice item, shape & color intersections	2
	Fifth practice item, shape and color intersections	3
41 to 55	Shape and color intersections, 15 items in random order according to one, two and three attributes as follows: 2 one attribute items 7 two attribute items 4 three attribute items 2 four attribute items	

Thus, the complete test as administered to the subjects contained 55 items varying across three subsections and involving the following breakdown of criterial attributes: 2 one attribute problems, 27 two attribute problems, 24 three attribute problems and 2 four attribute problems.

A subsequent and final revision of the test resulted in the elimination of nine items. These nine were deleted from the original 55 items since the item analysis showed that they possessed low or negative correlations with the subjects' total scores on the test and that they had a low item difficulty index for the total sample. No useful data were lost as a result of these deletions, rather, this served to strengthen the test and to raise its reliability to a score of .8825 as computed according to the Kuder-Richardson 20 formula.

The items which were deleted were numbers 7, 20, 22, 23, 25, 36, 39, 40 and 46. This left a total of 18 items in Subtest I, Matrices; 14 items in Subtest II, Row and Column Intersections; and 14 items in Subtest III, Shape and Color Intersections. This left a grand total of 46 items in the test.

A test Administration Manual may be found in Appendix IV. The latter gives complete instructions for those involved in administering the test to elementary school age subjects. The tape script is also in Appendix IV

The reliability coefficient for the total test for second grade subjects is .80, for fourth grade subjects it is .81 and for sixth grade subjects is .83. The reliability coefficient for all grades combined on the total test is .88.

An examination of the correlation of each item with the total score for the total sample reveals that of the 46 items, 36 correlate at .300 or higher, 7 correlate between .200 to .299 and 3 items fall within the range .075 to .167. A grade by grade breakdown of these data shows that the following numbers of items correlate above .200 with the total score: grade two, 36 items; grade four, 42 items and grade six, 40 items. The analysis of the item difficulty of each item for the total sample indicates that the index ranged from a low of .133 for item 32 to a high of .905 for item 8. The majority of the indices ranged from .400 to .800.

Reliability coefficients were also computed for each of the three subtests with the following results based on the total sample for all grades:

Subtest I, Matrices, 18 items, KR-20 = .84
Subtest II, Row and Column Intersections, 14 items, KR-20 = .51
Subtest III, Shape and Color Intersections, KR-20 = .69

The examiners found that the children taking the test were highly interested and motivated by it due to its innovative format, use of film-tape instructions and the colorful appearance of the test booklet. The subjects enjoyed taking the test and spontaneously cheered at times upon finding that they had performed correctly on the practice items.

The test is easily administered by one person, although it was found that a second member of the testing team was extremely useful to aid in setting up the equipment and distributing the test booklets. However, in a testing situation where the children would be coming to the testing room, or where a teacher would be administering the test to her own class, the administration could easily be handled by one person.

The cost of the instrument is relatively slight for the "hardware" items such as the film and audio tape, which would cost approximately twenty five dollars to reproduce. The test booklets represent the major cost of the test as they require a five color run in printing and are expendable at the end of the test. Naturally, the cost per booklet decreases with an increase in the number printed at one time. Based on a minimum order of 1000 booklets, the cost per booklet would be approximately $1.50.

The scoring of the tests is relatively simple and may be handled in at least two ways. The tests could be scored manually for small class size groups, or one might elect to use a machine scoring procedure in which the responses are transfered to mark-sense cards which are scored according to a marking key. The latter would cost approximately six cents per subject.

No major difficulties were noted in administering the tests. The only areas in which problems might be encountered involve the tendency

of some subjects to race on ahead of the others despite the pacing of each item. A teacher could easily control this by circulating through the testing room. The only other possible problem concerns the placement of the projector so that all subjects can see a large, bright image on the screen and the partial darkening of the room so that the subjects can see the film image and the practice items in their booklets simultaneously. The testing team did not find the latter to be a serious problem even under the most adverse lighting situations. Since the film is required only during the practice items, the team frequently opened the curtains or blinds after the film portion of the test had been completed.

Purdue Elementary Problem Solving Inventory (PEPSI)

I. Rationale and Guidelines for the Development of PEPSI

Our review of the problem-solving (PS) literature and especially the review of models and psychological processes involved in problem-solving led us to several conclusions regarding the nature of the problem-solving process and the means by which problem-solving abilities have been assessed in the past. The review also provided us with guidelines for the formulation of goals for our test, criteria for the selection of various problem-solving variables to be measured, and a rationale for the development of specific kinds of items.

In terms of the nature of the problem-solving process, our review made it clear that there was no single, general problem-solving factor, aptitude, or ability. Rather, problem-solving involved several different kinds of abilities, all playing an important role in the total process. Some of these abilities could be described as the ability to sense that a problem exists, to define the problem, to ask questions and see implications, to see familiar objects or events in a different perspective, and the ability to select appropriate solutions to problems. Many of these abilities, or operations, have been described by Guilford (1967) in his structure-of-intellect model. Thus, we decided to develop a series of PS tasks each measuring separate aspects or abilities in PS.

In the past, there has been a considerable lack of uniformity in problem-solving research. Various tasks have been employed including puzzles, anagrams, logico-deductive problems, simulation problems, and arithmetic problems. All of these kinds of problems are important, yet they have generally not been representative of real-life PS situations. Problem-solving abilities have also been measured in terms of amount of time to solution, number of errors made, or number of solutions generated. Again, these approaches have not accurately reflected the criterion of problem-solving situations in real life. We decided to avoid the available artificial tasks, to develop realistic PS tasks, and to use criteria which were closely related to the gross behavior represented in each task.

The review of the literature suggested several cognitive operations involved in problem-solving, and within each of those operations there are quite a number of specific skills related to school subjects. The objective of our new test, however, was not to measure these specific skills, but rather to assess the more general set of operations and variables common to all of the curricular areas. To this end, we concluded that such assessment could best be accomplished by operationally describing the behaviors required of student, for example, asking questions or selecting the best solution to a problem. Finally, the problem-solving literature demonstrated that each of the abilities selected for assessment were modifiable by instruction. Our new test, then, was also designed to have practical importance to the classroom.

In the construction of our test, the literature suggested that problem-solving could best be measured with a series of miniature problems aimed at separate factors. In addition, these problems should be representative of real-life situations. Since a large proportion of the population to be measured consisted of socially disadvantaged children and children from low socioeconomic backgrounds, much attention was paid to the particular learning problems of these groups. The disadvantaged are most likely to be handicapped in problem-solving when abstractions and elaborate cause-and-effect relationships are involved. Verbal aptitudes and reading ability are also likely to run low among the disadvantaged. Thus, the response format of our new test is entirely multiple-choice, no writing is involved, and each alternative is read to the students by means of an audio-tape.

Disadvantaged students may be easily frustrated by tasks they do not understand. Therefore, the difficulty level was kept low, and time pressures or other anxiety-producing restrictions were held to a minimum. Our new test makes use of real-life type problems in an attempt to make the test meaningful to students. It also attempts to increase students' motivation to work on the problems by means of humorous cartoons and a representation in the cartoon characters of several ethnic groups.

Memory for specific information may be a significant factor in performance on problem-solving tasks, particularly if they are related to curricular areas. We tried to avoid dependence on memory by structuring general, real-life tasks for which there would be minimum need for specific information. We also recognized that the most realistic response format would be open-ended, constructed responses. However several trials with tasks which called for open-ended constructed responses revealed that for general field use of our tests, scoring such tasks would probably be quite unmanageable. Thus, we decided to use multiple-choice responses throughout the test.

Finally, from our review of the research and theory literature we concluded that proper interpretation of the results of problem-solving tests would require some kind of age or grade norms and that this would, in turn, require that we develop tasks for several age and/or grade levels. Since the target population was to be second, fourth, and sixth graders we decided to develop one comprehensive test with items appropriate at each of these grade levels. Thus, performance could range from low second grade to high sixth grade level.

Other practical constraints influenced our efforts in developing the problem-solving tasks, but the major guidelines which directed our efforts were those stated above.

Cognitive Operations and Variables To Be Measured

Using the guidelines stated above, the following PS cognitive operations were selected to be measured with tasks designed for this project:

(1) Sensing the problem. This is the ability to detect, to see, or to become aware that a problem exists. It is classifiable in the "structure of intellect" (SI) as a cognitive factor. Many PS tasks merely state the problem, thereby jumping over Ss' ability to detect that a problem does or does not exist. Given a complex situation Ss are required, in this task, to determine if a problem does or does not exist.

(2) Identifying the problem. Given a problem situation, this cognitive operation requires Ss to specify what the problem is. Again in the SI it is a cognitive operation. In a complex situation Ss may not focus on the real or essential problem. This task seeks to determine if they can identify the problem.

(3) Clarifying the problem. Clarification of the problem involves several types of cognitive operations:

(a) Asking questions. This is the cognitive ability to ask questions which will clarify the problem. It is a divergent thinking operation.

(b) Guessing causes. This is the cognitive ability to state a number of possible causes for a problem situation. Again it is a divergent thinking operation.

(c) Clarification of the goal. This is the ability to ask questions or seek further information which will in turn be used to develop a search model, which will serve to clarify the goal, or result in criteria for an ideal solution, It is a divergent thinking operation.

(d) Judging if more information is needed. This is the ability to judge if more information is needed or if enough is available to proceed to solution. It is analogous to the cognitive operation of evaluation in the SI.

(e) Analyzing details of the problem and identifying critical elements. This is the ability to analyze a problem situation into its elements and to identify those aspects which are critical in problem identification or solution. It is the operation implied in level four of the Bloom Taxonomy.

(4) Redefinition or Transformation

This is the ability to change elements of the problem situation or common objects or events so that theymmight become useful in achieving a solution. In essence it is analogous to Guilford's Alternate Uses Test or Torrance's Unusual Uses Tests. It is a divergent thinking operation which results in the product called transformation. It is sometimes referred to as spontaneous flexibility.

(5) Seeing Implications

This is the ability to extrapolate, to see what the results would be if certain solutions to a given problem or conditions came about. It is represented by Guilford's Consequences Test which measures divergent thinking of implications with semantic content.

(6) Verification. This is the cognitive ability to be aware of the need to test, validate or verify an hypothesis, possible solution or solution that has already been tried out, to a problem. As such it is chiefly a cognitive ability as referenced in the SI. It is not, as defined here, the ability to perform or carry out a verification task. The latter will always involve specific skills related to particular curricular areas. In the present task it is the ability to see the next step in a given PS sequence as necessarily involving verification.

(7) Solving a problem. This cognitive ability was approached in two ways with reference to single and multiple solution problems.

(a) Solving a single solution problem. This task is essentially convergent at closure in that Ss are required to pick the one of several alternatives which actually represents a solution for a problem situation.

(b) Solving a multiple solution problem. This task is essentially divergent in that Ss are required to identify the most original, unique or unusual and suitable solutions for a multiple solution problem.

C. Instrumentation

All of the instrumentation follows a general format in which a cartoon or sequence of cartoons are presented on a screen and Ss have a test booklet which provides response format. The latter involves examining alternatives, picking the solution, and drawing an X on the box containing the solution. The alternatives are given as pictures or verbal descriptions which are printed in the booklet and read to the child. The problem description and directions are recorded on audio tape and played, synchronized, with the still pictures. Illustrations of types of problems for each of the cognitive operations specified above will be given next.

1. Sensing the problem. In this task Ss are shown a cartoon, comparable to Davis-Eels problems, and asked to determine if there is or is not a problem. Essentially the response is yes or no.

2. Identifying the problem. This task is essentially the same as the first type of task in the Davis-Eels games. Ss are shown a picture of a problem situation, given several verbal statements, and asked to identify the one statement which specifies the problem.

3. Asking questions. Given a cartoon and an oral statement of a problem situation, Ss are next given a series of groups of three questions and asked to pick from each three the questions which would be most useful in clarifying the problem.

4. Guessing causes. Given a cartoon and an oral statement of a problem situation, S are next given a series of groups of three possible causes for the problem and asked to pick from each three causes the one which would most likely be the cause of the problem.

5. Clarification of goal. In this task Ss are given a partial and ambiguously defined task or goal and asked to select from each of the groups of three alternatives offered, the question or piece of information which would clarify the goal or afford an adequate search model.

6. Judging if more information is needed. Given a cartoon and oral description of a problem situation Ss are asked to judge whether sufficient information is or is not available to proceed to a solution. The goal, search model, or ideal solution is well defined.

7. Analyzing details of the problem and identifying critical elements. In this task a problem is presented in cartoons and with oral description including full statement of the goal. Ss are asked to identify on the cartoon those elements which are needed in producing a solution. Ss are also asked to indicate the order in which elements would have to be used in working toward a solution.

8. Redefinition or transformation. Given a cartoon and oral description of a problem, Ss are asked to indicate which things in the cartoon could be used to yield a solution. Ss are required to redefine or transform common objects in order to see their potential use. For example, S is asked to make a doll by adopting parts of discarded clothing.

9. Seeing implications. Given a problem and a proposed solution Ss are asked to pick from groups of three the most likely result if the given solution were implemented.

10. Verification. Given a problem situation, Ss are required to select the next step from three stated alternatives, the correct one depicting a testing, validation, or verification activity.

11. Solving a single solution problem. Presented with a problem situation, Ss are required to select from three stated alternatives the one alternative which will solve the problem.

12. Solving a multiple solution problem.

    (a) Unusual solution: Presented with a problem situation, Ss are to choose from among 3 cartoons, the one that represents the most unusual solution to the problem.

    (b) How would you do it? Presented with a problem situation and three stated solutions, all tenable, Ss are asked how they would solve the problem.

While all of the tasks are specified as involving multiple choice response format, it is obvious that written or constructed responses would have been far preferable for several of the cognitive variable in PS, notably asking questions, guessing causes, clarification of the goals, redefinition or transformation, generation of multiple hypotheses, seeing implications, and solving a multiple solution problem. During the task development phase of the project, we explored the possible use of a constructed response format, at least with 4th and 6th grades, but found the scoring problem unmanageable for mass testing.

II. Production of the Instruments

In addition to guidelines for task development specified above, we also drew the following conclusions which guided us in task development: the total item pool should number about fifty, and in order to make the instrument diagnostically useful, reliable subscores should be identified as clusters of about eight or more items. For the total item pool we judged that fifty was a satisfactory compromise with regard to possible testing time and minimum hope concerning possible reliability of the total instrument and some of its subscores.

Subscores could be generated for thirteen component item types, but this would mean that some subscores would be based on as few as two items. These would obviously not yield reliable subscores. Thus, broader groupings with logical meanings or relationship were identified as follows:

Item Cluster	No. of Items	Reliability Estimate
A Sensing and Identifying (1 and 2)*	10 items	.28
B Clarification I (3 and 5)	7 items	.42
C Clarification II (3, 4, 5, 6, 7)	15 items	.50
D Problem Parts (8, 9)	9 items	.57
E Pre Solution (1, 2, 3, 4, 5, 6, 7)	25 items	.57
F Solving Problems I (9, 10, 12)	15 items	.55
G Solving Problems II (9, 10, 11, 12)	18 items	.68
H Solving Problems III (8, 9, 10, 11, 12)	22 items	.73

Differences among subgroups "Solving Problems I, II and III" may be described as follows. Solving Problem I consists of single and multiple solution problems and verification problems. Solving Problems II consists of the same set plus implications problems. Solving Problems III consists of the above plus the redefinition problems. Solving Problems I is the purest traditional set of problems. II and III take in components which are problem-like but conceptually different.

Preliminary Task Development

The rationale for the tasks and the statement of instrumentation quite clearly specified the parameters of the items to be developed. However, the actual problem situations had yet to be identified. Therefore as a first step in task development we developed a long list of problem situations which might realistically confront children in grades 2, 4 and 6, which could possibly be depicted in cartoons, and which would be culturally acceptable to diverse ethnic groups, boys and girls, and various socioeconomic levels. The four members of our PS team acted as a brainstorming group and generated a list of approximately 150 such problem situations. The list was then duplicated and used as a basis for subsequent task development.

In the next stage prototype items were developed on cards with a verbal description of the cartoon which would accompany the item. The card specified the item type according to the rationale for tasks, the verbal material of the stem, and the three response options. One or more items of the twelve types were developed and brought to a staff

*The numbers in parentheses refer to the tasks as described on pages

meeting for initial critique, suggestions, and corrections. The staff met weekly throughout the project for such discussions of the various theoretical and practical aspects of task development.

When a final form was agreed upon for all twelve item types, additional items were developed in each category as a part of an item pool. Approximately 150 items were so developed. Approximately 90 items were then identified as the most promising, and we proceeded with the development of cartoons for these items.

A professional artist who was also a cartoonist was selected to do the work. He was given preliminary orientation concerning the need to develop cartoons which would be appropriate for children in grades two, four, and six, boys and girls, and various ethnic and socioeconomic groups. A preliminary draft of each cartoon was brought to the group for examination and sent back for revision if the group felt it necessary.

In the next stage we began to have black-and-white slides made from the cartoons. Professional photographic services were available on the Purdue campus to do this work. As slides were completed they were brought back to the group for further critique. In many instances the projected cartoon revealed aspects not noted in or changed from the drawing which required further revisions of the drawing.

For the opening directions to orient children to the test, several color slides were made using a child who was in the fourth grade. He depicted several stages of preparation for and taking the test.

As slides were developed and the verbal presentation of the stems were prepared, items were then committed to a final item form on cards as shown in Figure 1. Each of these cards included a reproduction of the slide or slides involved in the item.

A first draft of the entire test was finally assembled by selecting the 60 best items and by including four or more items from each of the twelve categories. Simultaneously the oral script was developed covering the beginning directions, the verbal statement of each item, and all directions necessary to guide the children through the entire test. Development of the test booklet was also begun at this time.

The first completed draft of the instrument was presented with a Carousel projector and Wollensak tape recorder to the entire Belmont staff for critique. Several suggestions were made concerning ethnic representations of cartoon characters and socioeconomic conditions portrayed in the cartoons. These suggestions were incorporated in revisions of several items.

The First Trial With Children

The first trial run was conducted on Sunday, January 10, 1971 with a small group of eleven children representing grades one to seven and both sexes. We observed the children's performance on the test and made notes throughout. After the test we asked for their reactions. Item analyses were also carried out. The internal consistency index (KR-20) was .62, the mean was 76.64, the standard deviation, 4.39, and the standard error of measurement, 2.71. The analysis included item

correlations with total score and the percent of pupils selecting each option. Because N was only 11, this item analysis must be interpreted with considerable caution. The test included 87 items at this stage. This trial revealed many problems of administration, in the audio script, in the test booklet, and in the slides. Thus, we immediately set to work to revise the test and to prepare for a full-scale trial run to be carried out about three weeks later.

The Second Trial

The second trial with the revised test was carried out on Monday, February 15, 1971 with two classes each of grades two, four, and six in Gary, Indiana. These classes enrolled children of the same ethnic and socioeconomic status and diversity as the implied target population for the test.

Item analyses were conducted for each grade separately and for the three grades combined. These analyses yielded discrimination indices in the form of item correlations with total scores, difficulty indices as the percent of each group selecting each option, and reliability estimates of the split-half type. On the basis of these item analyses, items were revised, edited or dropped, and some new items were added. The test included 62 items at this stage. The analyses are summarized below:

The internal consistency index (KR-20) for the 140 second, fourth, and sixth graders, combined was .82. The mean score was 34.75 out of 62 items, with a standard deviation of 6.60 and standard error of estimate of 2.81.

For the second graders:

$N = 43$
$KR\text{-}20 = .60$
$\bar{X} = 25.42$
$SD = 4.28$
$SEM = 2.69$

For the fourth graders:

$N = 45$
$KR\text{-}20 = .85$
$\bar{X} = 27.87$
$SD = 5.07$
$SEM = 2.54$

For the sixth graders:

$N = 52$
$KR\text{-}20 = .69$
$\bar{X} = 31.39$
$SD = 4.41$
$SEM = 2.47$

The Third Trial

The third trial, run with the revised form of PEPSI, was carried out on Monday, March 15 with one class each of grades two, four and six in Gary, Indiana, again in a school comparable to the target type schools and children for which the test was developed. At this stage some new items had been added so that the total number of items was 65. The analyses of the results of this trial are presented next. These data were used to prepare the final form of the test.

For the 64 second, fourth and sixth graders, combined, the KR-20 was .86, with a mean of 46.26 correct out of 65 items, with a standard deviation of 8.35, and a standard error of estimate of 3.16.

For the second graders:

N	= 22
KR-20	= .72
$\bar{X}$	= 38.18
SD	= 6.25
SEM	= 3.29

For the fourth graders:

N	= 19
KR-20	= .75
$\bar{X}$	= 46.95
SD	= 6.11
SEM	= 3.06

For the sixth graders:

N	= 23
KR-20	= .44
$\bar{X}$	= 53.43
SD	= 3.49
SEM	= 2.60

The Final Form of PEPSI

The final form of PEPSI consisted of 49 items. The final large scale testing was set up in Gary to run on Monday, March 22 and then to resume seven days later on Monday, March 29 and to continue on March 30, 31 and April 1 and again on April 12. The first testing on March 22 in Nobel School was in a suburban school with all white and economically advantaged children. The final form of the test was prepared with the provision that the data for six classes at Nobel would be submitted for item analysis, and last-minute changes would be made if necessary. This analysis was completed on March 24 and was judged to be satisfactory so that no further changes were made in the test. The complete item analyses are given in Appendix X. The following is a summary of the analyses:

Combined Grades 2, 4, 6

N	= 1073
No. of items	= 49
KR-20	= .79
$\bar{X}$	= 34.84
SD	= 5.92
SEM	= 2.69

Fourth Grade

N	= 340
KR-20	= .70
$\bar{X}$	= 35.43
SD	= 4.87
SEM	= 2.65

Second Grade

N	= 331
KR-20	= .69
$\bar{X}$	= 29.64
SD	= 5.33
SEM	= 2.98

Sixth Grade

N	= 402
KR-20	= .59
$\bar{X}$	= 38.63
SD	= 3.65
SEM	= 2.35

A total of 36 items have correlations with total scores of .200 or higher in the total group of all three grades. At the second grade level there are 35 items which have correlations of .200 or higher, at the fourth grade level, 32 items, and at the sixth grade level 34 items.

The percent of students choosing each option may be used as a difficulty or easiness index. The percent of students selecting the right answer in the total group ranged from a low of 31% for item 4 to a high of 97% for item 45 with a mean value of 74%. For second graders the low percentage was 17% for item 33, the high was 96% for item 45, and the mean percentage was 63%. For fourth graders the low was 26% for item 4, the high was 97 for item 42, and the mean percentage was 75%. For sixth graders the low percentage was 40% for item 2, the high was 100% for item 36, and the mean percentage was 81%. Overall the test has a quite high easiness level for the number of students getting each item right.

IV. Revisions in PEPSI from draft to draft were based on (1) the item analyses, (2) observation of the children's behavior during testing, (3) critique by the PS team and the entire Belmont Staff, and (4) critiques on three occasions by Belmont National committees and Washington office staff.

In general the following corrections had to be made:

(1) Total testing time had to be cut to about 40 to 45 minutes. In the first version it was about 90 minutes, in the second about 60 minutes.

(2) Our conception of the appropriate keying for some items had to be changed.

(3) Some items which were far too difficult or far too easy had to be changed accordingly.

(4) Items which were poor discriminators or discriminated negatively underwent revisions to try to improve them.

(5) Original efforts to represent Blacks and Latin Americans in cartoons were not always successful and had to be revised in a number of cases.

(6) Backgrounds in pictures were often too much suburbia-oriented and had to be revised to represent inner-city scenes.

(7) A large number of new single and multiple solution problems were developed since items in that category seemed to be the best general discriminators.

(8) Timing of the directions and intervals for each task were revised to provide enough time for all or nearly all children to complete each item but to keep waiting time to a minimum.

(9) Several speakers were tried out on the audio script and found wanting. In the final form a professional announcer was used. The final form of the script was differentiated so that second graders received more response time than fourth and sixth graders.

(10) Some children seemed to have difficulty in identifying options in the answer booklets because separate options were not identified. Thus, we put in a large A, B, and C on the three options in the answer booklet.

V. Final Form of the Test

The final form of the test includes 49 items, two of which are completed by the children as trial runs.

Subtasks	No. of items
1. Sensing problem	5
2. Identifying problem	5
3. Asking questions	5
4. Guessing causes	2
5. Clarifying goal	2
6. Judging if more information is needed	3
7. Identifying relevant aspects	3
8. Redefinition	4
9. Implications	5
10. Verification	4
11. Single solution	3
12. Multiple solution	6

The final form of the test is best represented in the script of our audio tape which includes all of the verbal directions to the children, the directions to the examiner, the complete verbal statement of each item and its options, transitional directions such as page turning, and pictures of all slides. The script is presented in Appendix V.

The final form of the test is also represented in the response booklet which gives the verbal statement of each option or the picture used to depict an option.

The test is also described in the manual of directions for administration and scoring as shown in Appendix V . It should be noted that while the test booklet appears to be expendable since the children write on it, the manual indicates that mark-sense response cards can be used in testing children in grades four and six.

For preliminary analyses the full test has been subdivided into item clusters, as given on page 9, which could be used diagnostically in evaluating curricular programs or subgroups of children. As explained previously Solving Problems I represents the purest form of traditional problem solving tests while II and III include items of other types which require single solutions but are not traditionally included on problem solving tests.

The final form of the test is an instrument which children find interesting and easy to take. Because the difficulty levels are not high, they do not find it troublesome to produce responses. They also see much humor in the test and will laugh spontaneously if free or encouraged to do so by the examiner. From the examiner's point of view the test is easy to administer. Few questions or problems arise. The examiner's task is merely to run the tape recorder and activate the slides. It is desirable to have a second person circulate to make sure that all children are performing properly. But one teacher can easily administer PEPSI alone, particularly if the class is small.

The cost of the test and its administration should be moderate. If the regular booklet is used the cost per pupil will be approximately twenty cents. The slide set will cost about $43.00 and the two audio tapes $2.60 each. If the teacher administers the test, no costs will accrue for a special examiner. If scored by teachers there would be no scoring cost. If mark-sense cards are used it will cost about six cents per child to score the test.

One problem in administration of the test is the tendency for children to cheat by looking at one another's answers. Repeated admonitions to the group or to individuals sometimes fail to correct this condition. It may be necessary occasionally to move an individual child to a position in the room where he cannot communicate with any other children. The best antidotes for this problem seem to be to spread the children out in the room so that they are not sitting close together, to remind the group to work alone, and to isolate refractory children.

I. Brief Review of the Variables to be Measured

In the Final Report of Phase I, we stated that our intent was to develop two group measures of response style: one tapping the impulsivity-reflectivity dimension and one the interal-external locus of control. The literature review had suggested that these two variables were most likely to be associated with "cultural deprivation."

However, we found it very difficult to measure impulsivity-reflectivity in a group for two reasons. First, the expense involved in getting individual reaction times was too great--electronic equipment would make it possible to get accurate individual reaction times but its cost would be prohibitive. Since reaction time is the most important measure of Kagan's impulsivity-reflectivity variables, any attempt to measure this variable without getting reaction times would be futile. Secondly, other approaches we tried were unduly affected by peer pressures. For example, we attempted to get an average reaction time for each child by allowing the child to work at his own pace for fifteen items and then raise his hand when he was finished. However, we found that the children looked at each other more than the test items and felt pressure to keep up with their neighbors. Hence, the results were meaningless. Although we still believe this to be a worthwhile variable, the only meaningful way to measure it is individually with tests such as Kagan's (1966) Matching Familiar Figures Test.

Therefore, we chose to concentrate our efforts on the variable internal-external locus of control. This variable is very closely related to the factor that the "Coleman Report" on Equal Educational Opportunity (Coleman, 1966) referred to when it stated, "A stronger relationship to achievement than all the school factors together, is the extent to which an individual feels that he has some control over his destiny." Thus, this variable is, indeed, a very important one to include in any evaluation of curricula for cultur[illegible] disadvantaged children, such as those included in the Belmont Project.

It will be recalled that internal-external control is a higher-order expectancy variable in Rotter's (1966) social learning theory. Internality denotes the general expectancy that reinforcement is contingent upon, or controlled by, one's own behavior. It is roughly equivalent to intrumental of operant conditioning. Externality denotes the general expectancy that reinforcement is controlled by external forces (including luck) or other people and is not contingent on one's own behavior. It is roughly equivalent to classical or respondent conditioning. As was mentioned in our previous review, the internal-external dimension has important properties of cognitive, motivational, stylistic, and attitudinal variables and it is precisely the convergence of these variables into one factor that makes it such a unique and potentially powerful focus of inquiry for this project.

II. Pretest Production

A number of problems were encountered in trying to develop a group measure of internal-external control, however. A theoretically pure measure would require a series of paired probability statements such as, "There is a _____% chance the teacher will smile at me if I think of the right answer and a _____% chance if I don't." Such statements are obviously beyond the abilities of most elementary school children. Yet we needed a scale which would elicit the best possible index of a child's degree of preceived contingency of reinforcements on his behavior.

The only format which seemed feasible for group testing was a multiple-choice format where alternative responses came from the population of responses children are likely to make. We did some sampling of children's responses to the kinds of questions we wanted to ask by presenting to elementary school aged children a series of stimuli which poisted the occurrence of a reinforcement and asked the children to supply a response--e.g., "When are teacher's happy?" This sampling was informal but aided us greatly in developing test items.

At the outset we made a number of assumptions on which we decided to base our measure. First, we assumed that internal-external expectancies may be either highly generalized or very specific to situations and reinforcements and our items should reflect this, Secondly, we decided that our items should center on reinforcements relevant to academic-type behaviors because our interest was in measuring internal-external control as it is relevant to academic performance. Thirdly, it was assumed that likely reinforcements for young children would be things like approval, attention, or affection of both parents and teachers; peer reinforcements such as admiration, attraction, or envy; and self-reinforcements such as pride, satisfaction, etc. These assumptions guided us in developing items.

For the pretesting, it was decided to develop a four-alternative multiple-choice measure which permitted a choice from among two internal and two external alternatives. The following is an example of one of the items actually used in the pretesting:

> "This child had a good day at school today. Why do you think he had such a good day? Did he have a good day because:
>
> a. All the work was especially easy today.
> b. The child had done all his homework the night before.
> c. The teacher was in a good mood today.
> d. He worked hard during his free study time and finished his homework."

The first and third alternatives represent externally oriented choices while the second and fourth alternatives are internal choices.

In keeping with the cinepsychometric approach, both the stem of the items and their corresponding alternatives were presented visually with slides on a screen in front of the classroom. Figure 1 presents an ex-

ample of the item described above. During the testing, the child had before him a test booklet with each item illustrated in exactly the same way as it was on the screen in front of the room. A single item was presented on each page. Thus, on any given item the child had before him the same iconic representations on both the screen and his answer booklet. It was thought that this double redundancy of the stimulus material would aid the child in remembering each item alternative. An attempt was made to make the visual stimuli ethnically neutral by using stick-figure representations. The examiner stood in front of the room reading each item as it was presented on the screen and pointing to the appropriate alternatives as he read the words that corresponded to them. The child's response was simply to draw an "X" through the picture that represented the alternative he preferred. This response format eliminated the necessity for the child to be able to read or write. The scale had 44 items in all.

III. Pretesting Procedure and Results

Early in February this scale was presented to children in the second, fourth, and sixth grades at Duncan Elementary School in Gary, Indiana. These children were all black and came predominantly from lower-middle and upper-lower socio-economic backgrounds. Two teams of experimenters were employed with two members in each team. One member of each team read the instructions and the items to the children while the other member ran the slide projector. The pretesting all took place in one day and a total of 119 children were tested, including 32 second graders, 42 fourth graders, and 45 sixth graders.

Generally, the procedure went smoothly although the test seemed unduly long. It was necessary to go slowly through the first few items in order to be certain that each child understood what was required of him. The fourth and sixth graders learned very rapidly how to mark their answer booklets, while some second-graders required four or five items to learn to respond quickly and appropriately.

The results of this pretesting indicated that there were a number of major problems with our measure of internal-external control. One problem was that the children tended to choose the internal alternatives much more often than the external alternatives at all grade levels. Out of 44 items, the mean number of items on which external alternatives were chosen at each grade level were: second grade, 14.08 (range: 4-28); fourth grade, 5.88 (range: 0-14); and sixth grade, 4.18 (range: 0-14). Although the tendency to choose more internal than external alternatives does not necessarily present a problem, the fact that it tended to restrict the range of scores in this sample was indeed a problem. An item analysis revealed that the percent of children choosing an external alternative on any item varied from 3% to 66% at the second grade level, zero to 50% at the fourth grade level, and zero to 36% at the sixth grade level. In other words, at the sixth grade level the item that drew the most choices of an external alternative only drew such a response from 36% of the children.

A second major problem was the tendency for children to choose the third and fourth alternatives significantly more often than the first and second choices. Table 4 shows the mean number of choices of each alternative at each grade level. This tendency was independent of whether the alternatives illustrated internal or external choices.

Table 4

Mean Number of Choices of Each Alternative

	Alternatives			
Grades	1	2	3	4
2	7.72	9.00	10.88	14.34
4	6.29	6.43	12.77	16.50
6	7.27	6.40	12.16	18.18

The tendency to choose the last two alternatives most often suggests that the children at all grade levels had difficulty remembering the information for each alternative and, especially, the first two alternatives.

In spite of these major problems, the Kuder-Richardson reliabilities obtained at each grade level were: second grade, .68; fourth grade, .74; and sixth grade, .81. Thus, the children were responding in a fairly consistent manner to the items.

IV. Revision of the Internal External Scale

On the basis of our pretest findings, a number of revisions were made of the scale. Many of these revisions were prompted by comments made by the Office of Education's staff and consultants during a site visit at Purdue as well as from our pretesting experience. Perhaps it would be best to list the comments and criticisms made by the Office of Education staff before describing the actual revisions that were made:

Comments and Suggestions:

1. Perhaps the child has trouble holding 4 alternatives in mind (possibility - quiz child on 4 alternatives to see if this is true). Can the number of alternatives be reduced to two without forcing the child into an either-or situation?

2. Perhaps the children could be taught before the test to associate certain pictures with certain responses, so they would not have so many new stimuli to hold in mind.

3. Some pictures (choices) seem to be more directly representative of verbal wording of the alternative than others. Perhaps the child can remember these more easily and therefore chooses them simply because he can remember them.

4. Some pictures draw the child's interest faster than others (e.g., baseball, bat, T.V.). Stimulus value of the pictures should be on an equal level.

5. Children should have hair. Hair could be used for sex differentiation.

6. The symbols used to indicate "Luck" should be changed. In addition, the drawings used in the pretest are too stylized--some children may not know what they stand for.

7. Some alternatives may be favoring middle class. For example, father at the office may be foreign to many children.

8. To help the child put himself into the pictures, use pronouns to help the child identify. Example: If <u>you</u> were reading, and <u>your</u> teacher were frowning. . .

The first suggestion was well-taken and we have subsequently reduced the number of alternatives from which the child must choose from four to two. This change in format made the second suggestion unnecessary. In response to the third suggestion, we have carefully gone over each item and revised both the wording of alternatives as well as some of the pictures representing the alternatives. This has been useful and we believe there is now a more even and direct relationship between the wording of alternatives and their pictorial representation. In the process of reducing the number of item alternatives, we made an attempt to answer the fourth criticism by picking pictures with comparable interest value for each item. Some of this selection was done on the basis of our pretesting data (for example, eliminating choices where nearly all children chose the same alternative) but some selection necessarily had to be done on a more intuitive basis. If we had had time, we would have done some pilot testing with children of appropriate ages to compare children's preferences for the pictures. Unfortunately, the pace of this project did not allow for such pilot testing. In response to the fifth and sixth suggestions the children were given hair and generally made to be less stylized figures. However, we retained stick-figure presentations in order to insure the ethnic neutrality of the stimuli. The symbol for luck was also changed in the direction suggested. The seventh suggestion was again well-taken and we changed several items in order to picture fathers working at manual labor kinds of jobs rather than "at the office"

as we had previously done in some items. Finally, we did revise the wording of our item presentations in an attempt to get children to more readily identify with figures in the items, as the eighth comment above suggested. We did this by the use of the pronoun "you" in each item (see final instructions below).

In addition to these revisions, we decided to reduce the total number of items from 44 to 38. We would have reduced the number of items even further but it was felt that keeping a fairly large number of items in the scale would allow us to further identify the best items and reduce the scale more at a later time. In addition, we decided to keep both positive and negative presentations of each item situation as we had in the pretest. For example, to balance an item in which a child was pictured having a good day at school we included an item picturing a child having a bad day at school. We wanted to keep this feature because a child's internality may vary from positive to negative situations. It was also decided to include several "cue words" below each alternative to aid the child in remembering which alternative was represented by each picture. A further revision that was made of the test items themselves was to include an equal number of items in which a female was the "hero" as those in which a male was the "hero." The pretest had included only male-like figures.

A number of procedural changes were also made. Although we maintained the same response mode for second graders as we had in the pretesting (drawing an "X" through the chosen alternative), we changed the response mode of fourth and sixth graders. For these groups, the two alternatives were labeled "A" and "B" and the children chose the alternative they wanted by blackening the lines on an IBM card under "A" or "B" with a special machine-scorable pencil. This permitted a tremendous savings in time in the analyses. This change necessitated some slight revision in the instructions for second graders as opposed to fourth and sixth graders (see the two sets of instructions below). Another procedural change was to have the instructions tape-recorded rather than reading the instructions "live" during the testing. A pleasant-sounding female voice was employed to make two tapes, one for second graders and one for the fourth and sixth graders. This increased the ease of administering the test and permitted a more standardized administration.

V. Final Form of the Internal-External Scale

Copies of the final version of the scale are included in the test package. Transcripts of the taped instructions are included in Appendix VI. Perusal of this material will provide the best description of this scale. Briefly, it can be described as a visually presented, group measure of internal-external control with audio-taped instructions. It presents the subject with an equal number of positively and negatively toned situations in which he or she must choose either an internally or externally oriented explanation of the situation. It includes 38 items in all and is designed for use with elementary school children. The child does not have to be able to read or write to respond to this test and it should be especially useful with young and/or culturally disadvantaged children.

