STANFORD-OHWAKI-KOHS TACTILE BLOCK DESIGN INTELLIGENCE TEST FOR THE BLIND

FINAL REPORT

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Stanford University School of Medicine

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PART ONE - FINAL REPORT

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PART ONE

Stanford-Ohwaki-Kohs Tactile Block Design Intelligence Test for the Blind

PART TWO

Manual for the Stanford-Ohwaki-Kohs Block Design Test for the Blind

PART THREE

Manual for the Stanford-Kohs Block Design Test for the Blind

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FOREWORD

Measuring the intelligence of blind persons presents obvious difficulties. Most measures of intelligence consist mainly, and often solely, of paper-and-pencil tests, thus requiring vision. Vision is likewise required by those measures of intelligence that call for the performance of particular tasks.

Nor is the problem resolved by avoiding these difficulties through the use of the verbal portion of a Wechsler scale. True, the Wechsler verbal subtests have neither paper-and-pencil nor performance tasks; vision is not required. Does the limited range of verbal tasks, however, yield a generalizable estimate of the blind person's broad intelligence? How would he have fared on the performance portion of the Wechsler, if that could have been administered to him?

Efforts have been made to answer these questions by developing tactile counterparts of the Wechsler performance subtests. The success of such efforts has thus far been moderate. Not all the Wechsler performance subtests lend themselves to tactile adaptation.

The one performance subtest of the Wechsler scales with the greatest promise for adaptation to testing blind persons is the Kohs Block Design. This is true for both theoretical and practical reasons. Wechsler himself found the Block Design subtest to correlate highly with Full Scale IQ; it is, therefore, likely to provide one of the best brief measures of general intelligence. Practically, the Kohs Block Design has already shown initial success in an adaptation by Ohwaki.

Since further success in measuring the intelligence of blind persons seems dependent upon needed modification of the Ohwaki-Kohs test, it is fortunate that additional work on this test was made possible by a Vocational Rehabilitation Administration grant. It is doubly fortunate that the grantee group has a high level of relevant competence, including among its members the pioneer designer of the original Kohs test.

In view of the psychometric promise of this test for present purposes and in view of the professional proficiency of the project group, this Final Report should be read with interest and profit by all those concerned with the rehabilitation of blind persons.

Daniel Sinick, Ph.D.
San Francisco State College

PREFACE

Increasingly the barriers which in the past denied human beings security from hunger, adequate clothing, shelter and some degree of self-realization are being steadily removed. Millions of dollars are being spent on physical and mental rehabilitation services, and on the educational and vocational guidance of all handicapped persons, including the blind. There is great eagerness to develop sound and effective programs, but this desire far outstrips the knowledge and resources currently available. It is no longer a question of dollars. What is retarding the achievement of our educational and social objectives are the inadequacies in our diagnostic and prognostic procedures and instruments on which sound programs of educational guidance can be based. It is imperative that great and rapid progress must immediately be stimulated if we are to capitalize on the unprecedented opportunities now available to us.

In 1913, during the period that the writer was a resident fellow in training for clinical psychology at the Vineland (New Jersey) Training School for the Feebleminded, he was associated with Dr. Robert B. Irwin (Hayes, 1950) who was the first to attempt to determine the intelligence (I.Q.s) of blind children by adapting the Vineland Revision of the Binet Test. For the half century since then, efforts to develop instruments which would be serviceable have continued. Some progress has been made, yet much needs to be done, to provide measuring devices which are as free as possible from irrelevant distortions which blindness imposes on these devices.

In 1918 the writer developed the Block-Design Test to Measure Intelligence. It was based on the conviction that mental growth and brain power were determined by varying potentials to analyze and synthesize the materials and objects of one's environment and experience and that this capacity increased at increasing chronological ages. In more psychological terms, analysis and synthesis were represented in the mental growth processes from elementary sensations up through perceptions (a synthesis of sensations), through concepts (a synthesis of perceptions - the realm of abstract ideas), through judgments (a synthesis of concepts), and finally, through reasoning (a synthesis of judgments - logic), the highest manifestation of man's capacity - to think. The writer's aim was to develop a test which would, as far as possible, be language-free and culture-free and yet measure what one might designate as the capacity for "purposeful creativeness" as is exemplified in the achievements of great geniuses like those of Aristotle, Galileo, Newton, Marconi, Edison and Einstein.

