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ABSTRACT

The effects of modifications in intelligence test procedures upon the scores obtained by 232 normal, 102 mentally retarded, 106 cerebral palsied and 35 orthopedically handicapped children were investigated. Stanford-Binet tests in year-levels II through V were modified to require only a pointing or yes/no response. The modified form appeared to be valid with IQs within 3 points of scores obtained on the standard form. Additionally, Stanford-Binet tests at year-levels IX through XIII, three subtests of the Wechsler Intelligence Scale for Children (Digit Span, Block Design, and Coding) and a separate Memory for Block Designs test were modified. The modified Stanford-Binet tests at the higher level were not valid; the modified Digit Span Block Design subtests had a sufficient degree of validity; while the modified Coding subtest and the Memory for Block Designs test were significantly easier than the standard subtest. Results indicated that some modified tests can serve as substitutes for standard tests in the assessment of handicapped children. (DB)

FINAL REPORT

INTELLIGENCE TEST MODIFICATIONS ON HANDICAPPED AND NONHANDICAPPED CHILDREN

PROJECT NUMBER: 15-P-55277/9-02

GRANTEE AGENCY: San Diego State College Foundation

PROJECT DIRECTOR: Jerome M. Sattler, Ph.D.

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Significant Findings for Rehabilitation (and Social Service) Workers

The investigation, which was designed to evaluate the effects of test modifications on the performance of nonhandicapped and handicapped children, resulted in a number of findings which should be of value to rehabilitation and social service workers. The findings are listed below.

1. The modified Stanford-Binet tests located at year-levels II through V appear to be valid. Therefore, children who have limited or no speech or who have severe motor disabilities can be administered the modified tests as substitutes for the standard tests.

2. The modified WISC Digit Span and Block Design subtests appear to be valid. The Digit Span subtest can be administered to children who have speech difficulties since a pointing response appears to be an acceptable substitute for an oral response. The Block Design subtest can be administered to children who have motor difficulties because the examiner assembles the blocks into a design on instruction from the child.

3. The modified WISC Coding subtest resulted in an easier test. Therefore, the standard norms cannot be used. However, the modified subtest does appear to be useful, and can be used as an experimental test to assess the ability of cerebral-palsied and other handicapped children.

4. The modified Stanford-Binet tests which appear at year-levels IX through XIII, primarily memory tests, were easier than the standard tests. These results indicate that multiple-choice procedures for memory tests are likely to result in easier tests than procedures requiring the S to respond by rote memory.

5. The Memory for Block Designs test was too easy for normal children. However, there were many significant correlations between it and other memory and ability tests. It can be useful for research purposes, but needs to be expanded.

6. Degree of physical disability in cerebral-palsied children between 5 and 16 years of age appears to be related significantly to their level of intelligence.

7. The literature review indicated that the initial IQ's of cerebral-palsied children can be considered to be reliable and valid.

8. The project also supported in part other investigations related to examiner effects, testing minority group children, and racial experimenter effects. The appendix lists the publications relate. to these areas.

Contents

Preface

The work reported herein represents an effort to evaluate the effects of modifications in test procedures on the performance of both nonhandicapped and handicapped children. The modifications were designed so that children with special disabilities could be evaluated with the materials used in standard tests. The two most prominent tests in the field of individual assessment of children, the Stanford-Binet and WISC, were used in the present investigation. The modifications used in the investigation, for the most part, represent changes both in the test stimuli (usually keeping the standard stimulus and adding distractor stimuli in order to change the test into a multiple-choice format) and in the method of response (requiring only a pointing or a "yes" or "no" response). The alterations were necessary in order to be able to use the items in the assessment of children with special disabilities, especially disabilities which involve speech or motor coordination. We hope that the results of the investigation will prove to be of value to psychologists, educators, and rehabilitation personnel who work with physically handicapped children.

Acknowledgements

There are many individuals who have made this project possible. Without their support and help, the research could not have been carried out. Thanks are due to the Social and Rehabilitation Service of the U.S. Department of Health, Education, and Welfare for providing the financial support necessary to carry out the project and to the San Diego State College Foundation for providing the necessary support services. I am especially grateful to the following school districts and to the directors of school psychology services, superintendents, principals, and teachers, who cooperated on the project: Milton Grossman (School Psychology Services, Sweetwater Union School District, Chula Vista, California); Les Six and John Horn (School Psychology Services, Chula Vista City Schools, Chula Vista, California); John S. Dalley (Principal, Schweitzer Therapy Center, San Diego, California); Rodney Franklin (School Psychological Services, Cajon Valley Union School District, El Cajon, California); Raymond A. Lanoue (Principal, California Avenue School, Vista, California); William T. Hawes, (Principal, Chula Vista Jr. High School, Chula Vista, California); Bill Wilson (San Diego City Children Centers, San Diego, California); and John Griffith (Planning and Research, San Diego City Schools, San Diego, California).

In addition to the above schools and school districts, we received excellent cooperation from many child care centers, preschools, and homes for mentally retarded children. Their support and cooperation were much appreciated. I wish to acknowledge the following centers: Home of the Guiding Hands; Angels Unaware Center for the Retarded; St. Madeleine's Sophie Preschool Training Center for Retarded Children; Child Development Center, California State University, San Diego; Kiddie Korral Christian Preschool; Christopher Robin's; Little One's Nursery School; Tree House Nursery; Tiny Tim's Kindergarten & Nursery School; Loma Alta Preschool Nursery; United Methodist Preschool; Candy Cane College; Playhouse Nursery School; H Street Nursery School; Early Achievement Center; and Community Child Center.

During the early phase of the project, Elias Katz gave generously of his time to discuss the project with the principal investigator. His help, too, was appreciated.

There were many examiners who did the actual testing of children and their help also has been appreciated. Thanks are due to Joseph Ryan, Nancy Anderson, Dorothy Morena, Al Davidson, William Grimes, James Karolek, Judy Pepper, Michaela Osborne, William Safarjan, Patricia Volkerts, and Dan Skenderian. I am also grateful to Michael Dowdie, Dave Nichols, and Diane Dietz for their help on the project. Finally, I wish to thank the hundreds of children who participated in the project and their parents, who gave us permission to test their children. Their help has been much appreciated.

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Abstract

The effects of modifications in test procedures upon the scores obtained by nonhandicapped and handicapped children were investigated. The modified tests only required a pointing or "yes/no" response. First, Stanford-Binet tests in year-levels II through V were modified. The Ss were 133 normal, 27 mentally retarded, and 30 cerebral-palsied children. The modified form appears to be valid (rs of .83 to .92 with the standard form and IQ's within 3 points of the standard form). Second, 6 Stanford-Binet tests at year-levels IX through XIII, primarily memory tests, and 3 WISC subtests were modified. A Memory for Block Designs test was also evaluated. The Ss were 99 normal, 75 mentally retarded, 76 cerebral palsied, and 35 orthopedically handicapped children. The modified Stanford-Binet tests were not valid because the tests were too easy. The modified Digit Span and Block Design subtests, however, had a sufficient degree of validity (rs of .66 to .92). The modified Coding subtest was significantly easier than the standard subtest. The Memory for Block Designs test also was too easy, but it appears to be a promising test for evaluating memory ability. The results indicate that some modified tests can serve as substitutes for standard tests in the assessment of handicapped children.

Introduction

Intelligence tests which are designed for and standardized on a non-handicapped population are often administered to handicapped children. However, the physical disabilities of these children frequently make it impossible for them to perform on such tests. Therefore, modifications in test procedures are often necessary, but modifications can create problems in the use of test norms. Many writers have made suggestions for altering standard tests, but few suggestions have been put to experimental test. The present project was designed to evaluate the effects of modifications in test procedure upon the performance of nonhandicapped and handicapped children. The two scales that were studied were the Stanford-Binet Intelligence Scale and the Wechsler Intelligence Scale for Children (WISC). Selected tests or subtests from each scale were evaluated. In addition to evaluating the effects of modifications, a multiple choice Memory for Block Designs test was studied. All modifications were designed so that only a pointing or "yes/no" response was required from the child.

The procedures developed in the present investigation may be useful for those engaged in the intellectual assessment of children who have handicaps which interfere with their ability to take standard tests. While it is not likely that modifications in standard procedures will produce results that are equivalent to those obtained under standard procedures, it is important to know to what extent the modified procedure yields results that are similar to those obtained under standard procedures.

Two general types of modifications can be delineated, and both were evaluated in the present investigation. One concerns modifications in test stimuli; the other concerns modifications in test responses. Modifications in test stimuli are more difficult to design than modifications in test responses. The reason for this is that in going from a situation in which one stimulus is used to one in which four stimuli are used three new stimuli must be developed and evaluated. Thus, for example, in modifying the Picture Vocabulary test of the Stanford-Binet, from a test in which the child says the name of the picture to a multiple-choice test in which the child points to one of four pictures for each word, 54 new stimuli have to be designed for the 18 items that are in the test. Modifications in test responses are easier to construct when only the response modality is being altered because there are limited possibilities that are involved when changes are made from the standard response modality to a pointing response modality.

It is important to recognize that modifications in test stimuli are likely to alter the nature of the item, and consequently, the validity and reliability of the item may be affected. However, the validity and reliability of items which involve alterations solely in the response modality are likely to be less affected. The standard Stanford-Binet items that require verbal responses may require the child to recall the correct answer. Many possible choices are available to him. However, when the item is changed to a multiple-choice format, the child must recognize the correct choice. Recognition, in this case, may also involve a process of discrimination (i.e., eliminating three other possible choices) that was not involved in the usual case of recall. Therefore, the validity of a test should be evaluated whenever it is modified.

The investigation consisted of two separate but related studies. In Part I, the modifications of tests located at the lower year levels of the Stanford-Binet were studied. An effort was made to modify tests in year-levels II through V to enable children who are not able to speak or who have motor difficulties to respond to tests. In Part II, six Stanford-Binet tests and three WISC subtests were modified, and an experimental test--Memory for Block Designs--was studied. Different samples of children were used for each part of the investigation.

Review of Relevant Literature

The review of literature is divided into four sections. In the first section, nonresearch reports are described. These reports focus on the inappropriateness of standard procedures in testing handicapped children, the need for modifications, the problems associated with the use of test norms, and suggested modifications without research findings. The second section examines research findings. The third section focuses on the problem of the reliability and validity of the IQ obtained when testing cerebral-palsied children. The fourth section discusses the general findings. The review focuses on the cerebral palsied, not only because of the abundance of material available on this condition, but also because the problems associated with testing the cerebral palsied are similar to those encountered with many other handicapped groups. Tests which have been especially designed to evaluate handicapped children (e.g., the Columbia Mental Maturity Scale and the Hayes-Binet) are not reviewed.

Nonresearch Reports

Inappropriateness of Standard Test Procedures

The motor, speech, visual, and auditory difficulties of cerebral palsied and other handicapped children greatly limit the applicability of standardized tests, and make caution mandatory in interpreting the test results (Bice & Cruickshank, 1966; Burgemeister & Blum, 1949; Cardwell, 1947; Doll, 1954; Garrett, 1952; Haeussermann, 1952). Since cerebral-palsied children frequently perform motor tasks in a slow and laborious manner, they are at a particular disadvantage when time limits are imposed. It is extremely difficult to interpret test failures made by cerebral-palsied children because the examiner is not always certain whether the failure is due to the child's physical disability or to his limited mental ability (Garrett, 1952). The "literal administration, scoring and the interpretation of the Stanford-Binet tends to underestimate a child's ability almost in proportion with the child's severity of handicaps [Katz, 1955, p. 18]." Similarly, McIntire (1938) observed that standardized test scores may reflect the extensiveness of the cerebral-palsied child's physical handicap rather than the level of his intellectual ability. Lord (1937) further maintained that difficulties in test interpretation often make the concept of mental age misleading when it is applied to cerebral-palsied children.

Need for Modifications

In order to make standardized tests applicable to handicapped children, many modifications in administration and/or testing procedures have been advocated (Allen, 1962; Allen & Jefferson, 1962; Arnold, 1951; Berko, 1953; Bice, 1948; Bice & Cruickshank, 1966; Dunsdon, 1952; Eisenson, 1954; Heilman, 1949; Holt & Reynell, 1967; Jewell & Wursten, 1952; Katz, 1956, 1958; Keats, 1965; Kessler, 1966; Melnick, 1954; Meyer & Simmel, 1947; Michal-Smith, 1955; Miller & Rosenfield, 1952; Newland, 1963; O'Brien & Hewson, 1948; Portenier, 1942; Russ & Soboloff, 1958; Schonell, 1956, 1958; Sievers, 1950; Strother, 1945; Taylor, 1959). Testers report that they frequently modify standard procedures when examining handicapped children (Braen & Masling, 1959). The form of the modification, however, is dependent on the judgment of each individual examiner; in effect, each examiner may be creating his own test. Generally, little is known about the effects of modifications on the obtained test results (Sattler & Theye, 1967). For example, Blum, Burgemeister & Lorge (1951) wrote that in using modifications, "there is insufficient attention paid to cross checking the results with those of a more normal group of equated children [p. 177]." McCarthy (1958) too, noted, "The problem is: what do normal children do with the same [i.e., modified] tasks? [p.19]."

Use of Test Norms

Can standardized test norms be used when there have been modifications in test administration? Strother (1945) and Braen & Masling (1959) noted that test norms cannot be used when standardized tests have been altered, while Maisel, Allen & Tallarico (1962) pointed out that it is not known to what extent test modifications with handicapped children invalidate the norms established on a non-handicapped population. Katz's (1956) suggestion to omit those subtests which require physical abilities not possessed by the handicapped child leads to problems associated with reliability and validity (cf. Braen & Masling, 1959).

In spite of the difficulties in using test norms, it is still important to compare the cerebral-palsied child's performance with that of the normal child. While it is necessary, at times, to accommodate the test to the child, "No testing is valid if it is so unique that we cannot measure or place the child within accepted standardized normative ranges of mental development [Michal-Smith, 1955, p. 15]." It is important to compare the cerebral-palsied child with the non-handicapped child, because the latter sets the standards in the world at large (Allen, 1959; Maurer, 1940).

Suggested Modifications without Research Findings

There are a number of writers who have suggested specific alterations in intelligence test administration without presenting normative or statistical data. The effects of the suggested modifications are therefore unknown. Presenting items in a multiple-choice format, pantomiming responses, steadying the child's hand, enlarging objects, and having the child point are examples of untested modifications for use with cerebral-palsied and other handicapped children (Allen & Jefferson, 1962; Bice & Cruickshank, 1966; Dunsdon, 1952; Eisenson, 1954; Jewell & Wurstein, 1952; Katz, 1958; Keats, 1965; Neuhaus, 1967; Newland, 1963; O'Brien & Hewson, 1948; Schonell, 1958).

Research Findings

Seven studies have reported non-significant differences in scores between tests which were modified and tests which were administered using standard procedures, while three studies reported significant differences. Unfortunately, most studies failed to compare handicapped and non-handicapped groups; many of the studies also failed to use a repeated-measures design.

Nonsignificant Findings

Of the seven experiments with nonsignificant findings, four studied non-handicapped populations (Arnold, 1951; Maisel, Allen, & Tallarico, 1962; Tozier, 1968; Wamba & Marzolf, 1955), two studied handicapped populations (Katz, 1956; Livingston, 1957, and one studied both handicapped and non-handicapped populations (Wattron, 1956).

Maisel, Allen, and Tallarico (1962) gave the Leiter International Performance Scale (Leiter, 1952) to normal children between the ages of five and 11, using the standard procedure and also using a modified procedure which consisted of having the children indicate by pointing where they wanted the examiner to place the blocks. Because the adapted and standard methods of administration did not yield significantly different scores, the authors suggested that the standardized Leiter Scale norms could be used with both administrative procedures.

Arnold (1951) also studied the effects of having non-handicapped children, who had either average or retarded mental ability, motion where to place the Leiter Scale blocks. In addition, he also studied the effects on the Porteus Mazes (Porteus, 1959) test of a pointing modification which consisted of having the subjects motion where to draw the lines. All subjects, too, were administered the Stanford-Binet Scale (Form L) (Terman & Merrill, 1937) under standard conditions. Because the correlations between the Leiter Scale (modified) and the Stanford-Binet (standard) and between the Porteus Mazes (modified) and Stanford-Binet (standard) were highly significant in both groups (rs ranged from .81 to .94), Arnold concluded that both the Leiter Scale and the Porteus Mazes provided valid scores with the modified procedures.

Tozier (1968) studied the effects of a pointing modification of the Block Design subtest of the WISC (Wechsler, 1949). A board with six blocks showing the various possible positions of the blocks used in the construction of the designs was presented as the key for all experimental group subjects (adolescent non-handicapped males and females). Their task was to point to one of the blocks on the board and then to indicate where the block should be placed on a white, unlined sheet of paper. The experimental and control (standard administration) groups did not obtain significantly different scores. Since Tozier did not use a repeated-measures design, the relationship between the scores obtained using the two procedures is not known.

Wamba and Marzolf (1955) modified the Progressive Matrices test by having non-handicapped subjects between the ages of six and 11 indicate their responses by means of eye movements. The subjects achieved similar scores under both standard and eye-movement response conditions.

Katz (1956) proposed a pointing-scale method for scoring the Stanford-Binet (Form L) which involved scoring only those items that could be answered by pointing, and then prorating the score to obtain the mental age. He reported that a group of cerebral-palsied preschool children obtained equivalent scores under the standard and pointing-scale methods. Normal children were not studied.

Livingston (1957), studying partially sighted children between the ages of eight and 10, reported that enlarging the visual items of the Stanford-Binet (Form L) did not produce significantly different scores between the experimental and control groups. Non-handicapped children were not studied.

Wattron (1956) first studied blind children between the ages of seven and 17. The scores they obtained on a block design test, which required the use of tactile-kinesthetic perception, correlated highly with their Hayes-Binet scores. He then found that a non-handicapped group (matched for age and sex with the blind group) did not differ from the blind group in their scores on the modified test. However, the non-handicapped group was not given a standard block design test, and therefore it is not known to what extent the modified block design test produced scores which were different from those which would have been obtained using the standard procedure.

Significant Findings

Three studies reported that altering standard testing procedures resulted in scores which were not comparable to those obtained with the standard method. Graham & Shapiro (1953) found that in a group of normal children between the ages of 6-3 and 12-2, pantomime instructions led to significantly lower WISC Performance scores than did standard instructions. An oral Digit Symbol test, developed by Kaufman (1966) and administered to two adult medical-patient samples, was completed in less time than the standard written version. However, when the sample was divided into groups of young, middle, and older patients, no significant differences were found between oral and written performance in the youngest age group, whereas in the middle and older groups, more time was taken on the written version than on the oral version.

Koppitz (1970) studied the effect of presenting three to seven digits in an auditory and visual modality and the effect of having an aural and written response modality. The subjects were normal children in grades one through five. The visual modality of presentation consisted of showing all of the digits simultaneously on a card for 10 seconds to the child. This procedure differs from the usual digit span procedure in which the stimuli are presented successively. The visual presentation resulted in higher scores than the auditory presentation. However, the two response modalities were not significantly different.

It is probable that the conflicting findings are due partly to type of modification, subject population, and test content. The majority of the findings suggest, however, that modifying test procedures does not necessarily produce significant changes in performance.

Reliability and Validity of the IQ for Cerebral-Palsied Children

Writers have suggested, without presenting research data, that it is difficult to determine the reliability and validity of the IQ for cerebral-palsied children. Linde (1964), for example, noted that the reliability and validity of the tests found in the standard Wechsler and Stanford-Binet scales are too often dependent on normal speech and manual dexterity, thereby restricting the performances of cerebral-palsied children. Mecham, Berko & Berko (1960) wrote that the mental age of cerebral-palsied children increases in irregular steps; therefore, the mental age obtained on any one testing may not be reliable. They also cautioned against the use of first scores as the sole criterion in long-range planning. Russ & Soboloff (1958) wrote that, with cerebral-palsied children, the results of the initial psychometric examination are usually the lowest, and Sievers (1950) cautioned that a diagnosis of mental retardation should not be given to a cerebral-palsied child on the basis of a single administration of an intelligence test.

Test-retest and follow-up studies do not support these opinions. Portenier (1942) reported that retest IQs for 13 cerebral-palsied children, taken from a sample of 40 cerebral-palsied children between the ages of 2-7 years and 19-10 years, were in close agreement with those obtained from the first testing (reliability coefficient and retest interval were not reported). In most cases, the Stanford-Binet (Form L) was used for both testings.

Kogan (1957) studied test-retest IQ's using the Cattell Infant Intelligence Scale (Cattell, 1960), the Stanford-Binet Scale (Form L), or some combination of the two. The subjects were 31 cerebral-palsied children who had initially been tested between 2-0 and 6-9 years of age. Retest intervals ranged from seven to 32 months. There was an average difference of 6.5 points between the two tests; this was attributable largely to the probable errors of the test scores, therefore the reliability of the IQ's was highly satisfactory.

Crowell and Crowell (1954) studied test-retest IQ's obtained from the Stanford-Binet Scale (form not indicated) and from a variety of other individually administered intelligence tests. The sample consisted of 61 cerebral-palsied children (ages not indicated). The average test-retest interval was 30 months. The obtained reliability coefficient of .92 indicated that the initial IQ's of the subjects were adequately reliable.

Taylor (1959) conducted a follow-up study of 214 of 1800 cerebral-palsied subjects who had initially been tested on the Stanford-Binet Scale (form not indicated). The initial testing for all subjects was usually before age six and the follow-up was from three to 12 years later. The Wechsler Scales were generally used for the reevaluation. Only four of the 214 children changed by more than one IQ classification range, therefore indicating satisfactory reliability for the initial IQ classification.

Klapper and Birch (1966) obtained social, economic, and educational data for a sample of 89 out of 155 cerebral-palsied subjects. The 89 subjects were between 16 and 28 years of age and had been administered an individual intelligence test 14 to 15 years prior to the follow-up period. The initial IQ was found to have some prognostic significance, especially in relation to levels of employment and educational achievement. Their results indicate that the initial IQ has some predictive validity. Thus, although there is some controversy concerning the reliability of the IQs obtained on first testing cerebral-palsied children, the studies reviewed suggest that they usually have a satisfactory degree of reliability.

Discussion

The present survey indicates a need for studies using both normal and handicapped children to more fully evaluate the effects of modifications in intelligence test procedures. For the purposes of educational and vocational planning, it is important to compare a handicapped child's intellectual level with that of a handicapped group but also with that of a non-handicapped group.

While there are a number of non-verbal tests which are useful for the assessment of intellectual functioning in the handicapped child (cf. Allen, 1958; Allen & Collins, 1955; Allen & Jefferson, 1962), the Stanford-Binet and Wechsler tests are still frequently used (cf. Braen & Masling, 1959). Many authors have felt that the Stanford-Binet is an excellent instrument for assessing intelligence, even though modifications are sometimes necessary and even though many problems are encountered in administering the test to some handicapped children (Bice, 1948; Doll, Phelps & Melcher, 1932; Dunsdon, 1952; Eriksen, 1955; Hohman & Freedheim, 1958; Katz, 1955; Kogan, 1957; Lantz & Wolf, 1956; Michal-Smith, 1955; Miller & Rosenfeld, 1952; Portenier, 1942; Schonell, 1956; Sievers, 1950; Strother, 1952). However, there is an obvious need to standardize such modifications.

In addition to the need for improved ways of modifying standard tests, there is also a need to develop new methods for the assessment of the mental capacities of handicapped children (cf. Agassiz, 1955). Techniques need to be developed which can be used to assess children whose handicaps involve several avenues of communication (Kogan, 1957; Russ & Soboloff, 1958).