VI. The Cognitive Preference Test

A second aspect of response style was measured by a 15 item test of cognitive preference originally developed by McDaniel (1967). The Cognitive Preference Test is modeled after an instrument developed by Heath (1964) to evaluate certain outcomes of high school physics courses following a program of instruction advanced by the Physical Science Study Committee. Heath's concern was not whether the student can identify correct information, but rather what the student is likely to do with the information intellectually. He postulated four ways in which a student might choose to respond to instructional material: (1) remember specific facts or terms, (2) seek practical applications, (3) ask critical questions about the information, and (4) identify fundamental principles embodied in the information. Heath constructed a 20 item cognitive preference test in which the stem presented information and the four alternatives presented each of the four cognitive processes which might be applied to the material. He found that students taking the PSSC physics course differed from control groups by showing less preference for memory of specific facts and for practical applications, and a stronger perference for questioning assumptions and stating fundamental principles. These findings suggest that Heath's approach does measure differences in cognitive style.

The cognitive preference test used in the present study was constructed from a pool of 60 items which had been developed and tried out earlier with upper elementary and junior high school students. Each item introduces one or two sentences of information from a fourth grade history book. The stem is followed by two alternatives designed to measure the way the child chooses to respond to the material. He may choose either to remember some factual aspect of the material, or he may choose to perform some intellectual operation on it. In the latter category, the pupil may draw an inference, project a trend, generalize to a more inclusive statement or question the information given. Item 1 of the test is presented below:

> In pioneer days, lumber for homes was plentiful but nails had to be shipped from England. When some pioneers moved, they burned down the old houses to get nails for the new homes.
>
> A. This makes me think that nails had to be shipped from England.
> B. This makes me think that people find ways to have what they need.

Twenty items were selected from the pool of 60 on the basis of their simplicity and likely appeal to younger children and were pretested at Klondike Elementary School near West Lafayette, Indiana. Item analysis statistics were computed separately for grades 2, 4 and 6, and the 15 items with the best item statistics across the three grade levels were retained for the final test. (Appendix XI)

The 15 item cognitive preference test was added to the 38 items measuring locus of control and administered to the Gary sample as a single test administration. The cognitive preference section required 15 minutes to

administer and was not included in the battery at the second grade level in order not to extend the testing sessions beyond a reasonable length of time for the younger children.

As with Locus of Control, the instructions and items for the Cognitive Preference Test was presented simultaneously by print and tape recording. Each item was read by a female voice and pupils could follow in their own test booklet, or simply listen. Students responded by marking their selection (a or b) on an IBM answer card.

Administration of the New Cognitive Measures and the Selected Achievement Tests to the Specified Populations

The populations requested were advantaged and disadvantaged second, fourth and sixth graders who are Blacks, have Spanish surnames, or are other Caucasian children, forming an 18 cell sampling strata. The sample was obtained from the Gary Public Schools in Gary, Indiana. These schools have a large number of disadvantaged children eligible for Title I Programs. They also have a large percentage of Black children in the schools as well as Spanish surname children whose parents were immigrants from Spain, from Mexico, from the Southwestern states bordering Mexico, and more recently from Puerto Rico. These families have been in the Gary area, some since the early 1920's, some as the result of the importation of strike breakers in the 20's and 30's, and more recently the labor shortage resulting from World War II and the Korean War, which attracted men who were unskilled and did not need to be proficient in the English language. The Black populations have equally representative groups from the last five decades in this century. (Gary had the largest percentage of Blacks of any city in the North as reported in the 1930 census and many Blacks imigrated from the South to Gary during the period immediately following World War II.) Gary's population today has one of the highest percentages of Blacks of any city in the United States. Along with Cleveland, Gary gained nationwide publicity as a result of electing a Black mayor in 1960.

The Gary Schools have an exceptionally cooperative administrative staff and Division of Research and Developmental Services which facilitated this effort. Excellent data were available from the research staff on the distribution of pupils by grades, ethnic classification, and socioeconomic status. Separate populations were made available from the some 3 to 4,000 children available per grade for both our preliminary and the final testing with only minimum prior testing of these children during the school year for other purposes. It was also possible to avoid special and experimental groups. Further Gary had achievement tests and IQ data on these children which had been collected in late October, November (1970) and January (1971), and these data were available on a system wide basis via computer print-outs made available to the research team at Purdue.

After the initial development of the tests and local tryouts, editing, and restructuring administration of the initial experimental forms was accomplished with relatively large samples in the Gary Schools during the first few weeks in 1971. From this initial data gathering item analyses, internal consistency analyses, and in some instances

correlation against standard achievement and IQ test criteria, were made. Further item editing, final administrative preparations were made and the final forms of the research instruments were administered during the latter part of March, 1971.

Four teams, consisting of a principal investigator and a staff of graduate students, administered the tests in seven schools in round robin fashion over a period of two weeks. These schools had all indicated through their principals that they would concur in having the experimental testing in their schools. Each principal appointed a coordinator for his schools and kept in touch with the Gary Research Division coordinators and the Belmont administrative staff at Purdue University. All of these schools were visited by the administrative team from Purdue University for the purpose of rapport and to indicate our availability for questions from each of the school coordinators. All procedures were explained and the University phone number, as well as that of the school coordinator in Gary, were given them.

The testing went smoothly as the result of the careful coordination and planning. There were only two exceptions. One was in a school where the building coordinator had gather together appropriate grade 2 and 4 classes but had not realized that he was also to have all the other Latin surname pupils in grades 2 and 4 tested as well. This was discovered on the third day of testing. Even with this alert the fourth testing team in the round robin was unable to pick up these additional 60 Latin surname children. As a result a special trip had to be made to the Gary schools by all four teams two weeks later after Gary's Spring Vacation.

The second problem occurred when the principal of one of the predominately White, advantaged schools objected to the stimulus pictures used for obtaining the samples of written language production. The research team acceded to his wishes not to give this aspect of the testing in his school and as a result on this one variable the white advantaged sample is below the size we would have liked to have had.

The bulk of the final testing took place on March 29, 30, 31 and April 1, 1971. The testing of the affluent sample took place the week of March 22.

Thus as a result of extensive pretesting and practicing of all administrative procedures both informally in greater Lafayette as well as the more formal classroom pretesting sessions in the Gary schools, the final collection of data went smoothly. The problems were in general ones of an administrative nature and did not influence the test-taking performance of the children to an extent which would influence the interpretation of the test results. The empirical verification of this statement can be found in part in the high

internal consistency reliabilities which were found for the developed measures.

The oral and written language development data were collected on an individual or small group basis prior to the March period of formalized standard testing. Thus the preponderance of the Belmont Project testing took place during March. One group was tested in April, and the achievement and IQ tests were administered during late fall and early winter of 1970-71.

Sampling Plan Fulfillment.

One of the prime requirements of the Belmont Request for Proposal was to fill a 2 x 3 x 3, 18 cell stratified sampling plan with at least 50 subjects in each cell for each test or a minimum of 900 subjects in all. The three main variables were advantaged-disadvantaged; ethnic background, Black, Spanish speaking, and other Caucasian; and grade level. The grade level and the advantaged-disadvantaged stratification was no particular problem because of the population available. The school census counts were very accurate with only minor week-to-week deviations because of transfers and attendance variability. Furthermore the testing was planned for very late March and early April, when the weather is at its best and the health of the children probably as good as anytime during the year. The socioeconomic status data had been carefully checked at the beginning of the school year to determine eligibility for Title I reimbursement. The advantaged-disadvantaged classification was based on sampling within the schools that were so classified. Children in the advantaged schools who were eligible for the free school lunch program however, were also classified as disadvantaged. The very high socioeconomic status school picked in order to get an even better picture of the influence of socioeconomic status on the cognitive variables had very few Spanish surname children or Blacks and the few who were tested were omitted from the analyses in order to get better homogeneity in this "19th cell" of the sampling cell plan.

The n of the cell sizes for the cognitive tests is reported in the analyses of variance for each of these variables. (Note that to the three-way analyses of variance n's must be added the affluent white sample in each grade.) Test results for about 1200 to 1300 children were obtained for which excellent identification on the three strata (and among the tests) could be determined. The sample sizes were such that the results can be said to be clear cut with differences statistically significant generally well beyond the one percent levels or clearly of no practical importance. Analysis of variance error terms had on the order of 1,000 degrees of freedom and correlations (within grades) on the order of over 300 degrees of freedom. It is clear then that for reliability and validity determinations with tests of this quality, larger samples than those obtained would have been wasteful.

Statistical Analyses and Interpretation of Results

This segment of the Final Report is partitioned into six sections. Each of the first five include data, statistical tests and interpretations peculiar to a particular area of cognitive development. In the sixth section a summary of the intercorrelations among the cognitive, achievement and intelligence variables is developed. In addition principal components analyses of the correlation matrices are described and interpreted.

Concept Formation

In determining the differential effects of grade level, race and socioeconomic status on concept formation ability a 3 x 3 x 2 design was used.

For purposes of computer analysis of variance, dependent variables were identified as follows:

(1) Part I of the Concept Formation Test, the Piagetian conservations; (2) Part II of the Concept Formation Test, classical concept formation; (3) Concept Formation total scores. The population sample was classified and coded in the following manner: (A_1) disadvantaged, (A_2) advantaged children, (B_1) grade two, (B_2) grade four, (B_3) grade six, (C_1) Black, (C_2) Latin, and (C_3) White.

The analysis of variance for the dependent variables is reported in the first three tables of Appendix VII.

Main Effect Differences

Significant main effects ($p < .01$) on variables A, B, and C were found. Means for the main effects of variables A, B, and C on the dependent variables are listed in the next three tables of Appendix VII.

There was excellent separation by grade level with a greater difference between grade two and grade four scores than between grade four and grade six scores. This result was predictable on the basis of Piagetian Theory; the test sampled behavior peculiar to the concrete operations stage (ages 7 - 11). Grade six children tended to top out on the test, especially on Part I, but there still was a difference of more than three points on the total test between grade six and grade four as compared with a difference of more than seven points between grade two and grade four (possible 34 points).

Using a procedure due to Newman and Keuls it was found that Whites performed significantly better than Blacks or Latins while the Blacks and Latins scored about the same. Actually the Latins scored slightly less than the Blacks on each part of test. This may be attributable to a language factor. It should be noted that the examiners were White and the recorded voice on the test tape was that of a White female. This could have favored the White children.

The disadvantaged group scored significantly lower than the advantaged group on Parts one and two as well as the total test. However, the actual point difference was slight, 1.7 points on the total test.

Interactions Between Main Effects

For Part I (conservation) there were no significant interactions at the .01 level, however the A x C interaction approached significance at

the .05 level. For Part II (classical concept formation) there were two significant interactions; A x B ($p < .01$) and A x B x C ($p < .05$). No significant interactions were discernable for the total test. The means for the interactive effects of A x B are tabled in Appendix VII. The cell means and standard deviations for Parts I and II and for the total test may be found in Appendix VII. Here there appears to be little difference between advantaged and disadvantaged subjects at grade two. However, the advantaged fourth graders did nearly as well on Part II as did the disadvantaged sixth grade subjects. This view is supported by the cell means for Variable Two where cells A_2 B_2 C_2 and A_1 B_2 C_3, and A_2 B_3 C_2 and A_1 B_3 C_3 are compared. Further consideration of the cell means for variable 2 suggests an interaction of variables A, B, and C. For instance, cells A_1 B_2 C_3, A_2 B_2 C_1 and A_2 B_2 C_2 show little difference between means. Similarly for cells A_1 B_3 C_3, A_2 B_3 C_1 and A_2 B_3 C_2. Thus all three factors combined contribute variance which is above and beyond that explainable by the individual variables or by the variables taken pairwise.

Correlation of Concept Formation Measures with IQ and Achievement Scores

Analysis of the correlation matrix for the three grades on concept formation with the general achievement variables and IQ showed small correlations ranging from .08 to .36 with two-thirds of the coefficients falling in the range .15 to .28. Thus it appears that these tests tap a factor or factors independent of IQ and achievement. The correlations may be found in Appendix XII.

Intercorrelation of Concept Formation Measures

The correlations between Parts I and II of the Concept Formation Test were .332 at grade 2, .220 at grade 4 and .283 at grade 6. All of these are modestly sized correlations and indicate that while ability to score on the conservation items is positively related to the same ability on classical concept formation items the two tasks clearly are not identical. The correlations between Parts I or II and Total score were, of course, much higher. They ranged from .608 to .951.

Performance of Affluent and Advantaged White Children

A series of t-tests were used to determine if any differences existed between the scores of white advantaged (middle-middle and lower-middle class) children from the target population and a sample of White affluent children from the same school district. At grade two the affluent children did significantly better ($p < .01$) on Part I but the White advantaged group did significantly better ($p < .01$) on Part II. The Total score differences favored the affluent group. This result indicates that White affluent children's general development level was higher but that they were not superior in identifying common attributes. At grade four the significant differences ($p < .01$) favored the White advantaged children on all three measures. However the actual score differences were less than one point. At grade six the White advantaged group performed significantly better ($p < .01$) on Part I and on the total score but not on Part II. The actual point difference was extremely small. These data are tabled in Appendix VII.

Taken together these results indicate that there seems to be no consistent superority of the White affluent children over the White advantaged children. In fact the White advantaged group performed higher on more measures than the White affluent group.

Practical Considerations and Implications of the Analysis

It appears that the statistically significant differences among the ethnic groups and among the socioeconomic groups do not reflect true differences in the discriminability of the Concept Formation test. Only the factor of grade level yielded score differences sufficiently large to discriminate among children. For Black, Latin or White children or for disadvantaged, advantaged or affluent children little more than one or two items (often less than one item) ever separated them.

At the very least the Concept Formation Test achieved a measure of culture-fairness among children of varying ethnic and socioeconomic background.

Both oral and written versions of the Word Association Test were scored as 1) paradigmatic (response falling in the same general grammatical class as the stimulus item) and as 2) homogeneous (falling within the same subclass of noun or verb within the paradigmatic category). Thus a response is scored paradigmatic if "you give a noun, get a noun;" "give a verb, get a verb;" "give an adjective, get an adjective;" "give an adverb, get an adverb." A response is then subscored as homogeneous if the noun is the same subclass: "Give a mass noun," "get a mass noun;" "give a count noun, get a count noun;" and "give a transitive verb, get a transitive verb;" "give an intransitive verb, get an intransitive verb." Adjectives and adverbs do not have such subdivisions. Consequently, the numbers reported are specified as either a paradigmatic score or a homogeneous score. Of course the homogeneous score cannot exceed the paradigmatic score because a homogeneous response is by definition a paradigmatic response, but the reverse is not necessarily true.

Main Effect Differences

The following data were obtained from a 2 x 3 x 3 ANOVA. Tabular presentation of the analysis may be found in Appendix VIII. The three factors were socioeconomic status, advantaged; disadvantaged; grade level, 2, 4, and 6; and ethnicity, Black, Latin and White.

For the oral paradigmatic scores, all three main effects were statistically significant, for socioeconomic level at the .05 level and for grade and ethnicity at the .01 level. There were no significant interactions. For the oral homogeneous scores, again all three main effects were statistically significant, this time all at the .01 level, with no significant interactions. For the written paradigmatic scores, all three main effects were significant at the .01 level. In this case there were two significant interactions: advantagedness by grade at the .01 level and grade by ethnicity at the .05 level. For the written homogeneous scores all three main effects were statistically significant at the .01 level and one interaction, grade by ethnicity was significant at the .05 level.

Newman-Keuls post hoc tests were computed for the main effect means of grade and ethnic group for each of the four analyses. For each analysis, the means for each grade differed significantly from those of every other grade at the .05 level or better with one exception. Means for fourth and sixth grade children did not differ ($p < .05$) on the Written Homogeneous score. In two cases differences between ethnic groups were not significant ($p < .05$). These were between Black and White children on the Oral Paradigmatic score and on the Oral Homogeneous score. In all other comparisons among ethnic samples differences in mean scores were significant at the .05 level or better.

Note that in neither of the oral scores was there a significant difference between the Blacks and the Whites, but that this difference showed up at the .05 level in the written scores. As far as grade is concerned, the differences between grades 4 and 6 are at the .05 level where they occur in both oral and written, but it is interesting to note that in the written homogeneous there is no significant difference between these two grades. Evidently the difference in the written paradigmatic must be in the sub-classes of nouns and the verbs, with the 6th graders having more non-homogeneous responses than the 4th graders. It is, of course, the consistently low scoring of the Latins which is so salient.

There were no significant differences in performance between the advantaged White sample and the White affluent sample.

Interactions Between Main Effects

There were no significant interactions for the oral paradigmatic or the oral homogeneous. For the written paradigmatic there were two interactions, one, advantagedness by grade, and another, grade by ethnicity. Inspection of the means indicates that there is a greater difference between the disadvantaged second graders and advantaged second graders.

The grade by ethnic interaction in the written paradigmatic data was repeated in the written homogeneous data, and the patterns of the means was identifical. The order of Whites, Blacks, and Latins was maintained with the Blacks catching up to the Whites at the 4th grade level, but falling below them again at the 6th grade level. Latin and Black sixth graders are about the same.

Intercorrelation of Word Association Measures

Across the three grades, the oral paradigmatic correlated with the oral homogeneous at about a .96 or .97 level. The written paradigmatic, with the written homogeneous, correlated .91 at the second-grade level and at .96 at the fourth and sixth grade levels. It first appears that adding the finer scoring procedure of separating out homogeneous subclasses in the nouns and the verbs has little to offer; however, as mentioned before it is interesting that the difference between the written paradigmatic and the written homogeneous was significant at the fourth grade level and not significant at the sixth grade level. Thus, even though they correlate very highly there may be enough additional information to warrant inclusion of this differentiation.

Overall, the oral administration correlated with the written administration in the low 60's: .55 at grade two, .59 at grade 4, and .62 at grade 6. It is worthwhile to consider the two types of administration, despite this moderately high correlation, because of what was demonstrated in the Black/White comparison; that is, no difference between the Blacks and the Whites on the oral administration, and significant differences between the Blacks and the Whites on the written, showing clearly that the Blacks are at a disadvantage when it comes to the written form.

Correlation of Word Association Measures with I.Q. and Achievement Scores

The correlations among the oral and written forms, of the Word Association Test, IQ and standardized achievement tests may be noted Appendix XII. Note that the oral forms yield low to moderate correlations at grade two, in the .35 to .40 range; while the written forms yield somewhat higher correlations in the .56 to .69 range.

Among the fourth grade data, the correlation of .395 between Verbal IQ and written paradygmatic is the highest, and not unexpectedly, although it is lower than might have been predicted. Most of the correlations are between .30 and .40.

At the sixth grade level neither the verbal nor non-verbal IQ's, nor any of the standardized achievement tests were correlated significantly with the oral word association task, the highest correlation being .164 between oral homogeneous and "Maps", a study skill test in the achievement battery. For the written Word Association Task there is a significant correlation with the IQ verbal, but it is only .24. Other correlations between written word association scores and IQ and achievement scores range downward from this level.

Summary and Implications of the Analysis

The word association task is clearly a developmental one. Socio-economically, 2nd grade disadvantaged children score considerably lower than 2nd grade advantaged. Ethnically, Black and White children did not differ on the aural/oral individual administration; they did differ on the read/write group administration. Latins scored generally lower than Blacks and Whites on both administrations, though on the written task at the 6th grade level Latins and Blacks were essentially together while Whites were above both.

The lack of difference between Blacks and Whites shows that when Blacks are permitted to perform in an individual oral task with no obvious interference of dialect, and no confounding with a vocabulary task, this aspect of their language development is comparable. Thus, emphasis in the classroom probably should be put on vocabulary acquisition together with reading and writing skills. Latins, however, may well profit from oral Language Development lessons, particularly at the second-grade level and below.

One can see that for the written homogeneous score, the most stringent test, the disadvantaged second grade Latins had a mean of 7.1207; whereas, on the oral paradigmatic the "easiest" tests, the advantaged sixth grade Whites had a mean of 28.3750. This range displays the wide differences among the populations of interest.

Since this word association test apparently does not duplicate existing language tests currently in use in the schools, it could be included in a diagnostic battery for a quick assessment of oral language development, after standardization, of course. The cost in time and materials is small: the aural/oral individual administration only takes about 5 minutes per child, and 1 sheet of paper is the the sum total of materials, directions on one side and the word list on the other.

Results

The first question to be answered is which, if any, of the seven computer generated indices listed under Task 4 seem to be related to language maturity. Only those indices that increase in magnitude as children move from grade two to six can be considered valid indices of language maturity. Thus, examination of the average scores obtained by all of the children in the study at each grade level will identify those indices related to developmental level. These data are presented in Table 5.

Table 5

MEAN SCORES OF WRITTEN LANGUAGE PRODUCTION INDICES BY GRADE LEVELS

Language Production Index	Grade Level		
	2 (n=330	4 (n=277)	6 (n=350)
Total words used	80	143	149
Number of sentences	8.5	10.7	11.0
Number of commas	.37	2.4	2.2
Number of other punctuations	.10	.26	.41
Mean sentence length	13.3	17.2	16.0
Standard deviation of sentence length	4.80	8.53	9.35
Mean word length	3.3	3.6	3.7
Standard deviation of word length	1.30	1.44	1.56

Second grade children used, on the average, 80 words to complete their stories, fourth grade children used 143 words and sixth grade children used 149 words. Analysis of variance was used to evaluate the significance of the differences among the means in the above table. Significant differences do exist for all of the variables used with the single exception of mean sentence length. Seven of the eight indices of written language production appear to be useful as measures of language maturity.

These seven indices of language development were used to examine the performance of disadvantaged children compared with advantaged children. For this analysis the advantaged children are grouped together without regard to ethnicity or grade level. The mean scores obtained by each of these groups on the indices of language

development are shown in Table 6.

Table 6

MEAN SCORES OF WRITTEN LANGUAGE PRODUCTION INDICES BY SOCIOECONOMIC GROUPS

Language Production Index	Socioeconomic Group	
	Disadvantaged n=582	Advantaged n=375
Total words used	107	141
Number of sentences	8.5	11.7
Number of commas	.8	2.5
Number of other punctuation	.09	.43
Standard deviation of sentence length	8.27	7.51
Mean word length	3.5	3.6
Standard deviation of word length	1.39	1.47

Of the seven variables in the above table all but one exhibit statistically significant differences between the advantaged and disadvantaged groups. The standard deviation of sentence length did not discriminate between the two groups.

This does not mean that all subgroups of disadvantaged children of various ethnic origins and in different grade placements performed at a lower level than the advantaged children. The interactions of these variables will be examined later. In general, however, the data in Table 6 above suggest that disadvantaged children exhibit less language maturity than advantaged children on these indices.

The difference in performance of Blacks, Latins, and Whites are examined for the seven variables. These data are presented in Table 7 below.

Table 7

MEAN SCORES OF WRITTEN LANGUAGE PRODUCTION INDICES BY ETHNIC GROUPS

Language Production Index	Ethnic Group Blacks n=475	Latins n=356	Whites n=126
Total words used	127	105	140
Number of sentences	10.2	8.4	11.7
Number of commas	1.3	1.0	2.6
Number of other punctuation	.21	.14	.42
Standard deviation of sentence length	8.2	8.0	7.5
Mean word length	3.5	3.5	3.6
Standard deviation of word length	1.44	1.38	1.47

Most of the indices in the above table discriminate significantly among the ethnic groups. In general Whites showed more language maturity than Blacks and Blacks more language maturity than the Spanish speaking children. A predominantly White school in an advantaged neighborhood found the pictures objectionable, and refused to permit the administration of these tests. Therefore, almost all data presented in this report for White children reflects performance of disadvantaged Whites only.

While the gross comparisons reported in the t se tables above are instructive, some of the more interesting data ccur as particular subgroups are compared. Table 8 below, allows us to see how children in the various ethnic groups develop from grades two through six in the total number of words used in responding to the pictures.

Table 8

TOTAL WORDS USED: GRADE LEVEL BY ETHNIC GROUP

Grade Level	Ethnic Group Black	Latin	White
Second	90	64	85
Fourth	140	107	181
Sixth	152	142	152

From these data, it can be seen that the second grade child from a Spanish speaking family is likely to use far fewer words in written composition than his classmates, Black or White. His volume of output remains substantially below his peers at grade four, but by grade six these differences are becoming much less distinct. Remember that the data for White children are based almost entirely on disadvantaged children, while all socioeconomic groups are represented in the data for Blacks and Latins.

Examining the effects of depressed socioeconomic status as they act differently on Blacks, Latins and Whites, it may be observed from Table 9 that Both Blacks and Whites exhibit rather large differences in total words used to construct stories when the socioeconomic status of the families differ markedly. This is not so for the children of Spanish speaking origins.

Table 9

TOTAL WORDS USED: SOCIOECONOMIC STATUS BY ETHNIC GROUP

Socioeconomic Status	Ethnic Group		
	Black	Latin	White
Disadvantaged	112	100	110
Advantaged	143	109	170

Children from advantaged Spanish speaking families use only a few more words in producing their stories than do children from disadvantaged Spanish speaking families. This suggests that the decrements in language development among Latins observed on this task are most likely a function of other factors than those associated with socioeconomic levels.

Black and White disadvantaged children produce about an equal number of words in making their stories. Among the advantaged groups, however, the Whites produce more words than the Blacks. The figures for White children in the above table are quite conservative as most of the advantaged Whites entering into the figure shown are from the second grade.

Finaly, we may examine the performance of various socioeconomic groups at each grade level, without regard to ethnic groups. These data are presented in Table 10.

Table 10

TOTAL WORDS USED: SOCIOECONOMIC STATUS BY GRADE LEVEL

Socioeconomic Status	Grade 2	4	6
Disadvantaged	71	113	136
Advantaged	89	171	161

From these data, it may be observed that the advantaged children start somewhat higher in total word production in the second grade and almost double the number of words used in making a story by the time the fourth grade is reached. Disadvantaged children increase their word usage count by about 60 percent during the same period. Increments of growth between fourth and sixth grade are considerably smaller for both groups. It is possible to interpret the apparent drop in sixth grade, advantaged by remembering that the advantaged groups at all levels have hardly any representation of White children.

The analysis of variance summary tables evaluating the significance of the interactions among the variables described in the preceeding three tables may be found in Appendix XII together with the means and standard deviations for each cell.

Significant interactions were also found for the variable number of commas. The disadvantaged groups exhibit a regular progression in the number of commas used from .1 in grade two up to 1.5 in grade six. The advantaged groups used .4 commas in writing their stories in grade two, jumped to 4 commas per story in grade four, then dropped to 2.9 commas in grade six. Advantaged White children used the greatest number of commas in constructing their stories, disadvantaged Latins used the least commas. This same pattern was true with regard to all other punctuation marks employed (other than periods and commas) by the children in writing their essays. Advantaged Whites had .75 other punctuation marks while disadvantaged Latins had .08 other punctuation marks. Significant interactions were found in this study.

Summarizing the statistical analysis of the language production data six of the eight variables rather consistently differentiate

children at various grade levels, children in the two major socioeconomic levels and children in the three ethnic groups. Length of sentence and standard deviation of sentence length generally failed to make these differentiations. The failure of these last two variables may reflect the inability of the computer to detect run-on sentences.

Comprehensive interpretation of the written language production data is difficult because of virtual absence of advantaged Whites in grades four and six. Data do exist, however, for a group of affluent White children tested in a suburban Gary school. The means and standard deviations from this test are presented for each grade level in Appendix VIII. The comparisons possible with these data are illustrated in Table 11 which presents the total words used in stories by White children at three socioeconomic levels.

Table 11

TOTAL WORDS USED: BY WHITE CHILDREN AT THREE SOCIOECONOMIC LEVELS BY GRADE

Grade	Socioeconomic Level		
	Disadvantaged	Advantaged	Affluent
Second	73 (35)	99 (12)	200 (29)
Fourth	118 (27)	245 (1)	164 (41)
Sixth	140 (43)	165 (4)	226 (51)

The number of cases for each mean is shown in parenthesis

In general, the data from the affluent subjects corroborate that of other investigators that affluent White children exhibit higher scores on measures of language development than do less affluent children of the same ethnic group.

Turning to the relationships among the judgments of essay quality and the more mechanical indices of language development generated by the computer we find significant correlations (.05 level and better) for all judgments and total words used, number of sentences, and number of commas. The highest correlations obtained were for total words which correlated .28 with unity, .34 with development, .35 with imagination, and .35 with overall quality of the essays.

Overall essay quality also correlated .18 with number of sentences, .22 with number of commas, .16 with other punctuation, .11 with average sentence length, .20 with standard deviation of sentence length, .22 with average word length, and .10 with standard deviation of word length.

The total number of words used in producing the stories correlated significantly with a number of the cognitive and achievement variables:

Verbal IQ	.29
Vocabulary	.23
Spelling	.30
Capitalization	.29
Punctuation	.23
Language Usage	.24
Concept Formation	.26
Loops	.24
Unity	.28
Development	.34
Imagination	.35
Overall Quality	.35

All of the above correlations are significant at the .01 level or beyond, for a one tailed test, with 100 degrees of freedom. This is a very conservative estimate of significance since the number of cases on which these correlations were based ranged from 160 to 284.

Applying the same criterion regarding level of significance to the variable, Imagination, the following correlation coefficients are shown with other achievement and cognitive variables.

Verbal IQ	.23
Spelling	.23
Capitalization	.34
Punctuation	.34
Language Usage	.27
Use of References	.32
Arithmetic Problems	.30
Logical Thinking (row x columns)	.23
Logical Thinking	.27
Response Style	-.28
Problem Solutions	.23
Written Paradygmatic	.25
Written Homogenious	.28

Other correlations among the written language production variables, essay ratings and other achievement and cognitive variables may be found in Appendix XII.

In general, at the sixth grade level the measures of language maturity obtained from the written stories most consistently correlated with conventional measures of school achievement. This is true when considering the written language production measures generated by computer analysis of the essays as well as the ratings of essay quality.

Logical Thinking

Item analysis and internal consistency (KR-20) data for the Logical Thinking measures have been reported in an earlier section. The present discussion focuses on the data obtained from the entire sample of students. These data were analyzed in a 2 x 3 x 3 ANOVA. The three factors investigated were: advantaged-disadvantaged, grade level (two, four, and six), and ethnic group (Black, Latin, and White).

Using the total number of correct responses, four scoring keys for the Logical Thinking Test were developed. The first was for total score, while the other three were for the matrices, row and columns, and intersection parts, as described in the Logical Thinking section under Preparation of Measures of Cognitive Variables. An ANOVA was carried out for each of the keys. The tabled results of each of these analysis are presented in Appendix IX. Each table provides the degrees of freedom, mean square, F ratio, significance level, and amount of total variance accounted for by each factor. Factor A is advantaged-disadvantaged (1 = disadvantaged, 2 = advantaged); Factor B is grade (1 = second grade, 2 = fourth grade, 3 = sixth grade); and Factor C is ethnic group (1 = Black, 2 = Latin, 3 = White). We will consider three major aspects of these ANOVA's: the main effect differences, the interactions between main effects, and the practical implications of the statistically significant results.

In each of the four analysis conducted, the three main effects of advantagedness, grade, and ethnicity were found to be statistically significant. Tables of the means of each of the main effect groups and mean and standard deviations of the smallest cells are also presented in Appendix IX. As can be seen from these Tables, in all cases, advantaged children outscored disadvantaged children, sixth grade children outscored fourth grade children who, in turn, outscored second grade children, and White children outscored Latin children, who, in turn, outscored Black children.

Newman-Keuls post hoc tests were computed for the main effect means of grade and ethnic group for each of the four analyses. Differences between grades are significant at the .01 level. This finding is in keeping with the cognitive developmental theory underlying the test items. With regard to ethnicity, there are no significant differences between the scores of the Latins and the Blacks on any of the subtests. However, there are significant differences between the performance of the Latins and Whites and the Blacks and Whites. In each case and for each subtest and the total score, these differences are significant at the .01 level and indicate that White children perform at a higher level on these tasks than do children of the other two ethnic groups.

No significant interaction effects were found in the ANOVA for the Matrices subsection of the Logical Thinking Test. In the ANOVA for the Row and Column subsection, a significant interaction was found between

grade and ethnic group ($p < .05$). The basis of this interaction was in the reversal between the Latins and Blacks between grades two and four versus grade six. In all grades, Whites outscored the others, but in grades two and four, Blacks outscored Latins, while in grade six, Latins outscored Blacks.

In the ANOVA for the Intersections subtest, significant interactions were found between advantagedness and grade and between advantagedness and ethnic group ($p < .05$). The basis for the advantaged-grade interaction was the increasing disparity in means for grades two, four, versus grade six. Grade six was higher than grade four, which, in turn, was higher than grade two. In the vantagedness-ethnic group interaction, the interaction may be explained by the reversal between Latins and Blacks and between advantaged-disadvantaged. Whites were also higher in both advantaged and disadvantaged groups. However, in the advantaged groups, Blacks were higher than Latins, while for disadvantaged, Latins were higher than Blacks.

In the ANOVA for the total test, significant interactions were found between advantagedness and grade ($p < .05$), between grade and ethnic group ($p < .05$), and between advantagedness, grade, and ethnic group ($p < .05$). The advantagedness-grade interaction evidently is the result of the increasing disparity between the means for grades two, four, and six. Grade six was higher than grade four which, in turn, was higher than grade two. The grade-ethnic interaction may be explained by the reversal of Blacks and Latins for grades two and six versus grade four. Whites were highest in all grades, while in grades two and six, Latins were higher than Blacks, but in grade four, Blacks were higher than Latins. The second order interaction advantagedness-grade-ethnic group, evidently is the result of differential interaction effects between the first order interactions.

Correlation of Logical Thinking Measures with IQ and Achievement Scores

These correlations were computed for the three grade levels and will be reported in that manner. The correlations may be found in Appendix XII.

Grade Two. No intelligence measures were available for these subjects, however, their scores on the Logical Thinking Test correlated at a modest level with three measures of verbal ability. The results indicate that with the exception of the subtest on intersections, scores on the Logical Thinking Test are positively related to verbal ability. The correlations while significant, are relatively low.

Grade Four. The correlations with verbal and nonverbal intelligence scores at this grade level average approximately .5 and range from .37 to .52 for the various achievement measures. In general, the pattern of correlations follows that of the second grade children but is slightly higher.

Grade Six. The same general pattern holds true at this grade level. All of the correlations were positive and significant. With the exception of the non-verbal portion of the intelligence measures, which dropped, all other correlations were slightly higher than was the case with the fourth grade data.

Intercorrelation of Logical Thinking Measures

The intercorrelations of each of the three subtests with each other and the scores on the total test were computed for each of the three grade levels. In interpreting these data, one's attention is drawn to the fact that the total score correlations are indicative of a part-whole relationship with the preceding three subtests. These correlations may be found in Appendix XII.

Grade Two. The first two subtests are related as was expected since the second subtest is simply a more difficult variation of the first. The third subtest (intersections) operates as a separate element at this grade level. This is probably due to the more abstract nature of the test items and the higher degree of difficulty for children of this age.

Grade Four. At this grade level, which represents a transitionary stage in the development of logical classification abilities, the three subtests all intercorrelate significantly. This was to be expected according to the theory upon which the Logical Thinking Test was based and indicates that at this age children are beginning to develop a more refined concept of class inclusion.

Grade Six. The intercorrelations at this grade level are all significant and have increased in degree as compared with those for the grade four data. The development of the concept of class inclusion (as measured by these items) is usually well-developed by this age. Thus, it was expected that children in grade six would be able to perform well on the Logical Thinking Test.

Performance of Affluent and Advantaged Children

A final series of t tests was computed to determine the significance of differences between means for the white advantaged (lower-middle and middle-middle class) children in the target population and a sample of white affluent children in the same school district. These analyses were completed for each of the three subtests as well as the total score for the Logical Thinking Test. The results indicate that the difference between the two groups is either not significant, or significant in the favor of the target population. Hence, one may conclude that the Logical Thinking Test does not contain a socioeconomic bias which might operate in favor of affluent children.

Practical Considerations of the Analyses

One may conclude that the statistical analyses do not, by any large measure, indicate true differences in the discriminability of the Logical Thinking Test. Only the factor of grade level proved to account for any sizeable percentage of the variance between the subjects. While there were a few significant interactions between main effects the percentage of variance accounted for by these interactions was exceedingly small. In other words, for Black, Latin, or White children, or advantaged or disadvantaged children, fewer than one or two items ever separated them.

On the basis of this evidence, one may conclude that the Logical Thinking Test has at the very least achieved some degree of "cultural-fairness" and has relevancy for children of various racial and socio-economic backgrounds. Future analyses should now attempt to factor analyze these measures to identify and classify factors or abilities which appear to be developmental rather than racial, cultural, or experimental.

Problem Solving

Item analysis and internal consistency (KR-20) data for the problem solving test have been reported earlier in this report. This section focuses on the 2 x 3 x 3 analysis of variance for the entire sample of students. The three factors investigated were: advantaged-disadvantaged, grade level (two, four, and six), and ethnic group (Black, Latin, and White).

Using the total number of correct responses, nine scoring keys for Problem-Solving were developed. One key was for Ss' total score, the other eight keys corresponded to the eight subtests described earlier. An ANOVA was carried out for each of the keys. Tabled results of each of these analyses are presented in Appendix X. Each table provides the degrees of freedom, mean-squares, F-ratios, significance level, and amount of total variance accounted for by each factor. Factor A is advantaged-disadvantaged; Factor B is grade level; and Factor C is ethnic group; A1 is disadvantaged, A2 is advantaged; B1 is grade 2, B2 is grade 4, B3 is grade 6; C1 is Black, C2 is Latin, and C3 is White. We will now consider four major aspects of the statistical analyses: the main effect differences, the interactions between main effects, the amount of variation actually accounted for by each factor, the correlation of problem solving measures with IQ and achievement scores, and the practical implications of the results.

Main Effect Differences

In each of the nine analyses conducted, the three main effects of advantagedness, grade, and ethnic group were found to be statistically significant. Tables of means of each of the main effect groups and means and standard deviations of the smallest cells are also presented in Appendix X following the ANOVA tables. As can be seen from these tables, in all cases advantaged (level 2) children outscored disadvantaged children (level 1), sixth-graders, outscored fourth graders who, in turn outscored the second graders, and Whites outscored Blacks, who, in turn, outscored Latins.