The Block-Design Test has proven its usefulness by its incorporation, in part, in such intelligence measuring scales as the Wechsler-Bellevue, Grace Arthur, and the Goldstein-Scheerer Tests of Abstract and Concrete Thinking.

In 1960 Dr. Yoshikazu Ohwaki, Director of the Ohwaki Institute of Child Psychology in Sendai, Japan, published the results of his adaptation of the Block-Design Test for use in determining the intelligence (I.Q.s) of Japanese blind children. In the Introduction to his Manual he reports the ineffectiveness of the earlier adaptations of the Binet Test for the blind (Irwin, Haines and Hayes). Equally ineffective was the <u>verbal</u> section of the Wechsler-Bellevue, as well as Pressy's General Ability Test, the Kuhlmann-Anderson Test, and the Pintner Intelligence Test which were transcribed into Braille. Ohwaki (undated) goes on to say: "After many trials on normal subjects, we have found that the block-design test of S.C. Kohs is one of the excellent tests for the normal subject. We have come to the idea, that if the color is transposed into tactual surface, this block design test would be possible to use for the blind. We have tried many kinds of cloth which are easily and clearly determinable each other through tactile-motor behavior." Tests for reliability and validity provided Dr. Ohwaki and his associates with the assurance that this adaptation of the original Block-Design Test was an acceptable instrument.

Robert Sakata and Daniel Sinick (1964) stated: "Experience with the Ohwaki-Kohs at the San Francisco Lighthouse for the Blind reveals an instrument with great promise. Additional work is needed in this country to supplement and extend that already done by Ohwaki in Japan. Modification of the blocks and of their administration appears desirable, as well as further development of the test's validity and reliability. One of Ohwaki's findings, however, is that the test scores of blind subjects on the Ohwaki-Kohs are similar to the scores of sighted subjects on the original Kohs.

The promise of this test has two aspects. One is the evidence of its effective use with blind persons, both here and in Japan. The other is based upon the merit of the Kohs test itself."

In 1964 the Vocational Rehabilitation Administration of the United States Department of Health, Education and Welfare awarded a grant to the Division of Rehabilitation Medicine, Stanford University School of Medicine, for a study of the adaptation of the Block-Design Test by Dr. Ohwaki, and to further adapt it to the American scene.

The Stanford experience is presented in this report.

It is hoped that this effort and others will contribute substantially toward advancing our programs of educational and vocational guidance of the blind, and for "normalizing" their place and role in society.

S.C. Kohs, Ph.D.

ACKNOWLEDGMENTS

This research project would have been impossible without the assistance of a large number of individuals many of whom volunteered their time. The largest and possibly most important group of volunteers was the 500 blind persons who took the tests on one or two occasions. For many of these individuals, volunteering meant the inconveniences of travel, time away from their regular occupation, financial expense and, for many, it meant experiencing the anxieties associated with psychological testing. To these blind persons we owe whatever success and value this project may eventually yield.

The National Federation of the Blind and The American Council of the Blind, through their affiliated chapters, demonstrated a sincere interest in furthering professional aspects of rehabilitation by assisting in the recruiting of blind subjects.

Representing the voluntary agencies that assisted in the recruiting of subjects, provision of professional services or office space, the following individuals and their associates were particularly helpful: the late Winfield S. Rumsey, San Francisco Lighthouse for the Blind; Rose Resnick, California League for the Handicapped; C. Sargent Hearn, Palo Alto Society for the Blind; Nancy Tincher, Sixth Dist. California Congress of Parents and Teachers Braille Transcription Project; William F. Johns, Guide Dogs for the Blind, Inc.; Don Lathrop, Goodwill Industries of Santa Clara County, Inc.; John M. Holmes, Braille Institute of America, Inc.; Roy Kumpe, Arkansas Enterprises for the Blind; and Edmund J. Rubin, Mount Carmel Guild; Fred L. Crawford, New York Association for the Blind.