Research studies dealing with test modifications should use both correlational and analysis of variance designs; it is important to know the degree of relationship between scores obtained under modified and standard procedures, as well as whether there is a statistically significant mean difference between such scores. Caution is needed in applying the results obtained from group studies to the assessment of any one individual. While significant group differences may not appear in the scores obtained under modified and standard procedures, individual subjects may show large differences under the two procedures. It is suggested, therefore, that new norms be developed, norms based upon scores obtained under modified procedures covering the chronological age ranges to which the test is applicable for both normal and handicapped populations.

PART I: Stanford-Binet (Form L-M) Tests at Year-levels II through V

Methodology

Pilot Study

Every test in year-levels II through V of the Stanford-Binet (Form L-M) was studied, and modifications were made for those tests which could not be responded to by pointing in the standard form of the test. The following tests were not modified because the standard version of the test requires a pointing response: Delayed Response (II), Identifying Parts of the Body (II and II-6), Identifying Objects by Name (II), Identifying Objects by Use (II-6), Comparison of Balls (III-6), Discrimination of Animal Pictures (III-6), Comparison of Sticks (III-6), Pictorial Identification (IV and IV-6), Discrimination of Forms (IV), Aesthetic Comparison (IV-6), Pictorial Similarities and Differences I (IV-6), and Pictorial Similarities and Differences II (V). The test "Word Combinations" at year-level II, however, was not used because no modification appeared to be feasible.

In the pilot study, two tests, "Stringing Beads" (III) and "Paper Folding: Triangle" (V), were part of the original modification. However, the tests proved to be too difficult to modify, even after several modifications were attempted. Consequently these two tests were dropped from the final form.

During the pilot phase of the investigation, attention was given to constructing pointing modifications for each test and to develop an examiner's manual. Seven groups of children participated in the pilot phase to evaluate the modifications. The test modifications that were initially proposed needed revision because some turned out to be too easy while others turned out to be too difficult. The samples in the pilot phase consisted of seven to 10 normal children who were given various versions of the modified tests. In the pilot phase, item analyses were made for each test, for each item of a test, and for each response alternative of a test. The item analyses lead to further revisions of the tests. Directions also were revised on the basis of comments obtained from the examiners.

Part of the difficulty in constructing modified tests was that some of the concepts on the Stanford-Binet are difficult to depict in picture form. For example, the correct answer for one of the Opposite Analogies items (IV) ("The snail is slow, the rabbit is ______") is "fast." The concept "fast" is difficult to draw, especially when it must be recognized by a 4-year-old child. The correct answer ("dark") for a second Opposite Analogies item ("In the daytime it is light, at night it is ____") also was difficult to depict. Another difficult item was depicting "glass" for the correct answer to the Materials Test (IV-6) item b which asks what a window is made of.

The test "Repeating 2 Digits" (II-6) was too difficult when it was administered by pointing to numbers on a card which showed numbers 1 through 9 and then asking the child to point to the same numbers on the card. Another modification which consisted of showing the digits on cards one at a time and then asking the child to point to the digits on a card which showed the numbers 1 through 9 (as above) also was too difficult for 2½-year-old children. The test then was changed from using "digits" as stimuli to using "objects" as stimuli.

Composition of Sample for Lower Level

Preschools throughout San Diego County were contacted in order to obtain children who were between 2 and 5 years of age. In some cases, children were obtained through personal contacts. This occurred more frequently with children in the 2- to 3-year-age level because children in this age level usually do not attend preschools. Special centers were contacted in order to obtain children for the mentally retarded group and for the cerebral-palsied group. Children in all groups were tested only with parental permission or with permission of the center staff for those cases where parents were not available. Age and disability were the only two selection criteria for inclusion in the mentally retarded and cerebral-palsied groups. Age, birthdate, parental occupation, and no disability were the four selection criteria for inclusion in the normal group. In none of the groups was sex used to select children.

Normal

The normal sample was selected so that parental occupation comformed as closely as possible with the national distribution of occupational groups. The birthdays of the children at the time of testing were within two-months of each half-year interval beginning with age 2 and ending at age 5 (M chronological age = 47.9 months). No attempt was made to have an equal number of males and females. There were 133 children in the sample, 70 boys and 63 girls. Table 1 shows the national distribution of occupational groups and the distribution of occupational groups of the parents of the children in the normal sample. The largest discrepancies are four percentage points in categories III and IV. Overall, the distribution of parental occupations in the present sample appears to comform to that of the national distribution.

Table 1. National Distribution and Lower Level Normal Sample Distribution of Occupational Groups

	Occupational Group	National	Normal Group	
		%	N	%
I	Professional & Technical	10	17	13
II	Managers, Officials, Proprietors Farm Owners & Farm Managers	16	21	16
III	Clerical & Sales Workers	14	24	18
IV	Craftsmen, Foremen & Operatives	39	46	35
V	Service Worker-Public & Private	6	10	8
VI	Laborers-Farm & Nonfarm	10	15	11
		95	133	101

Mentally Retarded

There were 27 children in the mentally retarded group, 17 boys and 10 girls (M chronological age = 43.67 months).

Cerebral Palsied

There were 30 children in the cerebral-palsied group, 18 boys and 12 girls (M chronological age = 55.67 months).

Examiners

The examiners were full time graduate students in psychology at California State University, San Diego. All examiners had completed successfully a course in individual intelligence testing and were completing their remaining course requirements for the masters' degree. There were a total of 11 examiners, six male and five female. There was no attempt to randomly assign subjects to examiners because different examiners served during various time periods of the project and the availability of subjects was dependent on a number of factors, including the obtaining of permission from various schools, agencies, and parents to test children. Examiners were provided with names of subjects after parental permission slips were returned. There was little possibility of bias in the procedures that were used because assignments were constantly rotated, that is, examiners were usually assigned subjects for a two-week period and had to return for further names after they had tested their assigned children. All examiners were supervised by the project director, Jerome M. Sattler. Questions about scoring and administration were discussed whenever they arose.

Procedure

Test Order

The standard and modified tests were administered in counterbalanced order. Random permutations of 2 were used to determine the order in which the two forms were administered (i.e., standard or modified first).

Test-Retest Intervals

The test-retest interval ranged from 1 to 20 days. Of the 190 children tested, only seven were given the standard and modified tests more than seven days apart.

Materials

The directions for the modified tests, the test stimuli, and the record booklet which were used in the project are contained in a separate part of the Final Report, entitled "Supplement to the Final Report." However, this section contains a brief description of each of the modifications that were designed for year-levels II through V of the Stanford-Binet. In year-levels II through V there are 49 tests. Seven tests appear more than once making a total of 42 separate tests. Of these 42 tests, 27 were modified, 12 were not modified because they only require a pointing response, and three were not used in the modified form. A description of each modification follows.

Description of Modifications of Stanford-Binet Tests at Year-Levels II-V

II,1. S points to a block after E has pointed to a recess. E then places block in recess for S.

II,2. No change.

II,3. No change.

II,4. A multiple-choice procedure is used. E makes a four-block tower and S is asked to point to one of four pictures on a card which shows a four-block tower.

II,5. A multiple-choice procedure is used. E says word and S is asked to point to one picture which indicates the word.

II,6. Not used.

II,A. No change.

II-6,1. No change.

II-6,2. No change.

II-6,3. Six items are placed before the S. E says the word and S is asked to point to the item.

II-6,4. Same as II,5.

II-6,5. The Repeating 2 Digits test was modified in three ways. First, objects were substituted for digits. Second, instead of saying the names of the objects, E points to pictures. Third, the task was changed from one requiring an oral response to one requiring a pointing response.

II-6,6. A multiple-choice procedure is used. There are three separate cards. On each card there are four pictures. S is asked to point to the picture named by the E. The correct picture on the first card shows a child giving a dog to a man. The correct picture on the second card shows a child putting the button in a box. The correct picture on the third card shows a child putting a pair of scissors beside a block.

II-6,A. S points to a block after E has pointed to a recess. E then places block in recess for S.

III,1. Not used.

III,2. Same as II,5.

III,3. A multiple-choice procedure is used. E builds bridge and S is requested to point to one of four pictures on a card which shows the bridge. The procedure is repeated a second time.

III,4. The modification eliminates the need for the S to say the name of the animal. E says the name.

III,5. A multiple-choice procedure is used. A circle is first shown to S. S is then asked to point to the one drawing out of four which best looks like a circle. There are three trials.

III,6. A multiple-choice procedure is used. A line is first shown to S. S is then asked to point to the one drawing out of four which best looks like a line. There are three trials.

III,A. Same as II-6,5.

III-6,1. No change.

III-6,2. A multiple-choice procedure is used. The Stanford-Binet cards are used. However, instead of the S putting the two pieces together, he is shown a card with four pictures and is asked to select the one which shows the two pieces that are put together to make a pig. The same format is used for the ball.

III-6,3. No change.

III-6,4. A yes-no procedure is used. The E asks the S whether certain people, animals, or objects are in the picture. Six things are named for each picture, with three of them shown in the picture and three not shown in the picture. The same procedure is used with the remaining two pictures.

III-6,5. The S points to the button and to the appropriate box and the E places the button in the box.

III-6,6. A multiple-choice procedure is used. The S is asked to select the one picture which depicts the question.

III-6,A. No change.

IV,1. Same as II,5.

IV,2. A multiple-choice procedure is used. First, the modification eliminates the need for the S to name the object; initially E says the names. Then the S is shown a card with four objects and he is asked to point to the object that was hidden.

IV,3. A multiple-choice procedure is used. E says the analogy and S is asked to point to the picture which completes the analogy.

IV,4. No change.

IV,5. No change.

IV,6. A multiple-choice procedure is used. E asks the question and S points to his answer.

IV,A. A multiple-procedure is used. E reads the sentence and S is asked to point to the picture which best describes his answer. Each picture has three elements (e.g., two boys, candy, mother, or two boys, wagon, mother).

IV-6,1. No change.

IV-6,2. Same as IV,3.

IV-6,3. No change.

IV-6,4. A multiple-choice procedure is used. E asks question and S is asked to point to his answer.

IV-6,5. A multiple-choice procedure is used. E asks question and S is asked to point to his answer. Each picture has three elements (e.g., pencil on chair, box, and open door, or open door, pencil, and man and child).

IV-6,6. A multiple-choice procedure is used. E asks question and S is asked to point to his answer.

IV-6,A. No change.

V,1. A multiple-choice procedure is used. E shows S the incomplete man and then asks S to point to the picture that best shows the man completed. There are two trials.

V,2. Not used.

V,3. A multiple-choice procedure is used. E asks question and S is asked to point to his answer.

V,4. A multiple-choice procedure is used. A square is first shown to S. S is then asked to point to the one drawing out of four which best looks like a square. There are three trials.

V,5. No change.

V,6. A multiple-choice procedure is used. E shows S a complete card and then one that has been cut in two. E then shows S one-half of a card. Finally, E asks S to select the picture that shows where the rest of the card is. This procedure is used on two trials. On the third trial another procedure is used. E shows S a complete card. E then shows S the card cut in two. Finally, E asks S to select the picture that shows a whole card if the two pieces were put together.

V,A. A multiple-choice procedure is used. E ties knot around a pencil. E Then asks S to point to the picture that looks like the knot he tied.

Data Analysis

Four principal statistical procedures were used to evaluate the data. First, analysis of variance designs were used to evaluate the standard and modified IQ's and MA's obtained on the Stanford-Binet. In the normal group a 7 X 2 ANOVA design was used, with repeated measures on the last factor, to evaluate the IQ's and MA's. The first factor was the seven age levels, by half-year intervals, and the second factor was the treatment (standard and modified forms). In the mentally retarded and cerebral-palsied groups, a repeated measures design was used (treatment X subjects) to evaluate the IQ's and MA's. The treatment factor consisted of the standard and modified forms. Age was not used as a factor because there was no attempt made to select children according to birthdate and date of testing in these two groups.

Second, intercorrelations were performed using the IQ's and MA's obtained on the standard and modified forms together with the sex and socioeconomic level (SES) of the subjects. Third, biserial *r*s were used to evaluate item validity. Only the modified items were evaluated in this way. Fourth, a *t* test was used to evaluate the IQ's obtained by the spastic and nonspastic cerebral-palsied children.

Results

Analysis of Variance

Normal

IQ. Table 2 presents the mean IQ's for the seven age levels for the standard and modified IQ's and Table 3 presents the results of the analysis of variance. The significant effects were age level and the interaction between age level and treatment. However, the treatment variable was not a significant effect. The difference between the IQ's on the standard and modified forms was .16 points, in favor of the standard form. Simple effects tests at each age level indicate that only at the lowest age level (1-10 to 2-2) was the modified IQ higher than the standard IQ.

Table 2. Mean Lower Level (II-V) Stanford-Binet Standard and Modified IQ's for Seven Age Levels of Normal Children

		Mean IQ	
Age Level	*N*	Standard	Modified
1-10 to 2-2	19	115.37	122.79*
2-4 to 2-8	19	109.84	106.32
2-10 to 3-2	19	116.11	117.84
3-4 to 3-8	19	113.58	112.16
3-10 to 4-2	19	111.00	109.74
4-4 to 4-8	19	111.11	108.68
4-10 to 5-2	19	105.95	104.32
Total	133	111.85	111.69

*$p < .01$.

Table 3. ANOVA for Lower Level (II-V) Stanford-Binet using Standard and Modified IQ's for Seven Age Levels of Normal Children

(N = 133)

Source	MS	df	F
Between			
Age Level (A)	917.57	6	2.34*
Error	392.61	126	
Within			
Treatment (B)	1.66	1	.05
A X B	130.60	6	3.83**
Error	34.08	126	

* $p < .05$.
** $p < .01$.

MA. Table 4 presents the mean MA's for the seven age levels and for the standard and modified MA's, and Table 5 presents the results of the analysis of variance. Like IQ, the significant effects were age level and the interaction between age level and treatment. However, the treatment variable was not a significant effect. The large age level effect would be expected because there is a close relationship between MA and CA in a normal group. The difference between the MA's on the standard and modified forms was .47 points, in favor of the standard form. Simple effects tests at each age level indicated that there was a significant difference between the standard and modified MA's at three age levels. The modified MA was higher at the lowest age level (1-10 to 2-2) but lower at the second age level (2-4 to 2-8) and sixth age level (4-4 to 4-8).

Table 4. Mean Lower Level (II-V) Stanford-Binet Standard and Modified MA's for Seven Age Levels of Normal Children

		Mean IQ	
Age Level	N	Standard	Modified
1-10 to 2-2	19	29.53	31.37*
2-4 to 2-8	19	35.00	33.21*
2-10 to 3-2	19	44.21	44.79
3-4 to 3-8	19	49.11	48.42
3-10 to 4-2	19	54.47	53.84
4-4 to 4-8	19	60.32	58.53*
4-10 to 5-2	19	62.68	61.84
Total	133	47.90	47.43

* $p < .05$.

Table 5. ANOVA for Lower Level (II-V) Stanford-Binet using Standard and Modified MA's for Seven Age Levels of Normal Children

Source	MS	df	F
Between			
Age Level (A)	5605.02	6	72.01**
Error	77.84	126	
Within			
Treatment (B)	14.92	1	2.53
A X B	16.05	6	2.72*
Error	5.90	126	

* $p < .05$.
** $p < .01$.

Mentally Retarded

IQ. Table 6 presents the means and the ANOVA results for the mentally retarded group. The treatment effect was not significant; therefore, the standard and modified IQ's do not differ significantly in the mentally retarded group. There was a 2.93 difference between the two IQ's, in favor of the modified form.

MA. Table 7 presents the means and the ANOVA results for the mentally retarded group. The treatment effect was not significant; therefore, the standard and modified MA's do not differ significantly in the mentally retarded group. There was a .70 difference between the MA's, in favor of the modified form.

Table 6. ANOVA for Lower Level (II-V) Stanford-Binet using Standard and Modified IQ's of Mentally Retarded Children

(N = 27)

Source	MS	df	F
Treatment (A)	115.57	1	1.95
Ss (B)	490.64		
A X B	59.30	26	

M IQ (Standard) = 39.18
M IQ (Modified) = 42.11

Table 7. ANOVA for Lower Level (II-V) Stanford-Binet using Standard and Modified MA's of Mentally Retarded Children

(N = 27)

Source	MS	df	F
Treatment (A)	6.68	1	1.46
Ss (B)	202.92		
A X B	4.57	26	

M MA (Standard) = 37.48
M MA (Modified) = 38.18

Cerebral Palsied

IQ. Table 8 presents the means and the ANOVA results for the cerebral-palsied group. The treatment effect was not significant; therefore, the standard and modified IQ's do not differ significantly in the cerebral-palsied group. There was a 1.87 difference between the two IQ's, in favor of the modified form.

MA. Table 9 presents the means and the ANOVA results for the cerebral-palsied group. The treatment effect was not significant; therefore, the standard and modified MA's do not differ significantly in the cerebral-palsied group. There was a .07 difference between the two MA's, in favor of the modified form.

Table 8. ANOVA for Lower Level (II-V) Stanford-Binet using Standard and Modified IQ's of Cerebral-Palsied Children

(N = 30)

Source	MS	df	F
Treatment (A)	52.27	1	<1
Ss (B)	682.48		
A X B	57.36	29	

M IQ (Standard) = 80.43
M IQ (Modified) = 82.30

Table 9. ANOVA for Lower Level (II-V) Stanford-Binet using Standard and Modified MA's of Cerebral-Palsied Children

(N = 30)

Source	MS	df	F
Treatment (A)	.07	1	<1
Ss (B)	309.92		
A X B	23.86	29	

M MA (Standard) = 44.90
M MA (Modified) = 44.97

Comment on the analyses of variance. In only one of the three groups, the normal, was there a significant effect involving the treatment variable. However, after further data analysis, the effect turned out to be significant only at one of the age levels, namely, that between 1-10 and 2-2 years of age. At the six other age levels the standard and modified IQ's were not significantly different. These results suggest that IQ's and MA's obtained on the standard and modified forms are essentially similar. The only reservations to this generalization are at the lowest level of the examination. At this level, IQ's and MA's are higher on the modified form than on the standard form in a sample of above-average ability children.

Intercorrelations

The results of intercorrelations among seven variables (sex, SES, CA, standard IQ, standard MA, modified IQ, and modified MA) are shown in Tables 10, 11, and 12 for the normal, mentally retarded, and cerebral-palsied groups, respectively. In addition, in the cerebral-palsied group, seven additional scores are included which were obtained from the Survey of Degree of Physical Handicap (the scale ranged from no incapacity [1] to great incapacity [4]). In the Survey there are six separate areas that are evaluated: vision, hearing, speech, sitting balance, arm-hand use, and walking. In addition, a seventh rating was obtained, the total disability rating, by summing the six individual ratings. The primary correlations, as far as the investigation is concerned, are the ones based on the standard and modified IQ's. These correlations are uniformly high (.83, .92, and .88 in the normal, mentally retarded, and cerebral-palsied groups, respectively) and thereby indicate that the standard and modified IQ's are highly related. These high correlations are somewhat spurious because the modified form contains many of the same tests that are found in the standard form.

Sex was a significant variable only in the normal group. There was a significant, but moderate relationship between sex and standard IQ and between sex and modified IQ. High IQ's were associated with females, while high chronological ages were associated with males.

Socioeconomic status was not a significant variable among any of the correlations in the three groups.

In the cerebral-palsied group, of the six separate ratings concerning degree of physical handicap, four (vision, hearing, sitting balance, and arm-hand use) were not related significantly to any of the variables concerned with test scores. Speech ability, however, was significantly negatively related to mental age obtained on the standard and modified forms, and walking ability was significantly negatively related to mental age obtained on the standard form. Since the present sample had adequate visual and auditory capacities, these two modalities did not correlate with any of the other variables.

Related to the intercorrelations is the percentage of subjects who passed the standard and modified forms for each test. These data are shown in Figures 1 through 32 for each Stanford-Binet test in year-levels II through V that were used in the study. The figures show the percentage of subjects passing each test as a function of age level.

Table 10. Intercorrelation Matrix for Selected Variables using Stanford-Binet Tests (II-V) with Normal Children

(*N* = 133)

Variable	1	2	3	4	5	6	7
1. Sex[a]	--	-.07	-.21	.23	-.07	.25	-.07
2. SES			.03	-.11	-.05	-.06	-.03
3. CA				-.16	.87	-.27	.86
4. Standard IQ					.33	.83	.29
5. Standard MA						.14	.96
6. Modified IQ							.24
7. Modified MA							--
Mean	1.47	3.42	42.11	111.85	47.90	111.69	47.43
SD	.50	1.47	11.77	14.51	13.27	15.64	12.63

Note.--*r* = .16 at *p* = .05 and *r* = .21 at *p* = .01 (two-tailed).

[a]Male = 1, female = 2.

Table 11. Intercorrelation Matrix for Selected Variables using Stanford-Binet Tests (II-V) with Mentally Retarded Children

(*N* = 27)

Variable	1	2	3	4	5	6	7
1. Sex[a]	--	-.08	.17	.10	-.31	.16	-.18
2. SES			-.14	.19	.11	.12	.01
3. CA				-.40	-.13	-.54	-.05
4. Standard IQ					.52	.92	.50
5. Standard MA						.45	.91
6. Modified IQ							.52
7. Modified MA							--
Mean	1.37	4.19	116.26	42.81	36.15	43.67	37.26
SD	.49	1.75	109.80	14.27	9.03	16.46	9.03

Note.--*r* = .38 at *p* = .05 and *r* = .49 at *p* = .01 (two-tailed).

[a]Male = 1, female = 2.

Table 12. Intercorrelation Matrix for Selected Variables using Stanford-Binet Tests (II-V) with Cerebral-Palsied Children

($\underline{N}$ = 27)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Sex[a]		.03	.08	-.06	-.07	-.12	.03	.15	.00	-.06	.08	-.03	-.07	-.01
2. SES			.05	-.07	.04	-.22	-.09	-.09	.00	.19	.30	.27	.03	.24
3. CA				-.42	.62	-.54	.60	.12	.00	-.63	-.17	-.37	-.45	-.55
4. Standard IQ					.43	.88	.42	-.19	.00	.05	-.05	.04	-.03	-.02
5. Standard MA						.18	.95	.01	.00	-.57	-.19	-.32	-.48	-.54
6. Modified IQ							.31	-.11	.00	.27	.04	.10	.16	.19
7. Modified MA								.07	.00	-.48	-.14	-.31	-.37	-.44
8. Vision									.00	-.20	-.23	-.06	-.13	-.04
9. Hearing										.00	.00	.00	.00	.00
10. Speech											.33	.32	.44	.71
11. Sitting balance												.64	.48	.74
12. Arm-hand use													.53	.78
13. Walking														.79
14. Total disability rating														
Mean	1.40	3.93	55.67	80.43	44.90	83.27	45.97	1.17	1.00	2.00	1.50	1.53	2.33	9.53
$\underline{SD}$	.50	2.10	15.01	17.29	12.22	19.08	11.02	.46	.00	1.14	.82	.86	.96	2.84

Note.--$\underline{r}$ = .38 at $\underline{p}$ = .05 and $\underline{r}$ = .49 at $\underline{p}$ = .01 (two-tailed).