Newman-Keuls post hoc tests were computed for the main effect means of grade and ethnic group for each of the nine analyses. For each analysis, the means for each grade differed significantly from those of every other grade at the .01 level. In three of the analyses, for Problem Solving Total, Solving Problems II, and Solving Problems III, the means for each ethnic group differed significantly ($p < .01$) from those of every other group. In three analyses (Clarification I, Solving Problems I, and Presolution), the means for the White children differed significantly from those of the Black children at the .05 level. In two analyses, Sensing and Identifying and Problem Parts, the White means differed significantly from those of the Blacks and Latins ($p < .01$). Also, the means for the Latin children were found to be significantly lower ($p < .01$) than those for the Black or White children for subscores labeled Clarification II, Presolution, and Solving Problems I. White children scored significantly higher ($p < .01$) than Latin children on Clarification I.

Interactions Between Main Effects

In each of the nine analyses of variance, a statistically significant interaction was obtained between the main effects of advantagedness and grade. As can be seen from the tables of means, advantaged children at each grade level outscored the disadvantaged children at each corresponding grade. Thus, one may conclude that the interaction is more an artifact of the analysis. That is, the interaction in these cases is due to the large disparity between the achievement of advantaged sixth-graders and disadvantaged second graders.

In two cases, Sensing and Identifying Problems and Presolution, the advantagedness and ethnic group main effects interacted significantly. From the tables of means, one can see that for either advantaged or disadvantaged children, Whites outperformed Blacks, who, in turn, outperformed Latins. Again, one may conclude that the interaction effect was a result of the disparity between advantaged Whites and disadvantaged Latins.

Finally, in several cases, Solving Problems I, II, and III, the interaction between grade and ethnic group was statistically significant. In the Total Score and Problem Parts analyses, this interaction was significant at the .06 level. The means of the interaction subgroups demonstrate that, as before, this interaction is due to the disparity between the advantaged sixth-graders and disadvantaged second-graders.

Amount of Variance Accounted for in the Analyses

The last column in the ANOVA Table provides the percent of total variance (in decimal form) accounted for by each factor and interaction listed. This is, perhaps, the most crucial aspect of all of the analyses. One of the objectives of our project was to develop measures which would not penalize students because of their ethnicity. Although this factor is consistently statistically significant, it only accounts for from 0.6% to 3% of the total variation in the sample of Ss. The means of Black, White and Latin children also indicate that no more than three points, or three items, differentiate the three groups. This is roughly equivalent to saying that if a White child made one more error and a Black or Latin child made one more correct response, no differences at all would exist among the three groups.

By the same token, even though the main effect of advantaged-disadvantagedness was statistically significant, this factor only accounted for between 0.7% and 5% of the variance. Again, only one or two points (items) differentiated advantaged from disadvantaged children.

Only the grade factor accounted for any sizeable amount of variation, between 9% and 37%. Thus, one may conclude that this factor alone is the one for which our PS test truly discriminates children meaningfully. And, in fact, this was one of the objectives of our test, to develop a pool of items which could be solved by an increasingly larger percentage of children as average age of sample increased.

Correlation of Problem Solving Measures with IQ and Achievement Scores

For grades 2, 4, and 6 IQ and Achievement Test data were correlated with the Ss' scores on the total problem solving test and its eight subtests. (See Appendix XII.) For grade 2, correlations between Word Knowledge, Word Discrimination and Total Reading and the Problem Solving measures ranged from .219 to .515. For grades 4 and 6 Lorge-Thorndike IQ scores and achievement scores from the Iowa Tests of Basic Skills were available. In grade 4, correlations of the Problem Solving measures with verbal and non-verbal IQ scores ranged from .172 to .458. Correlations with the achievement measures ranged from .098 to .463. In grade 6, correlations with verbal and non-verbal IQ ranged from .063 to .400. Correlations with achievement measures ranged from .032 to .425. Most of these correlations are quite modest in magnitude, but overall they do indicate a discernable relationship between the problem-solving and achievement measures.

Intercorrelation of Problem Solving Measures

An alternate estimate of the reliability of the Problem Solving Test can be obtained by analyzing the intercorrelations of the subtests. The more highly correlated each of the subtests is with the other, the more consistent and/or reliable will be the entire test. That is, to the extent the subtests correlate with each other each subtest essentially will be measuring the same or similar problem solving abilities.

As can be seen in Appendix XII, for grade 2, these intercorrelations range from .215 to .962. For grade 4, the intercorrelations range from .125 to .966. For grade 6, the intercorrelations are high. One pattern does emerge, however. Of the lowest intercorrelations, most are between Sensing and Identifying and other subtests. Two explanations exist for this. One is that the Sensing and Identifying subtest is measuring a skill or ability distinct from the other subtests. The second explanation is more likely the true cause, however: the low intercorrelations may be the result of the low internal consistency of this subtest. Reliability imposes a ceiling on the degree of correlation, and since the reliability of this subtest is distinctly lower than that of the other subtests, intercorrelations involving it must be expected to be lower.

Performance of Affluent and Advantaged White Children

A final series of t-tests was computed to determine if any differences existed between the scores of the sub-sample of White, advantaged (lower-middle class) children from the target population and sample of White affluent children from the same school district.

Differences were found only at the second-grade level on total score ($p < .01$) in favor of the affluent sample. At the fourth-grade level, differences were found in favor of the target population on Total Score and Sensing and Identifying ($p < .05$, $p < .01$, respectively) and at the sixth-grade level, differences in favor of the target population were found for Sensing and Identifying ($p < .01$).

Practical Considerations and Implications of the Analyses

One may conclude that the statistical analyses do not, by any large measure, indicate true differences in the discriminability of the Problem Solving test. Only the factor of grade level proved to account for any sizeable percentage of variance between the Ss. While the factors of ethnicity and advantagedness and several interactions were statistically significant, they did not appear to be practically so. In other words, for Black, Latin, or White children, or advantaged and disadvantaged children, little more than one or two items (and in the majority of cases, less than one item) ever separated them.

On the basis of this evidence, one may conclude that the Problem Solving Test has, at the very least, achieved some degree of "culture-fairness" and relevancy for children of varying socio-economic and ethnic backgrounds. Greater emphasis may now be placed on future factor analyses of the measures obtained to identify and classify factors, or abilities, which appear to be developmental, rather than cultural or experimental.

RESPONSE STYLE: LOCUS OF CONTROL

Analysis of Variance Data

In addition to the item analysis and internal consistency data reported earlier for the Locus of Control scale, a 2 x 3 x 3 ANOVA was performed on data from the entire sample of students. The three factors investigated were: advantaged-disadvantaged, grade level (two, four and six), and ethnic group (Black, Latin and White).

The dependent variable on which this analysis was performed was the total number of external alternatives chosen by children. The results of this analysis are presented in Appendix XI. In this Appendix may be found the degrees of freedom, mean-squares, F-ratios, significance level, and amount of total variance accounted for by each factor. Factor A is advantaged-disadvantaged (1 = disadvantaged, 2 = advantaged). Factor B is grade level (1 = second grade, 2 = fourth grade, and 3 = sixth grade); and Factor C is ethnic group (1 = Black, 2 = Latin, and 3 = White). No interactions between factors occurred so the following paragraphs in this section will consider only the main effect differences, the amount of variance actually accounted for by each factor, and a discussion of the practical implications of the statistically significant results.

Main Effect Differences

The analysis of variance revealed statistically significant effects of grade level and ethnic group, but no significant effect of advantagedness. Tables of means of each of the main effect groups and means and standard deviations of the smallest cells are also presented in Appendix XI following the ANOVA tables. As can be seen from these tables, second-graders made more external responses than sixth-graders; also, the Black and Latin children made more external responses than the White children. Post hoc Newman-Keuls analyses (Winer, 1962) revealed that second-graders differed significantly from fourth and sixth-graders ($p < .01$) and fourth graders differed significantly from sixth-graders ($p < .05$). Further, Newman-Keuls analyses revealed that the Black and Latin children did not differ ($p < .05$) in externality but both were significantly more external than White children ($p < .01$).

The lack of a significant effect of advantagedness for IE was surprising, but may have been partially due to the proximity in socio-economic level between our advantaged (middle-middle and lower-middle class) and disadvantaged (upper-lower class) groups. Thus, further analyses were done to compare an upper-middle class group of White children from Nobel School in Gary, Indiana, with a sample of our "advantaged" White children (one-third of the sample of the White, advantaged children included in the ANOVA). A series of t-Tests revealed that the second-grade children from Nobel School made significantly less external responses ($\bar{X}$ = 8.14) than the second grade "advantaged" White children ($\bar{X}$ = 12.13)

($t = 4.5$, $df = 8$, $p < .01$). However, no significant differences between the Nobel School children and the other white children were found at the fourth grade level ($\bar{X} = 6.13$ and $\bar{X} = 7.25$ respectively; $t = 1.123$, $df = 103$, $p < .05$) or the sixth grade level ($\bar{X} = 6.68$ and $\bar{X} = 7.29$ respectively; $t = .611$, $df = 113$, $p < .05$. Thus, the scale discriminated between groups differing in advantagedness only at the second grade level.

Correlational Analyses

The coefficients of correlation obtained between the Locus of Control scores and the various school related tests may be found in Appendix XII. It should be remembered that the Locus of Control scale was scored simply by counting the number of external responses made by each S. Thus, it would be expected that the Locus of Control scores should be negatively correlated with performance on achievement and intelligence tests as, indeed, they were.

It should be noted that the correlation coefficients between Locus of Control scores and achievement and intelligence measures are generally small. This was considered desirable because the purpose of this project was to develop measures that were not highly correlated with currently employed achievement or intelligence tests. The critical value of r for an N of 300 is .113 at the .05 level of significance and .148 at the .01 level of significance; the critical value of r for an N of 400 is .098 at the .05 level of significance and .128 at the .01 level of significance. The correlation coefficients reported for the second and fourth grade are all significant at the .01 level. However, at the sixth grade level only seven variables (Verbal IQ, Vocabulary, Spelling, Capitalization, Punctuation, Word Usage, and Reference) are significantly correlated with Locus of Control at the .01 level; one variable (Reading) is significantly correlated with Locus of Control at the .05 level; and five variables (Non-verbal IQ, Maps, Graphs, Arithmetic Concepts, and Arithmetic Problems) are not significantly related to Locus of Control. The lower correlations at the sixth grade level may be partially due to the small variability in scores on the Locus of Control scale at this level.

Practical Considerations and Implications of the Analyses

Internal-external control as measured by this scale appears to be primarily a developmentally determined phenomenon. Surprisingly, it is not determined to any great extent by either ethnicity or advantagedness. Thus, the only true discriminability of this scale is between age groups. It is questionable, however, whether even the differences associated with age are large enough to be practically useful. For example, the difference in externality between second and sixth grade is only 4 to 5 points. Certainly, the significant statistical effect for ethnicity is of no practical value since the various ethnic group differed by less than two points.

One may conclude, therefore, that this scale offers some potential for determining developmental gains in internal control. It may also be useful at the second grade level for discriminating between socio-economic groups, but not at the fourthor sixth grade level.

Cognitive Preference Tests

The cognitive Preference test administered to children in grades 4 and 6, revealed a significant difference between the disadvantaged and advantaged children. (disadvantaged 7.85 advantaged 8.52) The mean score for children in grade 4 was 7.69 compared to 8.69 for grade 6. Blacks obtained a mean of 8.21 on the test, Latins a mean of 7.80 and Whites a mean of 8.56. The analysis of variance results for these groups is presented in Appendix XI along with the means and standard deviations for each cell. These means range from a low of 7.02 for disadvantaged fourth grade Latin students to a high of 9.25 for advantaged 6th grade White students. The White suburban children at Nobel school exhibited the following means at each grade level

	Mean	S.D.	N
Grade two	7.68	2.25	47
Grade four	8.58	2.28	52
Grade six	9.95	2.02	58

These data suggest that grade, socio-economic level and ethnic group are related to a preference for responding to instructional materials by going beyond rote mental processes t question the data, established trends, draw inferences, and relate specific facts to more general ideas.

The three highest correlations among the cognitive preference tests and the other variables employed in the study were with Verbal IQ, (.31), Logical Thinking (.32) and Unity in Writing Stories (.33). These correlations seemed to validate the assertion that an aspect of cognitive behavior related to preference to going beyond given data is being measured.

Interrelationships Among the Sets of New Cognitive Measures, the Standard School Achievement Measures, and Socioeconomic Status

Grade Two

In general the intercorrelations within the sets of new cognitive measures, within the achievement tests, and within indicators of verbal intelligence were reasonably high. In other words there is generally a rather high internal consistency reliability within each of these sets of measures. For instance, in grade two the intercorrelation among the Word Knowledge, Word Discrimination, and reading tests are .779, .807 and .695. (See Appendix XII for correlations referred to in this section.) The intercorrelations among the Logical Thinking and the Concept Formation measures were not as high, being on the order of about .30 to about .40 except where the part-whole correlations among several sub scores and total score are involved. The intercorrelations among the nine new Problem Solving Cognitive Measures often are as high as .50, .60, .70 and better, though occasionally there are some measures which intercorrelate more moderately. The intercorrelations among the several measures of Written Language Production were, in general, rather low except in a few instances. The intercorrelations among the oral and written Word Association measures were on the order of .50 to .57.

In general, it can be seen that within these several sets of measures of cognitive processes there is convergence, i.e., the reliability is rather good, but the interrelationships within sets of measures have been discussed more extensively in the separate sections reporting each of the sets of cognitive measures. These correlations, along with the Kuder-Richardson Formula 20 reliability coefficients, are sufficient to demonstrate convergent validity.

Discriminate validity is the second necessary criterion of a set of new measures. The concept requires that these separate sets of measures not be highly intercorrelated among themselves. Discriminate validity can be demonstrated both by reviewing the first order relationships among the sets of measures, and an overall assessment by means of a principal component analysis. The interrelationships between the various sets of new cognitive measures and the Word Knowledge, Word Discrimination, and Reading scores have been discussed in the separate reports of each the sets of new cognitive measures.

The interrelationship between the measures of Concept Formation and Logical Thinking show correlations that are rather moderate. The highest is .391 and the lowest .129. All are positive. Between Concept Formation and Response Style there are also correlations of a very moderate nature with the highest absolute value being .232. The intercorrelations between the Concept Formation measures and the Problem Solving measures are also rather low. The highest of the 27 correlations is .339 with most of them ranging between .10 and .30. The correlations between Concept Formation

measures and the measures of Written Language Production in general were even smaller than the correlations between Concept Formation and Problem Solving. The highest of these 24 correlations is .289, but many correlations are between zero and .10 with some correlations hovering around zero, and a few even slightly negative (though not significantly so). The indices of relationship between Concept Formation and the oral and written Word Association measures have a median value between .165 and .174, with a maximum of .308 and a minimum of .098.

The interrelationship between the sets of measures on Logical Thinking and Problem Solving are slightly higher than those previously reported in this section. Of the 36 correlations involved the range is from a high of .505, to three between .40 and .50, several in the .30s, and the rest ranging downward to zero. The correlations between Logical Thinking and Written Language Production are quite moderate with 10 of the 32 correlations being slightly negative and the highest only .281. The relationships between Word Association, and Logical Thinking are somewhat higher. The highest correlation is .428 with the median value .372. None were negative.

The Response Style variable is negligibly related to the Logical Thinking and Concept Formation variables. The highest absolute value of the correlations between any of these measures and Response Style is .287. The relationships between Problem Solving measures and Response Style is only slightly higher (in absolute value). The highest correlation between the nine variables assessing Problem Solving and Response Style is .359. The correlations between Written Language Production and Response Style are quite small several hovering near zero, and the highest is only .213 (in absolute value). The other aspect of Language Development, Word Association, with its four variables, is distinctly related to Response Style but again at a moderate level. In absolute value the smallest correlation is .264 and the largest .301.

It appears that Written Language Production and Word Association are substantially independent of one another with the single exception of the two variables measuring word length in Written Language Production, and the two variables for written Word Association. These seem to be rather interrelated, the correlations being .544, .415, .494, and .391. There are two other correlations in the .40's and a few in the .30's but the majority are in the teens or rather close to zero.

The relationship of socioeconomic status to all these measures is of considerable importance in this project involving culturally deprived children. Socioeconomic status is a point variable, advantaged or disadvantaged. Thus in general the maximum value of the correlations with this measure is somewhat limited because of the restriction in variability. But, certainly with the sample sizes involved any correlations that do exist between this variable and the others would be readily detected.

First, as an indication of the relative size of these relationships, the correlation between socioeconomic status variable and the school achievement measures (with their substantial verbal content and their cultural orientation) needs to be examined. In this case the three correlations of socioeconomic status with Word Knowledge, Word Discrimination, and Reading are .316, .219, and .321. These are not high correlations by general standards, but they are statistically significant and, as was indicated, do serve as an index against which to judge the size of the other relationships. The three Concept Formation variables, by contrast correlate only .119, .038, and .112 and the four logical thinking measures correlate only .148, .088, .033, and .166. The Response Style variable has essentially no relationship with socioeconomic status for these second grade subjects. The correlations of socioeconomic status with Problem Solving are somewhat higher than the eight associated with Logical Thinking, Concept Formation, and Response Style; but still are quite low, most of them being lower than the correlations of the school achievement measures with socioeconomic status. The highest correlation is only .264 with most of the correlations in the low .20's. The intercorrelation of the language development measures are of about the same order as those in the Problem Solving realm with the Word Association variables slightly higher and more consistently related to socioeconomic status than Written Language Production.

Thus socioeconomic status and the new cognitive measures in general have only a small relationship with each other, much lower than between socioeconomic status and the educational achievement measures.

To obtain a better overview of the interrelationship of all of the variables by determining their clustering in a multivariate hyperspace consisting of these 33 variables, a Principal Components Analysis followed by a Varimax Rotation was done on the intercorrelation matrix. (The program used was that developed by the University of Miami Biometric Laboratory as edited for use on CDC 6500 at Purdue University.) Principal components were extracted until the eigenvalue reached .80, and then successive varimax rotations were done on the first two components, the first three, etc., up to the limit of the number of principal components extracted from the correlation matrix. Two of the principal investigators, (Asher and Kane) reviewed the loading on the successive rotations, and felt they could agree as to which set of rotated factor loadings best identified the underlying dimensions of the original correlational matrix. Generally this was done by examining the last components to avoid solutions which gave substantial weight only to a single variable. Another criterion was the allocation of variance into a sufficient number of components so that they could be rather easily identified operationally from the variable loadings. A third criterion was a reexamination of the size of the eigenvalue for the last component accepted by the above two criteria, the percent of variance associated with that eigenvalue, and the cumulative percentage of variance extracted from the correlation matrix.*

*All of the rotated loadings are available at the Purdue Educational Research Center for those who wish to examine them.

Using these criteria for the Grade Two sample, 14 principal components were accepted by the investigators. The value of the last eigenvalue was .983 and 85.384 percent of the variance had been extracted from the correlational matrix at this point. The 14 components gave a rather clear solution with substantial loadings on the original variables.

The first component was composed of school achievement measures with the word length measures and the written paradigmatic and homogeneous measures from the Language Development cognitive measures. (See Appendix XIII for the rotated solution weights.) The second component was highly weighted on a series of tests given to this grade which were not formally a part of this study. (These were tests of a visual-perceptual nature and had been derived from the work of Seibert and Snow (1965) by McDaniel and Kephart (1971) for use with children at this age level.) The third component was substantially weighted with several of the Problem Solving set of cognitive measures while the fourth dealt primarily with the sentence length measures from the Written Language production variables. The fifth component selected the remaining Problem Solving measures. The sixth was composed of variables associated with the visual-perceptual tasks mentioned above. The seventh component has weights from the separate visual perceptual tests plus one aspect of the logical thinking measures. The eighth component is again substantially a variable from the visual perceptual tests plus one variable from the Written Language Production aspects of the language development measures.

The ninth component is comprised of the oral paradigmatic and oral homogeneous variables of the language development measures. The tenth component is weighted primarily on Response Style, socioeconomic status, and the Sensing and identification variable of the Problem Solving measures. The three measures of the Concept Formation battery weight heavily on the eleventh component while the twelvth is composed entirely of measures of the Logical Thinking. The thirteenth component is essentially a single variable, the "other punctuation," measure of the Written Language Production measures. The last component is comprised primarily of the words and sentences measures of the Written Language Production variables.

Grade Four

In grade four verbal and nonverbal IQ measures were given as a part of the Gary Schools' testing program as well as a more extensive series of standard school achievement measures, eight in all. The correlations among the two types of IQ tests, the eight achievement tests, and the interrelationships between the standard achievement tests and the two IQ tests and the two IQ tests all are rather high. The correlation between the IQ verbal and the IQ nonverbal scores is .739. (See Appendix XII for all correlations reported in this section.) The interrelationships among the standard achievement tests range from a high of .738 to a low of .543 with perhaps the majority of these correlations being in the .60's. Considering the two IQ tests and the eight standard achievement tests to some extent as alternate forms, these "test-retest reliabilities" are rather high. That the standard school achievement tests and the two forms of the IQ test are essentially measuring the same general cognitive dimension in fourth grade children, is evidenced by the size of the sixteen intercorrelations between the two IQ tests and the eight standard achievement tests. These range from a low of .497 to a high of .757, which is about the same magnitude as the intercorrelation among the standard achievement tests themselves. It can be concluded then that the IQ and standard achievement tests all are probably largely a verbal capacity or the ability to learn verbal material despite the nonverbal label given to the second part of the IQ test.

The same concern for a type of "alternate form reliability" needs to be examined for the tests of the new cognitive measures. The three intercorrelations within the Concept Formation variables are .220, .903, and .619, which indicates a reasonable reliability between two of the three measures and one relationship that is somewhat independent. The six intercorrelations among the four Logical Thinking variables are .446, .393, .299, .831, .679, and .754, again indicating to some extent a reasonable interrelationship. Response Style and Cognitive Preference correlate rather low, -.140, while the nine measures of Problem Solving have intercorrelations among themselves which range from a low of .125 to a high of .966. Three of these intercorrelations are in the .90's four in the .80's five in the .70's three in the .60's, and the rest lower than .60. Again considering these measures as types of alternative forms of the same dimension would indicate a fairly good "test-retest" reliability. The nine measures of Written Language Production are not nearly as highly intercorrelated as the Problem Solving measures, in fact six of the correlations are negative, although at least two of these are negligibly so. The highest intercorrelations are .678 and .645 and two of the remaining correlations are .388 and .353. The rest of these intercorrelations are of negligible size. The size intercorrelations among the Word Association measures of the language development dimension are fairly substantial. Two of the correlations are .973 and .961 while the remaining four range from .557 to .620. Again, this set of relationships indicates a fairly substantial intercorrelation. These "reliabilities" are valuable in that they suggest perhaps an upper bound of the intercorrelations among the sets of major cognitive dimensions of the study.

The first concern in examining the correlations among the sets of new cognitive variables is to examine the two IQ tests and the standard achievement tests in relationship to the Concept Formation, Language Development (both aspects), Logical Thinking, Problem Solving, and Response Style and Cognitive Preference variables. (This has been discussed in preceding sections where the major sets of the new cognitive tests were described.) In general, these intercorrelations were not great.

The Concept Formation correlations with IQ and achievement tests appear to be in the mid .20's. The Logical Thinking, intercorrelations appear to be somewhat higher although the midpoint appears to be in the mid .30's. Response Style again seems to have an average correlation with these two sets of variables in the mid .20's, while the Cognitive Preference correlates are on the order of about .30. The Problem Solving variable correlations with the IQ and achievement tests appear to be mainly in the .20's and .30's with a few in the .10's and .40's. None are under or over respectively these last two correlations. The Written Language Production appear to have intercorrelations with IQ and achievement tests somewhat more dispersed than the cognitive variables discussed previously. These approach correlations in the .50's with the highest being .530. At least two of the variables of Written Language Production are negatively intercorrelated with each other although not as strongly as with the IQ and school achievement tests. The Word Association measures seem to intercorrelate in the .20's and .30's with IQ and achievement variables with none higher than the latter range and only two lower than .20 , .198 and .166.

These sets of correlations just presented must not be exceeded by the correlations between the several new cognitive measures sets and should be substantially less if independence among the new cognitive measures was successfully achieved.

An examination of the intercorrelations among the new cognitive measures indicates that Concept Formation and Logical Thinking are intercorrelated from a low value of .186 to a high of .443. The median value seems to be about midway between these two for the remaining 10 correlations. The relationships between the three Concept Formation variables and Response Style are quite modest, -.119,-.201, and -.189. The correlations between Concept Formation and Cognitive Preference are even smaller, .083, .153, and .138. The twenty-seven correlations between Logical Thinking and Problem Solving variables are all positive but of low magnitude. The highest is .402 while the lowest is .120. The remainder are scattered through the upper teens and the .20's with six correlating in the .30's. The correlations between Concept Formation and Language Development are very small. The highest correlation between Written Language Production and Concept Formation is, .208, but many hover close to zero. The four variables comprising the Word Association measures of language development, as indicated, are also rather low. Of these twelve correlations the

highest is only .146 and the lowest -.026 with a median value of .119.

The interrelationships between Logical Thinking and the remaining major dimensions of the new cognitive tests are as follows. With Response Style the four correlations are -.204, -.140, -.112, and -.207. With Cognitive Preference, Concept Formation correlates .274, .192, .182, and .297. Logical Thinking and Problem Solving have 36 possible correlations in common, but again they tend to be rather modest in size. While two are in the low .40's, 12 of the correlations are in the teens, and the remaining correlations are in the .20's and .30's. The twelve measures of both aspects of language development correlate with the four measures of Logical Thinking rather negligently. Here the correlations are more balanced around zero with 12 of the correlations negative. (The largest of these is -.207.) Many of the correlations are essentially zero, and the rest have correlations in the .10's, and .20's, and 30's. Written Language Production and the Word Association measures do not seem to be materially different from these in their correlations with Logical Thinking.

The remaining unreported correlations with Response Style are Problem Solving and the two aspects of Language Development. The nine correlations of Response Style with Problem Solving are all negative but are rather small ranging from -.103 to -.211. Response Style and Written Language Production correlate negligibly with the largest correlation being -.133. The Word Association measures of Language Development, however, correlate somewhat more substantially though still at a rather low level. The range is from -.222 to -.272. Correlations of Cognitive Preference with Problem Solving measures are also not substantial, the largest correlation here is -.267 and the lowest .105. Language Development and Cognitive Preference also are negligibly correlated. The highest correlation is .224 and the lowest essentially zero, -.072. Written Language Production and Word Association measures within Language Development correlate with Cognitive Preference at about the same magnitude.

The remaining sets of interrelationships among the new cognitive dimension variables are those coupling Problem Solving and the two aspects of Language Development. There are 72 correlations between the Problem Solving and the Written Language Production measures of Language Development. Again the correlations are of very modest size. The highest is only .255 with many of the correlations quite close to zero, and 18 actually negative; none of the negative correlations is larger than -.097. It is obvious that the relationship between Problem Solving and Written Language Production, is very slight. Word Association measures are, however, correlated with Problem Solving somewhat higher. The absolute magnitude is still quite low. The highest is only .280, four are less than .10, and the rest are scattered between these two levels.

Of special interest again is the socioeconomic status correlations with all the other variables in the matrix. Recall that the socioeconomic status variable is a point variable with the range restrictions associated with such a measure. Again though it is the relative size of the correlations

that are of interest. The correlation of socioeconomic status with verbal IQ is .334 and with nonverbal IQ, .351. The educational achievement tests correlate .292, .303, .230, .199, .191, .240, .253, and .274 with socioeconomic status. Compare these correlations with the three correlations between the measures of Concept Formation and socioeconomic status, .215, .185, and .255. None of these correlations is as high as the correlations between the two measures of IQ and socioeconomic status. The highest of the Concept Formation and socioeconomic status correlations is lower than two of the eight educational achievement measures and essentially equivalent to the third, while the lowest Concept Formation-socioeconomic status correlation is lower than any of the ten IQ and educational achievement variables. The four correlations between socioeconomic status and Logical Thinking are .282, .132, .293, and .316. Again these are in general of the same magnitude or lower than the correlations between socioeconomic status and the educational achievement tests. All of these correlations are lower than the correlations between socioeconomic status and the two intelligence measures.

Socioeconomic status has essentially a zero relationship with Response Style and a correlation of only .129 with Cognitive Preference. With the nine Problem Solving measures, socioeconomic status does correlate somewhat better than the correlations between socioeconomic status and the previous cognitive measures reported above. However, the correlations are not of major importance. The highest correlation is .395, and the lowest is .183. The remaining seven fall between these two extremes. The correlations of socioeconomic status with the Language Development measures are lower than the correlations of socioeconomic status and Problem Solving. The four correlations are .172, .187, .108, and .136. correlations of socioeconomic status and Written Language Production measures range from .232 to a low of -.102.

Again, as with the second grade data, it appears that the major objective of the development of the new cognitive measures has been achieved in that these new cognitive measures have a low correlation with measures of intelligence and educational achievement tests. A second major objective in the development of the new cognitive measures was that they not intercorrelate highly among themselves. This too has been achieved in this grade. Third, in the development of cognitive measures for use in educational situations with culturally deprived children it is important that the cognitive measures do not correlate importantly with measures of socioeconomic status. This too has been accomplished at the fourth grade level as indicated by the correlations reported above.

To gain a better understanding of the overall interrelationship among all the new cognitive measures, the intelligence, tests and the educational achievement tests, a principal components analysis followed by a varimax rotation was done on the fourth grade intercorrelation matrix. The procedures used were essentially the same as those described for the analysis of second grade data.

In this instance an eleven principal component solution was accepted which extracted 76.331 percent of the variance of the intercorrelation matrix with the eigenvalue of the 11th component .973.

It is clear that the standard educational achievement tests and the intelligence tests, both verbal and nonverbal, are assessing essentially the same dimension in these fourth grade children. The weight of the verbal IQ measure on this component is .817. The eight educational achievement measures are weighted in the .70's, and the lowest weight of importance is the nonverbal measure of IQ, .655. The only other measures which have important weights on this component are five of the Written Language Production measures; mean word length, "commas", standard deviation of word length, words, and sentences.

The second component is composed primarily of five of the Problem Solving variables, the third component is composed almost entirely of the four Word Association measures from the language development dimension, while the fourth component is weighted substantially with the four measures of Logical Thinking and to some extent with the two word length measures from the Written Language Production aspect of the language development dimension. The fifth component is weighted heavily with three problem solving scores: clarification I, clarification II and the presolution measure together with the total score on Problem Solving. The sixth component is comprised of the three Concept Formation variables while the seventh component weights heavily the two measures of sentence length from the Written Language Production aspect of language development. Perhaps the sentence measure from the same set of scores could be included in this component.

Also from the Written Language Production measures of language development come the highest weights for the eighth component, words and sentences. The ninth component is primarily the sensing and identification measures from the Problem Solving dimension and to some extent the total score measure on Problem Solving. The tenth component is primarily an index of the total amount of punctuation from the Written Language Production measures of language development. The two highest weights on this component are commas and other punctuation. The eleventh component brings together the Response Style and socioeconomic status dimensions of the study.

It is apparent in the fourth grade sample that the clustering of these variables in the multivariate hyperspace is such that the interrelationships between the new cognitive dimensions, the IQ measures, and educational achievement measures are relatively low.

As in the second grade population, with the fourth grade sample the investigators demonstrated that both convergent and discriminant validity were established. Independent constructs of Concept Formation, Language Development, Logical Thinking, Problem Solving, and Response Style and Cognitive Preference were achieved.

The major aims of the project have been accomplished with the fourth grade sample.

Grade 6

By grade six evidently the psychological development of children has sufficient diversity so that the verbal and nonverbal forms of the intelligence tests now are not correlated highly. For this sample the correlation is only .276. The educational achievement tests still relate rather well with the verbal aspect of the intelligence tests. Four of the eleven correlations are in the high .60's, two in the low .60's, and three more in the .50's. The lowest two are .431 and .374. The correlation of achievement test scores with nonverbal IQ is much lower at this grade ranging from a high of .337 down to essentially zero with the median value being only .170.

The intercorrelations among the Concept Formation variables are rather moderate except where part-whole correlations exist. The intercorrelations among the Logical Thinking measures are somewhat higher than those for the Concept Formation, .417, .447, .343, .821, .683, and .802 with again the part-whole correlations being substantially greater. The intercorrelations among the Problem Solving measures are substantial. Several of the correlations are in the .80's and a number in the high .60's and .70's. There are some which are in the .10's and .20's. The Written Language Production measures of Language Development have some high intercorrelations of similar variables, but many of these correlations are in the .20's and .30's with a number essentially zero. The Word Association aspect of Language Development maintains the pattern of the oral phases correlating with the written phases on the order of .59 to .66, while the correlations between the two oral measures as well as that between the two written measures are on the order .95. Again, considering these as alternative measures of the same general dimension an indication of the upper limits of the possible correlations among the sets of cognitive variables is possible.

The relationship between the new cognitive variables, IQ, and achievement scores has been discussed in sections dealing specifically with each of the new cognitive measures. We now turn to the interrelationships among the sets of new cognitive measures.

The intercorrelations among the three Concept Formation variables and the four Logical Thinking variables range from a low of .162 to a high of .522. There are four correlations in the .40's, three in the .30's and two in the .20's. This set of relationships suggests that the intercorrelation between these two sets of variables is not of major importance. The three intercorrelations between Concept Formation and Response Style are much lower than those between Concept Formation and Logical Thinking. They are -.103, -.110, and -.130. The three correlations of Concept Formation with Cognitive Preference are also of negiglible magnitude, .045, .139, and .098. Of the twenty-seven correlations between Concept Formation and Problem Solving the highest is only .305 with all the others in the .10's and .20's. The correlations of the Concept Formation variables with Written Language Production aspects of Language Development

are even smaller with the highest only .277. A number of these correlations are essentially zero with seven negative. The greatest absolute value among the negative correlations is .113. Concept Formation correlations with Word Association aspects of Language Development are even smaller than with Written Language Production. The largest of these correlations is a negligible .116 while the lowest is .133. Eight of these twelve correlations range between -.031 and .093.

Logical Thinking has a minimal relationship with Response Style variables. The largest in absolute value is .156. Logical Thinking and Cognitive Preference variables correlate at a low level, but the relationship is distinctively positive. These correlations are .296, .140, .262, and .320. The thirty-six correlations between Logical Thinking and Problem Solving also are positive and range from a high of .452 to a low of .151. The majority of these correlations, however, are in the .20's and .30's. This is a distinct but moderate relationship. The correlations between Logical Thinking and Written Language Production are more scattered, positively and negatively. Eight of the correlations are negative. The largest correlation is only .277, and many of the correlations are between zero and twenty. Half of the correlations between Logical Thinking and Word Association measures are negative and half are positive. The two oral measures are negatively related to Logical Thinking variables, and the two written variables are positively related to Logical Thinking variables. None of the correlations are high however, the maximum being .185. The negative correlations could be labeled "Irish coefficients" (O'Four, O'Five, etc.).

The previously unreported Response Style relationships with the other cognitive variables are Cognitive Preference, Problem Solving, and the two aspects of Language Development. Response Style has a negligible correlation with cognitive preference, -.085. Response Style has a maximum correlation of -.205 with Problem Solving variables. All of the correlations between Response Style and Written Language Production are between -.097 and +.011, probably indicating a zero relationship between these variables. The same seems to be true of the Word Association variables, the highest absolute value among these correlations is .120.

Intercorrelations between Cognitive Preference and other new cognitive variables that have not been reported above are Problem Solving and Language Development. The maximum correlation between Problem Solving measures and Cognitive Preference is .184 the minimum .094, and the median value .138. The intercorrelation set indicates a minimal relation if any, between the two dimensions. With the Written Language Production aspects of Language Development the same appears to be true. Of these eight correlations the maximum is only .184. The Word Association variables of Language Development correlate essentially zero with the Cognitive Preference variable. The greatest absolute value is only .032.

Problem Solving and Written Language Production have 72 correlations to indicate the extent of the relationship between these two sets of

variables. Of all these correlations the maximum is .189, which suggests a negligible relationship between these two major cognitive dimensions. With Word Association the Problem Solving dimension has a maximum correlation of .205 among the 36 correlations involved. It seems fair to say that none of these relationships between Language Development and Problem Solving is of any practical importance.

Within Language Development the intercorrelations between Written Language Production and the Word Association measures are assessed by 36 correlations. Fourteen of these are negative and 22 positive. This balance between the positive and the negative correlations seems to indicate a near zero relationship. The maximum correlation is only -.160.

The socioeconomic status variable is of considerable importance to this study. It and verbal IQ scores correlate .332, but the correlation with nonverbal IQ is only .040. Considering the verbal nature of most of the achievement measures one would expect that the correlations with socioeconomic status would be of about the same order as with verbal IQ. The highest correlation of socioeconomic status with eleven achievement measures is .406 which interestingly enough is vocabulary. (Vocabulary may be the best indication of the influence of a family's socioeconomic status on children.) The other correlations with achievement measures range from a high of .297 to a low of .176.

The Concept Formation measures correlate .305, 272, and .359 with socioeconomic status which is about the same as the achievement and verbal IQ measures. Socioeconomic status and the four Logical Thinking measures correlate .326, .153, .365, and .380. Response Style correlates only -.052 with socioeconomic status while Cognitive Preference correlates with it .163. The nine Problem Solving measures correlate considerably lower with socioeconomic status than do the verbal IQ and achievement measures. The highest of these correlations is only .205, six are in the .126 to .174 range and two correlate .011 and .076. Socioeconomic status and the first three measures of Written Language Production words, sentences and commas-correlate .215, 221, and .250 respectively. However the other four measures are negligibly correlated with the possible exception of punctuation other than commas, which is .182. The four Word Association measures correlate negligibly with socioeconomic status. The two oral measures are somewhat negatively related while the two written measures have a very small correlation with socioeconomic status. The greatest absolute value of these four, however, is only .135.

It would seem that as individual differences become greater with maturation socioeconomic status does play a role, particularly in the verbal aspects of intelligence and the achievement measures. This is also true to some extent with the quantity of Written Language Production in terms of words, sentences, and punctuation. Logical Thinking and Concept Formation measures also seem to be somewhat more related at this grade level than they did in the previous grades.