Representing the public agencies that assisted in a similar manner were: David Mendelson, Division of Services for the Blind, California State Department of Rehabilitation; Perry Sundquist, Division for the Blind, California State Department of Social Welfare; Everett Wilcox, California School for the Blind; Harry E. Hayes, Division of Services for the Blind, State Department of Social Welfare of Kansas; Jerome R. Dunham, Northwest Rehabilitation Center for the Blind; D.W. Overbeay, Ohio State School for the Blind; B.G. Johnson, University of Arizona Rehabilitation Center; Bryant J. Cratty, Department of Physical Education, U.C.L.A.; George Rhodes, Long Beach Veterans Administration Hospital; Andrew Arnold, Division of Vocational Rehabilitation, California State Department of Rehabilitation; and William Nichols, Sacramento County Department of Welfare.

The permanent research staff was ably assisted in the collection of data by a sizable number of academically qualified and experienced "research examiners". These people made it possible to collect data from several regions of the country; D.R. Adamschick, Columbus; Faizunisa A. Ali, Los Angeles; Celia Beck, San Jose; David Caloca, San Francisco; Helen Frazier, Little Rock; Victor Ganzer, Seattle; Ronald Goldstein, New York City; George Mayo, Tucson; Daniel McCombe, San Diego; Robert McQuie, St. Louis; Donald Montoya, Long Beach; Barry Nyman, Seattle; Judy Philips, Seattle; Donald Ross, Tucson; William E. Svoboda, Topeka; Larry Taylor, Little Rock; Lyle and Lee Thume, Little Rock; and Marjana Wiener, Los Angeles.

Most appreciated were the several secretaries who managed the office, assisted the professional staff in numerous ways and generally contributed to the smooth operation of the research project. They reproduced and dispatched literally hundreds of letters recruiting volunteer research subjects. They organized and managed to keep the payroll and expense accounts straight for the numerous research assistants. Finally, they assisted the staff to prepare this and many other documents and gave the Project Director invaluable assistance in executing his responsibility. Rosemary Gutt joined the project before it even had a financial sponsor, continued to help from time to time and returned to assist with the Final Report. Reva Mayer and Julia Ennis consecutively executed the clerical responsibilities during the major portion of the project.

In addition to the foregoing acknowledgments, the Project Director wishes to express his personal appreciation for the invaluable assistance rendered by the professional staff. Mrs. Bernice Shapiro began with the inauguration of the project and remained to participate in a part of the writing of the Final Report. In the beginning she assisted in the gathering of background information and the preparation of materials and documents which were used during the first phase of the project. For the entire project, she was primarily responsible for the scheduling of subjects and staff for their research examination appointments and conducted many of the test administrations herself.

Soon after the project got underway, Mrs. Emily Garfield joined the staff as part-time research assistant. Along with finishing up the preparation of the original research instruments, becoming one of the traveling examiners for the staff in the Bay Area, she also worked out the process for and fabricated much of the redesigned apparatus. Her assistance in the preparation of all of the reports has been particularly appreciated.

Toward the end of the first year of the project, Richard M. Suinn, Ph. D., joined the staff as Principal Investigator. He examined a number of the research subjects, planned and supervised the statistical handling of the data and prepared the test manuals for the "Stanford-Ohwaki-Kohs Block Design Test for the Blind" and the "Stanford-Kohs Block Design Test for the Blind". With his professional guidance and assistance the project was expedited to completion within the two year grant supported period although it was originally planned as a three year study.

Drs. Kohs, Sinick, Graham, Cronbach, and Winters all rendered discreet and essential consultation services relating to problems which fell in their particular disciplines. Some received nominal stipends but all gave freely of their time and indicated sincere interest in contributing their knowledge to the advancement of this project and work for the blind in general.