[a]Male = 1, female = 2

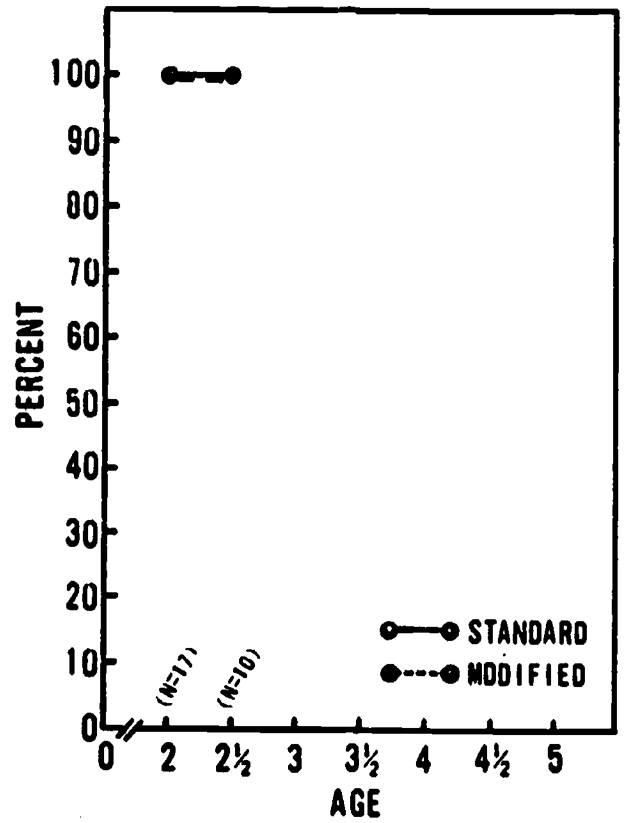

FIG.1 THREE-HOLE FORM BOARD (II,I)

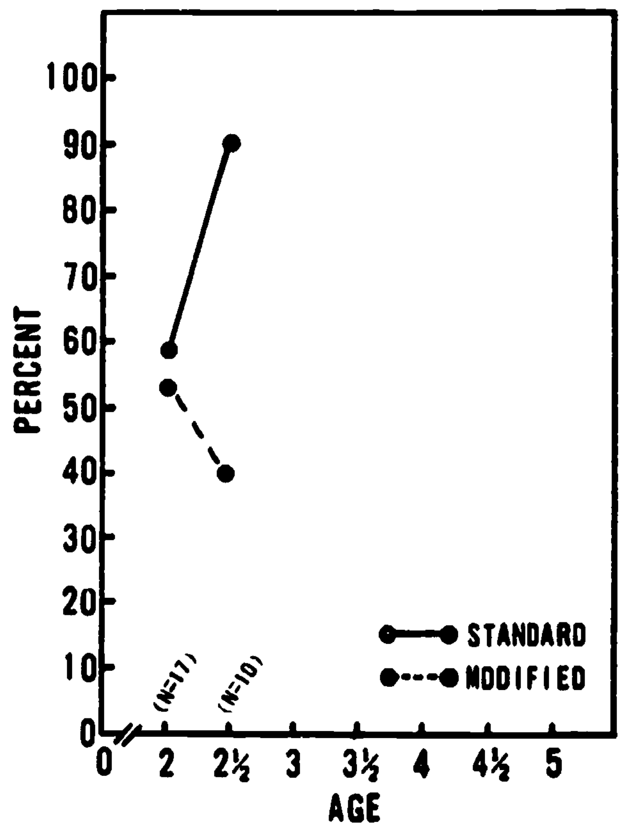

FIG.2 BLOCK BUILDING: TOWER (II,4)

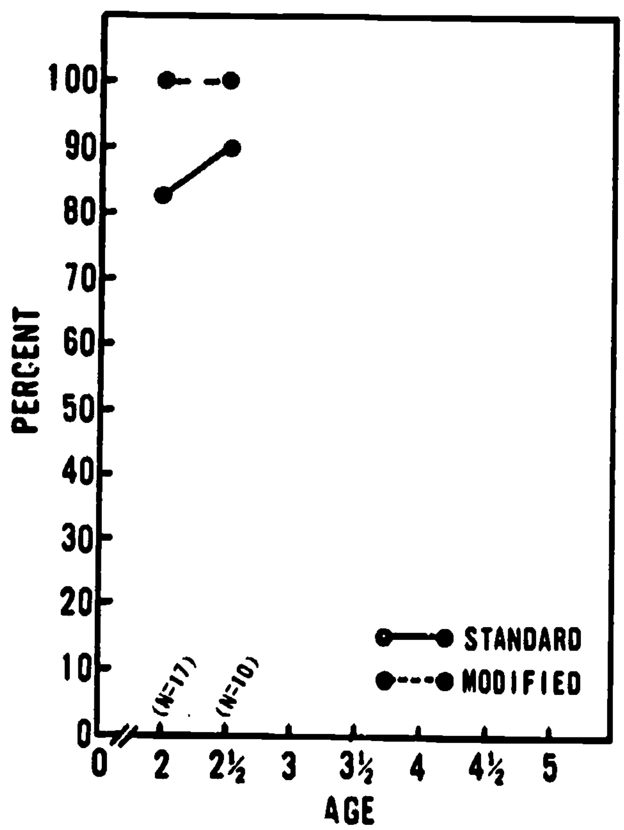

FIG.3 PICTURE VOCABULARY (II,5)

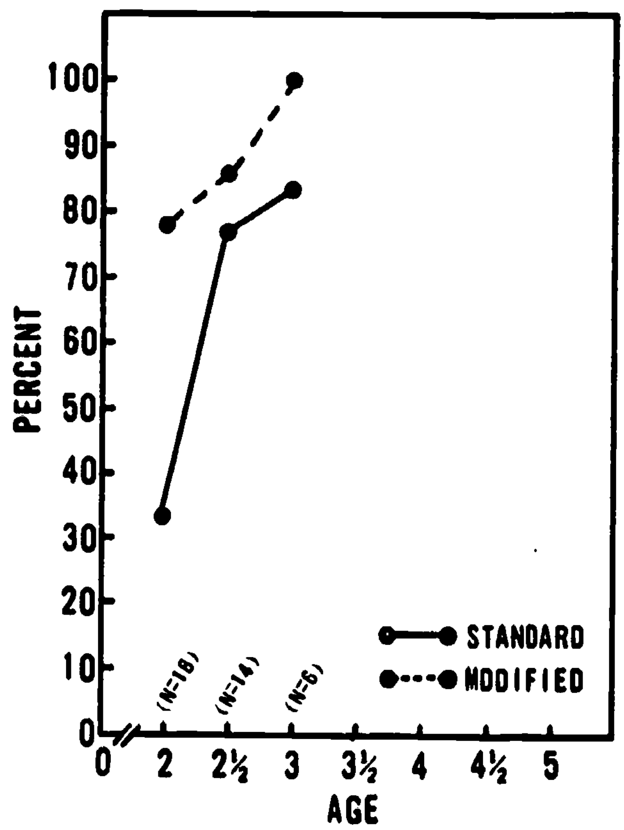

FIG.4 NAMING OBJECTS (II-6,3)

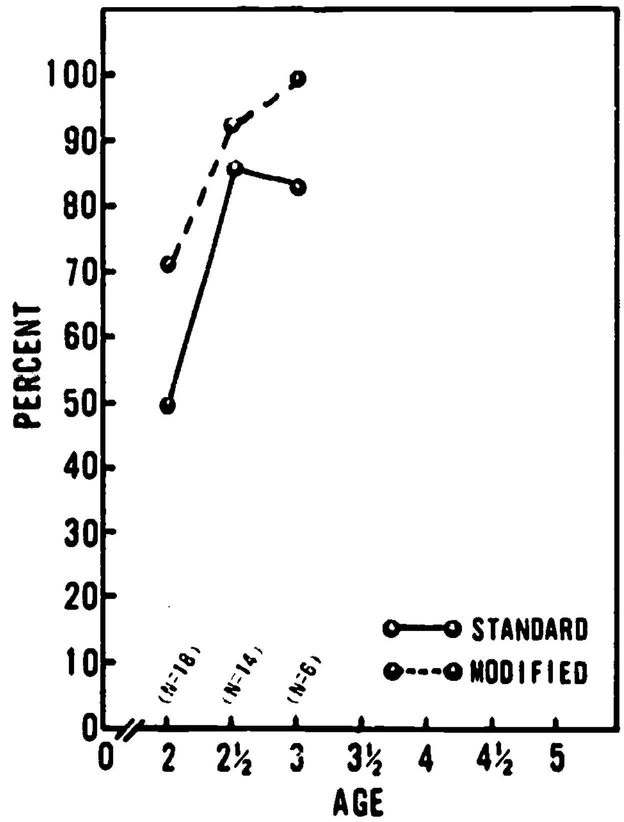

FIG.5 PICTURE VOCABULARY (II-6,4)

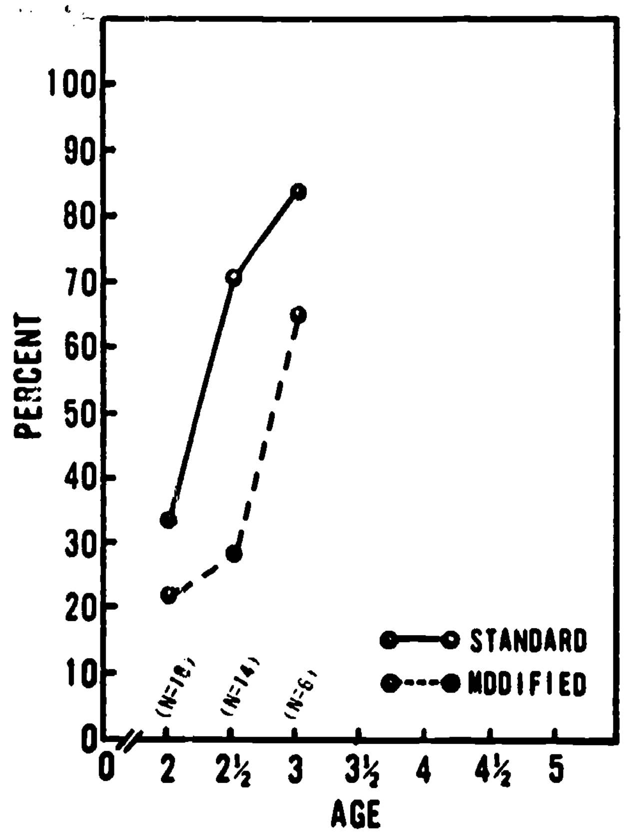

FIG.6 REPEATING TWO OBJECTS (II-6,5)

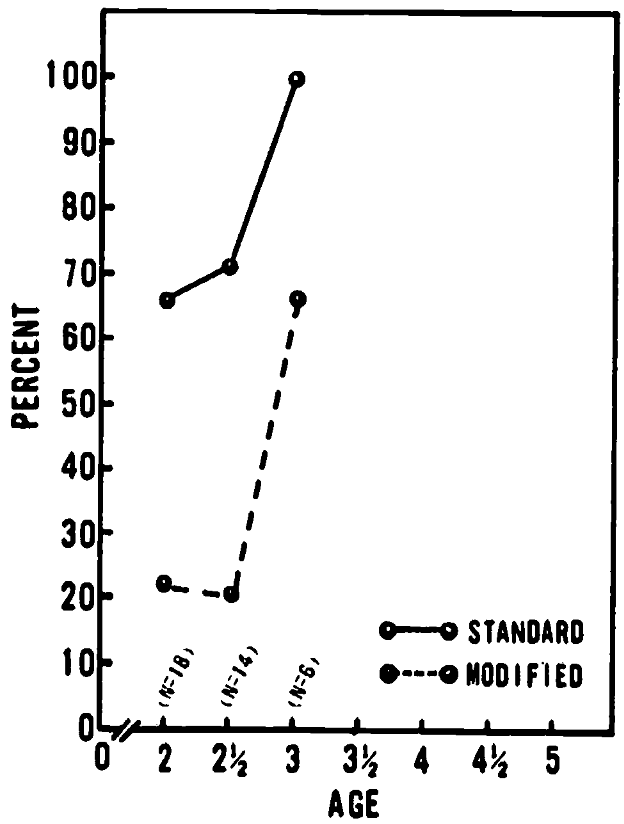

FIG.7 OBEYING SIMPLE COMMANDS (II-6,6)

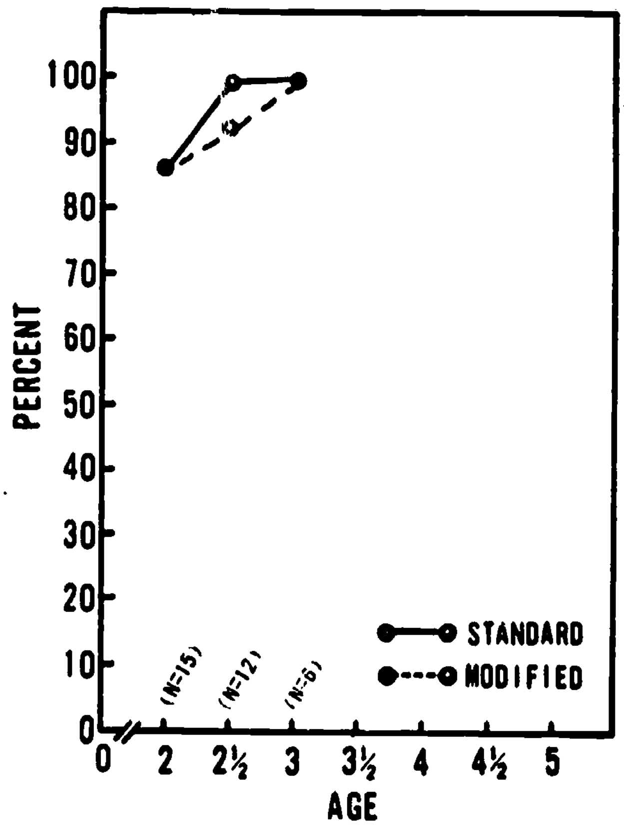

FIG.8 THREE-HOLE FORM BOARD: ROTATED (II-6, alt.)

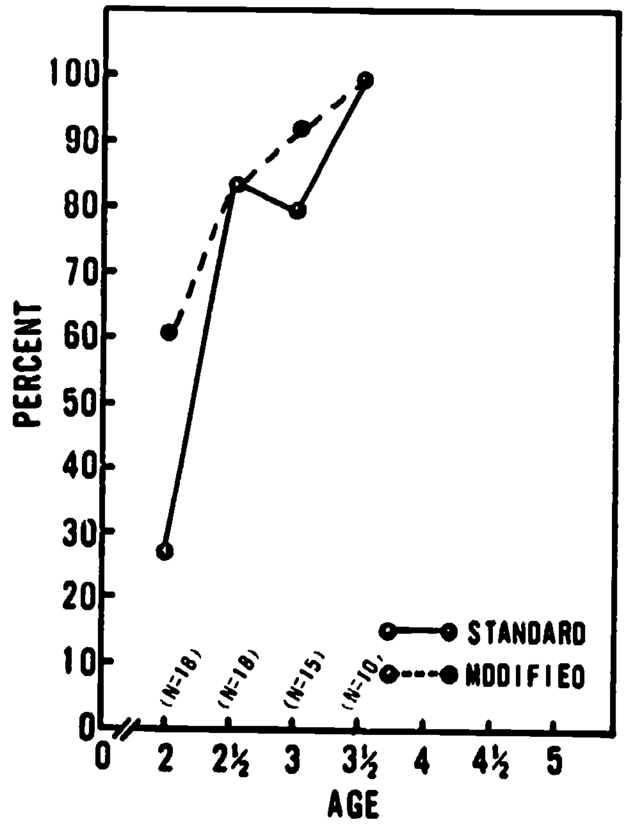

FIG.9 PICTURE VOCABULARY (III,2)

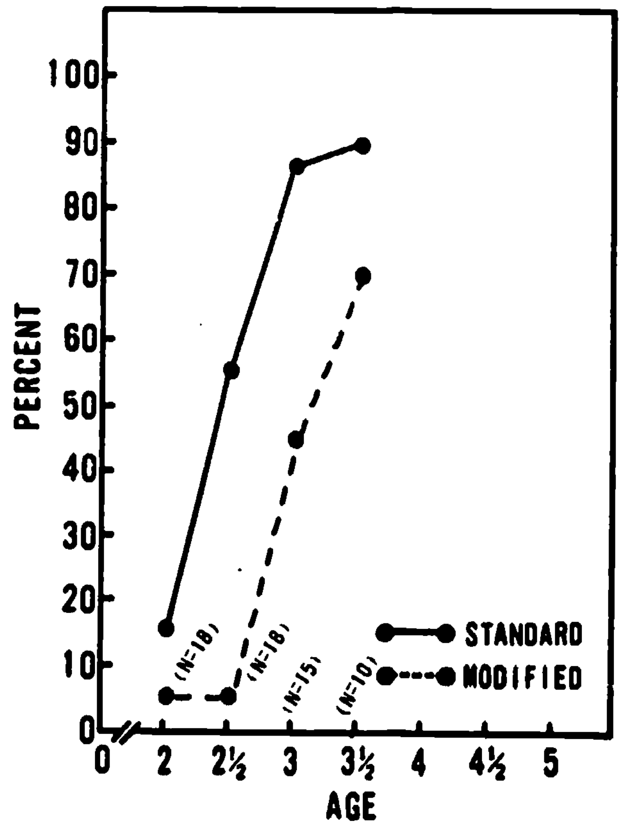

FIG.10 BLOCK BUILDING:BRIDGE (III,3)

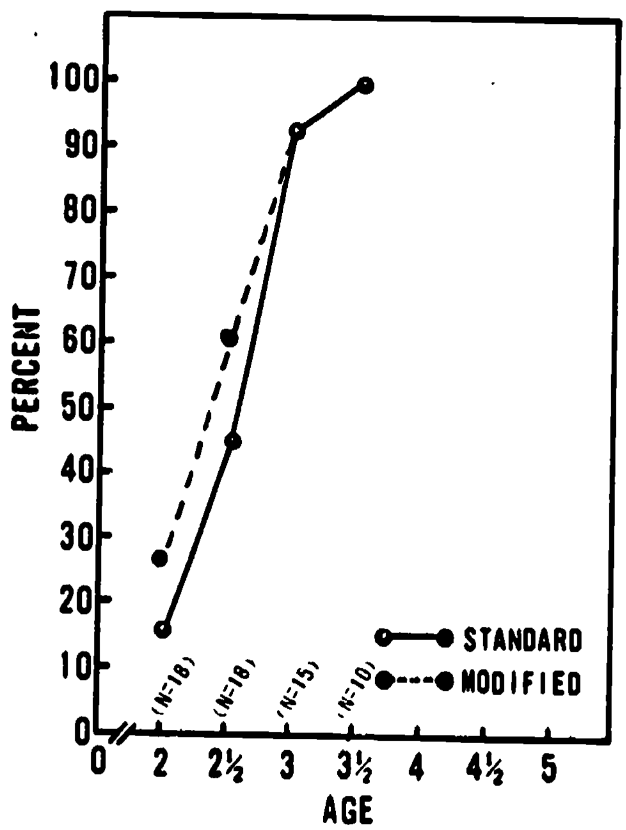

FIG. 11 PICTURE MEMORIES (III,4)

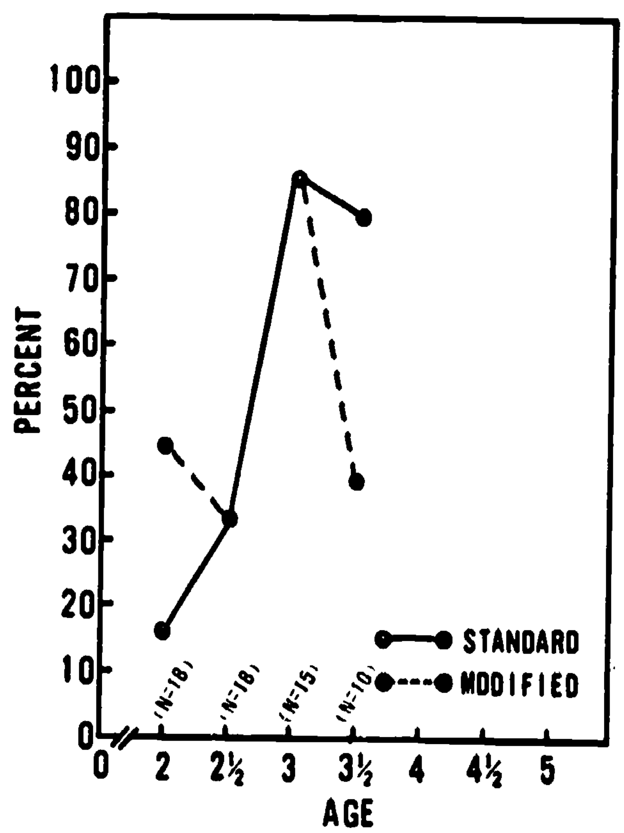

FIG. 12 COPYING A CIRCLE (III,5)

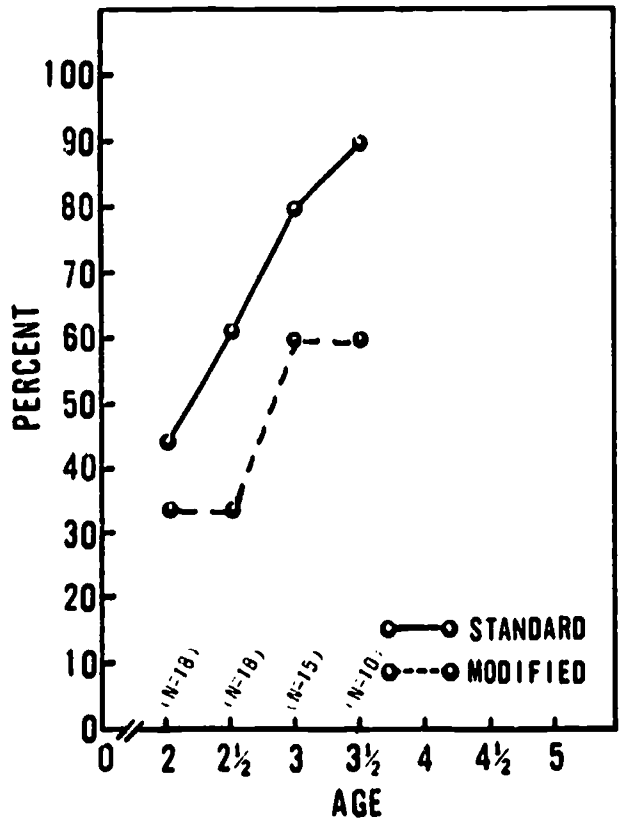

FIG.13 DRAWING A VERTICAL LINE (III,6)

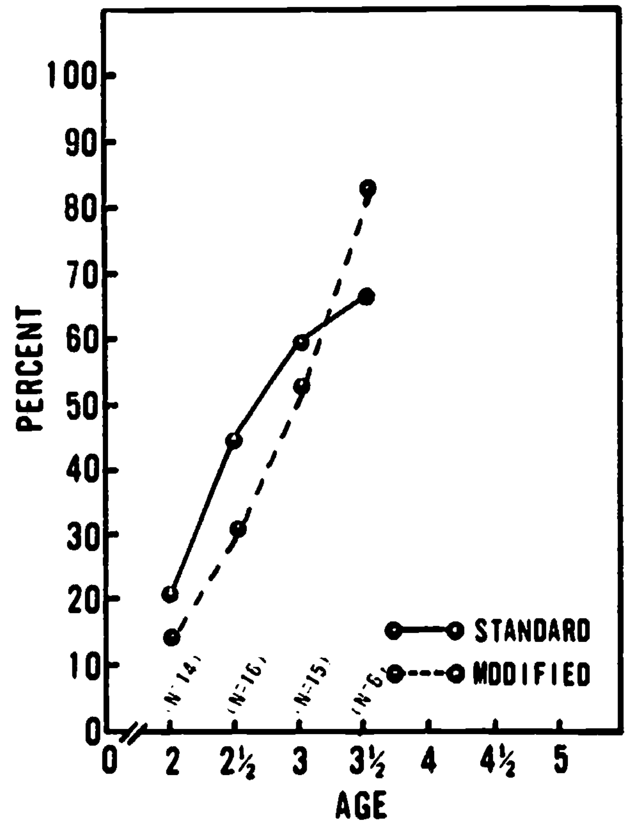

FIG.14 REPEATING TWO OBJECTS (III, alt.)