The principal components analysis and varimax rotation were done with these data as they were with data from grades two and four. In this instance the number of principal components selected was 12. The eigenvalue of the last component reached a value of 1.108. Of the total variance in the correlation matrix 74.771 percent was extracted.

The first component was one of a verbal capacity-educational achievement nature. These twelve measures from the correlational matrix weighted at .636 or above on this component. Five other variables weighted at .30 or above on this component also. They were the MIB score from the Concept Formation test, the total matrix score, loops score, and total score from the Logical Thinking set and the standard deviation of word length from the Written Language Production task. The second principal component is almost entirely defined by four variables from a set of special tests not directly related to the Belmont study which were added to the test battery for this grade only. The third component is weighted most heavily with five measures from the nine Problem Solving tests, namely, total Problem Solving, problem parts, and Problem Solving I, II, and III. The fourth principal component was very heavily weighted on all four of the variables measuring the Word Association aspect of Language Development. All the other variables were negligibly weighted on this component. The fifth component was comprised of Problem Solving variables: Problem Solving total, sensing and identification, Clarification I Clarification II, and presolutions. The sixth component was composed of the two sentence length variables from Written Language Production; mean sentence length and standard deviation of sentence length, as well as the total number of sentences. The sixth component is heavily weighted with all four of the Logical Thinking variables plus perhaps a small amount of the MIB variable from Concept Formation. Also weighting at a level above .30 were both the verbal and nonverbal IQ measures. The seventh principal component weights most heavily and primarily on the four Logical Thinking variables. However, smaller loadings are present from the two aspects of the intelligence tests, verbal and non-verbal. No other variable has important loadings on this component.

Three variables from the Written Language Production set of the Language Development domain comprise the eighth principal component; words, sentences, and number of commas used. All three of the Concept Formation variables; conservation, MIB, and total score, form the ninth principal component while the 10th is identified primarily with the mean and standard deviation of word length from Written Language Production. This component also has a weight of above .30 on verbal IQ. The 11th principal component weights at last on nonverbal IQ along with the other punctuation variables of Written Language Production. Socioeconomic status, and the vocabulary variable from the achievement measures also are weighted on this component. The last component accepted brings in Response Style, Cognitive Preference, and, of all things, the maps variable from the achievement test. This last variable may be related

to the specialized assistance and knowledge that very high socioeconomic parents can give to their children which may not be heavily emphasized in school.

As the principal components analyses progress from grades two through six, it becomes more apparent that the cognitive development of the children becomes more diffuse. Particularly the dimensionality of the analysis seems more readily identifiable. The intelligence test scores of the children in the fourth grade were correlated with each other to a rather large extent. By the time the test scores were taken in the sixth grade it is obvious that the correlation between verbal and nonverbal intelligence is quite low.

Summary

Strong confirmation is given to support the discriminant validity of these new cognitive measures and that they are indeed minimally correlated with socioeconomic status. The first order relationships of the cognitive measures developed for this study with standard school achievement measures are also low. Finally, the sets of measures comprising the new cognitive measures are minimally correlated. With the substantial internal consistencies of these measures and the generally favorable intercorrelations among the variables within the cognitive measure sets, the evidence that these tests meet the criteria of Campbell and Fiske (1959) for both convergent and discriminant validity is available, and a major aim of the project was accomplished.

Recommendations for Further Development and Use of the New Measures of Cognitive Development

First, the most obvious needs for tests which have demonstrated good reliability and initial validity standards is to obtain normative data on a national sample. Adequate norms should be constructed for the new cognitive measures for each of various ethnic populations, low socioeconomic status populations, etc.

Another immediate need is to construct a further pool of items, similar to the current items so that alternative forms of these new cognitive measures can be developed. These would be of value for pre and post testing in evaluating various kinds of experimental educational programs.

A third need is to construct forms of these measures for use in the pre-school kindergarten, and first grade levels, and also to develop forms appropriate for junior and senior high school students. As a start on these tasks, items which proved to be too difficult or too easy for the second, fourth and sixth grade samples could be used as a basis for these tasks.

It has been demonstrated that these cognitive tasks are essentially independent of typical verbal intelligence and school achievement measures and thus both of the following steps should be taken: (a) develop curricula which teach and facilitate these types of cognitive skills themselves, and (b) use these cognitive channels instead of the traditional verbal ones, to teach the content of traditional curricula.

Next, the areas tapped by these cognitive measures need to be extended by developing further tests in areas suggested by the psychological literature, and by expert reviewers (brought in at the end of the literature review). One example of this would be to extend the logical thinking tests to class relations as well as class inclusion operations.

While good internal consistency reliability has been established, reliability over time should also be studied. The current measures in some cases should be lengthened to improve the reliability sufficient for individual prediction purposes. Studies of these cognitive measures of students' development over time, need to be done much as such studies have been done with other intellectual, motor, and perceptual tasks.

Many experimental studies, as well as descriptive and developmental studies, of the influences of types of educational curriculum and other forms of training on these cognitive measures need to be made. As the result of the breakthroughs which ave been made in this study, the list of experimental studies that could be done is almost endless. Concurrent and predicitive validity studies of "real world" criteria other than achievement and IQ measures should be done in the near future. One of the most obvious studies of this kind is to predict performance on various types of training tasks as a result of knowledge of scores on these cognitive measures.

While many advantages have been found for the visual media approach to test administration developed in this study, it would be interesting to compare the validity and reliability of paper and pencil forms of these tests with the approach which has been used extensively in this series of cognitive measurements.

Additional principal components analyses using a more extensive sample of cognitive function measures need to be made to better define the psychological structure of the cognitive processes of children in elementary school, particularly those eligible for Title I support. Better identification of the functions sampled by these tests could be made from these analyses. This would extend the Campbell and Fisk (1959) convergent-discriminate validity analysis procedures started in this study. Inclusion of "marker dimension" tests in addition to the new cognitive measures and a few of the more traditional verbal achievement measures would determine better the nature of the cognitive domain of these newly developed cognitive measures.

A search of the psychometric literature was made covering the last ten years of journal publication. Of particular interest in this search were articles dealing with children in grades two through six (or in the equivalent age ranges). From the measurement instruments described in these articles a number of tests could be suggested for inclusion in such a battery. For example, Wisland and Many (1969) found three factors in the Illinois Test of Psycholinguistic Abilities. The first was a general psycholinguistic factor, the second a general skill factor, and the third a factor composed largely of visual-motor skills. Singer (1965), in a principal components study of fourth graders, used 30 reading, linguistic, perceptual, primary mental ability, and auditory tests and found five major dimensions. These were interpreted as visual meaning, auding, visual relationships,

speed of visual perception, and auditory perception. The Thurstone primary mental abilities (Thurstone & Thurstone, 1954) subtests of words and word grouping, space figure grouping, and perception and pictures seem to be major components of the first three factors found by Singer. The figure and ground test of The Holmes California Language Perception Test (1962) was a major component of Singer's fourth factor, speed of visual perception. The fifth factor, auditory perception, was loaded primarily with the three subtests of a Kwalwasser-Dykema-Holmes physical aptitude test.

Thus perhaps ten tasks, which seem to identify most of the individual differences in children's cognitive functioning, along with four to six of the tests which identified cognitive function in our sample could be given to children of several ethnic classifications with the good probability that most of the dimensionality of the cognitive space could be identified. The resulting major advance in knowledge of cognitive functioning of children at these ages in the various ethnic groups would be of considerable value to curriculum planners and teachers.

The number of interesting, and valuable studies suggested attest to the success of the initial project. The translation of psychological theory into practical educational assessment, when accomplished is always exciting. We recommend that this line of development which is off to so promising a start be continued so that the development of cognitive functioning in children may be may be more thoroughly understood. It seems clear that to the extent this is done the nation's schools will be able to provide educational opportunities for all our young people.

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Appendix I

Listing of Test Materials Submitted with this Report

Concept Formation

1 8 mm color film
1 Audio tape
50 Answer Booklets for the Conservation subtest
50 Answer Booklets for the MIB subtest

Language Development

50 Directions for individually administered Word Association Test
50 Answer forms for individually administered Word Association Test
50 Directions for group administered Word Association Test
50 Answer forms for group administered Word Association Test
50 Directions for "Make a Story" (Written Language Production Test)
50 Answer sheets for "The Wall"
50 Answer sheets for "Rich Man-Poor Man"

Logical Thinking

1 8 mm color film
1 Audio tape
50 Test Booklets

Problem Solving

1 Audio tape for use at grade 2
1 Audio tape for use at grades 4 and 6
1 Set of slides
50 Answer Booklets

Response Style

1 Audio tape for Internal-External Scale for use at grade 2
1 Audio tape for Internal-External Scale for use at grades 4 and 6
50 Answer Booklets for Internal-External Scale
50 "What I Like Best" (Cognitive Preference Test)

Appendix II

Administration Procedures for the Concept Formation Test

The test is easily administered by two people (1) team leader - film projectionist, (2) one to run the tape recorder. One person can administer it if both machines are placed together.

The room should be darkened enought so that the film is visible but light enought that the page can be seen by the children. The projector, tape recorder and screen should be prepared for use. Person two runs the audio tape at low volume until it says, "Now write your name on the booklet." Then the tape is shut off. The booklets for both Part I and Part II are distributed along with pencils where necessary. The children are then instructed to take the smaller booklet and lay the larger one to one side. They are instructed to record necessary information such as name, grade, age, etc.

Part I:

Next, on signal from the projectionist, person two starts the audio tape. On cue from the tape, person one starts the film and the two practice items of Part I are administered. Then both tape recorder and film are stopped and the children are asked if they have any questions.

On signal from the projectionist person two starts the audio tape with which the film was synchronized. Synchronization is achieved as follows. The cue for turning on the projector throughout Part I is the sentence, "Now watch the screen." As soon as the work "screen" is said on tape, the film projector is started and is left running until the black-out starts at the end of a sequence. The projector is then turned off with the audio tape continuing to run. When, "Now watch the screen!" is said the projector is started again.. After the initial stopping of the audio tape after the first two items, the audio tape runs continuously unless a child has a problem. Testing on Part I continues and is stopped only if problems develop. Such problems are very infrequent. Missing pages were the major source of testing problems on Part I of the test. In such a case, person two opens a booklet to the page where the child should be and tells him to continue in the new booklet. The new booklet is inserted at the page where the problem occurs in the original.

The last item in Part I consists of clay balls in glasses of water, one ball being extracted, flattened and held above the glass. The audio tape continued to run until it said "We are now finished. Close your booklets." Then the tape is turned off.

The children are then instructed to put the small booklets to one side, take the large booklets (for Part II) and put the same information

on the cover page as they had recorded on the small booklets.

Part II.

On signal from the projectionist, person two starts the audio tape. The projectionist synchronises the film as in Part I and two practice items are shown. As soon as the audio tape says (for the second of the two items)"... and this one has a notch in the wrong place.", the tape is shut off.

The children are then asked if they have any questions and the questions, if any, are answered as per the two items just shown. Then the children are told just to look at their own booklet and listen to the voice on the tape recorder -- there will be no more moving pictures. Room lights are turned on.

On signal from the projectionist, person two starts the audio tape. One more item is done and the tape stopped. The children are asked if there are any questions. If so, these are answered as per the practice items. Then the tape is started again and stopped only when necessary. If several children fall behind, the tape should be shut off for two or three minutes to allow them to catch up.

Audio Script-Concept Formation

At low volume
Today we are going to show you a movie and ask you questions about what you see. Your answers to the questions will help us make a better movie. Now write your name on the booklet. Stop

(PAUSE)

Open your book to the first page. It is green. Notice you have a picture of a star, a flower, and a key.

Now look at the screen.

---

1. If you think this set has more things, mark the star.
If you think this set has more things, mark the key.
If you think they have the same number mark the flower.

Since these two sets have the same number, we mark the flower like this. Mark your page now.

(PAUSE)

Turn the page. You should now be on the yellow page.

Now watch the screen.

---

2. Here we have two sets of things.

If you think this set has more things, mark the star.
If you think this set has more things, mark the key.
If you think both sets have the same number, mark the flower.

Since the set on the right has more, we mark the key. Now mark your page in the same way.

(PAUSE) STOP (grade 2)

Turn the page. Should should be on the blue page.

Here is the first question for you to do on your own.

Watch the screen.

---

3. Here there are the same number of eggs and cups.

Now watch.

(PAUSE)

If you think these are the same number eggs and cups, mark the flower.

If you think there are more eggs than cups, mark the star.

If you think there are more cups than eggs, mark the key.

(PAUSE) STOP

Now turn the page. You should be on the pink page.

Now watch the screen.

---

4. Here you see two rows which have the same number of buttons.

Now watch.

If you think both rows have the same number of buttons, mark the flower.

If you think this row has more buttons, mark the star.

If you think this row has more buttons, mark the key.

(PAUSE)

Now turn the page. You should be on the green page.

Now watch the screen.

Turn Volume up

---

5. Here you see two sets of chips.

If you think both sets have the same number of chips, mark the flower.

If you think this set has more chips, mark the star.

If you think this set has more chips, mark the key.

(PAUSE)

turn vol. up higher
Turn the page. You should be on the yellow page.

TURN VOLUME DOWN
Now watch the screen.

---

6. Both rows have the same number of things. Now watch.

(PAUSE)

If you think both rows of things have the same number, mark the flower.

If you think this row has more things, mark the star.

If you think this row has more things, mark the key.

(PAUSE)

Turn the page when you are finished.

You should be on the blue page.

Now watch the screen.

---

7. Both rods are the same length. Now watch.

(PAUSE)

If you think this rod is longer, mark the star.

If you think this rod is longer, mark the key.

If you think both rods are the same length, mark the flower.

(PAUSE)

Turn the page when you are finished.
You should be on the white page.

Now watch the screen.

---

8. Here are two rods.

(PAUSE)

If you think this rod is longer, mark the star.

If you think this rod is longer, mark the key.

If you think both rods are the same length, mark the flower.

(PAUSE)

Turn the page when you are finished.

You should be on the pink page.

Now watch the screen.

---

9. Both rods are the same length. Now watch.

(PAUSE)

If you think both rods are the same length, mark the flower.

If you think this rod is longer, mark the star.

If you think this rod is longer, mark the key.

(PAUSE)

Turn the page when you are finished.
You should be on the green page.

Now watch the screen.

---

10. One container of beads has more than the other. Now watch.

(PAUSE)

If you think both containers have the same amount of beads, mark the flower.

If you think this one has more beads, mark the star.

If you think this one has more beads, mark the key.

(PAUSE)

Turn the page when you are finished.
You should be on the yellow page.

Now watch the screen.

---

11. Both containers have the same amount of beads. Now watch.

(PAUSE)

If you think both containers have the same amount of beads, mark the flower.

If you think this one has more beads, mark the star.

If you think this one has more beads, mark the key.

(PAUSE)

Turn the page when you are finished.
You should be on the blue page.

Now watch the screen.

---

12. Notice that one container has more beads than the other. Now watch.

(PAUSE)

If you think both containers have the same amount of beads, mark the flower.

If you think this one has more beads, mark the star.

If you think this one has more beads, mark the key.

(PAUSE)

Turn the page when you are finished.
You should be on the yellow page.

Now watch the screen.

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13. Both clay balls have the same amount of clay. Now watch.

(PAUSE)

If you think both have the same amount of clay, mark the flower.

If you think this one has more clay, mark the star.

If you think this one has more clay, mark the key.

(PAUSE)

Turn the page when you are finished.

You should be on the green page.

Now watch the screen.

---

14. Both clay balls have the same amount of clay. Now watch.

(PAUSE)

If you think this one has more clay, mark the star.
If you think this one has more clay, mark the key.
If you think both have the same amount of clay, mark the flower.

(PAUSE)

Turn the page when you are finished.

You should be on the pink page.

Now watch the screen.

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15. Notice the container on the left has more juice. Now watch.

(PAUSE)

If you think both containers have the same amount of juice, mark the flower.

If you think this one has more juice, mark the star.

If you think this one has more juice, mark the key.

(PAUSE)

Turn the page when you are finished.
You should be on the white page.

Now watch the screen.

---

16. Both containers have the same amount of juice. Now watch.

(PAUSE)

If you think this one has more juice, mark the star.

If you think this one has more juice, mark the key.

If you think both containers have the same amount of juice, mark the flower.

(PAUSE)

Turn the page when you are finished.
You should be on the blue page.

Now watch the screen.

---

17. Both shapes have the same amount of space. Now watch.

(PAUSE)

If you think the two shapes have the same amount of space, mark the flower.

If you think this one has the greater amount of space, mark the star.

If you think this one has the greater amount of space, mark the key.

(PAUSE)

Turn the page when you are finished.
You should be on the yellow page.

Now watch the screen.

---

18. Both shapes have the same amount of space. Now watch.

(PAUSE)

If you think this one has the greater amount of space, mark the star.

If you think this one has the greater amount of space, mark the key.

If you think the two shapes have the same amount of space, mark the flower.

(PAUSE)

Turn the page when you are finished.
You should be on the green page.

Now watch the screen.

---

19. Both shapes have the same amount of space. Now watch.

(PAUSE)

If you think this one has the greater amount of space, mark the star.

If you think this one has the greater amount of space, mark the key.

If you think the two shapes have the same amount of space, mark the flower.

(PAUSE)

Turn the page when you are finished.
You should be on the pink page.

Now watch the screen.

---

20. Here you see two balls of clay that weigh the same. Now watch.

(PAUSE)

If you think this one weighs more, mark the star.

If you think this one weighs more, mark the key.

If you think they both weigh the same, mark the flower.

(PAUSE)

Turn the page when you are finished.
You should be on the blue page.

Now watch the screen.

---

21. Both of these have the same number of blocks. Now watch.

(PAUSE)

If you think this one has a greater volume, mark the star.

If you think this one has a greater volume, mark the key.

If you think they have the same volume, mark the flower.

(PAUSE)

Turn the page when you are finished.
You should be on the yellow page.

Now watch the screen.

---

22. Both of these have the same number of blocks. Now watch.

(PAUSE)

If you think they have the same volume, mark the flower.

If you think this one has a greater volume, mark the star.

If you think this one has a greater volume, mark the key.

(PAUSE)

Turn the page when you are finished.
You should be on the green page.

Now watch the screen.

---

23. Both balls have the same amount of clay. Now watch.

(PAUSE)

When the clay is put back, if you think the water will be higher on this one, mark the star.

If you think the water would be higher on this one, mark the key.

If you think the water on the two containers will be the same mark the flower.

(PAUSE)

We are now finished. Close your booklets.

Key for Concept Formation Test

Part I (Conservation)

Item	Correct Response
1	B - Flower
2	B - Flower
3	C - Key (Response broken)
4	B - Flower
5	B - Flower
6	A - Star (Response broken)
7	B - Flower
8	A - Star
9	B - Flower
10	C - Key
11	B - Flower
12	B - Flower
13	A - Star
14	B - Flower
15	B - Flower
16	B - Flower
17	B - Flower
18	B - Flower
19	B - Flower
20	B - Flower
21	B - Flower

Part II (MIB)

22	C
23	B
24	B
25	A
26	C
27	C
28	C
29	C
30	C
31	A
32	D
33	C
34	B

Appendix III

Directions for individually administered Word Association Task

The Administrator says:

"This is a word game. I'll say a word and you say the first word that it makes you think of. Then I'll say another word, and you answer with whatever word that one makes you think of. There are no right or wrong answers. We're only interested in what word comes to your mind when you hear certain words."

Directions for Written Word Association Task

The teacher says:

"Boys and Girls, this is a word game. Look at the first word in the list. What other word does that make you think of? Write your word on the same line as the first word. Now look at the second word...write next to it the first word that one makes you think of. Okay, now finish the list, word by word. There are no right or wrong answers. We're only interested in what word comes to your mind when you see certain words. Don't worry about spelling, just put it down as best you can."

To the Teacher:

1. If you think an example is needed write "hello" on the board. Then say this word might make you think of "everybody" or "goodbye" or "hi". Write just one word on each line. Make it the first word that comes to your mind.

2. If a child indicates that he can't read a word, tell him to guess. Encourage the children to move steadily on and not be stumped by any item.

3. This project requires ethnic identification of the child. Please circle B for Black, W for white or L for Latin (Cuban, Puerto Rican, Mexican).

Thank you very much.

Directions for Make a Story Test
(Written Language Production)

Distribute one of the pictures (it does not matter which picture is received first). Request that the pupils print their name in the upper right hand corner.

Say:

> "For this activity, you are to make up a story about this picture. Any story will do. Write your story on the lines below."

It is important that the teacher give no examples of stories. If children seem to want help with the kind of story to write, please ask them to look at the picture and assure them that the picture will suggest ideas to them.

The story should be completed on the front side of the paper. The back may be used if necessary to complete the last sentence of the story.

This exercise is not timed. After the children finish the first exercise, collect the papers, and distribute the second picture with the directions:

> "Now write your name in the upper right hand corner. Go ahead and make up a story about this picture just as you did before."

If children ask; the stories need not be related to each other.

APPENDIX IV

TEST USER'S MANUAL

Materials:

test booklets

super 8mm color film

audio tape

Instructions:

Set up the equipment in a semi darkened room. The projector must be far enough away from the screen so that the image projected will be easily seen by all children taking the test. You may find that it will be advantageous to darken the room for the practice items only and then to brighten it while the children are working in the response booklets.

The tape recorder should be set at 3 3/4 inches per second and should be stationed close to the film projector.

Let the tape recorder run until you hear two loud clicks close together. Turn the tape off immediately at this point. Turn on the film projector and allow it to run until the first item appears on the screen. Turn off the projector. When the test begins, turn both machines on simultaneously. They will be synchronized if you have performed these steps correctly.

Distribute the test booklets and have the children fill in the information one the cover as it pertains to name, school, age, sex, grade. Tell them that they are to do some puzzles, that puzzles will be shown to them on the screen and that they will see them in their booklets. A tape recording will tell them how to do the puzzles and when to turn to the next page in their books. It will also tell them how to mark the answers in their books. If they make a mistake, or wish to correct an answer, they are to put two X's over the incorrect answer and a single X on the correct one.

The test administrator will have to turn the film projector off and on again three separate times as follows:

1. To begin the test. Turn the projector off after the second practice item when the finger has completed the X on the response boxes.

2. Turn the projector on after the 20th item when the voice says "Stop and watch the screen". Turn the projector off again when the finger has made the X on the practice item.

3. Turn the projector on after the 40th item when the voice says "Stop and watch the screen." Turn the projector off after the hand has made an X after the second practice item. The tape recording will run for the entire duration of the test and will not be turned off until the end of the 55th item when the voice,says, "Stop and close your books."

Turn to the first page. It has a green triangle on it. Here is a puzzle for you to do. One of the spaces is empty. You are to decide whether one of these things fits in the empty space, or whether none of these things fits in the empty space. When you have decided, put an X on the answer you have chosen. (PAUSE) Here is how to do the puzzle.

The Puzzle has four columns. All of the things in the first column are orange, all of the things in the second column are green. All of the things in the third column are red, all of the things in the fourth column are blue. The puzzle also has four rows. All the things in the first row are circles, all of the things in the second row are squares, all of the things in the third row are triangles, all of the things in the fourth row are diamonds. To decide what goes in the missing space look at where the row and column come together. All of the things in this row are diamonds, so a diamond must go in the space. All of the things in the column are blue, so something blue must go in the empty space. The only thing that is both blue and a diamond is this blue diamond so you should put an X on the blue diamond.

Turn the page... This page has a red circle in the corner. Here is another puzzle for you to do. One of the spaces is empty. You are to decide whether one of these things fits in the empty space or whether none of the things fit the empty space. When you have decided, put an X on the answer you have chosen. Do this puzzle on your own, and then we will tell you the correct answer. Now do the puzzle. (PAUSE) Here is how to do the puzzle.

The puzzle has four columns. This time there are two things that are the same about each column. All of the things in the first row are red and triangle. In the second row they are green and circles. In the third row they are orange and square, and in the fourth row they are blue and triangle. The puzzle also has four rows. There is only one thing the same about the rows. All the things in each row are the same in size, but its size changes from very small in this row to very big in this row. So the size gets bigger as you go down the puzzle. To decide what goes in the missing square, look at where the row and column come together. All of the things in this column are orange squares so a orange square must go in the empty space. All of the things in this row are the same size so something the right size must go in the empty space. You must look for an orange square that is the right size. This is the only orange square that is the right size so you should have put an X across the orange square.

(Projector is turned off)

Now turn to page one and do the puzzle.

Turn to page 2

Turn to page 3
Turn to page 4
Turn to page 5
Turn to page 6
Turn to page 7
Turn to page 8
Turn to page 9
Turn to page 10
Turn to page 11
Turn to page 12
Turn to page 13
Turn to page 14
Turn to page 15
Turn to page 16
Turn to page 17
Turn to page 18
Turn to page 19
Turn to page 20

STOP!

Now turn the page and look at the screen. This page has a green square in the corner. This is a new kind of puzzle for you to do. This time there is only one row and one column for you to look at. In this puzzle one of the spaces is empty. You are to decide whether one of these things fits in the empty space. When you have decided, put an X on the answer you have chosen. Do the puzzle on your own and we will tell you the correct answer. Now do the puzzle. (PAUSE)

Here is how to do the puzzle. All of the things in the column are squares, so something square must go in the empty space. All of the things in the row are red, so something red must go in the empty space. You must look for something that is both red and square. This is the only thing that is both red and square so you should have put an X on the red square.

(Projector is turned off)

Now turn to page 21 and do the puzzle.

Turn to page 22
Turn to page 23
Turn to page 24
Turn to page 25
Turn to page 26
Turn to page 27
Turn to page 28
Turn to page 29
Turn to page 30
Turn to page 31

Turn to page 32
Turn to page 33
Turn to page 34
Turn to page 35
Turn to page 36
Turn to page 37
Turn to page 38
Turn to page 39
Turn to page 40

STOP!

Now turn the page and look at the screen. This page has a blue circle in the corner. This is a different kind of puzzle for you to do. Notice there is a place marked with an X. You must decide whether one of these things belongs in the place marked X. When you have decided, put a cross on the answer you have chosen. We will do this puzzle with you, here is how it is done.

Anything that is a circle would go here, anything that is a triangle would go in here. Anything that is orange would go inside this orange line. An orange circle would go in the place where the orange line and circle come together. An orange triangle would go in the place where the triangle and line come together. The X is in a place where the triangle and the orange line come together. So you must look for something that is both a triangle and orange. This is the only thing that is both orange and triangle, so you should have put a cross on this place.

Now turn to the next page and watch the screen. This page has an orange triangle in the corner. This is another puzzle for you to do. Notice there is a place marked with an X. You must decide whether one of these things belongs in the place marked X or whether none of the things belongs in the place marked X. When you have decided, put a cross on the answer you have chosen. Do this puzzle on your own and we will tell you the correct answers. (PAUSE)

Here is how to do the puzzle. Squares must go inside this square, Triangles must go inside this triangle, anything red must go inside this red line and anything blue must go inside this blue line. Look at where the red line and square come together. Red squares would go in here. Blue triangles would go where the blue line and triangle come together. Look at where the red and blue lines come together. Nothing could go here because nothing can be both red and blue at the same time. Look at where the square and triangle come together. Nothing could go here because nothing can be both square and triangle at the same time. The X marks a place inside the square but it is not inside the red line and it is not inside the blue line. So, you must look for any square that is neither red nor blue. The orange square is the only thing that is both a square and not red and not blue, so you should have put a cross on this orange square.

Now turn to page 41 and do the puzzle.

Turn to page 42
Turn to page 43
Turn to page 44
Turn to page 45
Turn to page 46
Turn to page 47
Turn to page 48
Turn to page 49
Turn to page 50
Turn to page 51
Turn to page 52
Turn to page 53
Turn to page 54
Turn to page 55

STOP. Put down your pencils and close your books.

Key for Logical Thinking Test

	Item	Correct Response
Matrices	1	B
	2	E
	3	C
	4	C
	5	D
	6	E
	* 7	E
	8	A
	9	B
	10	C
	11	B
	12	E
	13	B
	14	E
	15	C
	16	B
	17	C
	18	D
	19	D
	*20	B
Row and Column	21	A
	*22	D
	*23	C
	24	E
	*25	A
	26	D
	27	C
	28	B
Row and Column	29	C
	30	E
	31	D
	32	A
	33	C
	34	A
	35	B
	*36	C
	37	C
	38	E
	*39	B
	*40	B
Loops	41	C
	42	E
	43	B
	44	B
	45	B
	*46	E
	47	B
	48	B
	49	E
	50	B
	51	A
	52	D
	53	E
	54	C
	55	C

*These items were deleted from the scoring and data analysis as described in the section entitled Preparation of Measures of Cognitive Variables.

Appendix V

General Directions

The Purdue Elementary Problem-Solving Inventory is designed for use with culturally disadvantaged elementary school pupils of various ethnic backgrounds in grades two through six. The Inventory can be administered individually or to large groups of children. Materials for the Inventory include a set of drawings or pictures, made into slides, a tape recording of directions and text describing each item of the Inventory, and an answer booklet in which children mark all of their responses.

The answer booklet presents all of the alternative choices for each item. In its present form the Inventory consists of 49 items. Two examples are included. Six of the items are two-choice "Yes" or "No" response items. Three are three-choice, "Yes", "No", or "I don't know" response items. The remainder are three-choice, "A", "B", or "C" response items. Some of the alternatives are pictured, others have verbal selections. However, the response format is the same throughout the Inventory. Children need only mark an "X" over the box containing the correct alternative. The tape recording, in addition to describing each slide and introducing the item stems for each problem, also "reads" each of the printed alternatives. Therefore, little reading is required from the children.

Several pieces of audio-visual equipment are necessary for adequate test administration: a tape recorder with sufficient fidelity and clarity for all children in the room to hear, a slide projector, preferably with an extension slide changer to permit the teacher to move about the room during administration, and a screen large enough so that all children are able to see the slides clearly when presented. The teacher should be familiar with the workings of each of these pieces of equipment so that he may handle any breakdowns or interruptions during the testing session.

For testing, the classroom should be slightly darkened to permit good vision of the slides yet not so dark as to give children trouble when marking the test booklets. Ordinarily, pulling the drapes or shades near the the front of the room will be adequate. Desks should be spaced apart to discourage cheating and allow the teacher easy access to each child in case questions should come up during the test.

As the children seat themselves prior to the beginning of the test, the teacher should be sure each child has a sharpened pencil with an eraser. He should make sure children with difficulties in vision seat themselves where they can see the screen clearly.

By way of introduction to the test, the teacher should explain to the children that the test is not on a specific school subject such as arithmetic, or spelling. Rather, the Inventory is a measure of children's ability to solve commonsense problems which might be encountered in real-life.

The teacher should inform the children that they will be shown some pictures on the screen and that they should watch the pictures closely. Things will be happening in the pictures and they will be asked some questions about them. The children are to mark their answers in an answer booklet. If they have any problems, they are to raise their hand and the teacher will come around to their desks to help them.

The teacher may then pass out the booklets and ask the children to write or print their name and grade on the lines provided on the first page. The teacher may tell the children not to open their booklets yet (although no harm will be done if the children do leaf through it). Any other information which the teacher or particular school might wish may also be written on the front page of the booklet.

Finally, when all children have finished writing, the teacher may start the projector and tape recorder. It may be a good idea to remind the children to raise their hands if they have a problem or question during the test and caution them against shouting out answers to questions.

Once begun, the tape recording may run continuously. Considerable time is provided on the tape for children to mark their answers. Two tape recordings are available: one for use with second and third graders and one for the fourth, fifth, and sixth graders. More marking time is provided on the second and third-grade tape. The total time for test administration is approximately 40-45 minutes, provided no breaks are taken. Another of the teacher's duties during the test is to note the progress of the children and if they seem to be falling behind to stop the tape and permit them time to catch up.

The teacher, or test administrator, must also operate the slide projector during the test, and change the slides at the appropriate times. The recorded text indicates such times by: "Here is a new picture," or "In this next picture...." Before administering the Inventory for the first time, the teacher should listen to the tape and view the slides, following in the answer booklet to familiarize himself with the order of the slides and the times when they change in the text.

As mentioned before, the teacher must also be able to answer children's questions as they arise during the test. For this reason, it is probably best to have two people administer the test, one to operate the equipment, and another, free to go about the room helping children.

The recorded text provides a place to stop and rest. A tone sounds as a signal to stop the equipment. The rest period is strictly the prerogative of the teacher. The tape may be run continuously if the teacher does not think the children need a break or the tape may be stopped at any natural break sooner or later, depending on the particular classroom situation.

When the final slide has been viewed, the operator may rewind the tape and return the slide tray to the beginning. The books may be collected and the testing session concluded.

For scoring purposes, the Inventory may be divided into twelve different subtasks, or abilities, and eight subscores. Each may be useful for diagnostic purposes. If the tests are to be machine scored, it may be quite possible in the fourth, fifth, and sixth grades to have the children mark their answers on test response cards directly, rather than marking in the booklets.

Table 12 presents a brief description of each subtask and the number of items in the Inventory which attempt to measure that task. Table 13 presents the subtasks and number of items used to make up the eight subtests. Finally, Table 14 presents the correct alternative for each item in the Inventory and the subtask and subtest to which each item belongs.

TABLE 12

Number of Items for Each Subtask

	Subtask	No. of Items
1	Sensing that a problem exists	5 (and one sample)
2	Identifying a problem specifically	5
3	Asking questions about the problem	5 (and one sample)
4	Guessing causes	2
5	Clarifying the goal	2
6	Judging if more information is needed to solve the problem	3
7	Identifying relevant aspects of the problem situation	3
8	Redefining new uses of familiar objects	4
9	Seeing implications of some action	5
10	Sensing what should follow problem solution	4
11	Selecting the one possible solution among several alternatives	3
12	Selecting the best or most unusual solution among several possible solutions	6
		47

TABLE 13

Number of Items in Each Subtest

	Subtest (subtasks)	No. of Items
A	Sensing and Identifying (1 and 2)	10
B	Clarification I (3 and 5)	7
C	Clarification II (3, 4, 5, 6, and 7)	15
D	Problem parts (8 and 9)	9
E	Presolution (1, 2, 3, 4, 5, 6, 7)	25
F	Solving Problems I (10, 11, 12)	15
G	Solving Problems II (9, 10, 11, 12)	18
H	Solving Problems III (8, 9, 10, 11, 12)	22

TABLE 14

Key for each item and subtask and subtest to which each item belongs

Item		Correct Alternative	Subtask	Subtest
1	Example	YES	1	A, E
2		YES	1	A, E
3		YES	1	A, E
4		YES	1	A, E
5		YES	1	A, E
6		NO	1	A, E
7		A	2	A, E
8		C	2	A, E
9		A	2	A, E
10		B	2	A, E
11		C	2	A, E
12	Example	C	3	B, C, E
13		B	3	B, C, E
14		A	3	B, C, E
15		B	3	B, C, E
16		B	3	B, C, E
17		C	3	B, C, E
18		A	4	C, E
19		C	4	C, E
20		B	5	B, C, E

21	C	5	B, C, E
22	NO	6	C, E
23	NO	6	C, E
24	NO	6	C, E
25	C	7	C, E
26	A	7	C, E
27	C	7	C, E
28	C	8	D, H
29	B	8	D, H
30	A	8	D, H
31	B	8	D, H
32	C	12	F, G, H
33	B	12	F, G, H
34	C	12	F, G, H
35	A	9	G, H
36	C	12	F, G, H
37	B	12	F, G, H
38	C	12	F, G, H
39	B	11	F, G, H
40	A	11	F, G, H
41	C	11	F, G, H
42	C	9	G, H
43	A	9	G, H
44	B	9	G, H
45	C	9	G, H
46	A	10	F
47	C	10	F
48	A	10	F
49	B	10	F

Script for Problem Solving Test

(Times indicated in parentheses; first number for 4th and 6th grades, second number for second grade.)

Hello, boys and girls. We are going to do something today we think you will find interesting.

We are going to show you some pictures like this one on the screen. (Show slide 1) (PAUSE 5, 5 sec.)

Here's another picture. (Show slide 2) (PAUSE 5, 5 sec.)

When we show you pictures like these on the screen, we want you to watch them closely.

We are going to ask you some questions about the pictures.

When we ask you the questions, we want you to mark your answers in an answer booklet like the one on the screen (Show slide 3) (PAUSE 5, 5 sec.)

We will now give you an answer booklet. When you get your booklet, do not open it.

Print your full name on the first line (PAUSE 2, 2 sec.) and your grade on the second line, like the boy in the next picture. (Show slide 4) (PAUSE 3, 3 sec.) If you have any trouble, raise your hand and we will help you. (SOUND FOR BREAK) (STOP TAPE RECORDER UNTIL ALL CHILDREN HAVE A BOOKLET AND HAVE FINISHED WRITING THEIR NAME AND GRADE.) (PAUSE 6, 6 sec.)

Open your booklets to page 1. (PAUSE 7, 7 sec.) Look for the top row of boxes, next to the number 1. There are two boxes next to the number 1. A YES box, and a NO box. (PAUSE 4, 4 sec.)

Now, here is the next picture. (Show slide 5) (PAUSE 3, 3 sec.) If you think the little girl in this picture has a problem, mark a big X in the YES box next to number 1.

If you think the girl does not have a problem, mark a big X in the NO box next to the number 1.

Remember, mark YES if the girl has a problem; and mark NO if she does not have a problem.

Make your X fill the whole box. Make sure the lines are dark enough to see. (PAUSE 10, 14 sec.) This time, I'm going to tell you the correct answer. The answer is YES, there is a problem. It looks like the girl's mother doesn't want the cat in the house. Here is what your answer booklet should look like. (Show slide 6) (PAUSE 3, 5 sec.) There is an X in the YES box. It fills the whole box. Make your X's like that, too. (PAUSE 3, 5 sec.) Okay Now I want you to try some on your own. I will not tell you the answers each time. Look at the pictures on the screen and mark YES if you think there is a problem in the picture and NO if you don't think there is a problem.

Here is picture number 2. (Show slide 7) Mark YES if there is a problem, NO if there isn't. Put an X in the box you choose. (PAUSE 11, 14 sec.)