To Dr. Daniel J. Feldman, Director, Division of Rehabilitation Medicine, and the numerous administrative personnel of Stanford University, a special measure of thanks is extended for their support and cooperation in making this project operate as smoothly and effectively as possible.

It has indeed been strenuous at times but in spite of the pressures and frustrations it has been a pleasure to work on a challenging task with congenial and enthusiastic associates.

William L. Dauterman, Project Director

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I. INTRODUCTION

A. The Vocational Rehabilitation Problem

The authors of this project feel that narrowly construed vocational objectives are inadequate goals for individual vocational rehabilitation plans, currently, and will progressively become more inadequate. Chronic unemployment in our society is obviously becoming a normal situation and will change only toward a higher percentage of unemployment as automation and cybernation inevitably advance toward the elimination of physical and mental toil in our society. Dunham (1963) points out that blind persons, like everyone else in our society, must face the changing conditions of the present and future with regard to the probability that remunerative employment will not be available for all who wish to work, that high levels of training and the need for re-training several times during one's lifetime will be necessary, and that education and training for successful personal and social living should be viewed as reality oriented rehabilitation objectives. The present authors concur with Dunham and other writers in the field as to the importance of total preparation for life and socially creative activity whether the objective be vocational or occupational.

It is evident from the relatively high level of "unemployability" among persons who are blind that society has already accepted the reality of vocationally non-productive elements, and the responsibility for planning to meet their subsistence needs. The vocational rehabilitation goals of the future must be broader and must encompass the problems of individuals in quest of satisfying activities whether or not a significant portion of their efforts are spent as wage earners. Most satisfying occupations will also be those which contribute something to society whether the end product be utilitarian or esthetic.

Ultimate vocational success is the objective of any vocational rehabilitation program. The selection of the most suitable vocational objective is the most important step in the counseling process. The measurement of the rehabilitant's intellectual capacity to achieve his objective is frequently the most difficult, if not impossible, technical procedure confronted by the counselor of blind persons. The Wechsler Adult Intelligence Scale, the Wechsler Intelligence Scale for Children, and the Stanford-Binet Intelligence Scale when used with children, offer suitable verbal tests which correlate well with academic achievement and vocational performance on the technical, professional and managerial levels. Those children and adults, deprived of normal educational experiences or those having cultural or language differences, may be expected to perform poorly on these verbal tests. Whatever their performance, the I.Q. obtained is a measure of achievement in spite of deprivation but is not an objective measure of potential learning ability since the degree of deprivation cannot be quantified. Until recently, no standardized non-verbal performance scale has been available to measure the intellectual capacity or learning ability of blind subjects. It has been noted by many authorities that blind persons who are exposed to educational experiences in the Western culture, whether in school or elsewhere, frequently perform well on verbal tests while having less than average ability to cope with vocational and other activities of daily living. In such cases, high I.Q.'s obtained from verbal tests can mislead the subject and the counselor into setting inappropriately high occupational objectives. Conversely, low scores may result in a poor job adjustment or a rehabilitation failure.

While the specific nature of the educational and cultural differences which affect test results may vary from state to state and region to region, the general problem is known to exist throughout this and other countries. The development of a non-verbal test with minimal responsiveness to educational and cultural differences and with normative data for identifiable groups having age, sex, educational, cultural, occupational, and visual acuity differences should assist all professionally qualified clinicians to perform more accurate evaluations of the intellectual capacity of visually disabled persons.

B. Objectives

The purpose of the project was to contribute to the development of meaningful instruments for the measurement of the intelligence of blind persons through the refinement and field testing of the Ohwaki-Kohs Tactile Block Design Intelligence Test for the Blind and to supplement the existing adequate clinical tests, which are essentially tests of verbal ability, with a non-verbal performance test.