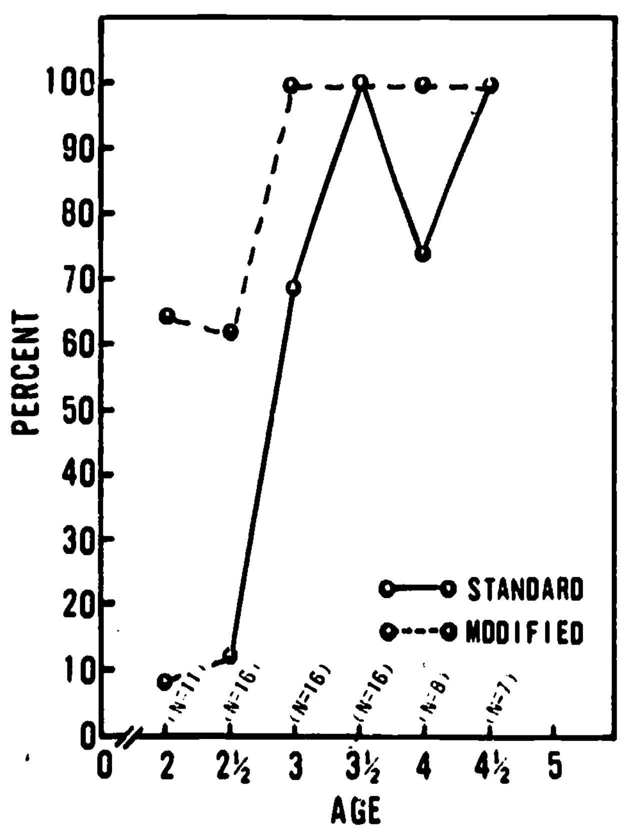

FIG.15 PATIENCE: PICTURES (III-6,2)

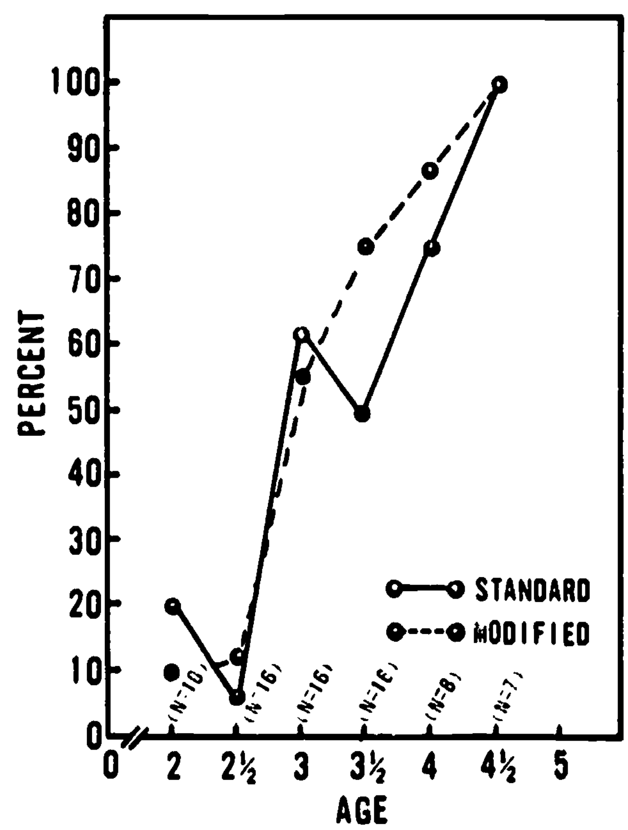

FIG.16 RESPONSE TO PICTURES (III-6,4)

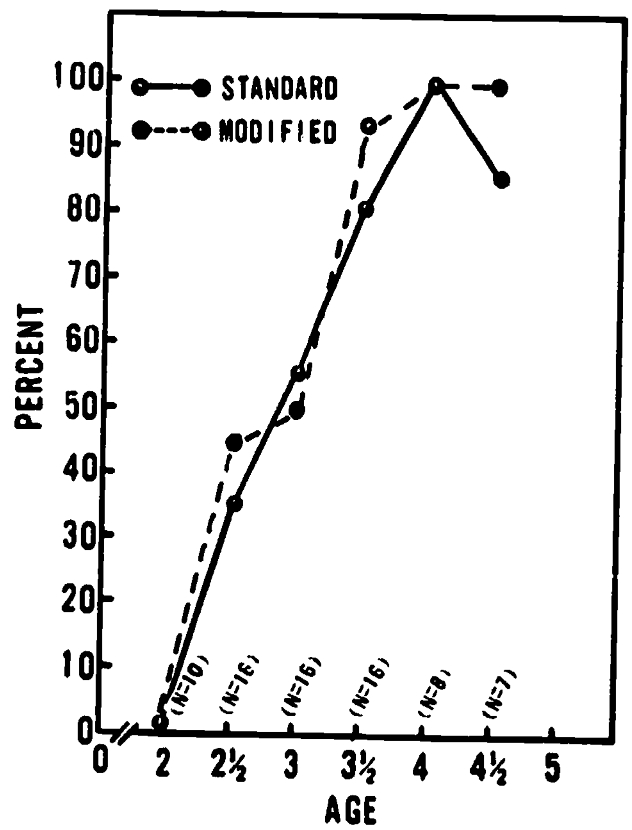

FIG. 17 SORTING BUTTONS (III-6,5)

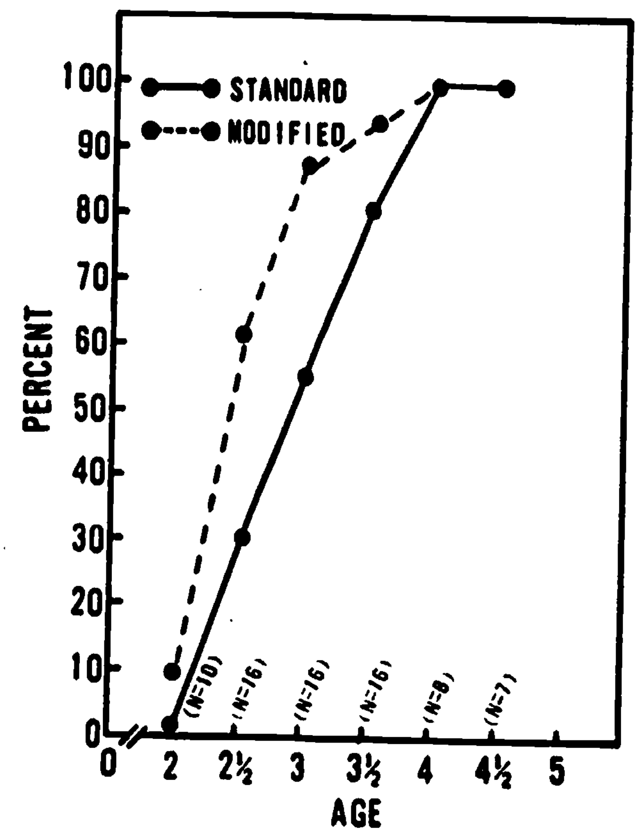

FIG. 18 COMPREHENSION I (III-6,6)

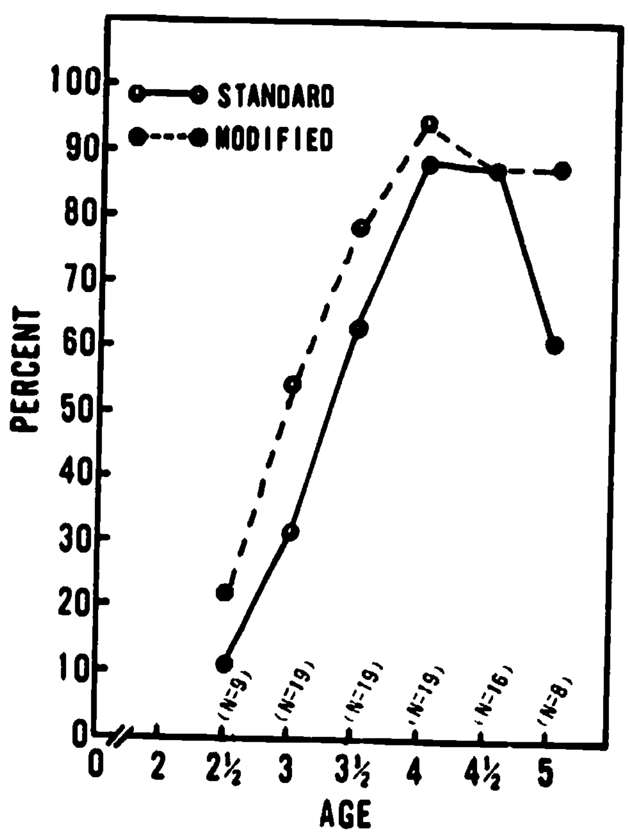

FIG. 19 PICTURE VOCABULARY (IV,1)

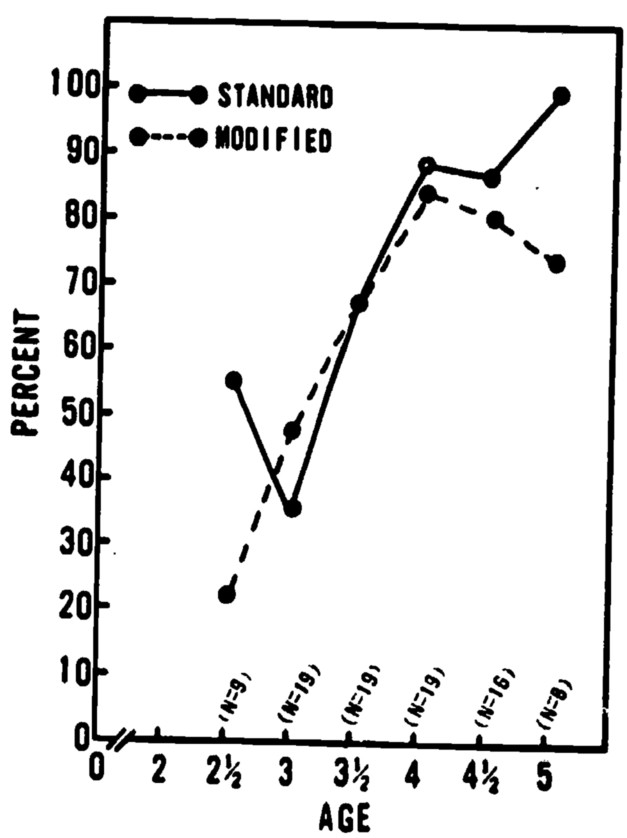

FIG. 20 NAMING OBJECTS FROM MEMORY (IV,2)

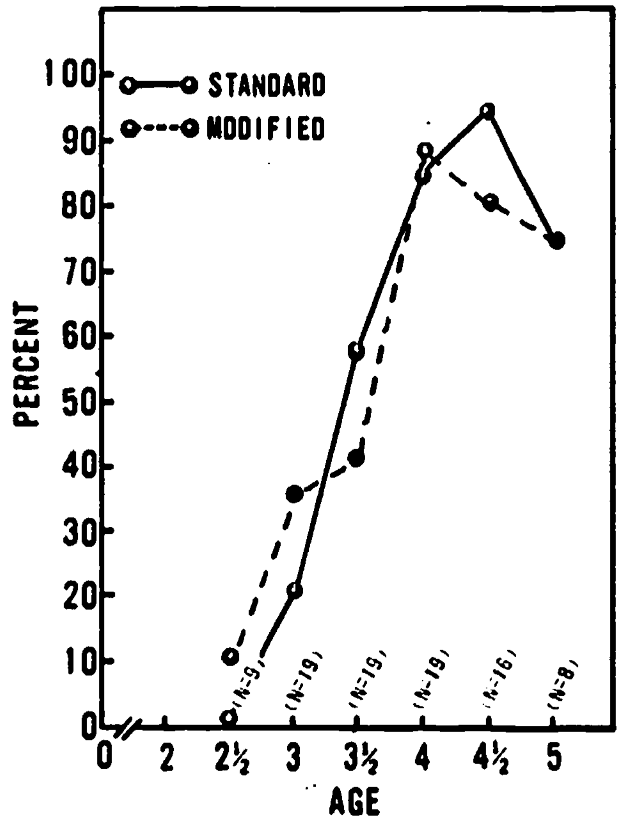

FIG.21 OPPOSITE ANALOGIES I (IV,3)

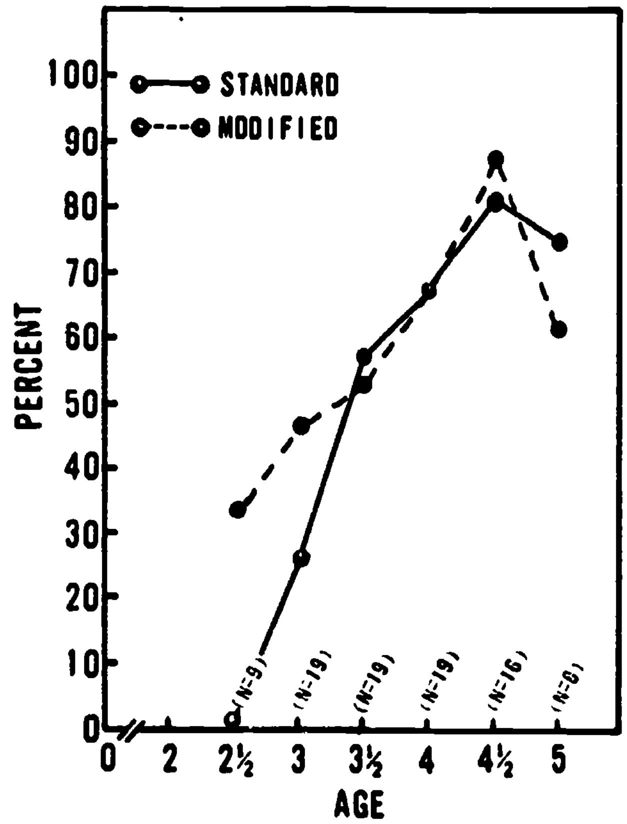

FIG.22 COMPREHENSION II (IV,6)

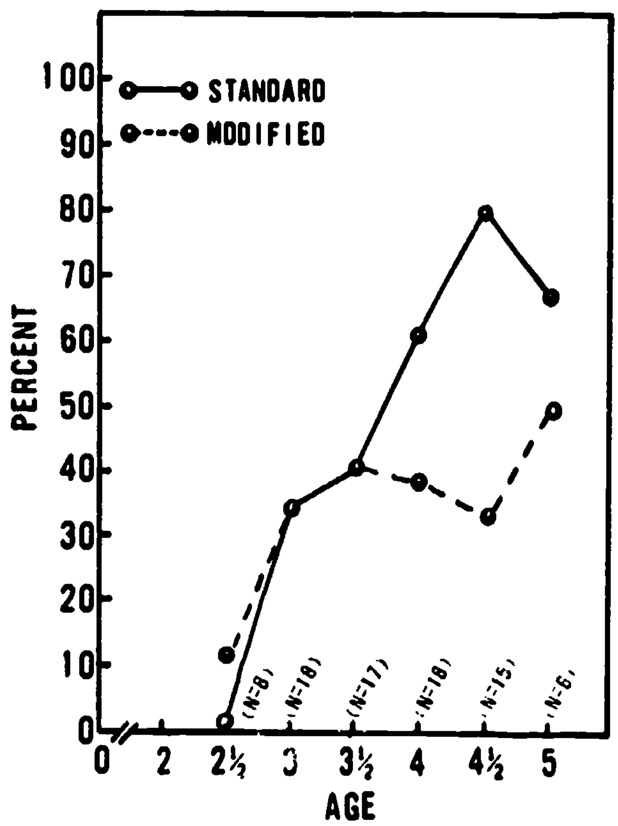

FIG.23 MEMORY FOR SENTENCES I (IV,alt.)

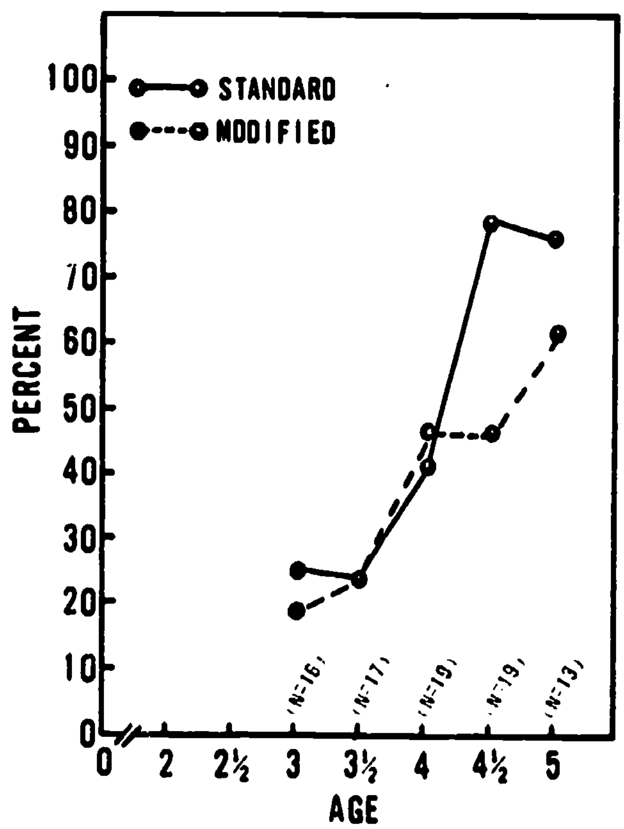

FIG.24 OPPOSITE ANALOGIES I (IV-6,2)

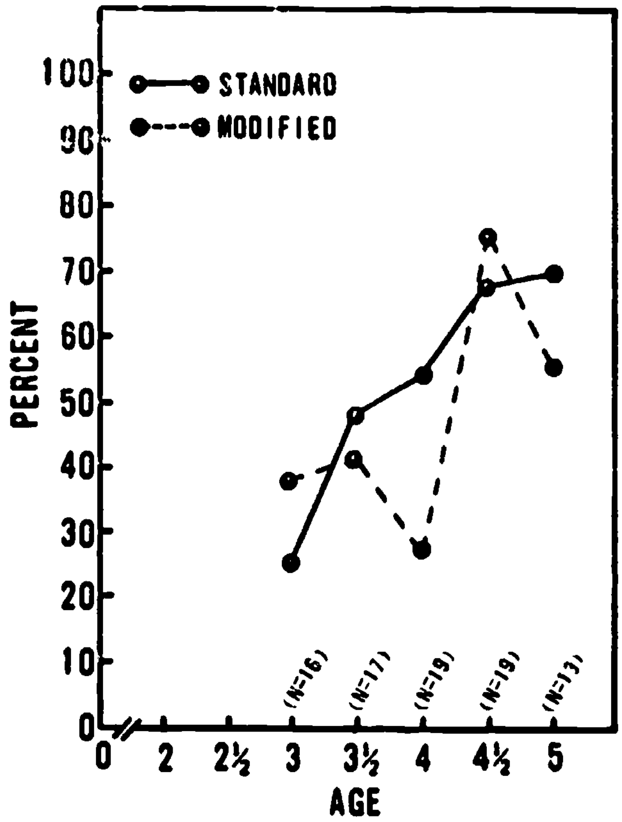

FIG.25 MATERIALS (IV-6,4)

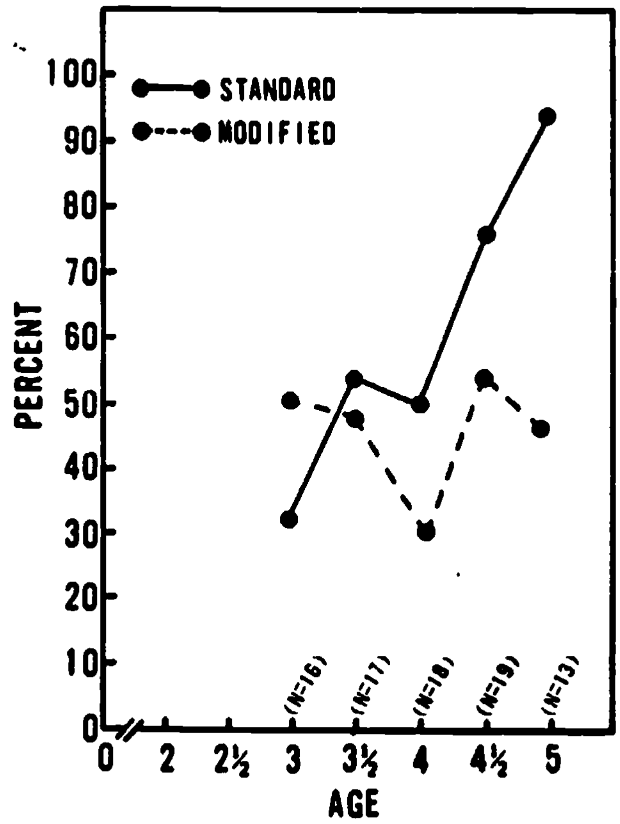

FIG.26 THREE COMMISSIONS (IV-6,5)

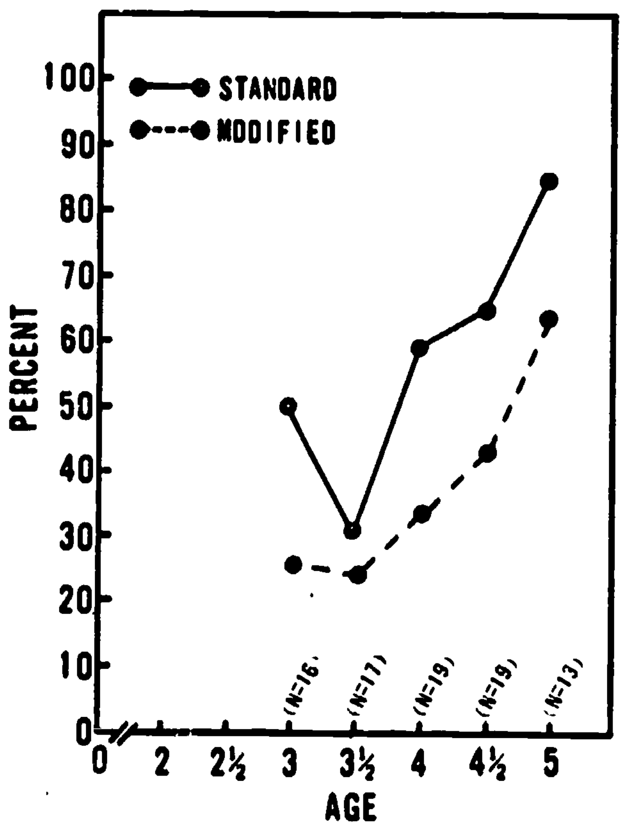

FIG.27 COMPREHENSION III (IV-6,6)

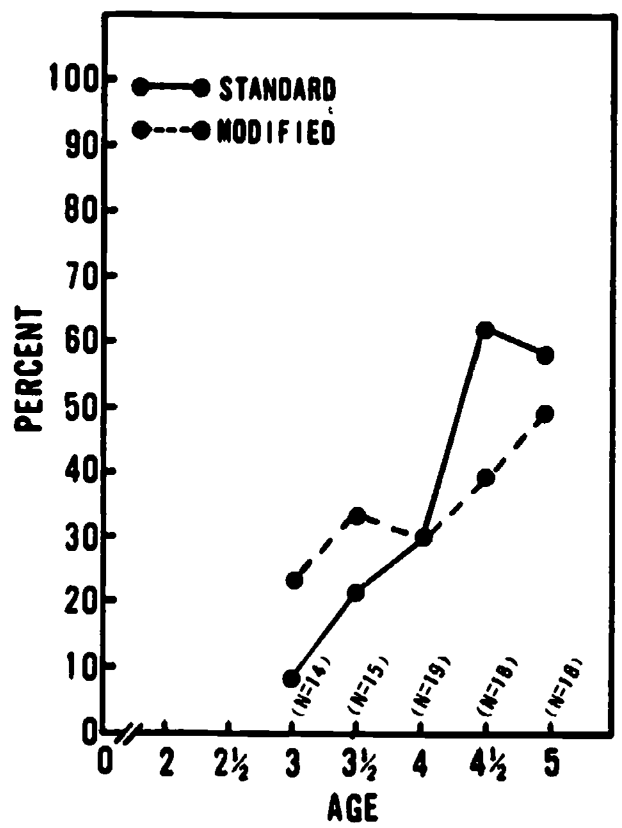

FIG.28 PICTURE COMPLETION: MAN (V,1)