Picture number 3. (Show slide 8) Is there a problem in this picture? (PAUSE 11, 14 sec.) Number 4. Is there a problem here? (Show slide 9) (PAUSE 11, 14 sec.)

Number 5. Is there a problem here? (Show slide 10) (PAUSE 11, 14 sec.)

Number 6. Is there a problem in this picture? (Show slide 11) (PAUSE 11, 14 sec.)

Now turn to page 2 in your books. (PAUSE 6, 6 sec.)

I'm going to show you some more pictures, but this time you have to decide exactly what the problem is. For example, look at this next picture. (Show slide 12) Study it closely. What do you think the problem is? (PAUSE 4, 4 sec.) In your answer books next to number 1 there are three boxes.

Listen carefully while I read the three choices.

Then put a big X in the box that tells what you think the problem is.

Box A says - The baseball might hit the man.

Box B says - The baseball might break a window.

Box C says - The little boy might catch the ball.

Mark an X in the box you choose. (PAUSE 10, 14 sec.)

Here is picture number 2. (Show slide 13) What is the problem here?

Listen carefully while I read the three choices. Then put an X in the box that tells what the problem is.

A. The boy's dog is lost.

B. The boy broke the dog's rope.

C. The boy thinks his dog has run away.

Mark an X in the box you choose. (PAUSE 10, 13 sec.)

Number 3. (Show slide 14) What is the problem here?

A. The boy sees something that surprises him.

B. The boy is afraid it will rain.

C. The boy is afraid his tent will fall down.

(PAUSE 10, 13 sec.)

Number 4. (Show slide 15) What is the problem here?

A. The boy is crying because his boat is too small.

B. He is crying because his boat has floated too far away.

C. He is crying because he has to go home now.

(PAUSE 9, 13 sec.)

Now turn to page 3. (PAUSE 6, 6 sec.)

Number 5. (Show slide 16) What is the problem here?

A. The girl wants to know how to play the game.

B. The girl wants to know if she has won.

C. The girl wonders where her other playing piece is.

(PAUSE 9, 13 sec.)

Now, we are going to do something different.

Look at this next picture. (Show slide 17)

It is hard to figure out what is going on. If we could ask some questions maybe we could find out what is happening. Which of the following questions would be best for us to ask, so we can figure out what the problem is.

Let's do number 1 as an example. (PAUSE 3, 3 sec.)

Listen carefully.

There are 3 boxes next to number 1. Each box contains a question we might ask. Look closely at the picture while I read the three questions. Then put an X in the box that is the best question to ask.

A. Why is the door so big?

B. Why is it snowing?

C. Why is the small boy trying so hard to open the door?

Mark your answer. (PAUSE 10, 13 sec.)

C is the correct answer. (PAUSE 3, 3 sec.)

C is the best question because if we could get the answer, we might be able to figure out what is going on in the picture. (PAUSE 3, 5 sec.)

Now, you try some on your own. This is number 2. Here are three more questions about the same picture. Which one would be best for you to ask?

A. What can you see from the window?

B. Is the woman scolding the boys?

C. Why is there a picture on the wall? (PAUSE 9, 12 sec.)

Number 3. Here are 3 more questions. Which one would be best to ask?

A. Were the 3 boys mean to the small boy?

B. Are the books interesting?

C. Can they get a drink?

(PAUSE 10, 13 sec.)

Now turn to page 4. (PAUSE 5, 5 sec.)

Find number 1. (PAUSE 3, 3 sec.) Here is a new picture. (Show slide 18) Study the picture closely. Many things are going on. Which one of the following questions should you ask if you want to figure out what is going on?

A. Why is the tree so small?

B. Why are the kids pulling on the tree?

C. Why is the girl wearing a striped dress?

(PAUSE 10, 13 sec.)

Now try number 2. Which one of these 3 questions should you ask?

A. Why is the house so large?

B. Why is the girl running toward the boys?

C. Is the small boy her brother?

(PAUSE 10, 13 sec.)

Number 3. Which one of these 3 questions should you ask if you want to figure out what is going on?

A. Why are the boys near the sidewalk?

B. Did the girl come out of the house?

C. Why is the dog barking at the boys? (PAUSE 10, 13 sec.)

Now turn to page 5. (PAUSE 5, 5 sec.) Find number 1. (PAUSE 3, 3 sec.) Here is a new picture. (Show slide 19) In this new picture we will ask you to try to figure out the causes of the trouble. Two cars just had a smashup.

Look closely at the picture while I read three possible causes of the accident. Then put an X in the box that tells the most likely cause of the accident.

A. The black car slid on ice.

B. The white car was going too fast.

C. The sun was too bright.

(PAUSE 10, 13 sec.)

Number 2. Which one of these three is the best guess of the cause of the accident?

A. The sun blinded the driver of the black car.

B. The stop sign was too small to see.

C. The black car was driving too fast to stop.

(PAUSE 10, 13 sec.)

Here is a new picture. (Show slide 20) This is number 3. Study the picture closely. Imagine yourself at the corner of Main and Oak Streets. Youwant to get to the A & P Store. What do you need to know to get there? I will read three questions. Pick the question which would be best for your to ask to find out how to get to the A & P.

A. Should I take Oak or Main Street?

B. What is the address of the A & P Store?

C. How far is it to the A & P Store?

(PAUSE 10, 13 sec.)

Now number 4. Here is another picture. (Show slide 21) These kids are on a committee. The committee must give a report about the Indian Geronimo. Which one of the following questions should they ask the teacher to be sure they know what to do?

A. Will we still get recess after the report?

B. Did Geronimo kill General Custer?

C. How long should the report be?

(PAUSE 9, 13 sec.)

Now turn to page 6 and find number 1. (PAUSE 5, 5 sec.)

Here is a new picture. (Show slide 22) These kids have to plan a party for Halloween. Their problem is that they must have quite a bit of money, they need the teacher's permission, and the party must be held on a day when there are no other big events. They find out that they have the money, and October 29 is a good day. Do they have enough information to go ahead planning the party? By number 1 mark YES if you think they have enough information; mark NO if you think they do not have enough information; or mark DON'T KNOW if you don't know or aren't sure if they have enough information. Go ahead and mark the box you choose. (PAUSE 10, 12 sec.)

Number 2. Here is the next picture. (Show slide 23) This boy wants to build a model airplane. He knows that he needs a razor blade, glue, blue and yellow paint, and a ruler. He gets a razor blade from his father, a ruler from his desk, and glue from the basement. Does he have everything he needs? Mark YES, NO. or DON'T KNOW. (PAUSE 8, 12 sec.)

Number 3. Here is the next picture. (Show slide 24) These kids were out playing. There was a house nearby. They found some empty purses, an empty jewelry box, and 3 spoons. Do they have enough information to s' that someone robbed the house? Mark YES, NO, or DON'T KNOW in your booklet by 3. (PAUSE 8, 12 sec.)

Now turn to page 7. (PAUSE 5, 5 sec.)

Find number 1. (PAUSE 3, 3 sec.) Here is the next picture. (Show slide 25)
This boy wants to put the books on the shelf. What should he be sure to notice or think about? Pick the most important thing from these three.

A. How many books are on the shelves?

B. Who put the bookcase where it is?

C. Where will he set the books when he gets to the shelf? (PAUSE 9, 11 sec.)

Number 2. Here are 3 more things the boy could do.
Which one is the best thing for him to do first?

A. Ask the boy who is sitting in the corner to help.

B. Put the books in the box.

C. Place the books on top of the bookshelf. (PAUSE 9, 11 sec.)

Number 3. Here are three more things the boy could do.
Which one is the best thing for him to do first?

A. Set the books on the table.

B. Push the table over by the shelf.

C. Kick the box out of the way. (PAUSE 9, 11 sec.) (SOUND, STOP FOR BREAK)

Now turn to page 8. Find number 1. (PAUSE 5, 5 sec.)
Here is a new picture. (Show slide 26)
This boy went down to the basement to play. He decided to make a play town out of some things he found there. He wanted to pretend that the town was real and that a flying saucer had landed in it. He imagined that the police ran out of the polic station to see what had landed. What thing could he use for a jail cell?

A. A room in the doll house.

B. An old padlock.

C. The bird cage. (PAUSE 8, 10 sec.)

Number 2. Before the police could get to the saucer, the boy imagined it took off flying up in the sky towards the sun. What could he use for the sun?

A. The window.

B. The lamp.

C. An old record. (PAUSE 8, 10 sec.)

Number 3. Here is a new picture. (Show slide 27) This girl is making a doll out of old clothes and things she found. She has made the body of the doll, but needs some eyes and a hair style. Where could she get the eyes?

A. From the shirt.

B. From the tie.

C. From the shoes. (PAUSE 8, 9 sec.)

Number 4. She is using an old wig for the doll's hair, but wants to tie it back in a pigtail. What thing could she use, or use part of, to tie the hair back?

A. The shirt.

B. The shoes.

C. The pants. (PAUSE 7, 8 sec.)

Now, turn to page 9 and find number 1. (PAUSE 5, 5 sec.)

Now, we are going to show you several pictures in a row. In the first picture there will be a problem. Then we will show you three more pictures. We want you to choose the picture that shows the most unusual way to solve the problem. By unusual we mean a way that most people would not think of to solve the problem. (Show slide 28)

In this picture a ball is caught on the roof. The children want to get it down. What is the most unusual way for them to get the ball down - a way most people would not think of?

A? (Show slide 29) (PAUSE 5, 5 sec.)

B? (Show slide 30) (PAUSE 5, 5 sec.)

C? (Show slide 31)

Mark an X on the picture you choose in your answer book. (PAUSE 7, 10 sec.)

Number 2. (Show slide 32) In this picture, the girl has hung some laundry out to dry, but she has used up all the space on the line and still has some clothing left over. What is the most unusual way for her to dry the left-over laundry?

A? (Show slide 33) (PAUSE 5, 5 sec.)

B? (Show slide 34) (PAUSE 5, 5 sec.)

C? (Show slide 35) (PAUSE 7, 10 sec.)

Number 3. (Show slide 36) In this picture, the children's swing has broken. They have no place to swing. What is the most unusual way for them to fix it so they can swing?

A? (Show slide 37) (PAUSE 5, 5 sec.)

B? (Show slide 38) (PAUSE 5, 5 sec.)

C? (Show slide 39) (PAUSE 7, 10 sec.)

Now, Number 4. (Show slide 40) This girl wants to hang a picture in her room. She puts a hook on the picture so that it can hang on the wall, but she has the hook very close to the edge of the frame. What will happen when the girl hangs the picture on the wall? Look at the next 3 pictures and choose the one that shows what will happen when the girl hangs the picture on the wall.

A? (Show slide 41) (5, 5 sec.)

B? (Show slide 42) (5, 5 sec.)

C? (Show slide 43) (7, 10 sec.)

Now turn to page 10 and find number 1. (PAUSE 5, 5 sec.) (Show slide 44) In this next picture, a group of boys want to play football. How should they choose sides? Look at the boxes by Number 1.

A. All the big boys go on one team.

B. All the boys with glasses go on one team.

C. They should choose sides evenly.

Mark an X in the box you choose. (PAUSE 6, 8 sec.)

Number 2. (Show slide 45) This girl's room is very crowded. If you wanted some more room to store things, where would you put them?

A. Out in the hallway.

B. In boxes under the bed.

C. In somebody else's room (PAUSE 6, 8 sec.)

Number 3. (Show slide 46) These boys have to move the dresser upstairs. How would you do it?

A. Empty out the drawers.

B. Carry it up just like it is.

C. Carry the drawers up first. (PAUSE 6, 8 sec.)

Now turn to page 11. Here is the next picture. (Show slide 47) (PAUSE 5, 5 sec.) This girl's school desk is wobbling. What could she do to make it steadier?

Look at the boxes by Number 1.

A. Get a higher chair.

B. Place a piece of folded paper under one leg.

C. Press down harder with her pencil. (PAUSE 6, 8 sec.)

Number 2. (Show slide 48) In this picture a window pane is broken. What could the boy do to stop the cold air from coming in the broken window?

A. Put a piece of cardboard over the window pane.

B. Put the chair in front of the window.

C. Build a fire in the fireplace. (PAUSE 6, 8 sec.)

Number 3. (Show slide 49) This boy and girl can't get their kite to fly. What could they do to get it to fly?

A. Cut the string.

B. Make the kite heavier.

C. Put a tail on the kite. (PAUSE 6, 8 sec.)

Turn to page 12 and look at this next picture. (Show slide 50) (PAUSE 5, 5 sec.) This boy is going to change the light bulb. If he standson the rocking chair, what might happen? Look at the boxes by Number 1.

A. The light might not work.

B. He might hit his head on the ceiling.

C. He might fall off the chair and get hurt. (PAUSE 6, 8 sec.)

Number 2. (Show slide 51) The girl in this picture is going to mix some of the red and white paint together. What will happen?

A. She will get a pink color.

B. She will spill all of it.

C. The paint will dry up. (PAUSE 6, 8 sec.)

Number 3. (Show slide 52) Look at the shelves in this picture. What might happen if you were to pile some boxes on the second shelf?

A. The cabinet might fall over.

B. The shelf might break under the load.

C. The boxes might not fit. (PAUSE 6, 8 sec.)

Number 4. (Show slide 53) Here two girls are arguing over who is going to play with the doll. What might happen if they keep pulling on the doll?

A. They will take turns playing with it.

B. One of the girls will win.

C. The doll may rip. (PAUSE 6, 8 sec.)

Turn to page 13 and look at this next picture. (Show slide 54) (PAUSE 5, 5 sec.) This girl is finishing a test in school. Before handing it in to the teacher, what should she do? Look at the boxes by Number 1.

A. Check her work.

B. Write a letter to a friend.

C. Copy her answers on another piece of paper. (PAUSE 6, 8 sec.)

Number 2. (Show slide 55) This boy is going to go swimming. He wants to blow up an inner tube to take with him. What should he do before blowing up the tube?

A. Empty the tub of water.

B. Go and get a towel.

C. Make sure the tube doesn't have a hole in it. (PAUSE 6, 8 sec.)

Number 3. (Show slide 56) There has been a heavy snow storm. The boy is going outside to play. What should he do before going down the stairs?

A. Watch out for ice on the stairs.

B. Slide down the rail.

C. Make a snowman on the steps. (PAUSE 6, 8 sec.)

Number 4. (Show slide 57) These two children have paid for some cokes and a toy in the store. What should the children do before going home?

A. Stop and drink some of the coke.

B. Check to see if they got the right change.

C. Play with the toy on the way home. (PAUSE 6, 8 sec.) (Sound for stop)

Appendix VI

To administer the Internal-External Scale to second grade children distribute test booklets and pencils and play the tape marked for use with second grade subjects. By following the grade 2 transcript you will know when to stop and start the tape as the test administration proceeds.

To administer the Internal-External Scale to fourth or sixth grade children we suggest using mark-sense cards as described on the audio tape for fourth and sixth grade administration. To do this each child should be provided with a test booklet, a mark-sense card and an appropriate pencil for use with the card. Turn on the tape for grades four and six and stop and start it as cued by the transcript in this Appendix. If you desire to have fourth and sixth graders mark an answer sheet or the test booklets you may do so but the tape will have to be remade to conform to the alternate format.

To administer the What I Like Best (Cognitive Preference Test) distribute test forms and read the directions with the students. You may have them circle answers on the test form, provide a separate answer sheet or use mark-sense cards. We favor mark-sense cards if they are available because of the great saving in clerical labor and because of the greatly increased scoring reliability effected by avoiding all hand scoring steps.

Script for Response Style Test

GRADE 2

Hello, boys and girls.

Today we want to show you some pictures about children at school. We want to find out how boys and girls your age feel about certain things. So we're going to ask you some questions about some children your age. This is not a test. There are no right or wrong answers. We just want to know how you feel about the questions.

Now, you should have two things in front of you: a booklet and a pencil. Look at your booklet. On the front of your booklet you can see a space to print your name and your grade. Go ahead and print your name and your grade in the space on the front of your booklet.

STOP TAPE

OK--have you all written your name and grade on your booklet? Good! We're ready to begin.

Remember, this isn't a test because there aren't any right or wrong answers. We just want to know how you feel about the questions.

OK--now look at this picture. The teacher is smiling while the child is reading in front of the class. Imagine you are the child in the picture. Why do you think the teacher would be smiling at you? Would she be smiling because:

You are trying hard to do your best? or because
The teacher likes the story you are reading?

1. Turn to the first page of your booklet. We want you to put a big X through the picture on the first page of your booklet that you think tells best why the teacher would be smiling. If you think the teacher would be smiling because you are trying hard, put an X through the picture on the left. This one. If you think the teacher would be smiling because she likes the story, put an X through the picture on the right. This one. Remember, you are going to put a big X through the picture that you think best shows why the teacher would be smiling--either this one--or that one. Did you make your X?

All right boys and girls--remember, every time the picture changes on the screen in front of the room, you turn the page in your booklet to the picture that matches.

Do you have any questions?

STOP TAPE.

2. Now let's look at the second picture. Don't draw an X through any picture until I tell you what they mean. This child and his father are talking and the father is happy. Imagine you and your father are the people in the picutre. Why would your father be happy. Would your father be happy because:

He knows you did your best in school, or because
Your father had an easy day at work and just feels good?

All right, draw a big X through the picture that you think gives the best reason for why your father would be happy. Would it be because your father knows you do your best in school, or because your father had an easy day at work?

Draw a big X either here--or here.

3. Here's the next picture. This child is taking a test. He is not doing well. If you made a bad grade on a test, would it probably be because:

No one helped you study for the test? or because
You never did your schoolwork?

Draw an X through the picture you think shows the best reason why you would not be doing well on the test. Is it because no one helped you study for the test, or because you never did your schoolwork?

Remember to make your X's nice and big.

4. This child got good grades on her report card. If you got good grades on your report card, would it probably be because:

You always listen to the teacher? or because
The teacher just gives good grades to everyone?

Put a big X through the picture that you think shows the best reason--this one or that one. (From here on, this same statement is repeated after each item).

5. This child is working on his schoolwork, and usually always finishes his schoolwork. When you finish your schoolwork, is it usually because:

Your father helps you with your schoolwork? or because
You always work very hard on your schoolwork?

6. This child is happy because all the other children like to play with him at recess. Do the other children like to play with him because:

They are all just being friendly? or because
He never starts fights?

7. Here is a child who is not happy. He is not happy because he could not read this book. When you have trouble reading a book, is it usually because:

You hate to read and don't want to read the book? or because
The book is so hard?

8. Why do you think this teacher is not happy. If this were your teacher, would she be unhappy because:

She feels bad because she lost her purse today? or because
You children had been bad all day?

9. The teacher has just asked a question to the class, and only one of the children knows the answer. If you were the only child who knew the answer to the teacher's question, would it probably be because:

You were listening when the teacher explained the answer the day before? or because
You were just lucky to have the teacher ask a question that you knew?

10. This child is sad because none of the other children in the class want to sit next to her. If nobody wanted to sit next to you, would it probably be because:

All the other children are smarter than you? or because
You are not very friendly?

DON'T REPEAT ANYMORE

11. This child had a bad day at school today. When you have a bad day at school is it usually because:

You did not do your homework the day before? or because
The work is extra hard that day?

12. Why do you think this teacher is happy? If this were your teacher, would she probably be happy because:

You children learned a lot today? or because
It's such a nice day today and the sun is shining?

13. Sam and Dave have just finished playing a game of basketball. Sam has just won and usually always wins at basketball. When you win a game like this, is it usually because:

The others on your team are good players? or because
You try very hard to win?

14. This mother and father are very angry. If this were your mother and father would they probably be angry because:

You got bad grades at school? or because
Your mother and father just had a fight?

15. This child is taking a test. She is doing well. When you make a good grade on a test, is it usually because:

The test is easy? or because
You paid attention in class?

16. This child is sad because none of the other children in the class want to sit next to him. Why do you think none of the children want to sit next to him? Is it because:

He never does his schoolwork? or because
He never has any money and is not good looking?

17. The teacher has just asked a question to the class, and all the children know the answer. When you children all know the answer is it because:

You all listened carefully to the teacher? or because
The question was very easy?

18. Why do you think this teacher is frowning? If this were your teacher, would she be frowning because:

She hates to give you bad grades? or because
She knows you did not study for your test?

19. This child is not learning much in class today. Whenever you don't learn much in school, is it because:

You did not listen when the teacher is talking? or because
Your teacher is a bad teacher?

20. This teacher is frowning while the child is reading in front of the class. If this child were you, why do you think the teacher would be frowning at you? Would she be frowning at you because:

She did not like the story you were reading? or because
You were not trying to do your best?

21. This child and his father are talking and the father is angry. If this were you and your father, why do you think your father would be angry? Would he be angry because:

He had a hard day at work today and doesn't feel good? or because
He knows you do not do the best you can in school?

22. This child is taking a test. He is doing well. When you make a good grade on a test, is it usually because:

You almost always do your schoolwork? or because
Your father helped you study for the test?

23. This child got bad grades on her report card. When you get bad grades on your report card, is it probably because:

The teacher just gives bad grades to everyone? or because
You don't listen to the teacher?

24. This child is supposed to be working on his schoolwork, but hardly ever finishes his schoolwork. When you have trouble finishing your schoolwork, is it usually because:

You just give up too easily? or because
Your parents will not help you with your schoolwork?

25. This child is sad because none of the other children like to play with him at recess. Do the other children not like to play with him because:

He always starts fights? or because
The other children are not friendly to him?

26. This child is happy because he just read this book by himself. When you are able to read a book all by yourself is it because:

The book was easy? or because
You like to read and want to read the book?

27. Why do you think this teacher is happy. If this were your teacher would she probably be happy because:

You children have been good all day? or because
It's Friday and she got paid today?

28. The teacher has just asked a question to the class, and all of the children, except one, know the answer. Why do you think the one child doesn't know the answer? When you are the only one who does not know the answer to a question is it usually because:

- You were unlucky to have the teacher ask a question that you did not know? or because
  You were not paying attention when the teacher asked the question?

ARE YOU KEEPING UP WITH MS BOYS AND GIRLS?

29. This child is happy because all the other children in the class want to sit next to her. Why do all the children want to sit next to her? If other children wanted to sit next to you would it be because:

You are very friendly? or because
You are smarter than all the other children?

This child had a good day at school today. When you have a good day school, is it usually because:

All the work was extra easy that day? or because
You did all your homework the night before?

31. Why do you think this teacher is not happy? If this were your teacher would she probably not be happy because:

- It is a cold and rainy day and that makes her sad? or because
  You children did not learn much today?

32. Bob and Larry have just finished playing this game of basketball. Larry has just lost and usually always loses at basketball. When you lose at a game like this, is it usually because:

You do not try hard enough to win? or because
The others on your team are bad players?

33. Why do you think this mother and father look happy. If this were your mother and father, would they probably be happy because:

They love each other? or because
You got good grades?

34. This child is taking a test. She is not doing very well. When you get a bad grade on a test, is it usually because :

You did not pay attention in class? or because
The test is hard?

35. This child is happy because all the other children in the class want to sit next to him. Why do all the children want to sit next to him? Is it because:

He always has a lot of money and is good looking? or because
He does good work in school?

36. The teacher has just asked a question to the class, but none of the children know the answer. When none of you know the answer, is it usually because:

The question that the teacher asked was very hard? or because
None of you were listening to the teacher?

OK BOYS AND GIRLS--WE'RE ALMOST FINISHED WITH PART I. HERE ARE THE LAST 2 QUESTIONS --

37. Why is this teacher smiling? If this were your teacher, would she be smiling because:

You children had studied hard for your test? or because
The teacher just likes to give good grades?

38. This child is learning a lot in class today. When you learn a lot in class, is it usually because:

Your teacher is a very good teacher? or because
You listen when the teacher is talking?

Script for Response Style Tests

GRADES 4 AND 6

Hello boys and girls.

You should have two things in front of you: an answer card and a special pencil. Look at your answer card. At the top of your answer card you'll find a space to write your name. Go ahead and write your name in the space on your answer card.

STOP TAPE

OK--have you all written your name on your answer card? Good! We're ready to begin.

Today we want to show you some pictures about children at school. We want to find out how boys and girls your age feel about certain things. So we're going to ask you some questions about some children your age. This is not at test. There are no right or wrong answers. We just want to know how you feel about the questions.

OK--now look at this picture. The teacher is smiling while the child is reading in front of the class. Imagine you are the child in the picture. Why do you think the teacher would be smiling at you? Would she be smiling because:

You are trying hard to do your best? or because
The teacher likes the story you are reading?

Look at your answer card and look for the number one underneath your name. When you find the number one on your answer card, put your finger there. Have you all found it?

STOP TAPE

Good! Now, do you see two columns next to the number one--column A and column B?

If you think the best answer to the questions is the picture on the left, then you'll fill in column A on your answer card. Or, if you think the picture on the right is the better answer, then you'll fill in column B on your answer card. Let me go over that again--column A is the picture on the left; column B is the picture on the right.

OK--let's do this first picture together. Why do you think the teacher in the picture would be smiling at you?

Because you are trying to do your best? Then fill in column A.

Or, if you think the teacher is smiling because she likes the story, fill in column B.

Column A is the picture on the left; column B is the picture on the right. All right--go ahead and mark your answer for #1.

2. Now let's look at the second picture. This will be #2 on your answer card, but don't mark your answer card until I tell you what the pictures mean. This child and his father are talking and the father is happy. Imagine that you and your father are the people in the picture. Why would your father be happy. Would he be happy because:

A. He knows you did your best in school, or because
B. Your father had an easy day at work and just feels good?

Go ahead and mark your answer card--column A if you think your father would be happy because he knows you did your best in school, or column B if you think he's be happy because he had an easy day at work.

3. Here's the third one. This child is taking a test. He is not doing well. If you made a bad grade on a test, would it probably be because:

A. No one helped you study for the test? or because
B. You never did your schoolwork?

Fill in column A if the reason is no one helped you study for the test, or column B if you never did your schoolwork.

4. This child got good grades on her report card. If you got good grades on your report card, would it probably be because:

A. You always listen to the teacher? or because
B. The teacher just gives good grades to everyone?

5. This child is working on his schoolwork, and usually alwasy finishes his schoolwork. When you finish your schoolwork, is it usually because:

A. Your father helps you with your schoolwork? or because
B. You always work very hard on your schoolwork?

6. This child is happy because all the other children like to play with him at recess. Do the other children like to play with him because:

A. They are just being friendly? or because
B. He never starts fights?

7. Here is a child who is not happy. He is not happy because he could not read this book. When you have trouble reading a book, is it usually because:

A. You hate to read and don't want to read the book? or because
B. The book is so hard?

8. Why do you think this teacher is not happy. If this were your teacher, would she be unhappy because:

A. She feels bad because she lost her purse today? or because
B. You children had been bad all day?

9. The teacher has just asked a question to the class, and only one of the children knows the answer. If you were the only child who knew the answer to the teacher's question, would it probably be because:

A. You were listening when the teacher explained the answer the day before? or because
B. You were just lucky to have the teacher ask a question that you knew?

10. This child is sad because none of the other children in the class want to sit next to her. If nobody wanted to sit next to you, would it probably be because:

A. All the other children are smarter than you? or because
B. You are not very friendly?

DON'T REPEAT ANYMORE

11. This child had a bad day at school today. When you have a bad day at school is it usually because:

A. You did not do your homework the day before? or because
B. The work is extra hard that day?

12. Why do you think this teacher is happy? If this were your teacher, would she probably be happy because:

A. You children learned a lot today? or because
B. It's such a nice day today and the sun is shining?

13. Sam and Dave have just finished playing a game of basketball. Sam has just won and usually always wins at basketball. When you win a game like this, is it usually because:

A. The others on your team are good players? or because
B. You try very hard to win?

14. This mother and father are very angry. If this were your mother and father would they probably be angry because:

A. You got bad grades at school? or because
B. Your mother and father just had a fight?

15. This child is taking a test. She is doing well. When you make a good grade on a test, is it usually because:

A. The test is easy? or because
B. You paid attention in class?

16. This child is sad because none of the other children in the class want to sit next to him. Why do you think none of the children want to sit next to him? Is it because:

A. He never does his schoolwork? or because
B. He never has any money and is not good looking?

17. The teacher has just asked a question to the class, and all the children know the answer. When you children all know the answer is it because:

A. You all listened carefully to the teacher? or because
B. The question was very easy?

18. Why do you think this teacher is frowning? If this were your teacher, would she be frowning because:

A. She hates to give you bad grades? or because
B. She knows you did not study for your test?

19. This child is not learning much in class today. Whenever you don't learn much in school, is it because:

A. You did not listen when the teacher is talking? or because
B. Your teacher is a bad teacher?

20. This teacher is frowning while the child is reading in front of the class. If this child were you, why do you think the teacher would be frowning at you? Would she be frowning at you because:

A. She did not like the story you were reading? or because
B. You were not trying to do your best?

21. This child and his father are talking and the father is angry. If this were you and your father, why do you think your father would be angry? Would he be angry because:

A. He had a hard day at work today and doesn't feel good? or because
B. He knows you do not do the best you can in school?

22. This child is taking a test. He is doing well. When you make a good grade on a test, is it usually because:

A. You almost always do your schoolwork? or because
B. Your father helped you study for the test?

23. This child got bad grades on her report card. When you get bad grades on your report card, is it probably because:

A. The teacher just gives bad grades to everyone? or because
B. You don't listen to the teacher?

24. This child is supposed to be working on his schoolwork, but hardly ever finishes his schoolwork. When you have trouble finishing your schoolwork, is it usually because:

A. You just give up too easily? or because
B. Your parents will not help you with your schoolwork?

25. This child is sad because none of the other children like to play with him at recess. Do the other children not like to play with him because:

A. He always starts fights? or because
B. The other children are not friendly to him?

26. This child is happy because he just read this book by himself. When you are able to read a book all by yourself is it because:

A. The book was easy? or because
B. You like to read and want to read the book?

27. Why do you think this teacher is happy. If this were your teacher would she probably be happy because:

A. You children have been good all day? or because
B. It's Friday and she got paid today?

28. The teacher has just asked a question to the class, and all of the children, except one, know the answer. Why do you think the one child doesn't know the answer? When you are the only one who does not know the answer to a question is it usually because:

A. You were unlucky to have the teacher ask a question that you did not know? or because
B. You were not paying attention when the teacher asked the question?

ARE YOU KEEPING UP WITH ME BOYS AND GIRLS?

29. This child is happy because all the other children in the class want to sit next to her. Why do all the children want to sit next to her? If other children wanted to sit next to you would it be because:

A. You are very friendly? or because
B. You are smarter than all the other children?

30. This child had a good day at school today. When you have a good day at school, is it usually because:

A. All the work was extra easy that day? or because
B. You did all your homework the night before?

31. Why do you think this teacher is not happy? If this were your teacher would she probably not be happy because:

A. It is a cold and rainy day and that makes her sad? or because
B. You children did not learn much today?

32. Bob and Larry have just finished playing this game of basketball. Larry has just lost and usually always loses at basketball. When you lose at a game like this, is it usually because:

A. You do not try hard enough to win? or because
B. The others on your team are bad players?

33. Why do you think this mother and father look happy. If this were your mother and father, would they probably be happy because:

A. They love each other? or because
B. You got good grades?

34. This child is taking a test. She is not doing very well. When you get a bad grade on a test, is it usually because :

A. You did not pay attention in class? or because
B. The test is hard?

35. This child is happy because all the other children in the class want to sit next to him. Why do all the children want to sit next to him? Is it because:

A. He always has a lot of money and is good looking? or because
B. He does good work in school?

36. The teacher has just asked a question to the class, but none of the children know the answer. When none of you know the answer, is it usually because:

A. The question that the teacher asked was very hard? or because
B. None of you were listening to the teacher?

OK BOYS AND GIRLS--WE'RE ALMOST FINISHED WITH PART I. HERE ARE THE LAST 2 QUESTIONS --

37. Why is this teacher smiling? If this were your teacher, would she be smiling because:

A. You children had studied hard for your test? or because
B. The teacher just likes to give good grades?

38. This child is learning a lot in class today. When you learn a lot in class, is it usually because:

A. Your teacher is a very good teacher? or because
B. You listen when the teacher is talking?

Key for Internal-External Scale

The key provided indicates responses in the "external" direction.

Item	Correct Response	Item	Correct Response
1	B	20	A
2	B	21	A
3	A	22	B
4	B	23	A
5	A	24	B
6	A	25	B
7	B	26	A
8	A	27	B
9	B	28	A
10	A	29	B
11	B	30	A
12	B	31	A
13	A	32	B
14	B	33	A
15	A	34	B
16	B	35	A
17	B	36	A
18	A	27	B
19	B	38	A

Key for What I Like Best (Cognitive Preference Test)

Item	Response	
	Factual	Intellectual Operation
40	A	B
41	B	A
42	B	A
43	A	B
44	B	A
45	A	B
46	B	A
47	A	B
48	A	B
49	B	A
50	A	B
51	B	A
52	A	B
53	B	A
54	A	B

Appendix VII
Table 15
Analysis of Variance for the Concept Formation Test
Dependent Variable One

Source	MS	D.F.	F-Ratio	Prob.	Var.
Total	25.851	1127			
Between	535.058	17			
A	708.783	1	39.2621	.0000	.0237
B	3986.662	2	220.8361	.0000	.2723
C	114.208	2	6.3264	.0023	.0066
AB	4.104	2	.2273	.7994	0.0000
AC	51.179	2	2.8350	.0574	.0023
BC	1.345	4	.0745	.9869	0.0000
ABC	17.377	4	.9626	.5716	0.0000
Within	18.053	1110			

Table
Analysis of Variance for the Concept Formation Test
Dependent Variable Two

Source	MS	D.F.	F-Ratio	Prob.	Var.
Total	6.383	1127			
Between	1[illegible].542	17			
A	97.687	1	24.1032	.0000	.0130
B	1201.722	2	296.5099	.0000	.3328
C	48.008	2	11.8453	.0001	.0122
AB	21.413	2	5.2833	.0055	.0048
AC	2.131	2	.5258	.5970	0.0000
BC	1.384	4	.3416	.8508	0.0000
ABC	11.361	4	2.8031	.0244	.0041
Within	4.053	1110			

Table 16
Analysis of Variance for the Concept Formation Test
Dependent Variable Three

Source	MS	D.F.	F-Ratio	Prob.	Var.
Total	44.725	1127			
Between	1241.071	17			
A	1332.737	1	50.4780	.0000	.0259
B	9428.769	2	357.1185	.0000	.3729
C	308.603	2	11.6885	.0001	.0112
AB	44.245	2	1.6758	.1856	.0007
AC	60.221	2	2.2809	.1005	.0013
BC	1.849	4	.0700	.9880	0.0000
ABC	18.599	4	.7044	.5918	0.0000
Within	26.402	1110			

Table 17
Means for Main Effects: Variables A, B, C
Dependent Variable One

	1	2	3
A	15.75	17.42	
B	12.69	17.84	19.22
C	16.38	16.13	17.24

Table
Means for Main Effects: Variables A, B, C
Dependent Variable Two

	1	2	3
A	8.28	8.90	
B	6.63	8.74	10.39
C	8.39	8.34	9.02

Table
Means for Main Effects: Variables A, B, C
Dependent Variable Three

	1	2	3
A	24.02	26.32	
B	19.32	26.58	29.61
C	24.78	24.47	26.26

Table 18

Analysis of Variance for Concept Formation Test

Part I

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS				
CELL		MEAN	S.D.
A 1	B 1 C 1	90	12.1111	5.5616
A 1	B 1 C 2	68	11.4118	5.4751
A 1	B 1 C 3	35	12.4286	6.3583
A 1	B 2 C 1	108	17.2037	4.2443
A 1	B 2 C 2	61	16.0328	4.5752
A 1	B 2 C 3	35	17.5429	4.5719
A 1	B 3 C 1	105	18.3143	3.4677
A 1	B 3 C 2	64	17.1406	4.4109
A 1	B 3 C 3	48	19.5208	2.2216
A 2	B 1 C 1	63	12.6667	5.2915
A 2	B 1 C 2	68	13.0441	5.4920
A 2	B 1 C 3	36	14.5000	6.1015
A 2	B 2 C 1	53	18.1509	4.0163
A 2	B 2 C 2	70	18.0571	2.9453
A 2	B 2 C 3	48	19.2292	3.0474
A 2	B 3 C 1	75	19.8400	1.5857
A 2	B 3 C 2	47	20.2766	1.4552
A 2	B 3 C 3	54	20.2037	1.2496

Table 19

Analysis of Variance for Concept Formation Test

Part II

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	90	6.4333	2.1932
A 1 B 1 C 2	68	6.1029	2.5809
A 1 B 1 C 3	35	7.2857	2.4443
A 1 B 2 C 1	108	8.5000	1.8163
A 1 B 2 C 2	61	8.0656	2.2051
A 1 B 2 C 3	35	8.2571	2.4536
A 1 B 3 C 1	105	9.5619	1.9061
A 1 B 3 C 2	64	9.9219	2.0103
A 1 B 3 C 3	48	10.3542	1.8507
A 2 B 1 C 1	63	6.4762	1.8392
A 2 B 1 C 2	68	6.6324	1.9993
A 2 B 1 C 3	36	6.8333	2.1580
A 2 B 2 C 1	53	8.8113	2.2707
A 2 B 2 C 2	70	8.7429	2.1915
A 2 B 2 C 3	48	10.0625	2.0359
A 2 B 3 C 1	75	10.5867	1.3665
A 2 B 3 C 2	47	10.5957	1.5416
A 2 B 3 C 3	54	11.3333	1.3459

Table 20

Analysis of Variance for Concept Formation Test

Total Scores

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS				
CELL	N	MEAN	S.D.	
A 1 B 1 C 1	90	18.5444	6.7544	
A 1 B 1 C 2	68	17.5147	6.7592	
A 1 B 1 C 3	35	19.7143	7.6025	
A 1 B 2 C 1	108	25.7037	4.9939	
A 1 B 2 C 2	61	24.0984	5.2176	
A 1 B 2 C 3	35	25.8000	6.0576	
A 1 B 3 C 1	105	27.8762	4.3339	
A 1 B 3 C 2	64	27.0625	5.5173	
A 1 B 3 C 3	48	29.8750	2.8999	
A 2 B 1 C 1	63	19.1429	6.0050	
A 2 B 1 C 2	68	19.6765	6.1872	
A 2 B 1 C 3	36	21.3333	7.4680	
A 2 B 2 C 1	53	26.9623	4.7025	
A 2 B 2 C 2	70	27.6000	3.9357	
A 2 B 2 C 3	48	29.2917	3.8146	
A 2 B 3 C 1	75	30.4267	2.0545	
A 2 B 3 C 2	47	30.8723	2.2805	
A 2 B 3 C 3	54	31.5370	1.9300	