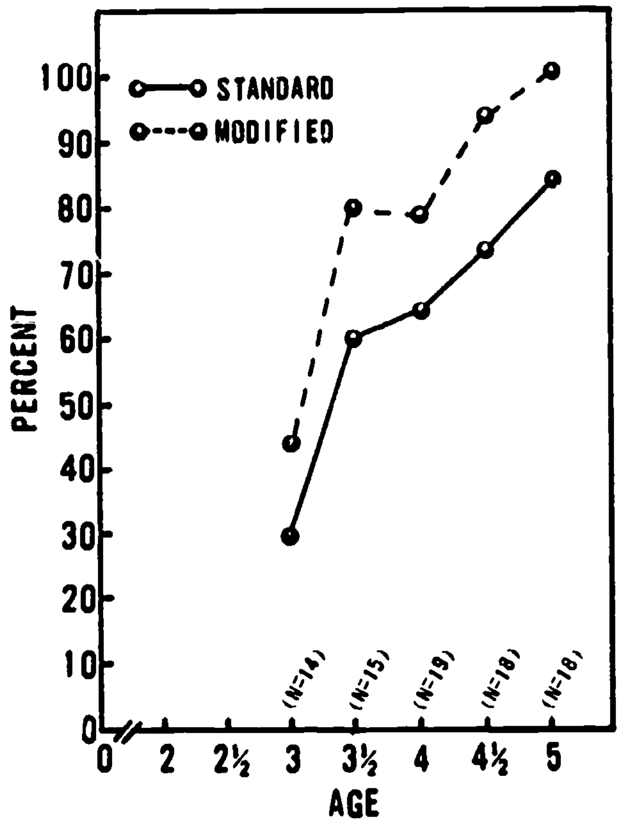

FIG.29 DEFINITIONS (V,3)

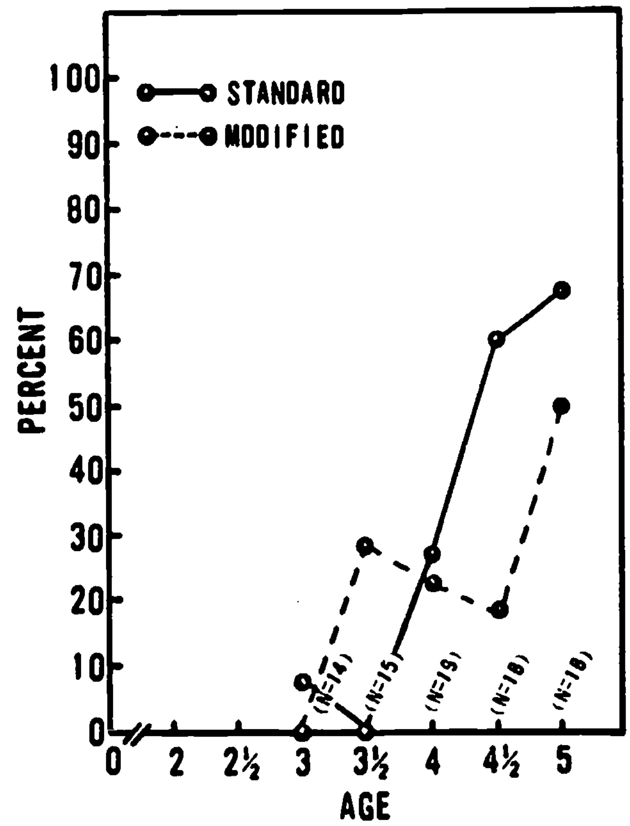

FIG.30 COPYING A SQUARE (V,4)

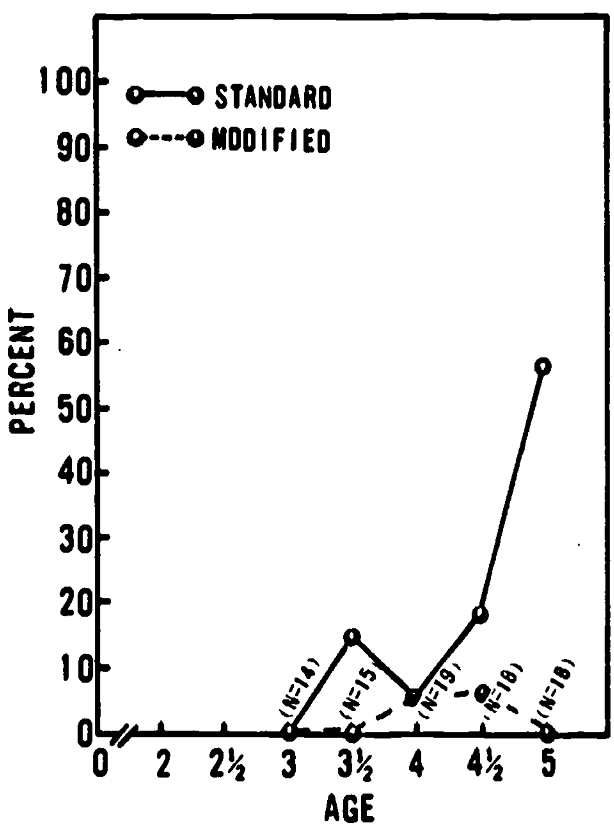

FIG.31 PATIENCE:RECTANGLES (V,6)

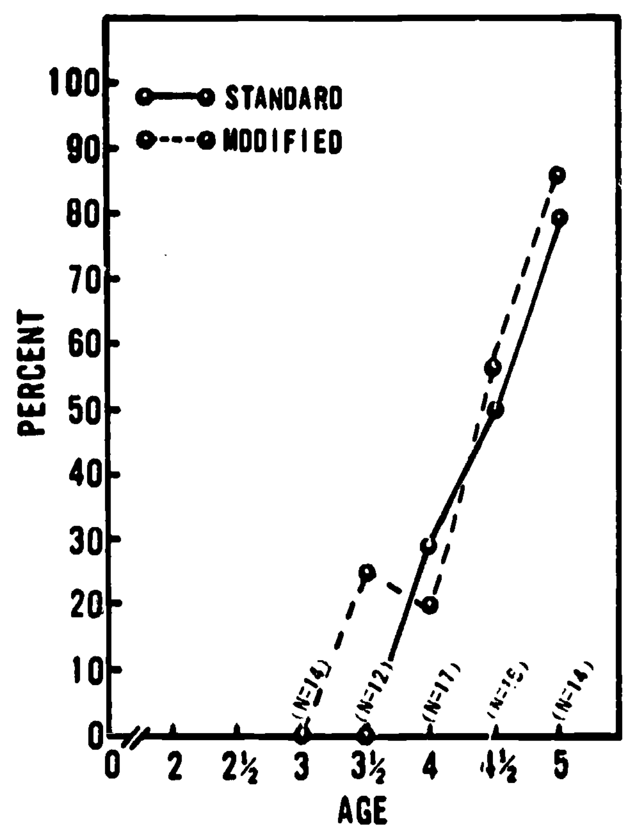

FIG.32 KNOT (V,alt.)

Item Validity

Tables 13 through 16 present biserial r's for the normal group, mentally retarded group, cerebral-palsied group, and for the total group. Each group is discussed separately.

Normal group. In the normal group, the biserial r's are generally low, ranging from -.14 to .30. Of the 32 correlations shown in Table 13, 11 are .15 or higher. The number of children used for the correlations ranged from 30 to 92. The samples' mean IQ's for the various tests are above average, with the exception of the IQ's for the samples for four tests at year-level II-6 where the IQ's are in the upper limits of the average range. The range of mean IQ's is from 108.91 to 113.12, while the range of standard deviations of the IQ's is from 12.81 to 19.62. The correlations indicate that some of the items are working effectively, while others are contributing little to test validity. The restricted range of the normal sample may, in part, have contributed to the relatively low correlations.

Mentally retarded group. The biserial correlations are much higher in the mentally retarded group than in the normal group, although there also are some large negative correlations. Of the 32 correlations that are shown in Table 14, 21 are .15 or higher. The range of coefficients is from -1.00 to .62. The four large negative coefficients are based on samples of 4 to 12 children, and occur at year-levels IV, IV-6, and V. The low number of subjects for these correlations, in part, reduces the saliency of the negative correlations. The number of children used for the correlations range from 4 to 23. The mean IQ's range from 33.00 to 56.80. These IQ's are in the lower range of mental retardation. The standard deviations range from 9.82 to 23.78. The correlations indicate that most of the modified tests are working well in the mentally retarded group.

Cerebral-palsied group. The biserial correlations in the cerebral-palsied group range from -.36 to .46. Of the 32 correlations shown in Table 15, 11 are .15 or higher. There are four negative correlations of -.15 or higher. The mean IQ's are in the Below-Average range (range of 80.17 to 87.32). The standard deviations range from 18.75 to 22.64. The correlations indicate that some of the items are working effectively, while others are contributing little to or detracting from test validity.

Total group. The biserial correlations in the total group range from -.34 to .40. Of the 32 correlations shown in Table 16, 13 are .15 or higher. The mean IQ's range from 85.53 to 105.60. The standard deviations are very large, ranging from 20.78 to 36.08. These deviations reflect the large variability of IQ's that existed in the total sample. Because the total group was not selected to represent a normal distribution of IQ ranges, it is difficult to evaluate the contribution of these biserial r's to test validity.

Table 13. Biserial r's for Modified Stanford-Binet (L-M) Tests at Year-Levels II through V for Normal Children

Test	Biserial r	Mean	SD	N
II,1 Three-hole Form Board	.00	110.29	19.62	31
II,4 Block building: Tower	.16	110.29	19.62	31
II,5 Picture vocabulary	.00	111.40	18.94	30
II-6,3 Naming objects	.28	108.91	19.03	43
II-6,4 Picture vocabulary	.05	108.91	19.03	43
II-6,5 Repeating 2 objects	.00	108.91	19.03	43
II-6,6 Obeying simple commands	.17	108.91	19.03	43
II-6,Alt. Three-hole Form Board: Rotated	.22	110.89	17.85	37
III,2 Picture vocabulary	.18	112.21	17.37	66
III,3 Block building: Bridge	.15	112.21	17.37	66
III,4 Picture memories	-.02	112.21	17.37	66
III,5 Copying a circle	.14	112.21	17.37	66
III,6 Drawing a verticle line	.18	112.21	17.37	66
III,Alt. Repeating 2 objects	-.04	113.17	16.98	53
III-6,2 Patience: Pictures	.11	110.73	16.19	78
III-6,4 Response to pictures	.05	110.73	16.19	78
III-6,5 Sorting Buttons	-.07	110.73	16.19	78
III-6,6 Comprehension I	-.11	110.73	16.19	78
IV,1 Picture vocabulary	.16	111.86	14.97	92
IV,2 Naming objects from memory	.14	111.42	14.64	92
IV,3 Opposite analogies I	.11	111.86	14.97	92
IV,6 Comprehension II	.21	111.49	15.21	92
IV,Alt. Memory for sentences I	.04	112.75	14.24	84
IV-6,2 Opposite analogies I	.19	112.34	13.93	86
IV-6,4 Materials	.30	112.28	13.93	86
IV-6,5 Three Commissions	-.06	112.34	13.93	86
IV-6,6 Comprehension III	.12	112.36	13.95	86
V,1 Picture completion: Man	.06	112.70	13.29	86
V,3 Definitions	-.04	113.12	12.81	86
V,4 Copying a square	.00	113.12	12.81	86
V,6 Patience: Rectangles	-.03	113.12	12.81	86
V,Alt. Knot	-.14	112.45	13.47	75

Table 14. Biserial r's for Modified Stanford-Binet (L-M) Tests at Year Levels II through V for Mentally Retarded Children

Test[a]	Biserial r	Mean	SD	N
II,1	.62	35.29	9.82	14
II,4	.29	36.71	11.15	14
II,5	.00	33.00	10.04	9
II-6,3	.53	37.46	13.36	13
II-6,4	.12	37.46	13.36	13
II-6,5	.29	37.46	13.36	13
II-6,6	.39	40.00	14.61	19
II-6,Alt.	.42	37.38	12.04	16
III,2	.21	40.18	13.88	17

Table 14. continued

Test[a]	Biserial r	Mean	SD	N
III,3	.31	38.40	11.87	20
III,4	.34	40.00	12.73	22
III,5	.34	41.57	14.53	23
III,6	.22	41.57	14.53	23
III,Alt.	.26	39.00	13.54	14
III-6,2	.18	43.89	13.63	18
III-6,4	.37	44.56	14.33	16
III-6,5	.33	43.89	13.63	18
III-6,6	.23	44.06	14.03	17
IV,1	.30	46.53	16.23	17
IV,2	.54	46.53	16.23	17
IV,3	.58	46.53	16.23	17
IV,6	.08	46.53	16.23	17
IV,Alt.	-.32	42.29	13.86	14
IV-6,2	.36	50.17	17.58	12
IV-6,4	-.59	50.33	17.38	12
IV-6,5	-.17	50.33	17.38	12
IV-6,6	.23	50.33	17.38	12
V,1	.00	56.80	23.78	5
V,3	.00	56.80	23.78	5
V,4	-.63	56.80	23.78	5
V,6	.00	56.80	23.78	5
V,Alt.	-1.00	51.25	23.43	4

[a]See Table 13 for test names.

Table 15. Biserial r's for Modified Stanford-Binet (L-M) Tests at Year Levels II through V for Cerebral-Palsied Children

Test[a]	Biserial r	Mean	SD	N
II,1	.00	80.17	22.12	12
II,4	-.13	80.17	22.12	12
II,5	.00	81.92	21.19	12
II-6,3	.30	82.38	22.64	13
II-6,4	.33	82.38	22.64	13
II-6,5	-.21	82.38	22.64	13
II-6,6	-.05	82.38	22.64	13
II-6,Alt.	.30	82.38	22.64	13
III,2	.43	81.47	19.73	17
III,3	.09	81.47	19.73	17
III,4	.16	81.47	19.73	17
III,5	.17	81.47	19.73	17
III,6	.28	81.47	19.73	17
III,Alt.	.07	81.47	19.73	17
III-6,2	.11	81.67	19.83	21
III-6,4	-.06	82.75	19.70	20
III-6,5	-.36	81.65	20.35	20
III-6,6	.46	81.67	19.83	21
IV,1	.11	84.86	18.75	28
IV,2	-.23	84.86	18.75	28

Table 15. continued

Test[a]	Biserial r	Mean	SD	N
IV,3	.26	84.86	18.75	28
IV,6	.12	84.86	18.75	28
IV,Alt.	.36	84.52	19.02	27
IV-6,2	.17	85.08	20.14	24
IV-6,4	.01	85.08	20.14	24
IV-6,5	.05	85.08	20.14	24
IV-6,6	-.08	85.08	20.14	24
V,1	.01	87.32	19.53	22
V,3	-.10	87.32	19.53	22
V,4	-.15	87.09	19.66	22
V,6	.00	87.32	19.53	22
V,Alt.	.10	87.32	19.53	22

Table 16. Biserial r's for Modified Stanford-Binet (L-M) Tests at Year-Levels II through V for Total Group

Test[a]	Biserial r	Mean	SD	N
II,1	.27	85.53	36.08	57
II,4	-.17	85.88	35.67	57
II,5	.00	90.63	34.61	51
II-6,3	.12	90.45	33.32	69
II-6,4	.11	90.45	33.32	69
II-6,5	-.22	90.45	33.32	69
II-6,6	.01	86.85	34.50	75
II-6,Alt.	.18	87.45	35.21	66
III,2	.18	94.74	32.21	100
III,3	.05	92.81	33.54	103
III,4	.19	92.10	33.62	105
III,5	.17	91.95	33.50	106
III,6	.00	91.95	33.50	106
III,Alt.	.00	94.39	32.58	84
III-6,2	-.04	95.23	29.54	117
III-6,4	.17	96.54	28.74	114
III-6,5	.05	95.34	29.65	116
III-6,6	.05	95.70	29.23	116
IV,1	.26	98.23	27.34	137
IV,2	.17	97.94	27.07	137
IV,3	.26	98.23	27.34	137
IV,6	.18	97.99	27.30	137
IV,Alt.	.14	98.76	27.72	125
IV-6,2	.33	100.86	25.29	122
IV-6,4	.21	100.84	25.21	122
IV-6,5	.07	100.88	25.24	122
IV-6,6	.05	100.13	25.12	122
V,1	.40	105.60	20.78	113
V,3	-.34	105.60	20.78	113
V,4	.06	104.98	21.18	113
V,6	.05	105.60	20.78	113
V,Alt.	-.04	104.55	21.37	101

[a]See Table 13 for test names.

Comment on biserial r's. Three of the tests (Memory for Sentences I at year-level IV, alternate; Materials at year-level IV-6, 4; and Knot at year-level V, alternate) which show large negative correlations in the mentally retarded group either do not show as large negative correlations in the normal group, or show positive correlations. One test, for example, Materials at year-level IV-6 has a biserial coefficient of .30 in the normal group and -.59 in the mentally retarded group. If we use the normal group as the standard for evaluating the validity of the modified tests, we can conclude that many of the tests are valid, while none are seriously working in a negative direction.

Cerebral Palsied: Spastic vs. Nonspastic

In the cerebral-palsied group, the IQ's of children with a spastic type of condition ($N = 18$) were compared with those who were not spastic ($N = 12$). Diagnoses were based on information contained in the children's school records. The two groups did not differ significantly on the IQ's they obtained on the standard administration (M IQ spastic = 83.50; M IQ nonspastic 75.83; $t = < 1$, $p > .05$) and on the modified administration (M IQ spastic = 85.28; M IQ nonspastic = 80.25; $t < 1$, $p > .05$).

Cerebral Palsied: Test-taking Ability

In the cerebral-palsied group, 13 of the 30 children were not able to be administered one or more of the standard tests. In contrast, only two children were not able to be administered three of the modified tests. The major handicaps of the cerebral-palsied children which interferred with their performance included no speech, spastic arm movements, or no use of arms. Thus, the modifications provided a means for a more thorough evaluation of these children.

Part II: Upper Level Stanford-Binet Tests, Three WISC Subtests, and Memory for Block Designs Test

Methodology

In the second part of the study, six Stanford-Binet tests located at year-levels IX through XIII, three WISC subtests (Digit Span, Coding, and Block Design), and a new test entitled, "Memory for Block Designs," were evaluated. Five of the six Stanford-Binet tests are memory tests, while one is a reasoning test.

Pilot Study and General Considerations

Initially, two or more modifications were proposed for each of the three WISC subtests. However, it soon became evident that time considerations would not permit a systematic evaluation of each type of modification. A different sample would have been needed to evaluate the effects of each type of modification, thereby doubling the number of subjects in each group. In addition, other factors became evident, and these are described below.

On the Digit Span subtest, a multiple-choice procedure could be used for Digits Forward but not for Digits Backward. This became evident when some children began to read the digits on the response cards from right to left after the Digits Backward series was read to them, thereby turning the task into another Digits Forward task. The final modification that was selected for study was the oral-pointing modification. This modification would allow for an evaluation of the effect of altering only the response modality.

On the Block Design subtest only the free space modification was used. A second modification, use of numbered squares, was not selected because this procedure could provide cues to the subjects which might enable them to solve the items more easily than on the standard presentation. Thus, only a plain white sheet of paper was used by the examiner as the designated area on which to construct the designs for the subjects.

On the Coding subtest, the modification selected was one in which the subjects did not have to make any marks. This modification is one which can be used to evaluate handicapped children with motor disabilities since it requires only a "yes" or "no" response from the subjects.

Composition of Sample for Upper Level

Schools throughout San Diego County were contacted in order to obtain normal, mentally retarded, cerebral palsied, and orthopedically handicapped children. Excellent cooperation was obtained from all of the school districts so that in the cerebral-palsied and orthopedically handicapped groups, in particular, nearly all of the available children in these groups were tested. Children in all groups were tested only with parental permission. Age and disability were the only two selection criteria for inclusion in the mentally retarded, cerebral-palsied, and orthopedically handicapped groups. Age, birthdate, parental occupation, and no disability were the four selection criteria for inclusion in the normal group. In none of the groups was sex used as a criterion to select children.

Normal

The normal sample was selected so that parental occupation conformed as closely as possible with the national distribution of occupational groups. The birthdays of the children selected were within one month of their birthdate at the time of testing. The sample ranged from 5-0 to 16-0 years of age (M chronological age = 10.46 years). There were 44 males and 55 females in the sample. Table 17 shows the national distribution of occupational groups and the distribution of occupational groups of the parents of the children in the normal sample. The largest discrepancies are four and three percentage points in Categories III and II, respectively. Overall, the distribution of parental occupations in the present sample appears to conform to that of the national distribution.

Table 17. National Distribution and Upper Level Normal Sample Distribution of Occupational Groups

	Occupational Group	National	Normal Group	
		%	N	%
I	Professional & Technical	10	10	10
II	Managers, Officials, Proprietors Farm Owners & Farm Managers	16	19	19

Table 17. continued

	Occupational Group	National	Normal Group	
		%	N	%
III	Clerical & Sales Workers	14	10	10
IV	Craftsmen, Foremen & Operatives	39	40	40
V	Service Worker-Public & Private	6	10	10
VI	Laborers-Farm & Nonfarm	10	10	10
		95	99	99

Mentally Retarded

There were 75 children in the mentally retarded group, 35 boys and 40 girls (*M* chronological age = 10.13 years).

Cerebral-Palsied

There were 76 children in the cerebral-palsied group, 40 boys and 36 girls (*M* chronological age = 9.92 years).

Orthopedically Handicapped

There were 35 children in the orthopedically handicapped group, 18 boys and 17 girls (*M* chronological age = 11.25 years).

Examiners

The examiners are described in Part I of the report.

Procedure

Test Order

The standard and modified tests were administered in counterbalanced order. Random permutations of 2 were used to determine the order in which the two forms were administered (i.e., standard or modified first).

Test-Retest Interval

The test-retest interval ranged from one to 29 days. Of the 287 children tested, only eight were given the standard and modified tests more than seven days apart.

Materials

The directions for the modified tests, the test stimuli, and the record booklet which were used in this part of the project are contained in a separate part of the Final Report, entitled "Supplement to the Final Report." However, this section contains a brief description of each of the modifications that were designed for the Stanford-Binet tests and WISC subtests, and a description of the Memory for Block Designs test.

Description of Modifications for Upper Level Stanford-Binet Tests and WISC Subtests, and Description of Memory for Block Designs Test

Stanford-Binet

Year IX,3. Memory for Designs I. A multiple-choice procedure is used. E shows the stimulus card, removes it, and S is asked to point to the one picture which shows the drawings.

Year XI,4. Memory for Sentences II. A multiple-choice procedure is used. E says the sentence and S is asked to point to the sentence that was read.

Year XII,A. Memory for Designs II. A multiple-choice procedure is used. E shows S the stimulus card, removes it, and S is asked to point to the one picture which shows the drawing.

Year XIII,1. Plan of Search. A multiple-choice procedure is used. E presents the situation to S and S is asked to point to the one drawing that shows the best way to hunt for the purse so as to be sure not to miss it.

Year XIII,3. Memory for Sentences III. A multiple-choice procedure is used. E says the sentence and S is asked to point to the sentence that was read.