Table 21
Means for Interactive Effects: Variable Two

		B		
		1	2	3
A	1	6.61	8.27	9.95
	2	6.65	9.21	10.84

Table 22
Means and Standard Deviations of Scores on
Concept Formation Test for White Affluent Sample

	Grade 2		4		6	
	Mean	SD	Mean	SD	Mean	SD
Part I	16.96	4.72	18.73	3.46	20.16	2.08
Part II	7.29	1.84	9.85	2.44	11.07	1.62
Total Score	24.25	7.47	28.58	4.90	31.22	2.80

Appendix VIII

Table 23
Analysis of Variance for Word Association Test:
Oral Paradigmatic Score

Source	M.S.	D.F.	F-Ratio	Prob.	Var
Total	67.326	513			
Between	335.519	17			
A	368.692	1	6.3421	.0117	.8092
B	1912.654	2	32.9006	.0000	.1072
C	463.496	2	7.9728	.0007	.0234
AB	68.282	2	1.1746	.3097	.0006
AC	4.721	2	.0812	.9215	0.0000
BC	36.214	4	.6229	.6497	0.0000
ABC	72.991	4	1.2556	.2857	.0017
Within	58.134	496			

Table 24
Analysis of Variance for Word Association Test
Oral Paradigmatic Score
Means of Main Effects and Interaction Groups

	1	2	3
A Main	22.4158	24.1716	
B Main	19.4851	24.1420	26.2540
C Main	24.4347	21.3339	24.1125
A By B			
1	18.3948	22.7424	26.1103
2	20.5754	25.5417	26.3977
A by C			
1	23.4570	20.6547	23.1358
2	25.4124	22.0131	25.0893
B by C			
1	21.3542	17.8630	19.2381
2	24.9678	21.8796	25.5787
3	26.9821	24.2591	27.5208

Table 25
Analysis of Variance for Word Association Test
Oral Paradigmatic Score
Means and Standard Deviations
of Smallest Sub-cells of Experiment

Cell	N	Mean	S.D.
A 1 B 1 C 1	54	18.6667	13.8073
A 1 B 1 C 2	47	17.8511	7.6214
A 1 B 1 C 3	42	18.6667	9.4834
A 1 B 2 C 1	25	24.2400	6.2402
A 1 B 2 C 2	23	19.9130	7.9767
A 1 B 2 C 3	27	24.0741	5.1510
A 1 B 3 C 1	28	27.4643	3.3937
A 1 B 3 C 2	25	24.2000	6.5574
A 1 B 3 C 3	33	26.6667	4.8391
A 2 B 1 C 1	24	24.0417	6.0252
A 2 B 1 C 2	24	17.8750	8.1578
A 2 B 1 C 3	21	19.8095	6.4469
A 2 B 2 C 1	23	25.6957	6.3420
A 2 B 2 C 2	26	23.8462	6.2270
A 2 B 2 C 3	24	27.0833	6.1000
A 2 B 3 C 1	22	26.5000	4.6368
A 2 B 3 C 2	22	24.3182	4.1677
A 2 B 3 C 3	24	28.3750	4.8077

Table 26
Analysis of Variance for Word Association Test
Oral Homogeneous Score

Source	M.S.	D.F.	F-Ratio	Prob.	Var.
Total	64.921	513			
Between	392.513	17			
A	584.688	1	10.8894	.0014	.0159
B	2091.424	2	38.9511	.0000	.1222
C	486.295	2	9.0569	.0003	.0259
AB	118.614	2	2.2091	.1087	.0039
AC	12.488	2	.2326	.7954	0.0000
BC	55.054	4	1.0253	.3943	.0002
ABC	112.542	4	2.0960	.0791	.0071
Within	53.694	496			

Table 27
Analysis of Variance for Word Association Test
Oral Homogeneous Scores
Means of Main Effects and Interaction Groups

	1	2	3
A Main	19.8440	22.0551	
B Main	16.9526	21.8832	24.0129
C Main	22.0055	18.9339	21.9093
A By B			
1	15.2763	20.3563	23.8995
2	18.6290	23.4100	24.1253
A By C			
1	20.6086	18.0950	20.8284
2	23.4024	19.7727	22.9901
B By C			
1	18.7014	15.5851	16.5714
2	22.5409	19.7174	23.3912
3	24.7744	21.4991	25.7652

Table 28
Analysis of Variance for Word Association Test
Oral Homogeneous Scores
Means and Standard Deviations
of Smallest Sub-cells of Experiment

Cell	N	Mean	S.D.
A 1 B 1 C 1	54	14.9444	11.1718
A 1 B 1 C 2	47	15.1702	7.5421
A 1 B 1 C 3	42	15.7143	8.8601
A 1 B 2 C 1	25	21.5600	6.3579
A 1 B 2 C 2	23	17.4348	8.0330
A 1 B 2 C 3	27	22.0741	5.6564
A 1 B 3 C 1	28	25.3214	4.3210
A 1 B 3 C 2	25	21.6800	7.1863
A 1 B 3 C 3	33	24.6970	4.9212
A 2 B 1 C 1	24	22.4583	6.2483
A 2 B 1 C 2	24	16.0000	8.3666
A 2 B 1 C 3	21	17.4286	6.2894
A 2 B 2 C 1	23	23.5217	6.8282
A 2 B 2 C 2	26	22.0000	6.9282
A 2 B 2 C 3	24	24.7083	7.4803
A 2 B 3 C 1	22	24.2273	5.3357
A 2 B 3 C 2	22	21.3182	4.4549

Table 29
Analysis of Variance for Word Association Test
Written Paradigmatic Scores

Source	M.S.	D.F.	F-Ratio	Prob.	Var.
Total	71.808	920			
Between	905.338	17			
A	1296.943	1	23.1121	.0000	.0188
B	5180.780	2	92.3236	.0000	.1550
C	1064.333	2	18.9669	.0000	.0305
AB	305.403	2	5.4424	.0048	.0075
AC	43.892	2	.7822	.5383	0.0000
BC	177.072	4	3.1555	.0137	.0073
ABC	49.176	4	.8763	.5305	0.0000
Within	56.115	903			

Table 30
Analysis of Variance for Word Association Test
Written Paradigmatic Scores
Means of Main Effects and Interaction Groups

	1	2	3
A Main	18.7363	21.3275	
B Main	14.9277	21.8254	23.3427
C Main	20.4466	17.8237	21.8255
A By B			
1	12.3831	21.0281	22.7978
2	17.4722	22.6227	23.8877
A By C			
1	18.7515	16.9530	20.5045
2	22.1417	18.6943	23.1465
B By C			
1	15.8738	11.7175	17.1917
2	23.2827	19.0020	23.1915
3	22.1834	22.7516	25.0933

Table 31
Analysis of Variance for Word Association Test
Written Paradigmatic Scores
Means and Standard Deviations
of Smallest Sub-cells of Experiment

Cell	N	Mean	S.D.
A 1 B 1 C 1	66	12.4545	8.4383
A 1 B 1 C 2	58	9.8448	6.8667
A 1 B 1 C 3	20	14.8500	10.2919
A 1 B 2 C 1	37	21.6765	7.3351
A 1 B 2 C 2	45	18.4667	8.2092
A 1 B 2 C 3	17	22.9412	7.5537
A 1 B 3 C 1	81	22.1235	6.6865
A 1 B 3 C 2	42	22.5476	7.0614
A 1 B 3 C 3	36	23.7222	6.9059
A 2 B 1 C 1	58	19.2931	7.7663
A 2 B 1 C 2	61	13.5902	9.1677
A 2 B 1 C 3	30	19.5333	8.3490
A 2 B 2 C 1	54	24.8889	7.1788
A 2 B 2 C 2	67	19.5373	7.9911
A 2 B 2 C 3	43	23.4419	6.6272
A 2 B 3 C 1	74	22.2432	7.5013
A 2 B 3 C 2	45	22.9556	6.4419
A 2 B 3 C 3	56	26.4643	4.9432

Table 32
Analysis of Variance for Word Association Test
Written Homogeneous Scores

Source	M.S.	D.F.	F-Ratio	Prob.	Var.
Total	73.061	920			
Between	758.352	17			
A	1062.859	1	17.6701	.0001	.0149
B	3832.026	2	63.7075	.0000	.1121
C	1290.740	2	21.4586	.0000	.0366
AB	153.807	2	2.5571	.0761	.0028
AC	151.627	2	2.5208	.0789	.0027
BC	195.984	4	3.2582	.0116	.0081
ABC	49.324	4	.8200	.5145	0.0000
Within	60.150	903			

Table 33
Analysis of Variance for Word Association Test
Written Homogeneous Scores
Means of Main Effects and Interaction Groups

	1	2	3
A Main	16.2947	18.6404	
B Main	13.0350	19.3055	20.0621
C Main	17.8062	15.0788	19.5175
A By B			
1	11.0054	18.3448	19.5338
2	15.0645	20.2662	20.5905
A By C			
1	15.7966	14.0720	19.0154
2	19.8158	16.0856	20.0197
B By C			
1	13.4796	9.1669	16.4583
2	20.4562	16.7886	20.6717
3	19.4828	19.2810	21.4226

Table 34
Analysis of Variance for Word Association Test
Written Homogeneous Scores
Means and Standard Deviations
of Smallest Sub-cells of Experiment

Cell	N	Mean	S.D.
A 1 B 1 C 1	66	10.0455	8.1777
A 1 B 1 C 2	58	7.1207	5.8552
A 1 B 1 C 3	20	15.8500	17.5568
A 1 B 2 C 1	68	18.8382	7.5777
A 1 B 2 C 2	45	15.6667	8.2379
A 1 B 2 C 3	17	20.5294	7.9145
A 1 B 3 C 1	81	18.5062	6.5919
A 1 B 3 C 2	42	19.4286	7.2554
A 1 B 3 C 3	36	20.6667	7.2585
A 2 B 1 C 1	58	16.9138	7.9743
A 2 B 1 C 2	61	11.2131	8.9165
A 2 B 1 C 3	30	17.0667	8.1407
A 2 B 2 C 1	54	22.0741	7.4120
A 2 B 2 C 2	67	17.9104	7.9042
A 2 B 2 C 3	43	20.8140	7.0921
A 2 B 3 C 1	74	20.4595	7.6752
A 2 B 3 C 2	45	19.1333	6.3629
A 2 B 3 C 3	56	22.1786	5.0600

Table 35

Means and Standard Deviations of Scores on Word Association Test for White Affluent Sample

	Grade 2		4		6	
	Mean	SD	Mean	SD	Mean	SD
Written Paradygmatic	18.75	7.92	24.05	6.68	24.20	5.76
Written Homogeneous	16.98	8.05	21.23	6.74	20.57	5.84

Table 36

Analysis of Variance for Written Language Production Scores: Total Words Used

Source	M.S.	D.F.	F-Ratio	Prob	" r
Total	2920.24	940			
Between	22709.47	17			
A	57114.89	1	22.35	.00	.02
B	97664.70	2	38.21	.00	07
C	21449.57	2	8.39	.00	.01
AB	7652.63	2	2.99	.05	.00
AC	10510.68	2	4.11	.02	.01
BC	7158.65	4	2.80	.02	.01
ABC	6439.08	4	2.52	.04	.01
Within	2555.76	923			

Table 37

Analysis of Variance for Written Language Production Scores:

Total Words Used

Means of Main Effects and Interaction Groups

	1	2	3
A MAIN	107.1409	140.8229	
B MAIN	80.0758	142.9128	118.9572
C MAIN	127.1963	104.6100	139.8394
A BY B	1	2	3
1	71.0612	113.6934	136.1530
2	89.0903	171.9171	161.1611
A BY C	1	2	3
1	111.5991	99.7336	110.0400
2	143.3935	109.4364	169.6389
B BY C	1	2	3
1	90.0556	64.3955	85.7762
2	140.0886	107.3313	181.3148
3	152.3446	142.0996	152.4273

Table 38

Analysis of Variance for Written Language Production Scores:

Total Words Used

Means and Standard Deviations of Smallest Sub-Cells

CELL CHARACTERISTICS:

CELL	N	MEAN	S.D.
A 1 B 1 C 1	84	72.5595	43.0789
A 1 B 1 C 2	65	67.7385	11.4723
A 1 B 1 C 3	35	72.8857	36.2311
A 1 B 2 C 1	88	123.8864	55.8867
A 1 B 2 C 2	43	100.2093	17.1831
A 1 B 2 C 3	27	117.6296	14.2998
A 1 B 3 C 1	111	138.3514	61.1679
A 1 B 3 C 2	67	131.4030	55.9489
A 1 B 3 C 3	43	139.6047	52.2148
A 2 B 1 C 1	58	107.5517	36.1372
A 2 B 1 C 2	57	61.0526	35.1317
A 2 B 1 C 3	12	98.6667	36.6738
A 2 B 2 C 1	5	156.2909	17.3766
A 2 B 2 C 2	63	111.4603	63.8331
A 2 B 2 C 3	1	245.0000	0.0000
A 2 B 3 C 1	71	166.3378	52.9974
A 2 B 3 C 2	51	152.7963	51.5135
A 2 B 3 C 3	4	165.2500	12.9711

Table 39

Analysis of Variance for Written Language Production Scores: Number of Sentences

Source	M.S.	D.F.	F-Ratio	Prob	Var
Total	33.36	940			
Between	103.23	17			
A	525.69	1	16.39	.00	.02
B	129.76	2	4.05	.02	.01
C	185.69	2	5.79	.00	.01
AB	15.33	2	.43	.63	.00
AC	75.06	2	2.34	.09	.00
BC	44.52	4	1.39	.23	.00
ABC	59.87	4	1.87	.11	.00
Within	32.07	923			

Table 40

Analysis of Variance for Written Language Production Scores:

Number of Sentences

Means of Main Effects and Interaction Groups

A Main	1	2	
	8.4622	11.6936	
B Main	1	2	3
	8.4833	10.7143	11.0362
C Main	1	2	3
	10.1741	8.3687	11.6910
A BY B	1	2	3
1	7.2353	8.5504	9.5930
2	9.7313	12.8702	12.4793
A BY	1	2	3
1	8.8261	7.6503	8.9098
2	11.5221	9.0866	11.1722
B BY C	1	2	3
1	9.4401	7.1513	8.8583
2	10.1205	7.9299	14.0926
3	10.9617	10.0247	12.1221

Table 41

Analysis of Variance for Written Language Production Scores:

Number of Sentences

Means and Standard Deviations of Smallest Sub-Cells

CELL	N	MEAN	S.D.
A 1 B 1 C 1	84	6.6905	5.8102
A 1 B 1 C 2	65	7.2154	5.4443
A 1 B 1 C 3	35	7.8000	6.1204
A 1 B 2 C 1	88	9.9318	5.8738
A 1 B 2 C 2	43	6.5581	4.4363
A 1 B 2 C 3	27	9.1852	5.4634
A 1 B 3 C 1	111	9.8559	6.1034
A 1 B 3 C 2	67	9.1791	5.7943
A 1 B 3 C 3	43	9.7442	4.3265
A 2 B 1 C 1	58	12.1897	6.3480
A 2 B 1 C 2	57	7.0877	4.9435
A 2 B 1 C 3	12	9.9167	4.0101
A 2 B 2 C 1	5	10.3091	5.4019
A 2 B 2 C 2		9.3016	6.8123
A 2 B 2 C 3	1	19.0000	0.0000
A 2 B 3 C 1	74	12.0676	5.7608
A 2 B 3 C 2	54	10.8704	4.6461

Table 42

Analysis of Variance for Written Language Production Scores: Number of Commas

Source	M.S.	D.F.	F-Ratio	Prob	Var
Total	4.39	940			
Between	49.39	17			
A	143.27	1	40.21	.00	.03
B	91.63	2	25.72	.00	.04
C	50.18	2	14.08	.00	.02
AB	42.82	2	12.02	.00	.02
AC	38.81	2	10.89	.00	.02
BC	31.57	4	8 86	.00	.03
ABC	30.78	4	8.64	.00	.03
Within	3.56	923			

Table 43

Analysis of Variance for Written Language Production Scores:

Number of Commas

Means of Main Effects and Interaction Groups

A Main	1	2	
	.7681	2.4551	
B Main	1	2	3
	.2665	2.3735	2.1949
C Main	1	2	3
	1.2585	.9791	2.5969
A BY B	1	2	3
1	.1374	.6677	1.4992
2	.3955	4.0793	2.8905
A BY C	1	2	3
1	.7180	.6981	.8883
2	1.7990	1.2697	4.3056
B BY C	1	2	3
1	.4965	.1382	.1548
2	1.3398	.8913	4.8889
3	1.9392	1.8983	2.7471

Table 11

Analysis of Variance for Written Language Production Scores:

Number of Commas

Means and Standard Deviations of Smallest Sub-Cells

CELL	N	Mean	S.D.
A 1 B 1 C 1	84	.1310	.4330
A 1 B 1 C 2	65	.1385	.5267
A 1 B 1 C 3	35	.1429	.6921
A 1 B 2 C 1	88	.8068	1.7995
A 1 B 2 C 2	43	.4186	1.5155
A 1 B 2 C 3	27	.7778	1.6718
A 1 B 3 C 1	111	1.2162	1.9027
A 1 B 3 C 2	67	1.5373	1.8694
A 1 B 3 C 3	43	1.7442	2.1502
A 2 B 1 C 1	58	.8621	2.0812
A 2 B 1 C 2	57	.1579	.7509
A 2 B 1 C 3	12	.1667	.3892
A 2 B 2 C 1	55	1.8727	2.5096
A 2 B 2 C 2	63	1.3651	2.5228
A 2 B 2 C 3	1	9.0000	0.0000
A 2 B 3 C 1	74	2.6622	2.6290
A 2 B 3 C 2	54	2.2593	2.7622
A 2 B 3 C 3	4	3.7500	.9574

Table 45

Analysis of Variance for Written Language Production Scores: Number of Other Punctuations

Source	M.S.	D.F.	F-Ratio	Prob	Var
Total	.37	940			
Between	1.02	17			
A	5.77	1	16.22	.00	.02
B	1.55	2	4.36	.01	.01
C	1.39	2	3.90	.02	.01
AB	.47	2	1.31	.27	.00
AC	1.38	2	3.87	.02	.01
BC	.29	4	.81	.52	.00
ABC	.21	4	.58	.68	.00
Within	.36	923			

Table 46

Analysis of Variance for Written Language Production Scores:

Number of Other Punctuations

Means of Main Effects and Interaction Groups

A Main	1	2	
	.0872	.1259	
B Main	1	2	3
	.1017	.2624	.4056
C Main	1	2	3
	.2078	.1434	.4184
A BY B	1	2	3
1	.0215	.0552	.1787
2	.1754	.4696	.6325
A BY C	1	2	3
1	.0925	.0821	.0867
2	.3231	.2045	.7500
B BY C	1	2	3
1	.1537	.0263	.1250
2	.1432	.1069	.5370
3	.3266	.2971	.5930

Table 47

Analysis of Variance for Written-Language Production Scores:

Number of Other Punctuations

Means and Standard Deviations of Smallest Sub-Cells

Cell Characteristics

CELL	N	MEAN	S.D.
A 1 B 1 C 1	84	.0833	.4168
A 1 B 1 C 2	65	0.0000	0.0000
A 1 B 1 C 3	35	0.0000	0.0000
A 1 B 2 C 1	88	.0682	.2954
A 1 B 2 C 2	43	.0233	.1525
A 1 B 2 C 3	27	.0741	.2669
A 1 B 3 C 1	111	.1261	.4071
A 1 B 3 C 2	67	.2239	.6233
A 1 B 3 C 3	43	.1860	.5458
A 2 B 1 C 1	58	.2241	.7265
A 2 B 1 C 2	57	.0526	.2941
A 2 B 1 C 3	12	.2500	.6216
A 2 B 2 C 1	55	.2182	.6580
A 2 B 2 C 2	63	.1905	.7152
A 2 B 2 C 3	1	1.0000	0.0000
A 2 B 3 C 1	74	.5270	1.1846
A 2 B 3 C 2	54	.3704	.9173
A 2 B 3 C 3	4	1.0000	1.4142

Table 48

Analysis of Variance for Written Language Production Scores:

Mean Sentence Length

Source	M.S.	D.F.	F-Ratio	Prob	Var
Total	143.53	940			
Between	100.38	17			
A	153.52	1	1.063	.30	.00
B	270.01	2	1.87	.15	.00
C	200.86	2	1.39	.25	.00
AB	20.89	2	.14	.87	.00
AC	68.83	2	48	.63	.00
BC	24.04	4	.17	.95	.00
ABC	83.90	4	.58	.68	.00
Within	144.33	923			

Table 49

Analysis of Variance for Written Language Production Scores:
Mean Sentence Length
Means of Main Effects and Interaction Groups

A MAIN	1	2	
	16.3793	14.6330	
B MAIN	1	2	3
	13.2848	17.1838	16.0498
C MAIN	1	2	3
	16.6549	16.3468	13.5166
A BY B	1	2	3
1	14.5142	17.4141	17.2095
2	12.0554	16.9536	14.8901
A BY C	1	2	3
1	16.3624	17.7240	15.0514
2	16.9475	14.9696	11.9819
B BY C	1	2	3
1	14.2763	13.2198	12.3582
2	18.9994	13.4559	14.0962
3	16.6891	17.3647	14.0955

Table 50

Analysis of Variance for Written Language Production Scores:
Mean Sentence Length
Means and Standard Deviations of Smallest Sub-Cells

CELL	N	MEAN	S.D.
A 1 B 1 C 1	84	15.7139	12.4705
A 1 B 1 C 2	65	13.9781	14.7749
A 1 B 1 C 3	35	13.8505	11.2320
A 1 B 2 C 1	88	15.7021	10.3306
A 1 B 2 C 2	43	21.2376	15.9375
A 1 B 2 C 3	27	15.3025	7.4500
A 1 B 3 C 1	111	17.6711	11.2231
A 1 B 3 C 2	67	17.9564	11.0090
A 1 B 3 C 3	43	16.0011	6.7204
A 2 B 1 C 1	58	12.8387	12.2104
A 2 B 1 C 2	57	12.4615	12.7857
A 2 B 1 C 3	12	10.8658	4.8130
A 2 B 2 C 1	55	22.2967	21.1735
A 2 B 2 C 2	63	15.6741	8.8316
A 2 B 2 C 3	1	12.8900	0.0000
A 2 B 3 C 1	74	15.7071	6.5133
A 2 B 3 C 2	54	16.7731	11.2281
A 2 B 3 C 3	4	12.1900	3.4781

Table 51

Analysis of Variance for Written Language Production Scores: Standard Deviation of Sentence Length

SOURCE	M.S.	df	F-RATIO	PRO	VAR
Total	46.8652	940			
Between	34.2934	17			
A	29.2200	1	.62	.56	0.0000
B	232.3964	2	4.93	.01	.0084
C	10.4275	2	.22	.80	0.0000
AB	4.9362	2	.10	.90	0.0000
AC	2.2515	2	.05	.95	0.0000
BC	8.5129	4	.18	.95	0.0000
ABC	4.9234	4	.10	.97	0.0000
WITHIN	47.0967	923			

Table 52

Analysis of Variance for Written Language Production Scores;
Standard Deviation of Sentence Length
Means of Main Effects and Interaction Groups

A MAIN	1	2	3
	8.2749	7.5130	
B MAIN	1	2	3
	5.7976	8.5348	9.3495
C MAIN	1	2	3
	8.2434	7.9718	7.4667
A BY B	1	2	3
1	5.9076	9.1871	9.7300
2	5.6876	7.8824	8.9691
A BY C	1	2	3
1	8.4197	8.4088	7.9962
2	8.0671	7.5348	6.9372
B BY C	1	2	3
1	6.0888	5.4399	5.8640
2	9.3223	8.3238	7.9582
3	9.3190	10.1516	8.5780

Table 53

Analysis of Variance for Written Language Production Scores:

Standard Deviation of Sentence Length

Means and Standard Deviations of Smallest Sub-Cells

Cell	N	MEAN	S.D.
A 1 B 1 C 1	84	6.4043	6.5403
A 1 B 1 C 2	65	5.6425	8.1325
A 1 B 1 C 3	35	5.6760	5.2832
A 1 B 2 C 1	88	9.6935	8.8839
A 1 B 2 C 2	43	8.6866	5.9850
A 1 B 2 C 3	27	9.1814	7.9988
A 1 B 3 C 1	111	9.1613	6.7044
A 1 B 3 C 2	67	10.8973	9.0519
A 1 B 3 C 3	43	9.1313	5.6524
A 2 B 1 C 1	58	5.7733	4.9191
A 2 B 1 C 2	57	5.2374	4.6460
A 2 B 1 C 3	12	6.0520	4.2447
A 2 B 2 C 1	55	8.9512	6.9721
A 2 B 2 C 2	63	7.9611	5.9036
A 2 B 2 C 3	1	6.7350	0.0000
A 2 B 3 C 1	74	9.4767	6.0634
A 2 B 3 C 2	54	9.4059	7.1231
A 2 B 3 C 3	4	8.0247	4.6207

Table 54

Analysis of Variance for Written Language Production Scores: Mean Word Length

SOURCE	M.S.	df	F-RATIO	PRO	VAR
TOTAL	.0733	940			
Between	.3766	17			
A	.4061	1	5.9987	.01	.0049
B	2.5745	2	38.0200	.00	.0727
C	.2538	2	3.7490	.02	.0054
AB	.0647	2	.9557	.61	0.0000
AC	.0435	2	.6428	.53	0.0000
BC	.0165	4	.2444	.91	0.0000
ABC	.1442	4	.2131	.92	0.0000
WITHIN	.0677	923			

Table 55

Analysis of Variance for Written Language Production Scores:
Mean Word Length
Means of Main Effects and Interaction Groups

A MAIN	1	2	
	3.4720	3.5618	
B MAIN	1	2	3
	3.3037	3.5583	3.6888
C MAIN	1	2	3
	3.5204	3.4538	3.5766
A BY B	1	2	3
1	3.2317	3.5066	3.6777
2	3.3757	3.6100	3.6998
A BY C	1	2	3
1	3.4737	3.4351	3.5071
2	3.5671	3.4724	3.6461
B BY C	1	2	3
1	3.3328	3.2090	3.3692
2	3.5553	3.4990	3.6206
3	3.6730	3.6533	3.7400

Table 56

Analysis of Variance for Written Language Production Scores

Mean Word Length

Means and Standard Deviations of Smalles Sub-Cells

Cell Characteristics

Cell	N	Mean	S.D.
A 1 B 1 C 1	84	3.2438	.3203
A 1 B 1 C 2	65	3.1772	.3351
A 1 B 1 C 3	35	3.2742	.3284
A 1 B 2 C 1	88	3.5280	.2946
A 1 B 2 C 2	43	3.4725	.2269
A 1 B 2 C 3	27	3.5194	.2099
A 1 B 3 C 1	111	3.6495	.2567
A 1 B 3 C 2	67	3.6559	.2556
A 1 B 3 C 3	43	3.7280	.2140
A 2 B 1 C 1	58	3.4220	.2373
A 2 B 1 C 2	57	3.2409	.2862
A 2 B 1 C 3	12	3.4643	.1726
A 2 B 2 C 1	55	3.5827	.2287
A 2 B 2 C 2	63	3.5256	.2289
A 2 B 2 C 3	1	3.7220	.0000
A 2 B 3 C 1	74	3.6967	.1876
A 2 B 3 C 2	54	3.6508	.1920
A 2 B 3 C 3	4	3.7520	.1480

Table 57

Analysis of Variance for Written Language Production Scores: Standard Deviation of Word Length

SOURCE	M.S.	df	F-RATIO	PRO	VAR
Total	.0521	940			
Between	.1808	17			
A	.3031	1	6.0942	.01	.0052
B	1.1388	2	22.8949	.00	.0444
C	.1651	2	3.3209	.03	.0047
AB	.0362	2	.7297	.51	0.0000
AC	.0008	2	.0161	.98	0.0000
BC	.0109	4	.2200	.92	0.0000
ABC	.0114	4	.2306	.91	0.0000
WITHIN	.0497	923			

Table 58

Analysis of Variance for Written Language Production Scores:
Standard Deviation of Word Length
Means of Main Effects and Interaction Groups

A MAIN	1	2	
	1.3913	1.4639	
B MAIN	1	2	3
	1.2960	1.4330	1.5561
C MAIN	1	2	3
	1.4393	1.3765	1.4744
A BY B	1	2	3
1	1.2755	1.3731	1.5251
2	1.3165	1.5030	1.5871
A BY C	1	2	3
1	1.3973	1.3372	1.4393
2	1.4813	1.4158	1.5095
B BY C	1	2	3
1	1.3275	1.2432	1.3173
2	1.4451	1.3731	1.4959
3	1.5452	1.5132	1.6101

Table 59

Analysis of Variance for Written Language Production Scores

Standard Deviation of Word Length

Means and Standard Deviations of Smallest Sub-Cells

Cell Characteristics

Cell	N	Mean	S.D.
A 1 B 1 C 1	84	1.2763	.2727
A 1 B 1 C 2	65	1.2293	.2652
A 1 B 1 C 3	35	1.3211	.2262
A 1 B 2 C 1	88	1.3970	.2264
A 1 B 2 C 2	43	1.2965	.2001
A 1 B 2 C 3	27	1.4259	.1724
A 1 B 3 C 1	111	1.5186	.2291
A 1 B 3 C 2	67	1.4850	.2232
A 1 B 3 C 3	43	1.5710	.2190
A 2 B 1 C 1	58	1.3788	.1665
A 2 B 1 C 2	57	1.2573	.2125
A 2 B 1 C 3	12	1.3135	.1609
A 2 B 2 C 1	55	1.4933	.2171
A 2 B 2 C 2	63	1.4497	.2175
A 2 B 2 C 3	1	1.5660	.0000
A 2 B 3 C 1	74	1.5719	.2031
A 2 B 3 C 2	54	1.5404	.2208
A 2 B 3 C 3	4	1.6493	.1196

Appendix IX

Table 60

Analysis of Variance for Logical Thinking Test

Total Scores

Source	M.S.	D.F.	F-Ratio	Prob	Var
Total	70.120	1144			
Between	2267.570	17			
A	3696.769	1	99.9849	.0000	.0456
B	15087.533	2	408.0659	.0000	.3751
C	1777.282	2	48.0694	.0000	.0434
AB	117.213	2	3.1702	.0410	.0020
AC	70.486	2	1.9064	.1469	.0008
BC	96.162	4	2.6008	.0341	.0030
ABC	90.560	4	2.4493	.0438	.0027
Within	36.973	1127			

Table 61

Analysis of Variance for Logical Thinking Test

Total Scores

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2	
	22.4186	26.1964	
B MAIN	1	2	3
	17.2897	25.2190	30.4138
C MAIN	1	2	3
	22.7934	23.2135	26.9156
A BY B	1	2	3
1	16.0715	22.9495	28.2350
2	18.5079	27.4886	32.5926
A BY C	1	2	3
1	20.8559	21.7987	24.6013
2	24.7309	24.6282	29.2299
B BY C	1	2	3
1	16.0947	16.6771	19.0972
2	23.8046	23.1071	28.7459
3	28.4816	29.8561	32.9037

Table 62

Analysis of Variance for Logical Thinking Test

Total Scores

Means and Standard Deviations of Smallest Sub-Cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	92	14.7609	5.8184
A 1 B 1 C 2	66	16.4091	6.2781
A 1 B 1 C 3	45	17.0444	5.5101
A 1 B 2 C 1	106	22.3302	5.7466
A 1 B 2 C 2	63	21.0476	6.3663
A 1 B 2 C 3	34	25.4706	6.7968
A 1 B 3 C 1	107	25.4766	6.7912
A 1 B 3 C 2	66	27.9394	5.9093
A 1 B 3 C 3	45	31.2889	4.4753
A 2 B 1 C 1	63	17.4286	6.6398
A 2 B 1 C 2	73	16.9452	6.0825
A 2 B 1 C 3	40	21.1500	7.3748
A 2 B 2 C 1	54	25.2778	5.5403
A 2 B 2 C 2	72	25.1667	6.2933
A 2 B 2 C 3	47	32.0213	6.2779
A 2 B 3 C 1	74	31.4865	5.8198
A 2 B 3 C 2	44	31.7727	6.2314
A 2 B 3 C 3	54	34.5185	4.8242

Table 63

Analysis of Variance for Logical Thinking Test
Subtest: Matrices

Source	M.S.	D.F.	F-Ratio	Prob	Var
Total	16.975	1144			
Between	508.036	17			
A	617.682	1	64.5621	.0000	.0313
B	3661.585	2	382.7206	.0000	.3759
C	265.318	2	27.7319	.0000	.0263
AB	15.354	2	1.6049	.1994	.0006
AC	2.018	2	.2110	.8121	.0000
BC	13.324	4	1.3927	.2331	.0008
ABC	19.270	4	2.0142	.0892	.0020
Within	9.567	1127			

Table 64

Analysis of Variance for Logical Thinking Test

Subtest: Matrices

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2	
	11.0673	12.6115	
B MAIN	**1**	**2**	**3**
	8.3630	12.3377	14.8175
C MAIN	**1**	**2**	**3**
	11.2001	11.4796	12.8385
A BY B	**1**	**2**	**3**
1	7.8125	11.3675	14.0218
2	8.9134	13.3078	15.6133
A BY C	**1**	**2**	**3**
1	10.3399	10.7465	12.1155
2	12.0602	12.2127	13.5615
B BY C	**1**	**2**	**3**
1	7.6612	8.1777	9.2500
2	11.9747	11.5377	13.5006
3	13.9643	14.7235	15.7648

Table 65

Analysis of Variance for Logical Thinking Test

Subtest: Matrices

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	92	6.9891	3.4402
A 1 B 1 C 2	66	7.8485	3.7509
A 1 B 1 C 3	45	8.6000	2.9879
A 1 B 2 C 1	106	11.2642	2.9642
A 1 B 2 C 2	63	10.6032	3.4151
A 1 B 2 C 3	34	12.2353	3.4206
A 1 B 3 C 1	107	12.7664	3.2753
A 1 B 3 C 2	66	13.7879	2.7317
A 1 B 3 C 3	45	15.5111	1.8904
A 2 B 1 C 1	63	8.3333	3.9554
A 2 B 1 C 2	73	8.5068	3.6558
A 2 B 1 C 3	40	9.9000	3.3112
A 2 B 2 C 1	54	12.6852	2.9449
A 2 B 2 C 2	72	12.4722	3.1932
A 2 B 2 C 3	47	14.7660	2.3051
A 2 B 3 C 1	74	15.1622	2.4940
A 2 B 3 C 2	44	15.6591	2.1668
A 2 B 3 C 3	54	16.0185	1.6425

Table 66

Analysis of Variance for Logical Thinking Test
Subtest: Row and Columns

Source	M.S.	D.F.	F-Ratio	Prob	Var
Total	5.186	1144			
Between	94.565	17			
A	67.023	1	17.4658	.0001	.0106
B	620.028	2	161.5753	.0000	.2076
C	96.013	2	25.0204	.0000	.0311
AB	.503	2	.1312	.8771	.0000
AC	8.513	2	2.2185	.1070	.0016
BC	16.662	4	4.3421	.0021	.0086
ABC	5.956	4	1.5520	.1837	.0014
Within	3.837	1127			

Table 67

Analysis of Variance for Logical Thinking Test

Subtest: Row and Columns

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2	
	4.6602	5.1688	

B MAIN	1	2	3
	3.4969	5.0868	6.1599

C MAIN	1	2	3
	4.5344	4.6927	5.5164

A BY B	1	2	3
1	3.2831	4.7972	5.9003
2	3.7106	5.3764	6.4195

A BY C	1	2	3
1	4.4028	4.4925	5.0852
2	4.6660	4.8928	5.9477

B BY C	1	2	3
1	3.4212	3.3917	3.6778
2	4.6640	4.5804	6.0160
3	5.5181	6.1061	6.8556

Table 68

Analysis of Variance for Logical Thinking Test

Subtest: Row and Columns

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	92	3.2391	1.7564
A 1 B 1 C 2	66	3.4545	1.7381
A 1 B 1 C 3	45	3.1556	1.7050
A 1 B 2 C 1	106	4.7170	2.0552
A 1 B 2 C 2	63	4.1746	1.9719
A 1 B 2 C 3	34	5.5000	1.8627
A 1 B 3 C 1	107	5.2523	2.0654
A 1 B 3 C 2	66	5.8485	1.9942
A 1 B 3 C 3	45	6.6000	2.2401
A 2 B 1 C 1	63	3.6032	1.5917
A 2 B 1 C 2	73	3.3288	1.6164
A 2 B 1 C 3	40	4.2000	1.8701
A 2 B 2 C 1	54	4.6111	1.8876
A 2 B 2 C 2	72	4.9861	2.3286
A 2 B 2 C 3	47	6.5319	2.0626
A 2 B 3 C 1	74	5.7838	2.1471
A 2 B 3 C 2	44	6.3636	2.0126
A 2 B 3 C 3	54	7.1111	2.0711

Table 69

Analysis of Variance for Logical Thinking Test
Subtest: Intersections

Source	M.S.	D.F.	F-Ratio	Prob	Var
Total	14.499	1144			
Between	153.161	17			
A	542.115	1	43.6932	.0000	.0319
B	705.166	2	56.8348	.0000	.0835
C	151.260	2	12.1912	.0000	.0167
AB	65.102	2	5.2471	.0057	.0063
AC	48.255	2	3.8892	.0202	.0043
BC	16.359	4	1.3185	.2600	.0010
ABC	14.153	4	1.1407	.3355	.0004
Within	12.407	1127			