Year XIII,6. Copying a Bead Chain from Memory. A multiple-choice procedure is used. E makes bead chain, removes it, and S is asked to point to the picture which shows the bead chain constructed by E.

WISC Subtests

Digit Span. An oral-pointing modification is used. The digits 1 through 9 appear on a rectangular white card which is 3 5/16 inches by 17½ inches. Each digit is surrounded by heavy black lines. These black lines or boxes are 1 9/16 inches by 13/16 of an inch. The card is placed in front of the child so that he can see clearly all of the digits. An unsharpened yellow pencil is used by the child to point to the digits. After E reads the digits, S is asked to point to the numbers on the card. The same procedure is used for Digits Forward and for Digits Backward.

Block Design. A pointing modification is used. Six blocks, showing the various colors that are used in the construction of the designs (red, white, and various positions of half-red and half-white), are attached to a board (see Figure 39). These blocks serve as a key for the S. The S is asked to point to a block on the board and then to a place on a white sheet of paper. After S designates the block and the location on the sheet of paper, E takes the block (with the designated color combination) from his reserve and places it on the designated location. A reserve supply of 18 blocks is used so that E would lose little time in placing the block selected by the S in the designated location. In all other respects, the procedures described in the standard administration are followed.

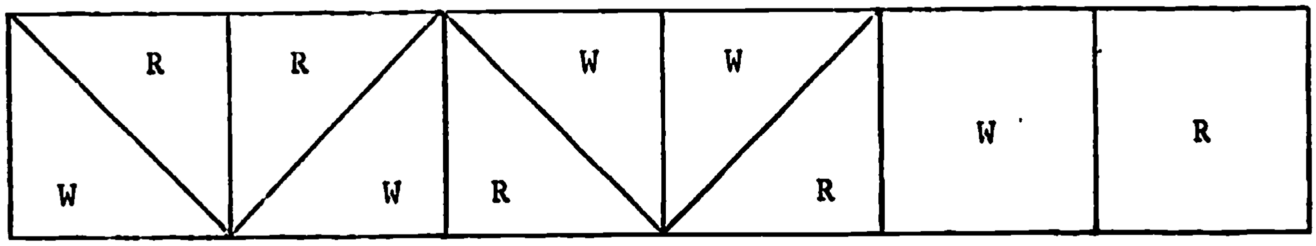

Figure 39. Arrangement of Block Design stimulus board.

Coding. A "yes"-"no" modification is used. The modification was designed so that the S is required to say "yes" or "no" depending on whether the symbol under the letter matched the symbol shown in the key. A specially prepared Coding form was constructed. Three boxes are used for each item. An empty box on the first row is used for the E to make a mark when the S says "yes." It is left blank when the S says "no." The second row shows the number. The third row shows the symbol. Under the three rows, the key is presented. By use of a randomization procedure, correct symbols and incorrect symbols were placed under each number. The incorrect symbols were selected from those shown in the standard key.

The standard WISC Coding numbers were used. However, instead of placing all of the letters on one page, four separate pages (trials) were used. The time limits were 24" for the first trial and 32" for each of the remaining trials. This modification was incorporated in order to study the rate of improvement over the four trials. The total time limit (120") is the same as that used in the standard form. The modified form appears in the Record Booklet in the Supplement.

Memory for Block Designs

The Memory for Block Designs test is a new multiple-choice memory test which incorporates the 10 WISC Block Design subtest stimuli. The E shows the S each WISC Block Design card for five seconds, beginning with card A, and after removing each card immediately presents the multiple-choice card on which four designs appear. The S's task is to point to the correct design.

The multiple-choice cards each have an overall dimensions of 7 14/16 inches by 2 inches. Each block design drawing is 1 9/16 inches by 1 9/16 inches. Each block in the drawing is 13/16 of an inch by 13/16 of an inch. There is 5/16 of an inch between drawings. The cards are shown in Figure 40.

Data Analysis

Various statistical procedures were used to evaluate the validity of the modified tests. For the Stanford-Binet tests, correlations were obtained between the standard and modified tests in each of the four groups. In addition to correlations, chi square analyses were conducted to evaluate the degree to which subjects passed both the standard and modified tests or failed one form of the test and passed the other form. Biserial correlations could not be obtained because a Stanford-Binet IQ was not available and an entire series of Stanford-Binet tests was not administered. Only selected Stanford-Binet tests were evaluated, primarily those which clearly involve a memory component.

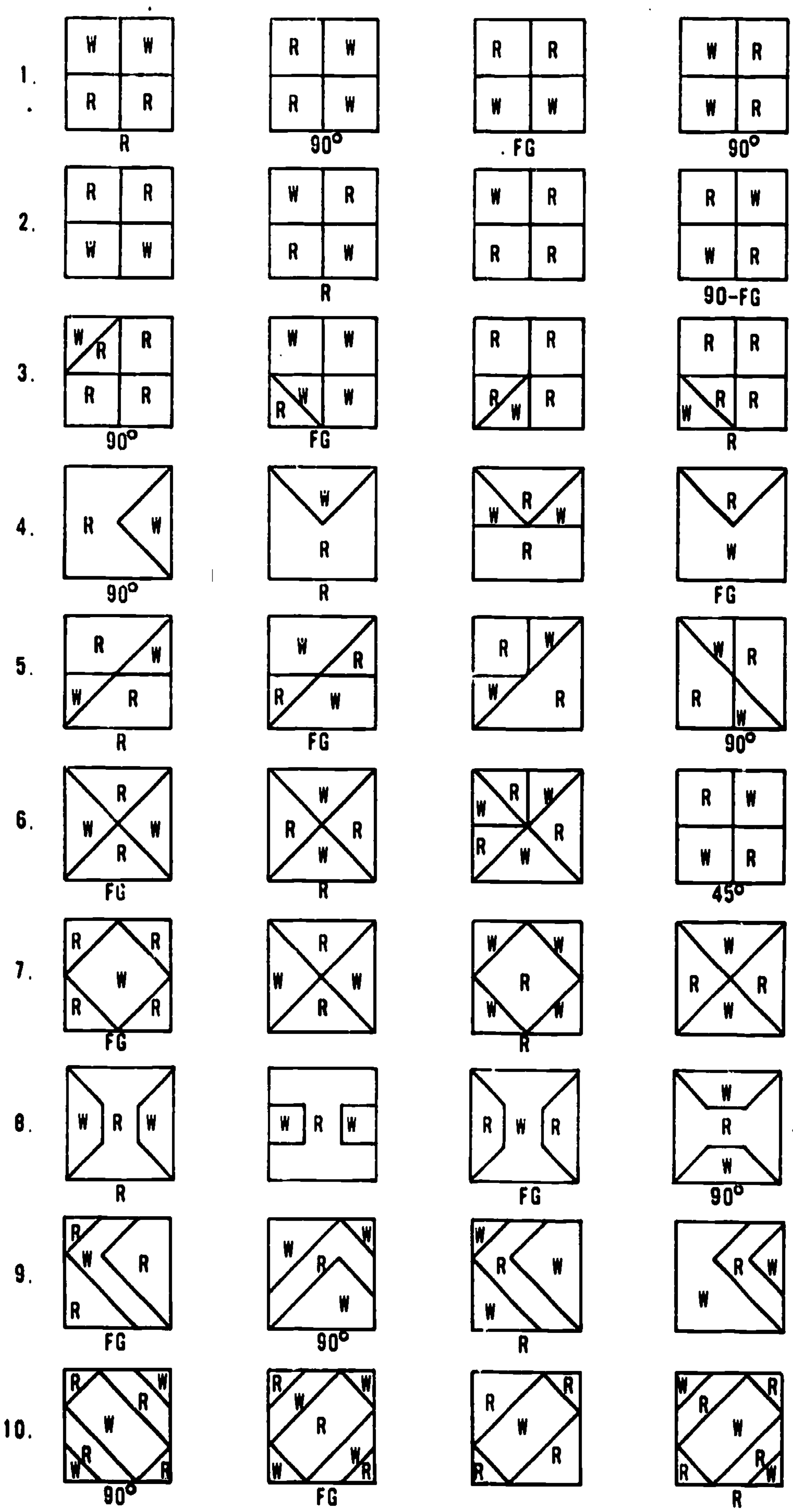

Figure 40. Memory for Block Design Stimulus cards (90° = 90° rotation; FG = figure ground inversion; R = correct answer).

For the WISC subtests, correlations were obtained between the standard and modified WISC subtest scaled scores and WISC IQ's in each of the four groups. In addition, analyses of variance procedures were used to evaluate the standard and modified WISC scaled scores and WISC IQ's. In the normal group three 10 X 2 ANOVA designs, with repeated measures on the last factor, were used to evaluate the Digit Span, Block Design, and IQ scores. The first factor was the 10 age levels (6 through 15) and the second factor was the scaled score (standard and modified). For the Coding subtest, a 7 X 2 ANOVA design was used because Coding B is only appropriate for children 8 years of age and older; therefore, children in age groups 9 through 15 were studied. The 8-year-old group was not evaluated because some children in this group were younger than eight years. The design for the mentally retarded, cerebral-palsied, and orthopedically handicapped groups was a treatment by subjects design. The two treatments were the standard and modified administrations. Age was not used as a factor because there was no attempt made to select children according to birthdate and date of testing in these three groups.

Intercorrelations were performed using IQ's obtained on the standard and modified WISC forms together with four subject variables: sex, socioeconomic level (SES), chronological age, and general IQ.

For the Memory for Block Designs test, standard scores were computed, and correlations were obtained between the raw scores on the Memory for Block Designs test and other variables. Finally, a *t* test was used to evaluate the WISC IQ's obtained by the spastic and nonspastic cerebral-palsied children.

Results

The results are discussed in four parts. The first part presents the results for the Stanford-Binet tests; the second, presents the results for the WISC subtests; the third, presents the results for the Memory for Block Designs Test; and the fourth, presents IQ's for spastic vs. nonspastic cerebral-palsied children.

Stanford-Binet Tests

Correlations between Standard and Modified Upper Level Stanford-Binet Tests

Table 18 presents the correlation coefficients between the standard and modified forms of the six upper level Stanford-Binet tests. In the normal group there were three significant correlations (Memory for Designs I, Memory for Sentences III, and Copying a Bead Chain from Memory), which range from .30 to .44. In the mentally retarded group there were four significant correlations (Memory for Designs I, Memory for Sentences II, Plan of Search, and Memory for Sentences III), which range from .25 to .43. In the cerebral-palsied group there were four significant correlations (Memory for Designs I, Memory for Sentences II, Memory for Sentences III, and Copying a Bead Chain from Memory), which range from .26 to .40. Finally, in the orthopedically handicapped group there were three significant correlations (Memory for Sentence II, Plan of Search, and Memory for

Sentences III), which range from .35 to .56. The standard and modified forms of the Memory for Sentences III test correlated significantly in all four groups; Memory for Designs I and Memory for Sentences II in three of the four groups; Plan of Search and Copying a Bead Chain from Memory in two of the four groups; and Memory for Designs II in none of the groups.

Table 18. Correlations between Standard and Modified Upper Level Stanford-Binet Tests

Tests	Normal	Mentally Retarded	Cerebral Palsied	Orthopedically Handicapped
Memory for designs I	.35**	.25*	.37**	.24
Memory for sentences II	.14	.41**	.26*	.36*
Memory for designs II	-.06	.20	.05	.08
Plan of Search	.11	.37**	.15	.56**
Memory for sentences III	.44**	.43**	.40**	.35*
Copying a bead chain from memory	.30**	.22	.28*	.19

* $p < .05$.
** $p < .01$.

Related to the correlations between the standard and modified tests is the percentage of subjects who passed the standard and modified forms for each test. These data are shown in Figures 33 through 38 for each Stanford-Binet test in the upper year levels that were used in the study. The figures show the percentage of subjects passing each test as a function of age level.

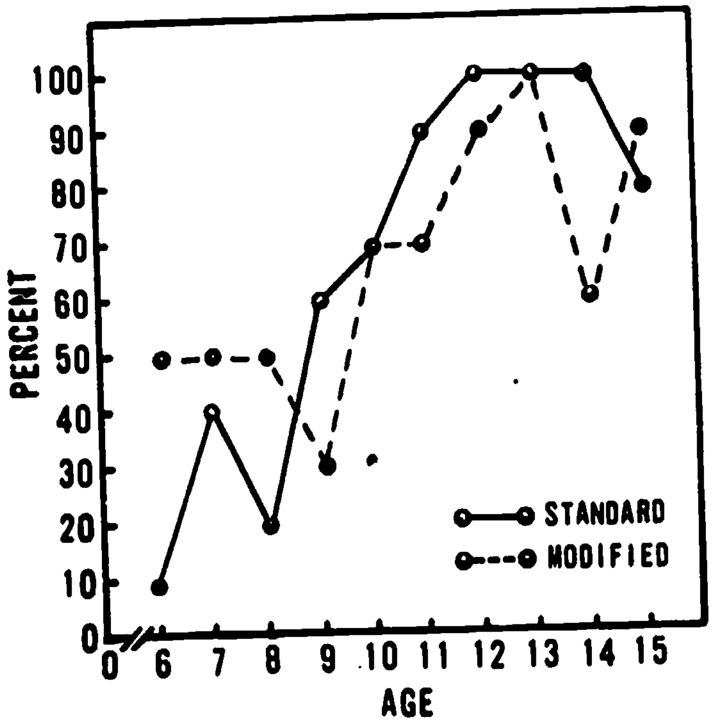

FIG. 33 MEMORY FOR DESIGNS I (IX, 3)

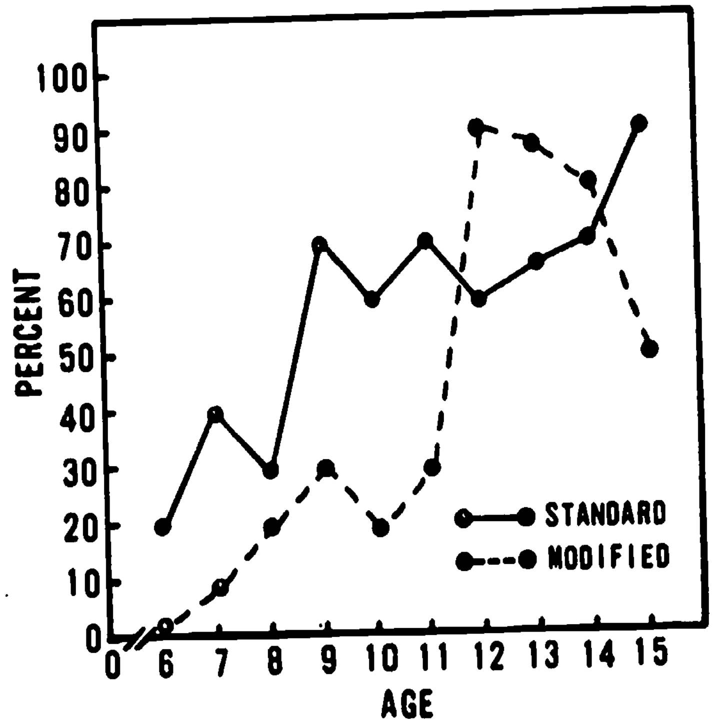

FIG. 34 MEMORY FOR SENTENCES II (XI, 4)

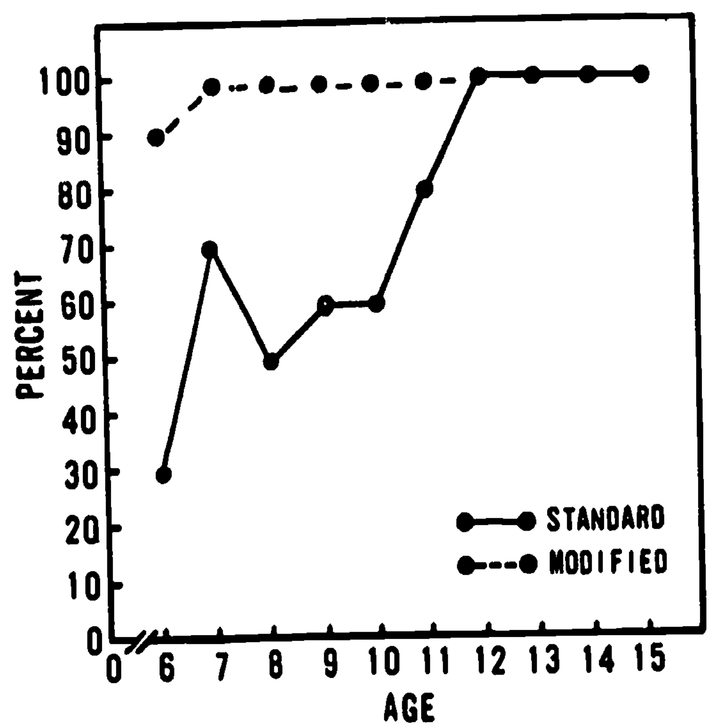

FIG.35 MEMORY FOR DESIGNS II (XIII, A)

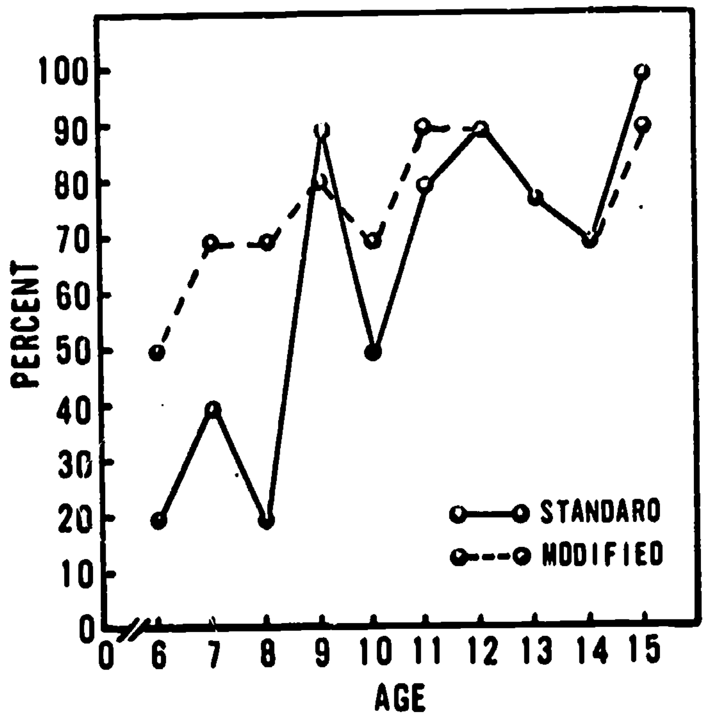

FIG.36 PLAN OF SEARCH (XIII,1)

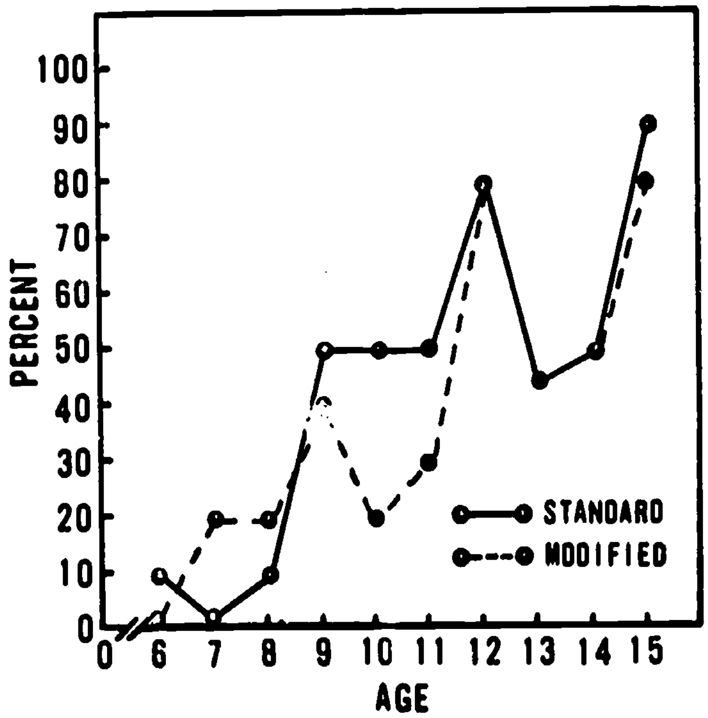

FIG.37 MEMORY FOR SENTENCES III (XIII,3)

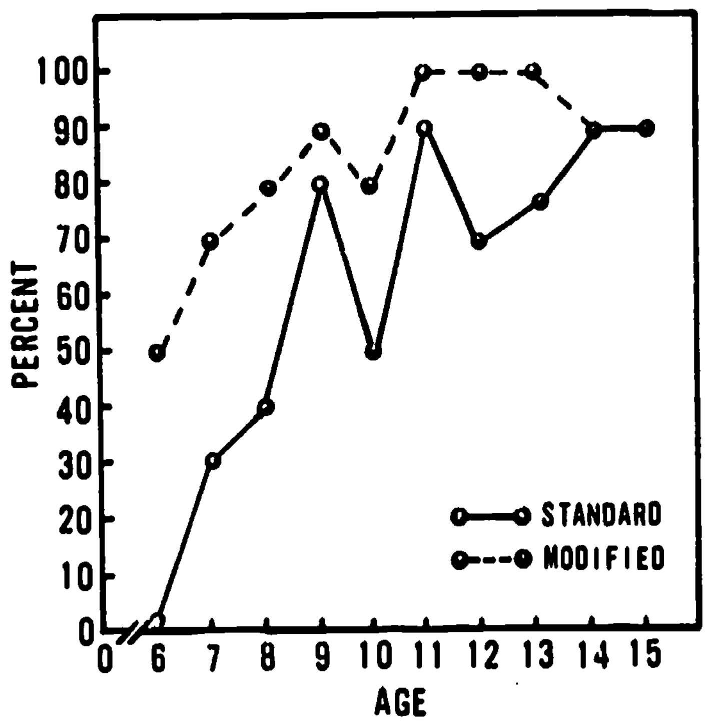

FIG.38 COPYING A BEAD CHAIN FROM MEMORY (XIII,6)

Chi Square Analyses for Upper Level Stanford-Binet Tests

An index of the validity of the upper level Stanford-Binet tests is the number of subjects who passed both the standard and modified forms and who failed both the standard and modified forms. Table 19 presents the number of subjects who obtained successes and failures on each of the six upper level Stanford-Binet tests that were studied in the investigation. Table 19 shows the number of subjects who were correct on both forms, correct on one form and incorrect on the other, and incorrect on both forms. Chi square analyses were performed for each group separately and for each test separately in order to determine whether the proportion of agreement (correct on both plus incorrect on both) was greater than the proportion of disagreement (correct on one and incorrect on the other). Thus, for example, the first chi square that was performed for the data of Table 20 was for the normal group for the Memory for Designs I test. The number of subjects who performed the same way on both forms was 71 (52 + 19), while the number of subjects who performed differently on the two forms was 29 (10 + 19). The chi square for these frequencies was 16.81, which is significant ($p < .01$). The chi squares for each test and group are shown in Table 20.

Table 19. Number of Ss Obtaining Successes and Failures on Upper Level Standard and Modified Stanford-Binet Tests

Test	Correct on both standard and modified				Correct on standard/ incorrect on modified				Incorrect on standard/ correct on modified				Incorrect on both standard and modified			
	NO	MR	CP	OR	NO	MR	CP	OR	NO	MR	CP	OR	NO	MR	CP	OR
Memory for designs I	52	6	10	8	10	3	7	5	19	20	11	8	19	46	48	14
Memory for sentences II	29	2	6	7	21	3	12	8	23	2	6	3	27	68	50	15
Memory for designs II	74	6	11	9	8	0	1	2	18	45	56	18	0	24	8	6
Plan of search	53	4	4	8	13	1	3	1	23	13	22	6	11	57	47	20
Memory for sentences III	27	1	5	6	16	4	7	7	11	0	4	3	46	70	58	18
Copying a bead chain from memory	58	5	10	11	4	2	4	5	27	24	22	9	11	42	39	9

Note.--Abbreviations are as follows: NO = normal, MR = mentally retarded, CP = cerebral-palsied, OR = orthopedically handicapped.