Table 70

Analysis of Variance for Logical Thinking Test

Subtest: Intersections

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2	
	5.7591	7.2057	
B MAIN	**1**	**2**	**3**
	5.0101	6.5736	7.8635
C MAIN	**1**	**2**	**3**
	6.0112	6.1971	7.2390

A BY B	1	2	3
1	4.7844	5.6546	6.8383
2	5.2359	7.4926	8.8887

A BY C	1	2	3
1	5.2067	5.8814	6.1891
2	6.8156	6.5127	8.2889

B BY C	1	2	3
1	4.4532	5.1188	5.4583
2	6.0590	5.9345	7.7272
3	7.5212	7.5379	8.5315

Table 71

Analysis of Variance for Logical Thinking Test

Subtest: Intersections

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	92	4.0652	2.1728
A 1 B 1 C 2	66	5.6212	9.5285
A 1 B 1 C 3	45	4.6667	2.2664
A 1 B 2 C 1	106	5.3774	2.7653
A 1 B 2 C 2	63	5.1746	2.5687
A 1 B 2 C 3	34	6.4118	2.6642
A 1 B 3 C 1	107	6.1776	2.9003
A 1 B 3 C 2	66	6.8485	2.8889
A 1 B 3 C 3	45	7.4889	2.9125
A 2 B 1 C 1	63	4.8413	2.5029
A 2 B 1 C 2	73	4.6164	2.3783
A 2 B 1 C 3	40	6.2500	3.4623
A 2 B 2 C 1	54	6.7407	2.7961
A 2 B 2 C 2	72	6.6944	2.8116
A 2 B 2 C 3	47	9.0426	3.2768
A 2 B 3 C 1	74	8.8649	2.8008
A 2 B 3 C 2	44	8.2273	3.1391
A 2 B 3 C 3	54	9.5741	2.8918

Table 72

Means and Standard Deviations of Scores on
Logical Thinking Test for White Affluent Sample

	Grade					
	2		4		6	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Matrices	11.41	2.73	4.24	1.74	5.80	2.27
Row and Column	13.96	3.18	5.54	1.98	7.94	3.20
Interactions	15.94	1.95	6.42	2.11	9.57	3.53
Total Score	22.70	5.15	28.85	6.60	33.65	5.53

Appendix X

Table 73

Analysis of Variance for Problem Solving Test

Total Scores

SOURCE	M.S.	D.F.	F-RATIO	PROB	VAR
TOTAL	33.817	1136			
BETWEEN	1063.494	17			
A	1868.758	1	102.8249	.0000	.0881
B	7190.828	2	395.6694	.0000	.3732
C	539.937	2	29.7096	.0000	.0272
AB	194.274	2	10.6898	.0001	.0092
AC	43.380	2	2.3869	.0902	.0019
BC	40.153	4	2.2094	.0650	.0029
ABC	28.297	4	1.5570	.1823	.0011
WITHIN	18.174	1119			

Table 74

Analysis of Variance for Problem Solving Test

Total Scores

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2	
	33.3849	36.0940	

B MAIN	1	2	3
	29.7684	35.5981	38.0518

C MAIN	1	2	3
	34.6067	33.5500	36.0617

A BY B	1	2	3
1	28.9436	33.4307	38.1805
2	30.9932	37.7656	39.5232

A BY C	1	2	3
1	33.4605	32.3998	34.2944
2	35.7528	34.7002	37.8290

B BY C	1	2	3
1	29.7778	28.0585	31.4689
2	35.8975	34.3718	36.5251
3	38.1447	38.2197	40.1911

Table 75

Analysis of Variance for Problem Solving Test

Total Scores

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	90	28.4444	4.6449
A 1 B 1 C 2	69	27.0435	5.4488
A 1 B 1 C 3	35	30.1429	5.4077
A 1 B 2 C 1	105	34.3143	4.2705
A 1 B 2 C 2	61	32.6721	4.9150
A 1 B 2 C 3	36	33.3056	5.5282
A 1 B 3 C 1	114	37.6228	3.8864
A 1 B 3 C 2	62	37.4839	3.6563
A 1 B 3 C 3	46	39.4348	3.5381
A 2 B 1 C 1	63	31.1111	4.4941
A 2 B 1 C 2	68	29.0735	4.7703
A 2 B 1 C 3	39	32.7949	5.3665
A 2 B 2 C 1	52	37.4808	3.1154
A 2 B 2 C 2	70	36.0714	4.7222
A 2 B 2 C 3	47	39.7447	2.4801
A 2 B 3 C 1	78	38.6667	3.2700
A 2 B 3 C 2	45	38.9556	3.7777
A 2 B 3 C 3	57	40.9474	2.1665

Table 76

Analysis of Variance for Problem Solving Test

Subtest: Sensing and Identifying (A)

SOURCE	M.S.	D.F.	F-RATIO	PROB	VAR
TOTAL	2.376	1136			
BETWEEN	21.748	17			
A	22.162	1	10.6482	.0015	.0074
B	126.977	2	61.0082	.0000	.0925
I	18.456	2	8.8675	.0003	.0121
AB	12.903	2	6.1996	.0025	.0080
AC	9.248	2	4.4433	.0119	.0053
BC	1.562	4	.7504	.5603	0.0000
ABC	1.536	4	.7380	.5687	0.0000
WITHIN	2.081	1119			

Table 77

Analysis of Variance for Problem Solving Test

Subtest: Sensing and Identifying (A)

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2	
	6.6935	6.9886	
B MAIN	**1**	**2**	**3**
	6.1717	6.9808	7.3706
C MAIN	**1**	**2**	**3**
	6.7489	6.6680	7.1062

A BY B	1	2	3
1	6.2476	6.6977	7.1353
2	6.0958	7.2639	7.6060

A BY C	1	2	3
1	6.6582	6.6497	6.7727
2	6.8396	6.6864	7.4396

B BY C	1	2	3
1	6.1159	5.8971	6.5022
2	6.7760	6.9395	7.2270
3	7.3549	7.1676	7.5894

Table 78

Analysis of Variance for Problem Solving Test

Subtest: Sensing and Identifying (A)

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	90	6.2000	1.8914
A 1 B 1 C 2	69	6.0000	1.4852
A 1 B 1 C 3	35	6.5429	1.5782
A 1 B 2 C 1	105	6.5905	1.5235
A 1 B 2 C 2	61	6.8361	1.6143
A 1 B 2 C 3	36	6.6667	1.2189
A 1 B 3 C 1	114	7.1842	1.3734
A 1 B 3 C 2	62	7.1129	1.5052
A 1 B 3 C 3	46	7.1087	1.4334
A 2 B 1 C 1	63	6.0317	1.3792
A 2 B 1 C 2	68	5.7941	1.4410
A 2 B 1 C 3	39	6.4615	1.3543
A 2 B 2 C 1	52	6.9615	1.2674
A 2 B 2 C 2	70	7.0429	1.4187
A 2 B 2 C 3	47	7.7872	1.1784
A 2 B 3 C 1	78	7.5256	1.2764
A 2 B 3 C 2	45	7.2222	1.4754

Table 79

Analysis of Variance for Problem Solving Test

Subtest: Clarification I (B)

SOURCE	M.S.	D.F.	F-RATIO	PROB	VAR
TOTAL	1.954	1136			
BETWEEN	40.378	17			
A	41.639	1	30.3889	.0000	.0181
B	298.108	2	217.5657	.0000	.2672
C	7.789	2	5.6848	.0039	.0058
AB	11.195	2	8.1707	.0006	.0088
AC	.244	2	.1780	.8382	0.0000
BC	1.355	4	.9888	.5864	0.0000
ABC	1.173	4	.8560	.5081	0.0000
WITHIN	1.370	1119			

Table 80

Analysis of Variance for Problem Solving Test

Subtest: Clarification I (B)

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2	
	4.9735	5.3779	

B MAIN	1	2	3
	4.1974	5.2644	6.0652

C MAIN	1	2	3
	5.1250	5.0561	5.3460

A BY B	1	2	3
1	3.9453	4.9109	6.0644
2	4.4496	5.6180	6.0661

A BY C	1	2	3
1	4.9515	4.8496	5.1194
2	5.2985	5.2626	5.5726

B BY C	1	2	3
1	4.2452	4.0379	4.3092
2	5.2264	5.1937	5.3732
3	5.9035	3.9366	6.3556

Table 81

Analysis of Variance for Problem Solving Test

Subtest: Clarification I (B)

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL	N	MEAN	S.D.
A 1 B 1 C 1	90	3.9667	1.3278
A 1 B 1 C 2	69	3.8406	1.4207
A 1 B 1 C 3	35	4.0286	1.2482
A 1 B 2 C 1	105	4.9143	1.3806
A 1 B 2 C 2	61	4.9016	1.3748
A 1 B 2 C 3	36	4.9167	1.3810
A 1 B 3 C 1	114	5.9737	1.0514
A 1 B 3 C 2	62	5.8065	1.1138
A 1 B 3 C 3	46	6.4130	.8049
A 2 B 1 C 1	63	4.5238	1.1620
A 2 B 1 C 2	68	4.2353	1.3171
A 2 B 1 C 3	30	4.5897	1.1173
A 2 B 2 C 1	52	5.5385	1.0930
A 2 B 2 C 2	70	5.4857	1.3269
A 2 B 2 C 3	47	5.8298	.8925
A 2 B 3 C 1	78	5.8333	.7964
A 2 B 3 C 2	45	6.0667	.8893
A 2 B 3 C 3	57	6.2982	.7062

Table 82

Analysis of Variance for Problem Solving Test

Subtest: Clarification II (C)

SOURCE	M.S.	D.F.	F-RATIO	PROB	VAR
TOTAL	5.151	1136			
BETWEEN	127.838	17			
A	169.805	1	51.6623	.0000	.0284
B	907.569	2	276.1224	.0000	.3089
C	41.458	2	12.6135	.0000	.0130
AB	25.512	2	7.7618	.0007	.0076
AC	6.020	2	1.8315	.1584	.0009
BC	3.496	4	1.0635	.3735	.0001
ABC	7.085	4	2.1555	.0710	.0024
WITHIN	3.287	1119			

Table 83

Analysis of Variance for Problem Solving Test

Subtest: Clarification II (C)

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2	
	8.8852	9.7018	
B MAIN	1	2	3
	7.5634	9.5039	10.8130
C MAIN	1	2	3
	9.4333	8.8958	9.5514
A BY B	1	2	3
1	7.1781	8.8107	10.6666
2	7.9488	10.1971	10.9594
A BY C	1	2	3
1	9.1172	8.5478	8.9904
2	9.7493	9.2437	10.1123
B BY C	1	2	3
1	7.7000	7.1621	7.8282
2	9.8302	9.0879	9.5937
3	10.7696	10.4373	11.2323

Table 84

Analysis of Variance for Problem Solving Test

Subtest: Clarification II (C)

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	90	7.1778	1.8211
A 1 B 1 C 2	69	6.9565	1.9810
A 1 B 1 C 3	35	7.4000	1.8818
A 1 B 2 C 1	105	9.3143	2.0954
A 1 B 2 C 2	61	8.5902	2.2831
A 1 B 2 C 3	36	8.5278	1.8744
A 1 B 3 C 1	114	10.8596	1.8284
A 1 B 3 C 2	62	10.0968	1.8966
A 1 B 3 C 3	46	11.0435	1.4901
A 2 B 1 C 1	63	8.2222	1.9045
A 2 B 1 C 2	68	7.3676	1.5250
A 2 B 1 C 3	39	8.2564	1.8598
A 2 B 2 C 1	52	10.3462	1.5452
A 2 B 2 C 2	70	9.5857	1.9671
A 2 B 2 C 3	47	10.6596	1.8211
A 2 B 3 C 1	78	10.6795	1.3338
A 2 B 3 C 2	45	10.7778	1.3651
A 2 B 3 C 3	57	11.4211	1.3881

Table 85

Analysis of Variance for Problem Solving Test

Subtest: Problem parts (D)

SOURCE	M.S.	D.F.	F-RATIO	PROB	VAR
TOTAL	2.324	1136			
BETWEEN	41.218	17			
A	99.264	1	57.2773	.0000	.0369
B	243.688	2	140.6121	.0000	.1837
C	31.201	2	18.0098	.0000	.0224
AB	12.965	2	7.4808	.0009	.0085
AC	1.177	2	.6791	.5119	0.0000
BC	3.833	4	2.2119	.0648	.0032
ABC	1.971	4	1.1370	.3372	.0004
WITHIN	1.733	1119			

Table 86

Analysis of Variance for Problem Solving Test

Subtest: Problem parts (D)

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2
	7.3722	7.9966

B MAIN	1	2	3
	6.7515	7.8958	8.4059

C MAIN	1	2	3
	7.5910	7.4385	8.0237

A BY B	1	2	3
1	6.3955	7.4138	8.3073
2	7.1075	8.3778	8.5045

A BY C	1	2	3
1	7.2316	7.1923	7.6927
2	7.9503	7.6847	8.3546

B BY C	1	2	3
1	6.6294	6.3672	7.2579
2	7.9397	7.5902	8.1575
3	8.2038	8.3582	8.6536

Table 87

Analysis of Variance for Problem Solving Test

Subtest: Problem parts (D)

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	90	6.1000	1.6493
A 1 B 1 C 2	69	6.0580	1.7895
A 1 B 1 C 3	35	7.0286	1.3391
A 1 B 2 C 1	105	7.5333	1.3378
A 1 B 2 C 2	61	7.1803	1.4202
A 1 B 2 C 3	36	7.5278	1.7966
A 1 B 3 C 1	114	8.0614	1.1696
A 1 B 3 C 2	82	8.3537	1.0549
A 1 B 3 C 3	46	8.5217	.9829
A 2 B 1 C 1	63	7.1587	1.3936
A 2 B 1 C 2	68	6.6765	1.7487
A 2 B 1 C 3	30	7.4872	1.7899
A 2 B 2 C 1	52	8.3462	.7893
A 2 B 2 C 2	78	8.0000	1.3077
A 2 B 2 C 3	47	8.7872	.5080
A 2 B 3 C 1	78	8.3462	1.0171
A 2 B 3 C 2	45	8.3778	.8605
A 2 B 3 C 3	57	8.7895	.4526

Table 88

Analysis of Variance for Problem Solving Test

Subtest: Presolution (E)

SOURCE	M.S.	D.F.	F-RATIO	PROB	VAR
TOTAL	9.889	1136			
BETWEEN	243.631	17			
A	314.659	1	50.2893	.0000	.0277
B	1710.892	2	273.4373	.0000	.3058
C	102.121	2	16.3212	.0000	.0179
AB	45.457	2	7.2650	.0011	.0078
AC	29.331	2	4.6877	.0095	.0041
BC	2.700	4	.4315	.7883	0.0000
ABC	10.166	4	1.6248	.1644	.0014
WITHIN	6.257	1119			

Table 89

Analysis of Variance for Problem Solving Test

Subtest: Presolution (E)

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2	
	15.5787	16.6903	
B MAIN	1	2	3
	13.7351	16.4048	18.1837
C MAIN	1	2	3
	16.1822	15.5638	16.6576
A BY B	1	2	3
1	13.4257	15.5085	17.8019
2	14.0446	17.4610	18.5655
A BY C	1	2	3
1	15.7755	15.1975	15.7632
2	16.5889	15.9301	17.5520
B BY C	1	2	
1	13.8159	13.0591	14.3304
2	16.6062	16.0274	16.8206
3	18.1245	17.6048	18.8217

Table 90

Analysis of Variance for Problem Solving Test

Subtest: Presolution (E)

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	90	13.3778	2.8662
A 1 B 1 C 2	69	12.9565	2.9378
A 1 B 1 C 3	35	13.9429	3.0092
A 1 B 2 C 1	105	15.9048	2.6765
A 1 B 2 C 2	61	15.4262	3.0466
A 1 B 2 C 3	36	15.1944	2.4239
A 1 B 3 C 1	114	18.0439	2.5045
A 1 B 3 C 2	62	17.2097	2.5871
A 1 B 3 C 3	46	18.1522	2.1496
A 2 B 1 C 1	63	14.2540	2.4161
A 2 B 1 C 2	68	13.1618	2.4164
A 2 B 1 C 3	39	14.7179	2.6945
A 2 B 2 C 1	52	17.3077	2.0536
A 2 B 2 C 2	70	16.6286	2.4148
A 2 B 2 C 3	47	18.4468	2.0516
A 2 B 3 C 1	78	18.2051	1.4958
A 2 B 3 C 2	45	18.0000	2.2664
A 2 B 3 C 3	57	19.4912	1.7436

Table 91

Analysis of Variance for Problem Solving Test

Subtest: Solving Problems I (F)

SOURCE	M.S.	D.F.	F-RATIO	PROB	VAR
TOTAL	4.208	1136			
BETWEEN	91.300	17			
A	170.353	1	59.0485	.0000	.0350
B	601.909	2	208.6359	.0000	.2505
C	36.430	2	12.6274	.0000	.0140
AB	14.765	2	5.1181	.0064	.0050
AC	4.092	2	1.4184	.2411	.0005
BC	10.302	4	3.5710	.0069	.0062
ABC	6.535	4	2.2651	.0594	.0031
WITHIN	2.885	1119			

Table 92

Analysis of Variance for Problem Solving Test

Subtest: Solving Problems I (F)

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2	
	9.6206	10.4385	
B MAIN	**1**	**2**	**3**
	8.5511	10.4034	11.1342
C MAIN	**1**	**2**	**3**
	10.0632	9.6865	10.3390
A BY B	**1**	**2**	**3**
1	8.0275	9.8683	10.9659
2	9.0746	10.9385	11.3024
A BY C	**1**	**2**	**3**
1	9.7789	9.2436	9.8412
2	10.3494	10.1293	10.8369
B BY C	**1**	**2**	**3**
1	8.7087	7.9599	8.9846
2	10.6093	9.9438	10.6572
3	10.8715	11.1557	11.3753

Table 93

Analysis of Variance for Problem Solving Test

Subtest: Solving Problems I (F)

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	90	8.4333	1.8510
A 1 B 1 C 2	69	7.4493	2.2065
A 1 B 1 C 3	35	8.2000	2.1530
A 1 B 2 C 1	105	10.2571	1.7266
A 1 B 2 C 2	61	9.4590	1.6889
A 1 B 2 C 3	36	9.8889	2.6702
A 1 B 3 C 1	114	10.6404	1.6350
A 1 B 3 C 2	62	10.8226	1.3970
A 1 B 3 C 3	46	11.4348	1.4705
A 2 B 1 C 1	63	8.9841	1.9049
A 2 B 1 C 2	68	8.4706	1.9353
A 2 B 1 C 3	39	9.7692	2.2297
A 2 B 2 C 1	82	10.9615	1.2980
A 2 B 2 C 2	70	10.4286	1.8694
A 2 B 2 C 3	47	11.4255	1.0372
A 2 B 3 C 1	78	11.1026	1.3825
A 2 B 3 C 2	45	11.4889	1.2725
A 2 B 3 C 3	57	11.3158	.9665

Table 94

Analysis of Variance for Problem Solving Test

Subtest: Solving Problems II (G)

SOURCE	M.S.	D.F.	F-RATIO	PROB	VAR
TOTAL	7.530	1136			
BETWEEN	178.794	17			
A	360.470	1	73.1446	.0000	.0415
B	1157.994	2	234.9742	.0000	.2694
C	79.903	2	16.2135	.0000	.0175
AB	39.137	2	7.9415	.0007	.0080
AC	4.674	2	.9484	.6103	0.0000
BC	20.359	4	4.1312	.0029	.0072
ABC	8.544	4	1.7338	.1390	.0017
WITHIN	4.928	1119			

Table 95

Analysis of Variance for Problem Solving Test

Subtest: Solving Problems II (G)

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2	
	13.6932	14.8830	

B MAIN	1	2	3
	12.2364	14.8104	15.8176

C MAIN	1	2	3
	14.2703	13.8121	14.7819

A BY B	1	2	3
1	11.4878	13.9800	15.6119
2	12.9850	15.6408	16.0233

A BY C	1	2	3
1	13.7819	13.2365	14.0612
2	14.7588	14.3877	15.5026

B BY C	1	2	3
1	12.3738	11.3481	12.9872
2	15.0171	14.2715	15.1424
3	15.4200	15.8167	16.2161

Table 96

Analysis of Variance for Problem Solving Test

Subtest: Solving Problems II (G)

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	90	11.8111	2.1770
A 1 B 1 C 2	69	10.6522	2.9146
A 1 B 1 C 3	35	12.0000	2.6458
A 1 B 2 C 1	105	14.4381	2.2098
A 1 B 2 C 2	61	13.5574	2.2842
A 1 B 2 C 3	36	13.9444	3.9202
A 1 B 3 C 1	114	15.0965	1.9999
A 1 B 3 C 2	62	15.5000	1.6962
A 1 B 3 C 3	46	16.2391	1.8035
A 2 B 1 C 1	63	12.9365	2.4021
A 2 B 1 C 2	68	12.0441	2.5941
A 2 B 1 C 3	39	13.9744	2.9867
A 2 B 2 C 1	52	15.5962	1.4985
A 2 B 2 C 2	70	14.9857	2.3986
A 2 B 2 C 3	47	16.3404	1.0689
A 2 B 3 C 1	78	15.7436	1.7316
A 2 B 3 C 2	45	16.1333	1.7268
A 2 B 3 C 3	57	16.1930	1.1250

Table 97

Analysis of Variance for Problem Solving Test

Subtest: Solving Problems III (H)

SOURCE	M.S.	D.F.	F-RATIO	PROB	VAR
TOTAL	10.236	1136			
BETWEEN	250.508	17			
A	529.695	1	80.4264	.0000	.0450
B	1611.271	2	244.6480	.0000	.2758
C	130.927	2	19.8794	.0000	.0214
AB	54.161	2	8.2235	.0005	.0082
AC	3.110	2	.4722	.6298	0.0000
B	25.286	4	3.8394	.0045	.0064
ABC	7.214	4	1.0953	.3574	.0002
WITHIN	6.586	1119			

Table 98

Analysis of Variance for Problem Solving Test

Subtest: Solving Problems III (H)

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2
	16.9928	18.4351

B MAIN	1	2	3
	15.3026	18.2993	19.5400

C MAIN	1	2	3
	17.6541	17.1250	18.3627

A BY B	1	2	3
1	14.4231	17.2822	19.2732
2	16.1821	19.3163	19.8069

A BY C	1	2	3
1	17.0085	16.4360	17.5339
2	18.2998	17.8141	19.1915

B BY C	1	2	3
1	15.3381	14.3272	16.2425
2	18.5491	17.5340	18.8147
3	19.0752	19.5140	20.0309

Table 99

Analysis of Variance for Problem Solving Test

Subtest: Solving Problems III (H)

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	90	14.5333	2.7075
A 1 B 1 C 2	69	13.5072	3.4241
A 1 B 1 C 3	35	15.2286	3.1444
A 1 B 2 C 1	105	17.7905	2.5408
A 1 B 2 C 2	61	16.6393	2.6333
A 1 B 2 C 3	36	17.4167	4.1705
A 1 B 3 C 1	114	18.7018	2.3117
A 1 B 3 C 2	62	19.1613	2.0179
A 1 B 3 C 3	46	19.9565	2.2086
A 2 B 1 C 1	63	16.1429	2.7407
A 2 B 1 C 2	68	15.1471	2.9232
A 2 B 1 C 3	39	17.2564	3.4922
A 2 B 2 C 1	52	19.3077	1.6749
A 2 B 2 C 2	70	18.4286	2.8314
A 2 B 2 C 3	47	20.2128	1.1967
A 2 B 3 C 1	78	19.4487	2.0363
A 2 B 3 C 2	45	19.8667	1.8902
A 2 B 3 C 3	57	20.1053	1.1754

Table 100

Means and Standard Deviations of Scores on
Problem Solving Test for White Affluent Sample

	Grade					
	2		4		6	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Total	34.59	4.45	38.44	3.49	40.98	2.48
Sensing and Identifying	6.35	1.36	6.58	1.26	7.66	1.46
Clarification I	4.92	1.15	5.73	1.07	6.37	.80
Clarification II	8.94	1.86	10.58	1.58	11.52	1.45
Problem Parts	7.94	1.49	8.48	1.04	8.71	.62
Presolution	15.29	2.39	17.15	2.12	19.18	2.06

Appendix XI

Table 101

Analysis of Variance for Response Style:
Cognitive Preference Total Scores

Source	M.S.	D.F.	F-Ratio	Prob	Var
Total	5.672	765			
Between	31.971	11			
A	78.142	1	14.7774	.0003	.0168
B	170.906	1	32.3198	.0000	.0381
C	33.571	2	6.3485	.0023	.0130
AB	.219	1	.0413	.8334	0.0000
AC	6.140	2	1.1611	.3137	.0004
BC	3.303	2	.6246	.5408	0.0000
ABC	8.197	2	1.5501	.2111	.0013
Within	5.288	754			

Table 102

Analysis of Variance for Response Style: Cognitive Preference

Total Scores

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS

A MAIN	1	2	
	7.8587	8.5287	
B MAIN	**1**	**2**	
	7.6983	8.6891	
C MAIN	**1**	**2**	**3**
	8.2168	7.8024	8.5620

A BY B	1	2
1	7.3650	8.3715
2	8.0510	9.0064

A BY C	1	2	3
1	7.7390	7.6444	8.1927
2	8.6946	7.9604	8.9312

B BY C	1	2	3
1	7.8519	7.2037	8.0392
2	8.5816	8.4011	9.0847

Table 103

Analysis of Variance for Response Style: Cognitive Preference

Total Scores

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL	N	MEAN	S.D.
A 1 B 1 C 1	100	7.5500	2.1195
A 1 B 1 C 2	62	7.0161	2.1841
A 1 B 1 C 3	34	7.4706	2.0427
A 1 B 2 C 1	111	7.9279	2.2872
A 1 B 2 C 2	66	8.2727	2.2364
A 1 B 2 C 3	47	8.9149	2.1451
A 2 B 1 C 1	52	8.1538	2.3713
A 2 B 1 C 2	69	7.3913	2.3528
A 2 B 1 C 3	51	8.6078	2.4090
A 2 B 2 C 1	68	9.2353	2.4134
A 2 B 2 C 2	51	8.5294	2.0722
A 2 B 2 C 3	55	9.2545	2.5475

Table 104

Analysis of Variance for Response Style: Locus of Control

Total Scores

SOURCE	M.S.	D.F.	F-RATIO	PROB	VAR
TOTAL	25.620	1144			
BETWEEN	263.435	17			
A	30.225	1	1.3718	.2399	.0003
B	1877.105	2	85.1964	.0000	.1265
C	234.297	2	10.6340	.0001	.0145
AB	3.391	2	.1539	.8580	0.0000
AC	14.909	2	.6767	.5132	0.0000
BC	29.045	4	1.3183	.2601	.0010
ABC	18.146	4	.8236	.5122	0.0000
WITHIN	22.033	1127			

Table 105

Analysis of Variance for Responce Style: Locus of Control

Total Scores

Means of Main Effects and Interaction Groups

MEANS FOR ALL EFFECTS.

A MAIN	1	2	
	9.9396	9.5995	
B MAIN	1	2	3
	12.4101	8.8486	8.0499
C MAIN	1	2	3
	10.2454	10.2407	8.8225
A BY B	1	2	3
1	12.5414	9.1309	8.1466
2	12.2789	8.5664	7.9532
A BY C	1	2	3
1	10.5333	10.5318	8.7537
2	9.9575	9.9496	8.8913
B BY C	1	2	3
1	12.4063	12.7709	12.0532
2	9.3692	9.4610	7.7157
3	8.9608	8.4902	6.6986

Table 106

Analysis of Variance for Response Style: Locus of Control

Total Scores

Means and Standard Deviations of Smallest Sub-cells of Experiment

CELL CHARACTERISTICS

CELL			N	MEAN	S.D.
A 1	B 1	C 1	90	12.5667	5.1757
A 1	B 1	C 2	63	13.0794	4.7733
A 1	B 1	C 3	46	11.9783	5.1833
A 1	B 2	C 1	100	9.7000	3.8756
A 1	B 2	C 2	62	9.5161	4.5222
A 1	B 2	C 3	34	8.1765	4.2674
A 1	B 3	C 1	111	9.3333	4.9860
A 1	B 3	C 2	66	9.0000	4.8453
A 1	B 3	C 3	47	6.1064	4.6822
A 2	B 1	C 1	61	12.2459	4.5777
A 2	B 1	C 2	80	12.4625	4.6876
A 2	B 1	C 3	39	12.1282	3.5996
A 2	B 2	C 1	52	9.0385	3.7780
A 2	B 2	C 2	69	9.4058	4.2645
A 2	B 2	C 3	51	7.2549	5.1414
A 2	B 3	C 1	68	8.5882	4.8043
A 2	B 3	C 2	51	7.9804	4.9497
A 2	B 3	C 3	55	7.2909	5.5733

Appendix XII

Table 107

Grade Two Variable Names and Numbers

1. Word Knowledge
2. Word Discrimination
3. Reading
4. Conservation
5. MIBS
6. Concept Formation Total
7. Matrices
8. Row and Column
9. Intersections
10. Logical Thinking Total
11. Internal External Scale
12. Socioeconomic Status
13. Problem Solving Total
14. Sensing and Identifying
15. Clarification I
16. Clarification II
17. Problem Parts
18. Pre Solution
19. Problem Solving I
20. Problem Solving II
21. Problem Solving III
22. Words
23. Sentences
24. Commas
25. Other Punctuation
26. Average Sentence Length
27. Standard Deviation Sentence Length
28. Average Word Length
29. Standard Deviation Word Length
30. Vision 1
31. Vision 2
32. Vision 3
33. Vision 4
34. Vision 5
35. Vision 6
36. Vision 7
37. Vision 8
38. Vision 9
39. Vision 10
40. Oral Paradygmatic
41. Oral Homogeneous
42. Written Paradygmatic
43. Written Homogeneous

CORRELATIONS

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.000															
2	.779	1.000														
3	.807	.695	1.000													
4	.157	.124	.205	1.000												
5	.220	.270	.340	.332	1.000											
6	.205	.193	.285	.951	.908	1.000										
7	.375	.348	.411	.326	.350	.391	1.000									
8	.258	.267	.287	.212	.211	.249	.412	1.000								
9	.084	.056	.124	.136	.129	.158	.090	.106	1.000							
10	.413	.373	.458	.326	.328	.384	.856	.618	.387	1.000						
11	-.289	-.255	-.322	-.181	-.232	-.230	-.264	-.175	-.160	-.287	1.000					
12	.316	.219	.321	.119	.038	.112	.148	.088	.033	.166	-.026	1.000				
13	.440	.413	.515	.245	.331	.314	.431	.355	.098	.505	-.359	.231	1.000			
14	.277	.267	.328	.109	.275	.182	.250	.273	.039	.293	-.267	-.046	.633	1.000		
15	.250	.240	.298	.198	.210	.235	.240	.181	.079	.265	-.173	.188	.504	.253	1.000	
16	.272	.252	.325	.235	.269	.285	.283	.202	.118	.325	-.241	.197	.625	.282	.720	1.000

CORRELATIONS

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
17	.363	.330	.388	.157	.272	.221	.355	.248	-.003	.391	-.284	.226	.717	.312	.186	.302
18	.341	.322	.405	.222	.339	.297	.334	.291	.103	.387	-.313	.108	.783	.759	.632	.839
19	.303	.265	.391	.188	.181	.217	.292	.270	.070	.355	-.237	.225	.775	.339	.215	.299
20	.381	.348	.464	.196	.243	.244	.381	.308	.069	.438	-.276	.253	.853	.361	.247	.356
21	.389	.347	.458	.204	.260	.256	.376	.305	.043	.436	-.303	.264	.877	.383	.236	.352
22	.405	.388	.465	.106	.157	.140	.232	.156	-.046	.200	-.213	.233	.317	.154	.220	.259
23	.344	.338	.406	.100	.051	.101	.207	.096	-.010	.176	-.198	.264	.282	.108	.187	.156
24	.290	.193	.297	-.015	.056	.006	.106	.059	-.012	.089	-.073	.182	.160	.023	.102	.154
25	.347	.163	.319	.206	.063	.194	.139	.150	.067	.204	-.162	.114	.251	.085	.189	.225
26	-.097	-.067	-.076	-.036	.057	-.011	-.094	.036	-.051	-.060	.040	-.050	-.048	-.045	-.022	.027
27	-.024	-.015	.040	.007	.065	.028	.011	.005	-.020	-.006	.009	-.053	.021	.066	.068	.041
28	.460	.527	.508	.133	.289	.207	.258	.200	-.007	.281	-.186	.198	.379	.277	.259	.308
29	.368	.361	.391	.048	.179	.099	.206	.118	-.062	.204	-.114	.127	.242	.186	.253	.217
30	.182	.322	.124	.440	.469	.492	.590	.152	.171	.489	-.172	0.000	.216	.060	.187	.183
31	.146	.224	.181	.296	.302	.326	.445	.375	.305	.528	.096	0.000	.398	.133	-.111	-.077
32	.129	.384	.263	.306	.323	.389	.430	.090	.348	.444	-.017	0.000	.258	.203	.019	-.112

CORRELATIONS

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
33	.094	.031	-.084	.038	.204	.095	.285	.157	.530	.445	-.182	0.000	.537	.315	.087	.295
34	.170	.300	.168	.440	.359	.458	.474	.216	.145	.427	-.164	0.000	.211	.004	.070	.107
35	.077	.218	.434	.242	.408	.328	.155	.272	.094	.222	-.354	0.000	.418	.167	.012	.056
36	-.366	-.327	-.226	.406	.051	.342	.271	-.004	-.146	.174	-.188	0.000	.396	.212	.053	.176
37	-.009	.117	.233	.088	.235	.147	.415	.124	-.260	.235	.094	0.000	.367	.115	.152	.295
38	.060	-.054	.323	.052	.159	.093	.062	.164	-.058	.130	-.076	0.000	.313	-.023	-.162	.036
39	-.126	.042	-.068	.549	.376	.562	.385	.301	-.057	.437	.194	0.000	.442	.125	.265	.234
40	.356	.339	.368	.165	.154	.187	.337	.356	.199	.385	-.264	.196	.450	.199	.284	.378
41	.402	.381	.399	.174	.156	.196	.383	.370	.226	.428	-.296	.252	.502	.247	.320	.415
42	.647	.699	.632	.135	.308	.213	.402	.267	.103	.420	-.301	.296	.459	.290	.295	.374
43	.607	.621	.566	.098	.277	.172	.376	.220	.071	.372	-.271	.259	.381	.281	.254	.335

CORRELATIONS

VARIABLE	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
17	1.000															
18	.382	1.000														
19	.452	.395	1.000													
20	.703	.446	.921	1.000												
21	.823	.456	.879	.962	1.000											
22	.236	.265	.194	.259	.256	1.000										
23	.269	.168	.174	.257	.261	.598	1.000									
24	.187	.118	.093	.141	.163	.261	.173	1.000								
25	.166	.202	.198	.225	.219	.185	.206	.235	1.000							
26	-.062	-.007	-.006	-.020	-.038	.274	-.459	-.022	-.048	1.000						
27	-.022	.066	.023	.021	.002	.334	-.249	.060	.008	.491	1.000					
28	.271	.368	.249	.310	.310	.331	.227	.176	.213	.011	.127	1.000				
29	.103	.254	.145	.152	.150	.234	.188	.218	.199	.008	.077	.636	1.000			
30	.307	.160	.012	.099	.164	-.078	-.010	0.000	0.000	-.097	-.272	-.272	-.262	1.000		
31	.376	.017	.441	.479	.488	.199	.254	0.000	0.000	-.095	-.119	-.124	-.365	.472	1.000	
32	.335	.029	.138	.215	.262	-.002	-.061	0.000	0.000	.109	-.016	-.105	-.139	.312	.384	1.000

CORRELATIONS

VARIABLE	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
33	.499	.373	.399	.512	.522	-.005	-.089	0.000	0.000	.060	-.187	-.076	-.217	.150	.314	.142
34	.294	.077	.083	.183	.204	.163	.107	0.000	0.000	-.041	.132	-.008	-.254	.685	.656	.170
35	.330	.172	.327	.309	.404	-.036	-.047	.023	0.000	-.009	-.068	.247	.195	0.000	0.000	0.000
36	.484	.298	.124	.264	.377	-.073	.134	-.345	0.000	-.102	-.068	-.215	-.162	0.000	0.000	0.000
37	.397	.315	.146	.297	.336	.110	-.098	.405	0.000	.226	-.065	-.097	-.088	0.000	0.000	0.000
38	.229	.010	.424	.414	.403	.116	-.159	.343	0.000	.218	.179	.413	.358	0.000	0.000	0.000
39	.442	.276	.246	.404	.426	.289	.042	-.121	0.000	.388	.112	.121	.026	0.000	0.000	0.000
40	.462	.383	.266	.388	.406	.136	.117	.154	.153	-.079	.033	.366	.283	.171	-.012	.117
41	.470	.436	.305	.419	.436	.182	.159	.174	.191	-.091	.025	.439	.236	.169	.089	.069
42	.394	.420	.249	.360	.368	.423	.371	.210	.197	-.111	.063	.544	.415	.048	.118	.308
43	.354	.387	.155	.273	.287	.350	.314	.192	.196	-.129	.054	.494	.391	.118	.093	.313

CORRELATIONS

VARIABLE	33	34	35	36	37	38	39	40	41	42	43
33	1.000										
34	.092	1.000									
35	0.000	0.000	1.000								
36	0.000	0.000	.033	1.000							
37	0.000	0.000	.101	.098	1.000						
38	0.000	0.000	.351	-.028	.320	1.000					
39	0.000	0.000	-.063	.367	.432	.084	1.000				
40	-.035	.148	.468	.298	-.121	-.047	.031	1.000			
41	.041	.067	.511	.253	-.131	-.142	-.027	.971	1.000		
42	.204	.118	.339	-.227	-.045	.240	-.033	.546	.573	1.000	
43	.166	.205	.174	-.075	-.086	.120	-.077	.506	.517	.913	1.000

Table 108

Grade Four Variable Names and Numbers

1. Intelligence-Verbal
2. Intelligence-Non Verbal
3. Vocabulary
4. Reading Comprehension
5. Spelling
6. Capitalization
7. Punctuation
8. Usage
9. Arithmetic Concepts
10. Arithmetic Problems
11. Conservation
12. MIBS
13. Concept Formation Total
14. Matrices
15. Row and Column
16. Intersections
17. Logical Thinking Total
18. Internal-External Scale
19. Cognitive Preference
20. Socioeconomic Status
21. Problem Solving Total
22. Sensing and Identifying
23. Clarification I
24. Clarification II
25. Problem Parts
26. Pre Solution
27. Problem Solving I
28. Problem Solving II
29. Problem Solving III
30. Words
31. Sentences
32. Commas
33. Other Punctuation
34. Average Sentence Length
35. Standard Deviation Sentence Length
36. Average Word Length
37. Standard Deviation Word Length
38. Oral Paradygmatic
39. Oral Homogeneous
40. Written Paradygmatic
41. Written Homogeneous

CORRELATIONS

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.000															
2	.739	1.000														
3	.719	.548	1.000													
4	.685	.545	.727	1.000												
5	.641	.497	.582	.604	1.000											
6	.666	.541	.587	.604	.690	1.000										
7	.617	.516	.583	.594	.668	.738	1.000									
8	.641	.556	.602	.605	.543	.641	.600	1.000								
9	.767	.666	.697	.702	.587	.641	.620	.603	1.000							
10	.688	.635	.557	.585	.594	.590	.582	.537	.715	1.000						
11	.270	.253	.279	.247	.142	.264	.166	.219	.259	.243	1.000					
12	.320	.368	.285	.262	.208	.272	.217	.252	.350	.286	.220	1.000				
13	.354	.361	.347	.319	.236	.329	.226	.285	.360	.318	.903	.619	1.000			
14	.519	.567	.481	.453	.394	.406	.448	.374	.524	.504	.301	.377	.410	1.000		
15	.315	.341	.332	.317	.246	.299	.287	.243	.357	.284	.260	.303	.328	.446	1.000	
16	.362	.411	.363	.343	.162	.256	.251	.267	.362	.317	.186	.217	.246	.343	.299	1.000

CORRELATIONS

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
17	.553	.607	.535	.516	.373	.440	.446	.412	.573	.510	.332	.396	.443	.431	.679	.754
18	-.323	-.239	-.241	-.201	-.214	-.235	-.257	-.225	-.260	-.204	-.119	-.201	-.199	-.204	-.140	-.112
19	.308	.257	.368	.334	.307	.247	.241	.307	.296	.286	.083	.153	.138	.274	.192	.182
20	.334	.351	.292	.303	.230	.199	.191	.240	.253	.274	.215	.185	.255	.282	.132	.293
21	.458	.417	.401	.413	.292	.337	.353	.379	.463	.386	.291	.372	.402	.434	.252	.290
22	.180	.172	.182	.190	.098	.134	.163	.187	.213	.145	.172	.174	.216	.140	.128	.120
23	.377	.270	.258	.295	.270	.303	.278	.283	.342	.348	.120	.188	.160	.270	.165	.127
24	.402	.303	.284	.318	.317	.318	.295	.270	.384	.355	.171	.230	.239	.302	.181	.174
25	.229	.263	.242	.234	.133	.129	.213	.235	.233	.205	.218	.276	.298	.298	.135	.186
26	.410	.329	.322	.352	.299	.322	.317	.310	.417	.358	.224	.270	.300	.309	.209	.200
27	.344	.329	.312	.302	.173	.242	.233	.277	.344	.276	.243	.321	.338	.351	.191	.234
28	.345	.348	.315	.305	.194	.249	.252	.241	.349	.294	.254	.328	.350	.372	.190	.255
29	.340	.347	.325	.314	.179	.223	.258	.298	.342	.283	.264	.343	.365	.373	.189	.242
30	.399	.327	.258	.322	.346	.453	.365	.355	.301	.311	.097	.095	.121	.240	.171	.195
31	.324	.318	.259	.382	.375	.485	.406	.301	.323	.303	.088	.128	.129	.361	.150	.096
32	.464	.372	.386	.414	.462	.443	.432	.415	.426	.421	.168	.080	.171	.325	.185	.122

CORRELATIONS

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
33	.185	.181	.142	.151	.145	.146	.212	.168	.151	.182	.091	.061	.101	.164	.027	.092
34	-.078	-.105	-.116	-.140	-.171	-.206	-.218	-.172	-.178	-.146	-.053	-.097	-.087	-.207	-.038	.114
35	-.113	-.204	-.068	-.092	-.119	-.137	-.185	-.116	-.174	-.169	-.033	-.092	-.068	-.192	-.115	.024
36	.463	.243	.412	.468	.494	.435	.349	.376	.447	.389	.168	.126	.208	.240	.028	-.113
37	.530	.314	.406	.461	.477	.467	.409	.38:	.438	.377	.146	.110	.167	.219	.057	-.148
38	.307	.202	.349	.294	.317	.365	.299	.201	.319	.244	.124	.119	.151	.229	-.111	.151
39	.314	.191	.331	.299	.356	.379	.316	.215	.305	.265	.140	.119	.168	.237	-.103	.140
40	.395	.198	.339	.264	.387	.358	.275	.276	.322	.291	.137	-.023	.098	.191	-.005	.159
41	.357	.166	.296	.285	.356	.341	.226	.230	.291	.255	.117	-.026	.080	.156	-.035	.135

CORRELATIONS

VARIABLE	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
17	1.000															
18	-.207	1.000														
19	.247	-.140	1.000													
20	.316	-.084	.129	1.000												
21	.448	-.211	.267	.395	1.000											
22	.171	-.119	.105	.183	.494	1.000										
23	.259	-.103	.176	.255	.585	.131	1.000									
24	.247	-.141	.179	.208	.672	.125	.760	1.000								
25	.296	-.118	.207	.324	.728	.246	.276	.312	1.000							
26	.322	-.172	.194	.307	.789	.636	.661	.645	.375	1.000						
27	.360	-.151	.204	.245	.771	.151	.324	.388	.534	.383	1.000					
28	.385	-.167	.223	.294	.830	.198	.360	.405	.722	.422	.942	1.000				
29	.377	-.155	.232	.317	.857	.218	.345	.405	.834	.432	.912	.966	1.000			
30	.248	-.083	.2[illegible]	.147	.255	-.002	.172	.208	.128	.161	.234	.239	.215	1.000		
31	.302	-.068	.182	.072	.168	.017	.078	.092	.064	.081	.167	.175	.140	.445	1.000	
32	.287	-.134	.167	.232	.186	.017	.228	.230	.012	.190	.186	.176	.128	.388	.353	1.000

CORRELATIONS

VARIABLE	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
33	.152	-.106	.124	.150	.108	.056	.106	-.031	.111	.008	.118	.126	.131	.207	.219	.322
34	-.071	-.031	-.032	.057	-.078	-.097	-.043	-.018	-.018	-.071	-.049	-.060	-.041	.137	-.504	-.076
35	-.137	.028	-.072	-.102	-.086	-.031	-.076	-.071	-.024	-.073	-.043	-.057	-.040	.150	-.316	-.032
36	.109	-.108	.207	.111	.173	.081	.200	.208	-.006	.210	.190	.179	.126	.232	.321	.339
37	.074	-.062	.169	.230	.167	-.039	.207	.243	.016	.167	.190	.161	.133	.226	.	.319
38	.153	-.222	.133	.172	.266	.026	.185	.280	.180	.250	.228	.241	.231	.118	.025	.224
39	.157	-.224	.144	.167	.252	.017	.194	.267	.171	.234	.205	.228	.213	.167	.064	.213
40	.171	-.272	.103	.108	.206	.033	.148	.207	.125	.180	.191	.196	.186	.268	.284	.323
41	.128	-.260	.109	.136	.167	.030	.144	.185	.113	.161	.189	.184	.179	.301	.249	.290

CORRELATIONS

VARIABLE	33	34	35	36	37	38	39	40	41
33	1.000								
34	-.057	1.000							
35	-.036	.468	1.000						
36	.088	-.240	-.150	1.000					
37	.042	-.128	-.119	.978	1.000				
38	-.035	.020	.036	-.402	-.026	1.000			
39	-.022	.013	.014	.300	.079	.973	1.000		
40	.171	.023	-.095	.341	.244	.557	.599	1.000	
41	.149	-.001	.064	.309	.255	.567	.620	.961	1.000

Table 109

Grade Six Variable Names and Numbers

1. Intelligence-Verbal
2. Intelligence-Non Verbal
3. Vocabulary
4. Reading Comprehension
5. Spelling
6. Capitalization
7. Punctuation
8. Usage
9. Maps
10. Graphs
11. References
12. Arithmetic Concepts
13. Arithmetic Problems
14. Conservation
15. MIBS
16. Concept Formation Total
17. Matrices
18. Row and Column
19. Intersections
20. Logical Thinking Total
21. Internal-External Scale
22. Cognitive Preference
23. Socioeconomic Status
24. Problem Solving Total
25. Sensing and Identifying
26. Clarification I
27. Clarification II
28. Problem Parts
29. Pre Solution
30. Problem Solving I
31. Problem Solving II
32. Problem Solving III
33. Words
34. Sentence
35. Commas
36. Other Punctuation
37. Average Sentence Length
38. Standard Deviation Sentence Length
39. Average Word Length
40. Standard Deviation Word Length
41. Unity
42. Development
43. Imagination
44. Overall Quality
45. Oral Paradygmatic
46. Oral Homogeneous
47. Written Paradygmatic
48. Written Homogeneous

CORRELATIONS

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.000															
2	.276	1.000														
3	.676	.064	1.000													
4	.698	.337	.642	1.000												
5	.661	.105	.595	.576	1.000											
6	.613	.223	.478	.602	.646	1.000										
7	.594	.268	.489	.607	.574	.685	1.000									
8	.586	.109	.488	.605	.509	.558	.588	1.000								
9	.374	.170	.413	.445	.366	.401	.372	.302	1.000							
10	.500	.174	.514	.540	.399	.420	.455	.396	.438	1.000						
11	.646	.184	.487	.603	.561	.552	.622	.546	.392	.532	1.000					
12	.673	.118	.592	.634	.576	.568	.547	.488	.408	.581	.642	1.000				
13	.431	.146	.389	.442	.429	.433	.446	.387	.410	.459	.538	.559	1.000			
14	.236	.083	.211	.231	.215	.258	.208	.165	.131	.193	.198	.213	.198	1.000		
15	.366	.194	.280	.350	.323	.366	.351	.297	.259	.339	.362	.346	.260	.283	1.000	
16	.349	.152	.293	.341	.317	.370	.325	.266	.222	.306	.320	.324	.273	.898	.676	1.000

CORRELATIONS

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
17	.496	.221	.408	.411	.342	.458	.423	.380	.265	.348	.439	.413	.359	.334	.454	.466
18	.402	.241	.282	.340	.267	.320	.344	.303	.180	.315	.322	.267	.166	.162	.357	.289
19	.436	.206	.405	.455	.347	.346	.362	.338	.252	.358	.393	.385	.267	.208	.402	.345
20	.582	.284	.487	.526	.415	.489	.488	.443	.302	.445	.499	.472	.353	.325	.522	.490
21	-.170	-.034	-.149	-.110	-.165	-.222	-.197	-.182	-.068	-.008	-.192	-.081	-.088	-.103	-.110	-.130
22	.308	.160	.260	.260	.216	.242	.211	.269	.103	.188	.282	.207	.140	.045	.139	.098
23	.332	.040	.406	.298	.297	.197	.233	.189	.176	.233	.250	.2·	.198	.305	.272	.359
24	.400	.182	.425	.375	.271	.309	.321	.322	.262	.270	.338	.332	.285	.223	.290	.305
25	.103	.063	.216	.096	.107	.041	.065	.042	.133	.146	.032	.132	.035	.170	.216	.231
26	.256	.136	.224	.217	.168	.183	.230	.213	.075	.095	.281	.201	.157	.149	.127	.173
27	.298	.114	.281	.252	.233	.214	.256	.258	.155	.133	.290	.232	.204	.202	.104	.203
28	.273	.114	.260	.246	.153	.227	.199	.225	.201	.178	.245	.231	.214	.141	.181	.192
29	.271	.118	.326	.237	.230	.178	.222	.210	.188	.179	.226	.241	.166	.241	.199	.277
30	.294	.125	.263	.285	.174	.252	.213	.233	.160	.188	.251	.222	.243	.123	.196	.185
31	.319	.136	.312	.303	.197	.277	.241	.254	.183	.211	.276	.255	.266	.154	.221	.221
32	.333	.140	.318	.313	.192	.281	.240	.266	.206	.215	.289	.262	.268	.153	.221	.220

CORRELATIONS

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
33	.286	.063	.233	.227	.297	.290	.226	.243	.121	.100	.194	.204	.162	.214	.191	.265
34	.288	.131	.199	.216	.271	.311	.271	.178	.154	.152	.202	.196	.168	.219	.208	.277
35	.317	.073	.252	.254	.316	.290	.314	.249	.097	.117	.251	.221	.126	.101	.191	.174
36	.071	-.014	.232	.131	.095	.157	-.011	.133	.069	-.046	-.045	.019	-.056	.108	-.010	.082
37	-.165	-.093	-.073	-.147	-.142	-.186	-.155	-.089	-.136	-.186	-.118	-.144	-.138	-.096	-.075	-.113
38	-.113	-.080	-.027	-.078	-.110	-.135	-.061	-.036	-.044	-.137	-.077	-.099	-.097	-.092	-.075	-.111
39	.467	.115	.313	.405	.399	.317	.279	.359	.219	.236	.354	.358	.172	.134	.029	.123
40	.454	.082	.376	.375	.451	.311	.266	.333	.224	.243	.280	.331	.179	.164	.047	.155
41	.381	.079	.199	.208	.215	.423	.350	.402	.169	.130	.406	.262	.409	.070	-.001	.060
42	.404	.117	.171	.145	.309	.399	.398	.345	.206	.115	.478	.226	.396	.077	-.128	.010
43	.234	.030	.116	.037	.234	.338	.336	.271	.150	.003	.320	.148	.305	.087	-.054	.051
44	.371	.081	.180	.142	.273	.419	.394	.371	.192	.092	.433	.230	.402	.085	-.067	.044
45	.025	.046	.014	.041	-.019	-.054	.004	-.034	.158	.016	-.006	.024	.081	.050	-.133	-.031
46	.015	.042	.029	.035	-.016	-.007	.001	-.062	.164	.021	.017	.014	.083	.041	-.117	-.030
47	.240	.061	.101	.152	.185	.219	.184	.228	.107	.105	.223	.171	.172	.089	.093	.116
48	.244	.054	.110	.140	.190	.196	.173	.216	.123	.110	.208	.161	.184	.096	.076	.112

CORRELATIONS

VARIABLE	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
17	1.000															
18	.417	1.000														
19	.447	.343	1.000													
20	.821	.683	.802	1.000												
21	-.156	-.091	-.087	-.147	1.000											
22	.296	.140	.262	.320	-.085	1.000										
23	.326	.153	.365	.380	-.052	.163	1.000									
24	.377	.326	.341	.452	-.143	.184	.205	1.000								
25	.177	.172	.168	.229	-.006	.094	.174	.564	1.000							
26	.216	.151	.154	.227	-.150	.126	.011	.545	.187	1.000						
27	.220	.160	.206	.257	-.081	.127	.076	.622	.180	.689	1.000					
28	.256	.270	.237	.321	-.084	.108	.126	.636	.135	.276	.257	1.000				
29	.256	.211	.241	.312	-.062	.145	.156	.773	.713	.601	.818	.262	1.000			
30	.279	.251	.243	.331	-.205	.138	.147	.669	.140	.200	.189	.464	.216	1.000		
31	.305	.280	.272	.366	-.190	.152	.150	.721	.141	.231	.222	.688	.241	.943	1.000	
32	.312	.300	.278	.378	-.179	.145	.161	.762	.160	.270	.253	.801	.274	.869	.958	1.000

CORRELATIONS

VARIABLE	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
33	.132	.006	.244	.189	-.057	.142	.215	.132	.066	.025	.146	.106	.149	-.034	.005	.040
34	.188	.099	.277	.259	-.076	.126	.221	.133	.034	.020	.168	.106	.147	.061	.083	.105
35	.144	.080	.215	.201	-.097	.184	.250	.144	.068	.073	.090	.046	.108	.005	.027	.035
36	.094	-.017	.127	.109	-.024	.039	.182	.071	.078	.035	.003	.084	.049	-.031	-.008	.016
37	-.151	-.145	-.096	-.165	.011	-.010	-.121	-.014	.071	.039	-.054	-.048	.002	-.130	-.133	-.118
38	-.123	-.154	-.122	-.158	-.039	-.033	-.072	.027	.123	.034	-.016	-.059	.061	-.105	-.101	-.102
39	.143	.194	.096	.185	-.047	.179	.029	.134	-.089	.041	.082	.148	.009	.151	.173	.189
40	.178	.138	.142	.208	-.019	.088	.106	.137	-.056	.017	.101	.127	.043	.113	.124	.150
41	.230	.110	.198	.274	-.265	.334	0.000	.294	-.073	.294	.215	.224	.131	.288	.286	.289
42	.210	.169	.127	.256	-.270	.258	0.000	.273	-.065	.273	.276	.202	.186	.204	.218	.226
43	.217	.232	.126	.274	-.280	.187	0.000	.246	.004	.292	.279	.091	.229	.184	.158	.159
44	.245	.181	.161	.292	-.304	.281	0.000	.299	-.045	.316	.288	.189	.207	.246	.241	.246
45	-.087	-.014	-.026	-.047	-.095	.010	-.123	.052	.096	.043	.080	.036	.113	-.087	-.065	-.044
46	-.084	.045	-.041	-.033	-.093	.001	-.135	.067	.112	.082	.102	.049	.138	-.100	-.081	-.047
47	.107	.169	.124	.168	-.095	-.025	.086	.164	.009	.011	.050	.182	.043	.176	.195	.205
48	.116	.185	.136	.184	-.120	-.032	.107	.155	.012	-.001	.041	.159	.038	.180	.190	.196

CORRELATIONS

VARIABLE	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
33	1.000															
34	.680	1.000														
35	.397	.305	1.000													
36	.258	.248	.138	1.000												
37	-.007	-.569	-.041	-.087	1.000											
38	.104	-.394	-.017	-.033	.624	1.000										
39	.039	.085	.302	-.003	-.076	-.067	1.000									
40	.125	.155	.239	.088	-.090	-.104	.733	1.000								
41	.284	.188	.211	.096	.085	.105	.192	.089	1.000							
42	.341	.186	.246	.163	.064	.210	.260	.120	.801	1.000						
43	.345	.160	.165	.165	.122	.201	.153	.063	.650	.775	1.000					
44	.348	.183	.223	.156	.111	.198	.219	.098	.895	.940	.891	1.000				
45	-.089	-.160	-.137	-.028	.151	.058	.028	-.059	.396	.244	.267	.331	1.000			
46	-.046	-.093	-.116	-.007	.154	.076	.038	-.028	.402	.257	.275	.339	.959	1.000		
47	.036	.047	-.051	.030	-.058	.032	.150	.107	.325	.338	.234	.329	.598	1.000		
48	.053	.067	-.030	.045	-.068	.019	.144	.100	.330	.343	.276	.339	.667	.643	.957	1.000

Appendix XIII

Table 110

Grade Two Variable Names and Numbers

1. Word Knowledge
2. Word Discrimination
3. Reading
4. Conservation
5. MIBS
6. Concept Formation Total
7. Matrices
8. Row and Column
9. Intersections
10. Logical Thinking Total
11. Internal External Scale
12. Socioeconomic Status
13. Problem Solving Total
14. Sensing and Identifying
15. Clarification I
16. Clarification II
17. Problem Parts
18. Pre Solution
19. Problem Solving I
20. Problem Solving II
21. Problem Solving III
22. Words
23. Sentences
24. Commas
25. Other Punctuation
26. Average Sentence Length
27. Standard Deviation Sentence Length
28. Average Word Length
29. Standard Deviation Word Length
30. Vision 1
31. Vision 2
32. Vision 3
33. Vision 4
34. Vision 5
35. Vision 6
36. Vision 7
37. Vision 8
38. Vision 9
39. Vision 10
40. Oral Paradygmatic
41. Oral Homogeneous
42. Written Paradygmatic
43. Written Homogeneous

VARIMAX ROTATION

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	PERCENT OF VARIANCE													
	12.580	6.181	12.690	4.608	7.482	3.584	4.260	4.043	6.440	3.389	7.428	5.513	2.946	4.180
	CUMULATIVE PERCENT OF VARIANCE													
	12.580	18.761	31.451	36.119	43.601	47.185	51.446	55.489	61.929	65.318	72.745	78.258	81.204	85.384
	14 ROTATED FACTOR LOADINGS													
1	.791	-.119	-.180	-.059	-.150	.042	.020	-.071	-.074	-.021	.013	-.085	.285	-.095
2	.833	-.203	-.152	-.031	-.143	.116	-.113	.032	-.068	-.034	-.035	-.123	.042	-.025
3	.760	-.047	-.287	-.022	-.079	-.004	-.091	-.295	-.108	.101	-.148	-.101	.264	-.030
4	-.010	-.160	-.091	-.006	-.882	.071	.024	.056	-.093	-.038	-.894	-.095	.198	-.064
5	.309	-.198	-.142	.049	-.181	.007	.050	-.089	.056	.201	-.581	-.098	-.250	.128
6	.095	-.181	-.120	.008	-.131	.055	.041	.017	-.057	.037	-.934	-.112	.092	-.012
7	.220	-.252	-.145	-.076	-.136	.242	.044	-.234	-.173	.074	-.259	-.662	-.102	-.187
8	.153	-.100	-.208	.051	-.066	-.158	.016	.066	-.163	.046	-.049	-.745	.140	.090
9	.043	-.096	-.007	-.006	-.023	.061	.842	.086	-.084	-.008	-.096	-.120	.130	.093
10	.230	-.180	-.233	-.042	-.130	.155	.306	-.122	-.167	.042	-.230	-.758	.008	-.098
11	-.153	.097	.136	.032	.111	.118	-.198	.137	.295	-.650	.135	-.080	-.117	.207
12	.250	.020	-.191	-.009	-.117	-.033	.081	-.127	-.220	-.530	-.066	.144	.087	-.933
13	.224	-.023	-.792	-.011	-.446	.083	.031	-.059	-.158	.161	-.141	-.167	.023	-.068
14	.245	.113	-.351	.002	-.404	.267	-.059	.242	.068	.523	-.004	-.179	.056	.053
15	.180	-.009	-.058	.016	-.001	-.060	.016	.010	-.109	-.117	-.138	-.052	.101	-.040
16	.132	-.015	-.184	.031	-.854	-.125	.112	-.161	-.175	.004	-.128	-.042	.008	-.078
17	.124	-.119	-.684	-.040	-.117	.287	-.043	-.232	-.328	.041	-.106	-.089	-.158	-.246
18	.210	.066	-.328	.020	-.011	.073	.016	.013	-.102	.295	-.102	-.143	.028	-.026
19	.145	-.010	-.888	.019	-.077	-.142	.086	.037	-.016	-.016	-.070	-.083	.157	.050
20	.168	-.041	-.924	.017	-.121	.001	.061	-.069	-.118	-.029	-.083	-.136	.054	-.075
21	.149	-.056	-.938	-.012	-.110	.066	.019	-.112	-.181	.015	-.111	-.110	.012	-.089
22	.393	-.052	-.159	.016	-.120	-.080	-.083	-.080	.058	.002	-.037	-.084	.103	-.654
23	.314	-.037	-.160	-.388	-.040	-.092	-.106	.074	.007	-.008	-.031	-.043	.159	-.758
24	.256	-.018	-.047	.031	-.055	-.049	.013	-.742	-.023	-.054	.116	.007	.275	-.057
25	.139	.110	-.093	-.021	-.116	.017	.075	-.146	-.065	.040	-.134	-.064	.750	-.131
26	-.083	.065	-.015	.839	-.033	.088	.000	-.113	.090	-.079	-.036	-.030	-.072	.170
27	.052	.010	-.030	.864	-.005	-.065	-.033	.041	-.067	.092	-.002	.031	.042	-.089
28	.628	.379	-.156	.099	-.121	-.337	.008	.008	-.136	.026	-.176	-.154	-.076	-.095
29	.515	.563	.014	.003	-.098	-.272	-.033	-.108	-.136	.042	-.143	-.169	-.013	-.057
30	.075	-.764	.035	-.214	-.150	.134	.097	-.126	-.087	.002	-.343	-.167	-.099	.116
31	.049	-.661	-.458	-.070	.223	.097	.172	.168	.148	-.071	-.094	-.331	.047	-.180
32	.266	-.159	-.132	.059	.199	.747	.247	.023	-.007	-.001	-.303	-.090	.016	.132
33	-.075	-.115	-.487	-.073	-.258	.186	.700	-.030	.139	.126	.120	-.096	-.183	.012
34	.128	-.831	-.058	.096	.010	-.097	.048	.004	-.053	.065	-.287	-.167	-.087	-.145
35	.217	.071	-.335	-.069	.142	-.240	-.060	-.090	-.447	.315	-.278	-.020	-.061	.393
36	-.571	.109	-.304	-.118	-.133	.242	-.202	.116	-.406	.201	-.328	-.049	-.104	-.322
37	-.099	-.010	-.272	.051	-.270	.213	-.405	-.658	.214	-.032	-.069	-.251	-.078	.123
38	.158	.219	-.419	.203	.277	-.333	.026	-.527	.105	.125	-.184	-.048	-.182	.139
39	-.224	.195	-.309	.274	-.264	.122	-.212	.019	.125	-.272	-.525	-.422	-.158	-.160
40	.262	-.009	-.177	.013	-.175	.016	.016	.040	-.887	-.007	-.039	-.166	.046	.031
41	.207	.000	-.209	-.021	-.219	-.013	.063	.076	-.857	-.003	-.010	-.191	.097	.016
42	.796	.072	-.167	.007	-.126	.105	.165	-.069	-.307	.048	-.061	-.072	-.124	-.168
43	.732	.025	-.068	-.010	-.136	.194	.142	-.048	-.327	.076	-.040	-.048	-.151	-.228

Table 111

Grade Four Variable Names and Numbers

1. Intelligence-Verbal
2. Intelligence-Non Verbal
3. Vocabulary
4. Reading Comprehension
5. Spelling
6. Capitalization
7. Punctuation
8. Usage
9. Arithmetic Concepts
10. Arithmetic Problems
11. Conservation
12. MIBS
13. Concept Formation Total
14. Matrices
15. Row and Column
16. Intersections
17. Logical Thinking Total
18. Internal-External Scale
19. Cognitive Preference
20. Socioeconomic Status
21. Problem Solving Total
22. Sensing and Identifying
23. Clarification I
24. Clarification II
25. Problem Parts
26. Pre Solution
27. Problem Solving I
28. Problem Solving II
29. Problem Solving III
30. Words
31. Sentences
32. Commas
33. Other Punctuation
34. Average Sentence Length
35. Standard Deviation Sentence Length
36. Average Word Length
37. Standard Deviation Word Length
38. Oral Paradygmatic
39. Oral Homogeneous
40. Written Paradygmatic
41. Written Homogeneous

VARIMAX ROTATION

	1	2	3	4	5	6	7	8	9	10	11
PERCENT OF VARIANCE	20.443	11.037	8.103	6.467	6.471	5.679	4.578	4.158	3.932	3.366	2.579
CUMULATIVE PERCENT OF VARIANCE	20.443	31.480	39.583	46.070	52.540	58.219	62.797	66.955	70.387	73.752	76.331

11 ROTATED FACTOR LOADINGS

1	.817	-.142	.148	-.147	-.187	-.123	-.021	-.026	-.005	.134	.073
2	.655	-.186	.009	-.357	-.105	-.123	.097	.037	-.016	.180	.035
3	.773	-.163	.174	-.180	-.003	-.128	-.016	.047	.080	-.004	-.010
4	.795	-.154	.092	-.124	-.061	-.102	.005	-.108	.089	-.021	-.. 8
5	.764	.003	.213	.007	-.122	-.048	.083	-.123	.005	.041	.037
6	.741	-.028	.215	-.076	-.113	-.130	.115	-.247	.048	-.003	.059
7	.735	-.082	.127	-.117	-.084	.017	.160	-.119	.090	.071	.108
8	.743	163	.039	-.062	-.041	-.050	-.034	-.066	.120	.118	.051
9	.780	3	.127	-.196	-.157	-.123	.104	.006	.049	.026	.075
10	.708	.	.097	-.189	-.192	-.094	.101	-.014	-.022	.149	-.094
11	.131	. .10	.091	-.065	-.027	-.889	-.019	-.032	.090	.093	-.080
12	.245	-.276	-.082	-.206	-.089	-.4 3	.099	.078	-.006	-.110	.270
13	.210	-.211	.036	-.144	-.063	-.921	.030	.006	.069	.027	.058
14	.428	-.222	.083	-.521	-.140	-.239	.259	-.084	-.096	.061	.041
15	.292	-.057	-.248	-.567	-.128	-.251	.026	-.178	-.025	-.150	.205
16	.226	-.131	.114	-.781	-.005	-.047	-.136	.008	.077	.082	-.115
17	.439	-.204	.011	-.779	-.111	-.234	.082	-.115	-.022	.033	.032
18	-.229	.081	-.204	.054	.046	.074	.041	-.113	-.054	-.169	-.769
19	.399	-.218	-.005	-.162	.013	.077	-.034	-.096	.084	-.069	.074
20	.255	-.235	.094	-.198	-.191	-.146	-.030	.253	.072	.402	-.422
21	.257	-.746	.084	-.127	-.457	-.129	.035	-.036	.309	.031	.018
22	.134	-.147	-.038	-.026	-.117	-.121	.042	.034	.912	.025	.027
23	.224	-.206	.044	-.026	-.837	-.013	.019	-.005	-.028	.078	.009
24	.221	-.246	.134	-.008	-.878	-.061	-.000	-.033	.020	-.062	.003
25	.086	-.802	.062	-.112	-.070	-.067	.000	.057	.178	.063	-.020
26	.245	-.270	.096	-.067	-.744	-.110	.027	-.003	.507	-.038	.012
27	.177	-.870	.080	-.044	-.143	-.127	.012	-.093	-.084	.017	.035
28	.172	-.929	.093	-.070	-.147	-.112	.028	-.070	-.018	.040	.020
29	.162	-.957	.079	-.082	-.126	-.114	.007	-.033	.032	.043	.013
30	.349	-.128	.112	-.114	-.074	.012	-.234	-.757	-.035	.140	-.075
31	.333	-.082	.062	-.082	.041	-.016	.465	-.727	-.015	.135	-.046
32	.474	.026	.163	-.005	-.159	-.068	.004	-.220	-.114	.460	-.072
33	.117	-.089	-.021	-.027	.068	-.018	.051	-.128	.040	.810	.135
34	-.118	.015	.016	-.093	-.038	.050	-.856	.140	-.106	.044	.001
35	-.120	14	.074	.058	.066	-.009	-.798	-.136	.054	-.072	.014
36	.597	-.030	.210	.426	-.080	-.192	.170	-.116	-.085	-.050	-.092
37	.653	-.041	-.031	.448	-.159	-.144	.049	-.093	-.243	.032	-.137
38	.220	-.134	.873	-.064	-.082	-.025	.007	.165	-.000	-.129	-.014
39	.226	-.111	.891	-.051	-.082	-.047	.017	.115	-.013	-.110	-.015
40	.232	-.054	.785	.093	-.053	-.026	-.094	-.309	.002	.189	.127
41	.192	-.058	.807	.056	-.049	-.018	-.059	-.255	-.006	.185	.110

Table 112

Grade Six Variable Names and Numbers

1. Intelligence-Verbal
2. Intelligence-Non Verbal
3. Vocabulary
4. Reading Comprehension
5. Spelling
6. Capitalization
7. Punctuation
8. Usage
9. Maps
10. Graphs
11. References
12. Arithmetic Concepts
13. Arithmetic Problems
14. Conservation
15. MIBS
16. Concept Formation Total
17. Matrices
18. Row and Column
19. Intersections
20. Logical Thinking Total
21. Internal-External Scale
22. Cognitive Preference
23. Socioeconomic Status
24. Problem Solving Total
25. Sensing and Identifying
26. Clarification I
27. Clarification II
28. Problem Parts
29. Pre Solution
30. Problem Solving I
31 Problem Solving II
32. Problem Solving III
33. Words
34. Sentence
35. Commas
36. Other Punctuation
37. Average Sentence Length
38. Standard Deviation Sentence Length
39. Average Word Length
40. Standard Deviation Word Length
41. Unity
42. Development
43. Imagination
44. Overall Quality
45. Oral Paradygmatic
46. Oral Homogeneous
47. Written Paradygmatic
48. Written Homogeneous

VARIMAX ROTATION

1	2	3	4	5	6	7	8	9	10	11	12
PERCENT OF VARIANCE											
14.796	8.743	8.517	6.927	6.580	4.267	6.593	4.399	4.458	4.186	2.866	2.438
CUMULATIVE PERCENT OF VARIANCE											
14.796	23.539	32.056	38.983	45.562	49.829	56.423	60.822	65.280	69.466	72.332	74.771

12 ROTATED FACTOR LOADINGS

1	.673	.158	-.141	-.067	.130	-.057	.311	.162	-.034	.319	.038	.071
2	.113	.010	-.083	-.065	.066	-.068	.382	.249	-.003	.083	-.551	-.288
3	.675	-.018	-.164	-.015	.198	.054	.180	.062	-.008	.196	.387	-.034
4	.736	-.047	-.144	-.092	.107	-.016	.256	.139	-.022	.242	-.015	-.056
5	.679	.079	-.015	-.036	.112	-.046	.111	.202	-.049	.279	.124	.211
6	.636	.267	-.106	.001	.029	-.115	.205	.214	-.107	.133	-.031	.208
7	.675	.224	-.051	-.012	.104	-.047	.226	.190	-.040	.072	-.165	.218
8	.589	.214	-.104	-.008	.089	.012	.213	.115	.024	.218	.062	.248
9	.612	.055	-.110	-.129	.047	-.038	-.017	.025	-.088	-.029	.005	-.305
10	.730	-.068	-.086	-.033	.025	-.078	.163	-.061	-.089	-.016	-.033	-.195
11	.721	.291	-.099	-.002	.091	-.038	.193	.020	-.072	.087	-.098	.121
12	.801	.053	-.094	-.029	.097	-.037	.102	.015	-.079	.107	.054	-.005
13	.679	.317	-.151	-.034	.000	-.098	-.050	-.066	-.180	-.139	-.065	-.109
14	.112	.045	-.055	-.045	.131	-.068	.082	.051	-.913	.124	.098	-.003
15	.381	-.233	-.127	.019	.038	.066	.416	.225	-.407	-.177	-.155	.175
16	.261	-.066	-.101	-.023	.117	-.028	.251	.155	-.887	.019	.006	.081
17	.353	.166	-.145	.076	.091	-.079	.627	-.065	-.284	-.007	.103	.038
18	.185	.032	-.157	-.101	.116	-.095	.674	-.049	-.036	.109	-.132	.141
19	.344	.028	-.143	-.022	.072	-.045	.623	.169	-.066	-.068	.173	-.069
20	.388	.137	-.136	-.012	.118	-.085	.813	.038	-.191	.008	.096	.018
21	-.077	-.299	.112	.041	-.038	-.025	-.082	.015	.089	.033	-.037	-.464
22	.168	.330	-.044	.138	.036	.031	.403	.020	.055	.115	.089	-.354
23	.294	-.128	-.095	.018	-.011	-.001	.271	.183	-.228	-.068	.488	.026
24	.226	.074	-.666	-.064	.630	.079	.173	.093	-.065	.008	.043	-.031
25	.065	-.252	-.137	-.127	.559	.244	.182	.158	-.084	-.170	.172	-.186
26	.108	.267	-.120	.072	.741	-.014	.068	-.105	-.050	.031	-.094	.122
27	.164	.200	-.095	.012	.839	-.118	.014	.005	-.063	.065	-.050	.064
28	.124	.063	-.748	-.078	.157	-.015	.089	.061	-.052	.064	.013	-.079
29	.152	.018	-.148	-.065	.924	.058	.110	.103	-.093	-.052	.065	-.063
30	.148	.116	-.875	.021	.053	-.056	.118	-.071	-.027	.018	-.001	.107
31	.162	.102	-.946	.002	.072	-.053	.120	-.035	-.049	.036	-.006	.065
32	.160	.09	-.950	-.022	.115	-.050	.120	-.005	-.045	.057	.002	.030
33	.168	.269	.022	.041	.029	.007	-.026	.809	-.159	-.051	.152	-.046
34	.150	.134	-.029	.032	.056	-.591	.050	.673	-.132	-.034	.109	-.035
35	.197	.130	.041	.139	.041	.076	.107	.573	-.010	.270	.061	.057
36	-.061	.134	.008	-.02	.026	-.101	.093	.277	.000	.083	.634	-.088
37	-.143	.109	.072	-.013	.017	.872	-.049	-.092	.001	.007	-.028	-.043
38	-.065	.147	.045	-.025	.036	.842	-.119	.088	.047	-.069	-.003	.054
39	.292	.113	-.095	-.050	-.045	-.012	.028	.024	-.037	.847	-.068	-.037
40	.306	-.017	-.062	-.012	-.011	-.054	.003	.070	-.075	.817	.078	-.020
41	.222	.827	-.175	-.232	.032	.043	.056	.080	.008	.016	-.003	-.043
42	.207	.864	-.107	-.167	.085	.063	028	.157	.054	.089	-.003	.059
43	.073	.824	-.033	-.152	.157	.088	.100	.122	-.020	.005	.051	.135
44	.182	.921	-.115	-.196	.107	.083	.066	.124	.014	.040	.019	.056
45	-.002	.218	.094	-.877	.098	.078	-.068	-.162	-.022	-.021	-.028	-.201
46	-.013	.228	.105	-.862	.133	.071	-.062	-.119	-.022	-.008	-.035	-.212
47	.132	.116	-.157	-.865	-.072	-.032	.081	.045	-.009	.051	.008	.238
48	.124	.131	-.145	-.887	-.079	-.048	.092	.049	-.015	.042	.039	.220