Table 20. Chi Square Analyses for Proportion of Agreement of Successes and Failures on Upper Level Stanford-Binet Tests

(See Table 19 for data)

Test	Normal	Mentally Retarded	Cerebral Palsied	Orthopedically Handicapped
Memory for designs I	16.81**	10.45**	21.01**	1.83
Memory for sentences II	1.21	54.61**	18.50**	3.03
Memory for designs II	22.09**	2.61	18.01**	.46
Plan of search	7.29**	28.13**	8.22**	11.43**
Memory for sentences III	20.25**	58.08**	35.15**	10.32**
Copying a bead chain from memory	13.69**	6.25*	6.45*	7.36**

* $p < .05$.
** $p < .01$.

The results of the chi square analyses indicate that on five of the six tests in the normal group there were significantly more subjects who performed the same way on both forms of the tests that there were subjects who performed differently on both forms of the tests. The only test having a nonsignificant chi square was Memory for Sentences II. In the mentally retarded group five of the six chi squares were also significant. However, in this group the nonsignificant chi square was on the Memory for Designs II test. In the cerebral-palsied group all of the chi square tests were significant. However, the frequencies for Memory for Designs II were in a direction opposite that that predicted. That is, the pattern of disagreement was greater than the pattern of agreement on the two forms. In the orthopedically handicapped group there were only three significant chi squares (on Plan of Search, Memory for Sentences II, and Copying a Bead Chain from Memory), and all frequencies were in the predicted direction.

WISC Subtests

Correlations between the Standard and Modified WISC Subtests and IQ's

Table 21 presents the correlations between the standard and modified WISC subtest scaled scores and IQ's for each of the four groups. The WISC IQ's were obtained by the method proposed by Tellegen and Briggs (1967). The Digit Span, Block Design, and Coding subtests can be considered to constitute a short form of the WISC. This short form was used to obtain WISC IQ's. All correlations were significant at the .01 level. The coefficients ranged from .47 to .92. These data indicate that the standard and modified subtest scaled scores and the standard and modified IQ's are highly correlated.

Table 21. Correlations between Standard and Modified WISC Subtest Scaled Scores and IQ's

Subtest	Normal	Mentally Retarded	Cerebral Palsied	Orthopedically Handicapped
Digit Span	.70*	.68*	.78*	.92*
Block Design	.66*	.78*	.82*	.70*
Coding B	.56*	.74*	.62*	.47*
IQ	.71*	.84*	.80*	.83*

* $p < .01$.

Analyses of Variance of WISC Scores

Digit Span. Tables 22 through 25 present the Digit Span ANOVA results for the four groups. The standard and modified forms were not significantly different in the normal and orthopedically handicapped groups, whereas the modified form was significantly more difficult than the standard form in the mentally retarded (by .80 points) and cerebral-palsied (by .85 points) groups. Age and the interaction between age and treatment were not significant factors in the normal group.

Table 22. ANOVA for Standard and Modified WISC Digit Span Scaled Scores of Normal Children

($N = 99$)

Source	df	MS	F
Ages (A)	9	16.55	1.15
Error	89	14.37	
Treatment (B)	1	2.88	1.12
A X B	9	2.74	1.06
Error	89	2.57	

M Digit Span Scaled Score (Standard) = 11.35
M Digit Span Scaled Score (Modified) = 11.11

Table 23. ANOVA for Standard and Modified WISC Digit Span Scaled Scores of Mentally Retarded Children

($N = 72$)

Source	MS	df	F
Treatment (A)	25.00	1	10.76*
Ss (B)	12.00		
A X B	2.32	71	

M Digit Span (Standard) = 3.88
M Digit Span (Modified) = 3.04

* $p < .01$.

Table 24. ANOVA for Standard and Modified WISC Digit Span Scaled Scores of Cerebral-Palsied Children

(N = 76)

Source	MS	df	F
Treatment (A)	27.80	1	8.06*
Ss (B)	27.31		
A X B	3.45	75	

M Digit Span (Standard) = 7.38
M Digit Span (Modified) = 6.53

* $p < .01$.

Table 25. ANOVA for Standard and Modified WISC Digit Span Scaled Scores of Orthopedically Handicapped Children

(N = 35)

Source	MS	df	F
Treatment (A)	5.16	1	3.96
Ss (B)	30.86		
A X B	1.30	34	

M Digit Span (Standard) = 8.23
M Digit Span (Modified) = 7.69

Block Design. Tables 26 through 29 present the Block Design ANOVA results for the four groups. In each group the standard Block Design subtest yielded significantly higher scores than the modified Block Design subtest. The discrepancies between the standard and modified forms was greatest in the normal group (1.69 points) and least in the cerebral-palsied group (.60 points). While mean differences in all groups were significant, the discrepancy was less than a point in the cerebral-palsied group and in the orthopedically handicapped group. Age and the interaction between age and treatment were not significant factors in the normal group.

Table 26. ANOVA for Standard and Modified WISC Block Design Scaled Scores of Normal Children

(N = 99)

Source	df	MS	F
Ages (A)	9	29.21	1.92
Error	89	15.20	
Treatment (B)	1	141.12	47.05*
A X B	9	7.54	2.51
Error	89	3.00	

M Block Design Scaled Score (Standard) = 12.00
M Block Design Scaled Score (Modified) = 10.31

* $p < .01$.

Table 27. ANOVA for Standard and Modified WISC Block Design Scaled Scores of Mentally Retarded Children

(N = 74)

Source	MS	df	F
Treatment (A)	16.22	1	6.92*
Ss (B)	19.37		
A X B	2.35	73	

M Block Design (Standard) = 5.24
M Block Design (Modified) = 4.58

* $p < .05$.

Table 28. ANOVA for Standard and Modified WISC Block Design Scaled Scores of Cerebral-Palsied Children

(N = 76)

Source	MS	df	F
Treatment (A)	13.92	1	6.65*
Ss (B)	21.57		
A X B	2.09	75	

M Block Design (Standard) = 6.39
M Block Design (Modified) = 5.79

* $p < .05$.

Table 29. ANOVA for Standard and Modified WISC Block Design Scaled Scores of Orthopedically Handicapped Children

(N = 34)

Source	MS	df	F
Treatment (A)	25.53	1	7.65*
Ss (B)	16.89		
A X B	3.07	33	

M Block Design (Standard) = 8.18
M Block Design (Modified) = 7.00

* $p < .01$.

Coding. Tables 30 through 33 present the Coding ANOVA results for the four groups. In each group the standard Coding subtest yielded significantly lower scores than the modified Coding subtest. The discrepancies ranged from 1.48 in the mentally retarded group to 3.32 in the cerebral-palsied group. Age and the interaction between age and treatment were not significant variables in the normal group.

Table 30. ANOVA for Standard and Modified WISC Coding Scaled Scores of of Normal Children

(N = 69)

Source	df	MS	F
Ages (A)	6	26.43	1.77
Error	62	14.93	
Treatment (B)	1	185.15	40.54*
A X B	6	4.43	.98
Error	62	4.57	

$\underline{M}$ Coding Scaled Score (Standard) = 13.48
$\underline{M}$ Coding Scaled Score (Modified) = 15.78

* $p < .01$.

Table 31. ANOVA for Standard and Modified WISC Coding Scaled Scores of Mentally Retarded Children

(N = 65)

Source	MS	df	F
Treatment (A)	70.89	1	22.23*
Ss (B)	21.23		
A X B	3.19	64	

$\underline{M}$ Coding (Standard) = 5.14
$\underline{M}$ Coding (Modified) = 6.62

* $p < .01$.

Table 32. ANOVA for Standard and Modified WISC Coding Scaled Scores of Cerebral-Palsied Children

(N = 63)

Source	MS	df	F
Treatment (A)	346.67	1	46.14*
Ss (B)	30.07		
A X B	7.51	62	

$\underline{M}$ Coding (Standard) = 4.30
$\underline{M}$ Coding (Modified) = 7.62

* $p < .01$.

Table 33. ANOVA for Standard and Modified WISC Coding Scaled Scores of Orthopedically Handicapped Children

(N = 30)

Source	MS	df	F
Treatment (A)	64.07	1	6.99*
Ss (B)	25.37		
A X B	9.17	29	

$\underline{M}$ Coding (Standard) = 6.90
$\underline{M}$ Coding (Modified) = 8.97

* $p < .05$.

Rows on modified WISC Coding. The Coding subtest was modified in two ways. One major modification was placing correct and incorrect symbols under the various numbers. The second modification consisted of timing separately each of the rows of digits. In the standard WISC Coding subtest there are four rows, the last three of which contain an equal number of digits (25 digits). The first row, however, contains fewer digits than the remaining three rows (18). Thus, it was anticipated that there would be a significant difference between the scores on the first row and those on each of the remaining three rows.

A treatment by subjects design was used to evaluate the scores obtained on the four rows. Tables 34 through 37 present the ANOVA results. The row factor was a significant effect in the normal, mentally retarded, and orthopedically handicapped groups. However, in the cerebral-palsied group the row factor was not a significant effect.

Newman-Keuls tests were conducted in the three groups in which there was a significant row main effect. (Means are shown in the ANOVA tables.) In the normal group, the mean on the first row was significantly lower ($p < .01$) than the means on each of the three remaining rows. In addition, the mean of the second row was significantly lower than the means on the third and fourth rows. The mean on the third row was not significantly different from the mean of the fourth row. In the mentally retarded group and in the orthopedically handicapped group the mean on the first row was significantly lower ($p < .01$) than the means on each of the three remaining rows. No other differences were significant.

Table 34. ANOVA for Four Rows of Modified WISC Coding with Normal Children

(N = 99)

Source	MS	df	F
Rows (A)	190.12	3	53.23*
Ss (B)	101.84		
A X B	3.57	293	

M Row 1 Raw Score = 11.26
M Row 2 Raw Score = 13.03
M Row 3 Raw Score = 13.90
M Row 4 Raw Score = 14.42

* $p < .01$.

Table 35. ANOVA for Four Rows of Modified WISC Coding with Mentally Retarded Children

(N = 72)

Source	MS	df	F
Rows (A)	18.66	3	12.52*
Ss (B)	47.16		
A X B	1.49	210	

M Row 1 Raw Score = 5.22
M Row 2 Raw Score = 6.15
M Row 3 Raw Score = 6.34
M Row 4 Raw Score = 6.22

* $p < .01$.

Table 36. ANOVA for Four Rows of Modified WISC Coding with Cerebral-Palsied Children

(N = 69)

Source	MS	df	F
Rows (A)	7.10	3	.85
Ss (B)	65.00		
A X B	8.32	204	

M Row 1 Raw Score = 7.00
M Row 2 Raw Score = 7.55
M Row 3 Raw Score = 7.71
M Row 4 Raw Score = 7.63

Table 37. ANOVA for Four Rows of Modified WISC Coding with Orthopedically Handicapped Children

(N = 33)

Source	MS	df	F
Rows (A)	20.25	3	11.64*
Ss (B)	42.50		
A X B	1.74	96	

M Row 1 Raw Score = 7.94
M Row 2 Raw Score = 9.12
M Row 3 Raw Score = 9.18
M Row 4 Raw Score = 9.82

* $p < .01$.

WISC IQ's. Tables 38 through 41 present the WISC IQ ANOVA results for the four groups. In each group the standard and modified WISC IQ's were not significantly different from each other.

Table 38. ANOVA for Standard and Modified WISC IQ's of Normal Children

(N = 99)

Source	df	MS	F
Ages (A)	9	1031.06	2.55
Error	89	404.73	
Treatment (B)	1	8.41	.11
A X B	9	119.50	1.58
Error	89	75.41	

M WISC IQ (Standard) = 114.10
M WISC IQ (Modified) = 113.69

Table 39. ANOVA for Standard and Modified WISC IQ's of Mentally Retarded Children

(N = 71)

Source	MS	df	F
Treatment (A)	10.71	1	< 1
Ss (B)	557.30		
A X B	47.50	70	

M IQ (Standard) = 64.72
M IQ (Modified) = 64.17

Table 40. ANOVA for Standard and Modified WISC IQ's of Cerebral-Palsied Children

(N = 76)

Source	MS	df	F
Treatment (A)	257.92	1	2.59
Ss (B)	896.90		
A X B	99.73	75	

M IQ (Standard) = 74.03
M IQ (Modified) = 76.63

Table 41. ANOVA for Standard and Modified WISC IQ's of Orthopedically Handicapped Children

(N = 35)

Source	MS	df	F
Treatment (A)	1.73	1	< 1
Ss (B)	747.60		
A X B	71.05	34	

M IQ (Standard) = 84.94
M IQ (Modified) = 84.63

Intercorrelations

The results of intercorrelations among six variables (sex, SES, CA, IQ, WISC IQ standard, and WISC IQ modified) are shown in Tables 42 through 45 for the normal, mentally retarded, cerebral-palsied, and orthopedically handicapped groups. In addition, in the cerebral-palsied and orthopedically handicapped groups, seven additional scores are included which were obtained from the Survey of Degree of Physical Handicap (the scale ranged from no incapacity [1] to great incapacity [4]). In the Survey there are six separate areas that are evaluated: vision, hearing, speech, sitting balance, arm-hand use, and walking. In addition, a seventh rating was obtained, the total disability rating, by summing the six individual ratings.

Variable 4 requires some explanation. This IQ was derived from an assortment of tests that represented either previous IQ scores in the child's records or IQ scores estimated from the Stanford-Binet Vocabulary test. In the latter case, the method suggested by Cureton (1954) was used to obtain an IQ. In some cases IQ's were not available for some subjects because examiners failed to administer the Vocabulary test and an IQ also could not be obtained from the child's school records. The general IQ represented by Variable 4 is based on an assortment of tests, and it should be considered as a rough approximation of a general level of intelligence.

We first examine the correlations between the WISC IQ's (standard and modified), which were based on the three subtests (Digit Span, Block Design, and Coding), and the general IQ. The two WISC IQ's correlate significantly with Variable 4, the general IQ, in all four groups at a level which is less than .01. The lowest correlations are in the normal group (.39 and .29 for the standard and modified IQ's, respectively). In the mentally retarded, cerebral-palsied, and orthopedically handicapped groups the correlations are higher (all .55 or above).

Sex was a significant variable only in the cerebral-palsied group. Poorer vision was associated with boys.

Socioeconomic status was a significant variable only in the cerebral-palsied group. Cerebral-palsied children coming from a high socioeconomic status level tended to have more speech difficulty than cerebral-palsied children coming from a low socioeconomic level.

Chronological age was a significant variable in the normal group and in the cerebral-palsied group. In the normal group, higher WISC standard and modified IQ's were associated with older children. In the cerebral-palsied group, walking difficulty was associated with younger children.

In the cerebral-palsied group, the general IQ, in addition to its significant correlations with the two WISC IQ's, was significantly negatively associated with visual ability, speech ability, and the total disability ratings. Further, in the cerebral-palsied group, WISC IQ's (standard and modified) were significantly negatively associated with visual ability, arm-hand use ability, and tot l disability ratings. Correlations among the six individual variables associated with the degree of physical handicap ratings indicated that four of the six ratings were significantly intercorrelated, namely, speech, sitting balance, arm-hand use, and walking. The total disability rating also was correlated significantly with these four variables as well as with visual difficulties. Visual difficulty and hearing difficulty were not correlated with any of the other separate disability ratings.

The total disability rating, as we have seen, correlated significantly with general IQ, the two WISC IQ's, and with all of the separate disability ratings, with the exception of vision. The corelations involving the total disability rating and the six separate disability ratings represent somewhat spurious correlations because the individual disability ratings comprise the total rating.

In the orthopedically handicapped group, the general IQ, in addition to its significant correlations with the two WISC IQ's, was significantly negatively associated with speech difficulty and with the total disability ratings. The standard WISC IQ was negatively associated with speech ability and with arm-hand use ability, while the modified WISC IQ was negatively associated only with speech ability. Correlations among the six individual variables associated with the degree of physical handicap ratings indicated that visual ability was correlated significantly with sitting balance, arm-hand use, and total disability ratings. Sitting balance was correlated significantly with arm-hand use and walking. Hearing was not correlated significantly with any of the variables because all of the children in the sample could hear adequately.

The total disability rating, as we have seen, correlated significantly with general IQ, the two WISC IQ's, and with all of the separate disability ratings, with the exception of hearing and speech. As mentioned previously, the correlations involving the total disability ratings and the individual disability ratings are somewhat spurious.

Table 42. Intercorrelation Matrix for Selected Variables in Normal Group

Variable	1	2	3	4	5	6
1. Sex[a]		-.03	.05	.02	.12	.07
2. SES			.01	-.06	-.06	-.18
3. CA				-.12	.35	.27
4. IQ					.39	.29
5. WISC IQ (S)[b]						.71
6. WISC IQ (M)[b]						
Mean	1.56	3.52	125.59	105.81	113.95	113.64
SD	.50	1.44	34.57	20.53	16.60	16.43
N	99	99	99	81	99	99

Note.--For *N* = 99 *r* = .20 at *p* = .05 and *r* = .26 at *p* = .01 (two-tailed); for *N* = 81 *r* = .22 at *p* = .05 and *r* = .28 at *p* = .01 (two-tailed).

[a]Male = 1, female = 2.

[b]S = standard, M = modified.

Table 43. Intercorrelation Matrix for Selected Variables in Mentally Retarded Group

Variable	1	2	3	4	5	6
1. Sex[a]		-.19	.06	-.11	-.15	-.10
2. SES			-.11	.16	.18	.12
3. CA				.03	.04	.12
4. IQ					.57	.55
5. WISC IQ (S)[b]						.84
6. WISC IQ (M)[b]						
Mean	1.53	4.40	121.59	61.14	63.73	63.62
SD	.50	1.66	22.12	14.29	18.06	17.43
N	75	75	75	69	73	73

Note.--For *N* = 75 *r* = .23 at *p* = .05 and *r* = .30 at *p* = .01; for *N* = 73 *r* = .23 at *r* = .05 and *r* = 30 at *p* = .01; for *N* = 69 *r* = .24 at *p* = .05 and *r* = .31 at *p* = .01 (all two tailed).

[a]Male = 1, female = 2.

[b]S = standard, M = modified.

Table 44. Intercorrelation Matrix for Selected Variables in Cerebral-Palsied Group

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Sex[a]		.06	.02	.03	-.21	-.13	-.33	-.11	-.09	.05	-.02	-.03	-.10
2. SES			.02	-.08	.00	.05	.10	.08	-.30	-.06	-.09	-.10	-.14
3. CA				-.18	-.13	.07	.15	.13	.02	-.12	.09	-.27	-.04
4. IQ					.68	.55	-.24	.01	-.38	-.15	-.20	-.05	-.30
5. WISC IQ (S)[b]						.80	-.16	.07	-.45	-.14	-.43	-.12	-.37
6. WISC IQ (M)[b]							-.14	.09	-.30	-.05	-.27	-.08	-.23
7. Vision								-.07	.16	.08	-.15	.16	.35
8. Hearing									.06	-.07	-.01	-.04	.06
9. Speech										.50	.42	.38	.74
10. Sitting balance											.41	.68	.81
11. Arm-hand use												.34	.70
12. Walking													.76
13. Total disability rating													
Mean	1.47	3.78	119.08	82.68	74.03	76.63	1.29	1.03	1.61	1.51	1.91	2.28	9.62
SD	.50	1.78	31.39	19.48	21.39	23.22	.51	.23	.78	.86	.87	.81	2.69
N	76	76	76	68	76	76	76	76	76	76	76	76	76

N Note.--For N = 76 r = .23 at p = .05 and r = .29 at p = .01 (two-tailed); for N = 68 r = .24 at p = .05 and r = .31 at p = .01 (two-tailed).

[a] Male = 1, female = 2.

[b] S = standard, M = modified.

Table 45. Intercorrelation Matrix for Selected Variables in Orthopedically Handicapped Group

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Sex[a]		-.12	-.02	.21	.05	.15	.23	.00	-.09	-.02	-.02	-.06	.01
2. SES			.32	.10	.06	.07	.09	.00	-.24	.12	.29	-.09	.06
3. CA				.15	-.06	.02	.06	.00	-.11	.06	.11	.00	.05
4. IQ					.61	.76	-.07	.00	-.71	-.03	-.29	-.11	-.34
5. WISC IQ (S)[b]						.83	-.14	.00	-.52	.01	-.37	-.09	-.31
6. WISC IQ (M)[b]							-.10	.00	-.58	.06	-.31	-.10	-.29
7. Vision								.00	.04	.37	.64	.08	.65
8. Hearing									.00	.00	.00	.00	.00
9. Speech										.01	.04	.07	.31
10. Sitting balance											.52	.54	.80
11. Arm-hand use												.18	.74
12. Walking													.64
13. Total disability rating													
Mean	1.49	4.03	135.00	89.55	84.94	84.63	1.31	1.00	1.23	1.49	1.43	2.23	8.69
SD	.51	1.69	35.22	20.91	20.73	19.72	.68	.00	.60	.78	.70	.84	2.31
N	35	35	35	29	35	35	35	35	35	35	35	35	35

Note.--For N = 35 r = .33 at p = .05 and r = .43 at p = .01 (two-tailed); for N = 29 r = .37 and r = .47 at p = .01 (two-tailed).

[a]Male = 1, female = 2.

[b]S = standard, M = modified.

Memory for Block Designs

Standard Scores

Table 46 presents the standard scores ($\underline{M}$ = 10, $\underline{SD}$ = 3) for the Memory for Block Designs test for the mentally retarded, cerebral-palsied, and orthopedically handicapped groups. Standard scores could not be obtained for the normal group because their mean score was very high ($\underline{M}$ = 8.83). Thus, the test proved to be too easy for the normal sample. However, the test has a satisfactory range of standard scores for the cerebral-palsied group and for the orthopedically handicapped group. The range is less satisfactory for the mentally retarded group.

Table 46. Memory for Block Designs Standard Scores for Three Groups

	Standard Scores		
Raw Score	Mentally Retarded	Cerebral Palsied	Orthopedically Handicapped
10	12	15	13
9	11	13	12
8	11	12	10
7	10	11	9
6	10	9	8
5	10	8	6
4	9	6	5
3	9	5	4
2	8	4	2
1	8	2	1
0	8	1	0

Note.--Normals not included because there was limited variability in the group and because the mean was 8.83.

Correlations

The raw scores for the Memory for Block Designs test were correlated with 29 other variables in the normal and mentally retarded groups and with 36 other variables in the cerebral-palsied and orthopedically handicapped groups (see Table 47). The seven additional variables in the latter two groups were for the variables associated with the Survey of Degree of Physical Handicap form.

In the normal group, despite the limited range of scores, there were many significant correlations between the Memory for Block Designs test and the other variables. The highest correlations were with "Copying a Bead Chain from Memory" (.44) and with "Memory for Designs II" (.39). The test also correlated significantly with the estimated WISC IQ's (with the standard form, $\underline{r}$ = .28; with the modified form, $\underline{r}$ = .35). In the mentally retarded, cerebral-palsied, and orthopedically handicapped groups, many of the correlations between Memory for Block Designs and other variables were also significant. Thus, for example, IQ, Memory for Designs I, and Memory for sentences III were significantly correlated with Memory for Block Designs in all three groups. In the cerebral-palsied and orthopedically handicapped groups, speech proficiency was significantly negatively related to Memory for Block Designs scores (-.31 and -.41, respectively). Thus, handicapped children with poor speech tend to have low Memory for Block Designs scores.

In the original proposal, an analysis of the incorrect responses on the Memory for Block Designs test was planned. The aim was to compare the incorrect responses of the cerebral-palsied children with those of the normal children in order to see whether any systematic differences appeared in their incorrect choices. However, because the test proved to be too easy for the normal children, this analysis was not performed.

Table 47. Correlations between Memory for Block Designs and other Variables

Variable	Normal	Mentally Retarded	Cerebral Palsied	Orthopedically Handicapped
1. Sex	-.07	-.08	-.03	-.03
2. SES	-.08	-.05	.03	.28
3. CA	.34**	.37**	.34**	.57**
4. IQ	.10	.35**	.43**	.59**
5. Memory for designs I (S)	.34**	.31**	.42**	.45**
6. Memory for sentences II (S)	.18	.17	.44**	.36*
7. Memory for designs II (S)	.39**	.18	.32**	.45**
8. Plan of search (S)	.28**	.32**	.31**	.42*
9. Memory for sentences III (S)	.08	.27*	.31**	.51**
10. Copying a bead chain from memory (S)	.29**	.30*	.37**	.46**
11. Digit Span (S)	.22*	.24	.55**	.59**
12. Coding B (S)	-.01	.40**	.49**	.26
13. Block Design (S)	.24*	.28*	.47**	.45**
14. WISC IQ (S)	.28**	.31**	.55**	.53**
15. Memory for designs I (M)	.33**	.21	.38**	.17
16. Memory for sentences II (M)	.36**	.04	.26*	.27
17. Memory for designs II (M)	.05	.36**	.27*	.29
18. Plan of search (M)	.07	.26*	.35**	.32
19. Memory for sentences III (M)	.21*	.23	.22	.30
20. Copying a bead chain from memory (M)	.44**	.32**	.37**	.22
21. Digit Span (M)	.34**	.28*	.50**	.60**
22. Coding B (M)	.02	.39**	.44**	.11
23. Block Design (M)	.14	.08	.53**	.47**
24. Coding B Row 1 (M)	.30**	.34**	.30*	.57**
25. Coding B Row 2 (M)	.33**	.47**	.48**	.34
26. Coding B Row 3 (M)	.29**	.47**	.41**	.39*
27. Coding B Row 4 (M)	.33**	.41**	.47**	.52**
28. Coding B Total (M)	.32**	.44**	.48**	.48**
29. WISC IQ (M)	.35**	.27*	.58**	.54**
30. Vision	---	---	-.11	-.12
31. Hearing	---	---	.07	.00
32. Speech	---	---	-.31**	-.41*
33. Sitting balance	---	---	-.15	-.02
34. Arm-hand use	---	---	-.04	-.25

Table 47. continued

Variable	Normal	Mentally Retarded	Cerebral Palsied	Orthopedically Handicapped
35. Walking	---	---	-.22	.08
36. Total disability rating	---	---	-.23**	-.20
M	8.83	5.90	6.62	7.66
SD	1.71	2.15	2.23	2.18
N	99	71	76	35

Note.--(S) indicates standard, (M) indicates modified.

* $p < .05$.
** $p < .01$.

Cerebral Palsied: Spastic vs. Nonspastic

In the cerebral-palsied group, the IQ's (based on the three WISC subtests that were administered) of children with a spastic type of condition ($N = 51$) were compared with those who were not spastic ($N = 20$). Diagnoses were based on information contained in the children's school records. The two groups did not differ significantly on the IQ's they obtained on the standard administration (M IQ spastic = 75.51; M IQ nonspastic = 71.40; $t = .01$, $p > .05$) and on the modified administration (M IQ spastic = 76.43; M IQ nonspastic = 75.55; $t = .02$, $p > .05$).

Discussion

The major purpose of the investigation was to develop, if possible, a nonverbal form of selected Stanford-Binet tests and WISC subtests which could be used to assess children with impaired speech and motor abilities. In one part of the project, a systematic attempt was made to modify those Stanford-Binet tests that occur at year-levels II through V which require a verbal or motor response. In the second part of the project selected Stanford-Binet tests were modified at year-levels IX through XIII, and three WISC subtests--Digit Span, Block Design, and Coding--were modified. We first turn to a discussion of the results for the lower level Stanford-Binet tests.

The results of the analyses of variance and of the intercorrelations for the modified tests at year-levels II through V of the Stanford-Binet indicate that the modified form of the Stanford-Binet for these lower year levels provides valid IQ's. IQ's on the standard and modified forms differed in the normal group by .16 points; in the mentally retarded group, by 2.93 points; and in the cerebral-palsied group, by 1.87 points. In the latter two groups, the mean IQ obtained on the modified form was higher than the mean IQ obtained on the standard form. The results, using MA as the dependent measure, were essentially similar to those using IQ.

The standard deviations of the standard and modified IQ's in the normal group are also similar. They are respectively, 14.51 and 15.64, and closely conform to the expected standard deviation of 16.00. Similarly, in the mentally retarded group, the standard deviations on the standard and modified forms are 14.27 and 16.46, while in the cerebral-palsied group, the standard deviations are 17.29 and 19.08, respectively.

The correlations between the standard and modified Stanford-Binet IQ's were high in the normal, mentally retarded, and cerebral-palsied groups, (.83, .92, and .88, respectively). These correlations, of course, are based on two forms which have overlapping tests, so that the IQ's are not independent of each other. Overall, the modified form appears to have an acceptable level of concurrent validity.

The biserial correlations for the modified tests are less satisfactory than desired. They were generally low, although approximately one-third of the items in the normal group had coefficients that were above .15. It would have been interesting to compare the biserial correlations of the standard form tests with those of the modified form tests, but this comparison is not possible because the analyses for the standard tests were not performed. The limited item validities may be in part a function of the limited number of subjects in the normal group for some of the analyses (e.g., less than 50 subjects for tests at year-levels II and II-6) and the higher than average mean IQ for the sample. Although item validities are not as satisfactory as possible, the modified items, as a whole, as we have seen, provide IQ's and MA's that are very similar to those provided by the standard items.

A number of interesting findings appeared in the cerebral-palsied group. Degree of physical disability, for the most part, was not related to either IQ or MA. The significant correlations involving degree of physical disability indicated that low mental ages were associated with speech difficulty and with walking difficulty. The mean IQ obtained on the standard form by the cerebral-palsied children was 80.43, while their mean IQ on the modified form was 83.27. These means are in the below average range. The mean IQ's generally are similar to those reported in the literature. If the two forms of the Stanford-Binet can be considered as alternate forms, then the correlation of .88 between the two forms in the cerebral-palsied group indicates that the IQ is reliable. This result is congruent with the literature review which indicated that the IQ obtained in testing cerebral-palsied children can be considered to be reliable. Finally, the results indicated that the children with a spastic condition obtained IQ's that were not significantly different from those with a nonspastic condition.

For the upper-level Stanford-Binet tests, two statistical procedures were used, namely, correlations between the two forms and chi square analyses. The results of the chi square analyses are somewhat more supportive of the hypothesis that the modified and standard forms provide comparable results than the results of the correlations between the two forms. The significant correlations in the normal group are low; similarly, the significant correlations in the remaining three groups (mentally retarded, cerebral-palsied, and orthopedically handicapped) are also generally low. In contrast, most of the chi squares were in a direction which supported the hypothesis that the two groups would perform similarly on the two forms of the test.

Part of the reason why the modified Stanford-Binet tests in the upper year levels do not appear to meet highly acceptable levels of validity is that the modifications led to easier tests. That is, the percent correct on the modified tests was in all cases in the normal group and in a majority of the cases in the other three groups higher on the modified tests than on the standard tests. For example, on the Copying a Bead Chain from Memory test the percent correct on the standard form was 62% while on the modified form it was 85%. Similarly, on the Plan of Search test the percent correct was 56% on the standard form compared with 76% on the modified form. Even more drastic changes were evident in the three other groups. These results indicate that multiple-choice modifications of memory tests, including memory for designs, sentences, or bead chains, are likely to be easier than the non-multiple-choice standard presentation. Thus, if we can generalize, multiple-choice procedures used with memory tests for children between 5 and 16 years are likely to lead to more easier tests than their counterpart tests which require the child to reproduce the stimulus by rote. While it is possible that multiple-choice procedures could be devised which use more difficult distractors, the distractors used in the present investigation were only slightly changed in some cases from the correct alternative. Therefore, the results suggest that it is likely to be difficult to use a multiple-choice procedure for memory tests for children between 5 and 16 years of age.

The results for the three WISC subtests which were modified (Digit Span, Block Design, and Coding) indicated that there is, in general, a satisfactory degree of reliability for the three modified forms, although mean differences between the standard and modified forms are significantly different for some tests and for some groups.

The correlations between the WISC modified Digit Span and standard Digit Span range from .68 to .92 in the four groups. In two of the four groups (mentally retarded and cerebral-palsied) there were significant differences between the standard and modified forms, but these differences were less than a point in both groups. Thus, it appears that an aural-pointing administrative format can serve as a substitute for the standard administrative format--aural-oral--when the child has speech difficulties.

The correlations between the WISC modified Block Design and standard Block Design range from .66 to .82 in the four groups. These correlations indicate that the scaled scores on the standard and modified forms are significantly related, although the degree of relationship is somewhat lower than is desirable. Interestingly, the highest correlation (.82) occurred in the cerebral-palsied group.

In all four groups the modified form was significantly more difficult than the standard form. This would be expected because the child could not handle the blocks himself, and therefore was deprived of the opportunity to use trial-and-error procedures in attempting to solve the tasks. However, in the four groups the smallest mean difference between the two forms occurred in the cerebral-palsied group (.60 points). Thus, the high correlation between the standard and modified Block Design forms and the minimal difference between the two forms in the cerebral-palsied group indicate that the modified Block Design subtest can serve as a substitute for the standard Block Design subtest for children with severe motor disabilities.

The correlations between the WISC modified Coding and standard Coding range from .47 to .74. These correlations indicate that the scaled scores on the standard and modified forms are significantly related, although the degree of relationship is somewhat lower than is desirable. In all four groups the modified form was significantly easier than the standard form. The cerebral-palsied group had the largest difference between the two forms, 3.32 points, which represents a difference of 77%. The smallest absolute difference was in the mentally retarded group, 1.48 points, which represents a difference of 29%. In the normal group the difference was 2.30 points, which represents a difference of 17%. In the orthopedically handicapped group the difference was 2.07 points, which represents a difference of 30%.

The modified Coding subtest enabled the cerebral-palsied group to obtain scores which were 77% higher than they obtained on the standard form. However, because the normal group also performed at a higher level on the modified form, it does not appear likely that the modified form can be used as a substitute for the standard form using the standard norms. The results, however, do suggest that the modified Coding subtest provides a means of assessing cerebral-palsied children. As a crude approximation, the norms for the standard Coding subtest may be used for the modified Coding subtest by subtracting 23% from the child's score. The figure of 23% was arrived at by averaging the gains of a group with a mean standard scale score which was close to 7 (orthopedically handicapped) and of a group with a mean standard scale score which was close to 13. Thus the gain for an average child (a mean of 10) is estimated to 23%, which is the average of 30% and 17%. Further research is needed to determine the validity of the modified Coding subtest. The present results indicate that the modified Coding subtest provides minimally reliable scaled scores.

The modifications on the Coding subtest permitted an assessment of learning efficiency because each row was timed separately. The results showed that only in the normal group was there a significant degree of improvement from the second to the third row. In three of the four groups (the exception was the cerebral-palsied) there also was significant improvement from the first to the second row; this, as we have seen, was due simply to the fact that there were fewer symbols in the first row than in the three remaining rows. It is difficult to account for the failure of the cerebral-palsied group to increase their scores significantly. They did increase their mean score from 7.00 on the first row to 7.55 on the second row, but the gain was not significant. Timing each of the rows separately appears to be a useful method of evaluating learning efficiency on the Coding subtest.

Another method of evaluating the modified and standard forms of the three subtests was to evaluate the WISC IQ's estimated from the three subtests. The results indicated that the standard and modified IQ's are highly comparable. The range of correlations was from .71 to .84 in the four groups, while mean differences between the two IQ's ranged from .31

to 2.60 in the four groups. Only in the cerebral-palsied group was the mean difference greater than one point. The reason why the mean differences between the standard and modified IQ's were small was that the higher scores on the Coding subtest were counterbalanced by the lower scores on the Block Design subtest. In all four groups, as well, the standard deviations were similar for the standard and modified WISC IQ's.

A further test of the validity of the modified WISC IQ was to compare it with previous IQ scores or with an estimated IQ based on the Stanford-Binet Vocabulary test. This comparison generally yielded acceptable levels of concurrent validity. The correlations between the modified WISC IQ and the general IQ ranged between .29 to .76. These results are somewhat surprising if we consider that the general IQ's were based on an assortment of heterogenous tests. Nevertheless, the results point out that both the standard and modified short forms of the WISC, composed of the Digit Span, Block Design, and Coding subtests, have acceptable levels of concurrent validity.

In the cerebral-palsied group, degree of physical disability was related to both the general IQ and the WISC IQ. These findings suggest that the more physically disabled the cerebral-palsied child is, the more likely he is to have a low IQ. This conclusion, however, is limited to cerebral-palsied children between 5 and 16 years of age, because a significant relationship between the two variables was not established with the cerebral-palsied children between 2 and 5 years of age.

The mean general IQ of the cerebral-palsied group was 82.68. This estimate is similar to the mean IQ obtained by the younger group. As in the younger cerebral-palsied group, the children with a spastic condition obtained IQ's that were not significantly different from those with a nonspastic condition. In the orthopedically handicapped group, there also was a significant relationship between general IQ and total disability rating. Thus, like the cerebral-palsied child, the more physically disabled the orthopedically handicapped child is, the more likely he is to have a low IQ.

The results for the Memory for Block Designs test turned out to be somewhat disappointing. The main problem was the failure of the test to discriminate among the normal children. The test was too easy for these children. However, in the mentally retarded, cerebral-palsied, and orthopedically handicapped groups the results were somewhat more encouraging. Using the general IQ as a criterion, the test had correlations ranging from .35 to .59 (all significant) in the three groups. In all four groups the Memory for Block Designs test was also shown to be correlated significantly with many other tests and subtests. However, the standard scores for the test, even in the mentally retarded, cerebral-palsied, and orthopedically handicapped groups, are somewhat restricted. Thus, in its present form, the test can only be used as a rough measure of memory ability. The results strongly suggest that a memory for block design test can be a useful addition to the available memory tests, if the test could be expanded to more items, especially ones with more difficult designs. The correlations between the Memory for Block Designs test and the other memory tests suggest that the test is measuring a different facet of memory than the other memory tests that were studied.

Summary

The investigation was designed to evaluate the effects of modifications in test procedures upon the scores obtained by normal, mentally retarded, and handicapped children. The primary tests studied were the Stanford-Binet and the WISC. In addition, a new Memory for Block Designs test was investigated. There were two different parts to the investigation. In the first part, only tests in year-levels II through V of the Stanford-Binet were studied. In the second part, six Stanford-Binet tests, primarily memory tests appearing at year-levels IX through XIII, and three WISC subtests--Digit Span, Block Design, and Coding--were studied. The modifications were designed so that speech and motor dexterity would not be required in the child's responses.

In the first part of the investigation, 27 Stanford-Binet tests were modified. Some modifications were relatively simple, such as asking the child to point to a stimulus instead of saying the name of the stimulus, while other modifications were extensive, such as constructing multiple-choice cards for each of the Picture Vocabulary items. Many of the modifications introduced a multiple-choice procedure. In most cases, only a pointing response was required. Not all of the tests could be modified. The "Stringing Beads" and "Paper Folding" tests were not used in the final form after repeated unsuccessful attempts were made to modify the tests. In the standard version of the Stanford-Binet, 12 tests at year-levels II through V only require a pointing response; therefore, these tests were not modified.

There were three groups of children who served as subjects in the first part. In the normal sample there were 133 children (70 males, 63 females) selected according to parental occupation in order to obtain a representative sample. Their birthdays were within two months from the date of testing. In the mentally retarded group there were 27 children (17 males, 10 females), and in the cerebral-palsied group there were 30 children (18 males, 12 females). The mean ages of the children ranged from 43.67 months to 55.67 months. Sex was not used as a selection criterion. All children were administered the standard and modified forms of the Stanford-Binet in counterbalanced order.

The results of the modifications for the lower level Stanford-Binet tests were highly encouraging. Correlations between the standard and modified forms in the three groups ranged from .83 to .92. In addition, differences in mean IQ's between the standard and modified IQ's were small, ranging from .16 to 2.93 points. Also of interest was that 13 of the 30 cerebral-palsied children were not able to take one or more of the standard tests because of their physical handicaps, while only two of the 30 cerebral-palsied children were not able to take a total of three of the modified tests. The results of the modifications suggest that the modified Stanford-Binet tests can be used as a substitute for the standard tests when children have speech or motor disabilities which interfere with their performance on the standard Stanford-Binet tests at year-levels II through V.

In the second part of the study, Stanford-Binet and WISC subtests were studied, along with the Memory for Block Designs test. The six Stanford-Binet tests were Memory for Designs I, Memory for Sentences II, Memory for

Designs II, Plan of Search, Memory for Sentences III, and Copying a Bead Chain from Memory. The modification for the six Stanford-Binet tests consisted of the introduction of a multiple-choice procedure for each of the above tests. The modification for the WISC Digit Span subtest consisted of changing the oral response to a pointing response by having the child point to numbers on a card which showed the digits one through nine. For the Block Design subtest, the modification consisted of having the examiner construct the design after the child designated a particular block from a sample showing the various block positions and also designated the location on a sheet of paper where the block should be placed. For the Coding subtest, the modification consisted of having a symbol shown under each number and asking the child to indicate whether the symbol in the box was correct, that is, whether it matched the symbol for the number that appeared in the key. In addition, the four rows were timed separately, although the total time for the subtest was the same as that used in the standard version. Finally, for the Memory for Block Designs test, a multiple-choice procedure was used. Each WISC Block Design Card was shown to the child, after which he was asked to point to the correct design on a card showing four different designs.

There were four groups of children who served as subjects in the second part. In the normal sample there were 99 children (44 males, 55 females) selected according to parental occupation in order to obtain a representative sample. Their birthdays were within one month from the date of testing. In the mentally retarded group there were 75 children (35 males, 40 females), in the cerebral-palsied group there were 76 children (40 males, 36 females), and in the orthopedically handicapped group there were 35 children (18 males, 17 females). The mean ages of the children ranged from 9.92 years to 11.25 years. Sex was not used as a selection criterion. All children were administered the standard and modified tests and subtests in counterbalanced order.

The results for the six Stanford-Binet tests were not encouraging. While chi square analyses indicated that the subjects performed similarly on both the standard and modified forms, correlations between the two forms, when significant, were low. The multiple-choice procedure led to easier tests. The results indicate that it is likely to be a difficult task to devise multiple-choice memory tests that will be of comparable difficulty to tests that require subjects to respond by rote, particularly for children between 5 and 16 years of age.

The results for the three WISC subtests indicate that the modified procedures that were used in the investigation for the Digit Span and Block Design subtests can be used as alternate procedures for testing handicapped children. In the four groups, correlations between the standard and modified subtests ranged from .66 to .92, and all correlations were highly significant. Mean differences between the standard and modified subtests in the four groups were less than one scaled score point for the Digit Span subtest and less than two scaled score points for the Block Design subtest. In contrast, the modified Coding subtest does not appear to be a feasible substitute for the standard Coding subtest. Although significant correlations were obtained between the standard and modified subtests in the four groups (.47 to .74), in the cerebral-palsied group the mean difference between the two forms was high, 3.32 scaled score points. The modified Coding subtest is an easier subtest than the standard subtest. The modified subtest, however, has promise as a test for evaluating handicapped children because it requires only a "yes" or "no" response. It also has the potential of providing a crude estimate of learning ability.

The Memory for Block Designs test proved to be too easy for the normal subjects and also had a limited range of standard scores in the mentally retarded group. The range was somewhat more satisfactory in the cerebral-palsied and orthopedically handicapped groups. However, in all four groups there were significant correlations between the Memory for Block Designs test and other variables. The test needs to be expanded to include more difficult items. It appears to be a promising test and is likely measuring a different facet of memory than memory for design and sentences tests. In its present form, the test can only be used as a rough measure of memory ability.

Other interesting findings indicated that the mean IQ's obtained by the younger cerebral-palsied children were 80.43 (SD = 17.29) on the standard Stanford-Binet and 83.27 (SD = 19.08) on the modified Stanford-Binet. For the older children, the mean IQ obtained on a variety of tests was 82.68. These estimates are similar to those reported in the literature. However, lower mean IQ's were obtained by the cerebral-palsied children, as estimated from the three WISC subtests: 74.03 (SD = 21.39) on the standard form and 76.63 (SD = 23.22) on the modified form. Similarly, the mean IQ's of the orthopedically handicapped group were lower on the WISC (84.94, SD = 20.73, standard; 84.63, SD = 19.72, modified) than on other tests (89.55, SD = 20.91). In contrast, in the normal and mentally retarded groups, estimated WISC IQ's were higher than IQ's obtained on other tests. In the normal group, the mean IQ on the standard form was 113.95 (SD = 16.60), 113.64 (SD = 16.43) on the modified, and 105.81 (SD = 20.53) on other tests. In the mentally retarded group, the mean IQ on the standard form was 63.73 (SD = 18.06), 63.62 on the modified form (SD = 17.43), and 61.14 (SD = 14.29) on other tests. Correlations between the two forms for the IQ's estimated on the basis of the three subtests ranged from .71 to .84 in the four groups.

The extensiveness of physical disability was, for the most part, not related to IQ scores obtained by the younger cerebral-palsied children on the Stanford-Binet. However, for the cerebral-palsied children between 5 and 16 years of age, degree of physical disability was related to level of intelligence. The greater the disability, the more likely the child was to have a lower IQ.

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Appendix

The project not only directly contributed to an evaluation of the effects of test modifications but also indirectly contributed to a number of related investigations and projects that were carried out by the principal investigator. At the time of the final report, two articles have been published which are related to the problem of test modifications. These are noted below. The other work of the principal investigator, which was also carried on during the project, led to a number of publications and these, too, are noted below.

Publications Resulting, in part, from Support Provided by the Social and Rehabilitation Service

1. Sattler, J. M. Racial experimenter effects. In K. S. Miller & R. M. Dreger (Eds.), Comparative studies of blacks and whites in the United States. New York: Academic Press, 1973. Pp. 8-32.

2. Sattler, J. M. Intelligence testing of ethnic minority-group and culturally disadvantaged children. In L. Mann and D. Sabatino (Eds.), The first review of special education. Vol. 2. Philadelphia: The JSE Press, 1973. Pp. 161-201.

3. Sattler, J. M. Examiners' scoring style, accuracy, ability, and personality scores. Journal of Clinical Psychology, 1973, 29, 38-39.

4. Sattler, J. M. Assessment of children's intelligence. Philadelphia: Saunders, 1973. (In press)

5. Sattler, J. M., & Anderson, N. E. Peabody Picture Vocabulary Test, Stanford-Binet, and Stanford-Binet Modified with normal and cerebral palsied preschool children. Journal of Special Education, 1973, 7. (In press)

6. Sattler, J. M., & Martin, S. Anxious and nonanxious examiner roles on two WISC subtests. Psychology in the Schools, 1971, 4, 347-349.

7. Sattler, J. M., & Ryan, J. J. Scoring agreement on the Stanford-Binet. Journal of Clinical Psychology, 1973, 29, 35-38.

8. Sattler, J. M., & Ryan, J. J. Who should determine the scoring of WISC Vocabulary responses? Journal of Clinical Psychology, 1973, 29, 50-54.

9. Sattler, J. M., & Tozier, L. L. A review of intelligence test modifications used with cerebral palsied and other handicapped groups. Journal of Special Education, 1970, 4, 391-398.