PHASE ONE: The specific aims were (1) to improve the physical form of the test toward better tactual discriminability and durability; (2) to modify test administration instructions and procedure toward better standardization on an English speaking population; (3) to determine the validity and reliability of the Stanford modification of the test; and (4) to write an Ohwaki-Kohs manual standardized on a population of adult Americans, (the revision is currently titled Manual for the Stanford-Ohwaki-Kohs Block Design Test for the Blind).

PHASE TWO: As the work progressed during the first year, it became evident that a new apparatus was needed for the tactile version of the block design test, even though the material had been brushed and stiffened periodically. The specific aims of this phase were: (1) to find entirely new materials out of which to fabricate a new form of the test, (the new version of the tactile block design test is known as The Stanford-Kohs Block Design Test for the Blind); (2) to prepare test instructions and administration procedures to accommodate the use of the new apparatus; (3) to validate the new with the old; (4) to determine the validity and reliability of the new test; (5) to write an examiner's manual for the Stanford-Kohs Block Design Test for the Blind standardized on a group of 300 adult Americans; and (6) to produce 100 sets of the new apparatus and manual for distribution to investigators and clinicians for further field testing and for the stimulation of future scientific investigations.

C. REVIEW OF THE LITERATURE: Performance Tests of Intelligence for the Blind

One of the earliest attempts to assess the performance ability of the blind in a literal sense was Bradway's (1937a). Using the Vineland Social Maturity Scale, she examined seventy-three residents of an institution for the blind in Pennsylvania, limiting her sample to students who became blind before age four and who had at most form perception but not travel vision (1937b). Results showed that the visually handicapped were delayed in their performance of the various activities of daily living that comprise the scale. These findings cannot be called conclusive due to the restricted sample and paucity of subjects at each age level. However, Bradway concluded that the blind did not dominate their environment as much as the average person. Maxfield and Fjeld (1942) studying preschool blind children using the Vineland Social Maturity Scale found them to be more docile and to have less initiative than partially sighted children. All three researchers found a tendency for the social quotient (S.Q.) of blind subjects to decline with advancing age. Bradway noted that none of the performance items were failed merely because of blindness, and attempts to re-score the scale with allowances for use of special devices and aids available to the blind failed to result in appreciably higher scores for these subjects.

Prior to 1942, little work was done toward developing performance tests for the adult blind. Intelligence tests for use with blind children basically involved the elimination or modification of test items requiring sight. Irwin began in 1914 to combine items from the Binet and any other appropriate source in the first attempt to develop a chronologically scaled intelligence test (Hayes, 1950). Much of the early work was confined to development of tests of manual dexterity and manipulation and did not touch upon non-verbal intelligence testing. Samuel P. Hayes carried on limited experimental work in the 1930's adapting the Minnesota Mechanical Ability Tests, Kohs Block Design Test, Whipple's Aiming and Steadiness Tests and the O'Connor Finger Dexterity Test (Bauman and Hayes, 1951). This early work showed the importance of concrete tests in measuring and assessing abilities of the blind, and pointed up the importance of a kinesthetic and orientation factor to the blind. Beginning in 1942 at the Trainee Acceptance Center in Philadelphia various tests of manual skills were used with the blind; the Minnesota Rate of Manipulation Test, the Pennsylvania Bi-Manual Work Sample, the O'Connor Finger Dexterity Test, and the Purdue Pegboard (Bauman, 1950). Specialized tests of aptitudes have been more difficult to devise for the blind except for tests of motor skills and dexterity (Arnstein, 1956; U.S. Civil Service Comm. 1956).

Non-verbal intelligence test development began in 1945 when Bauman devised the Non-Language Learning Test from material used with children (Bauman and Hayes, 1951). The test consists of a small formboard with blocks cut in patterns that will fit into recesses in the board only in certain combinations. The examiner demonstrates the best series of moves for returning four blocks to the board, and the subject must demonstrate his learning of this series of moves. As well, he must show an ability to discriminate forms and match shapes by touch. Bauman (1954) found low positive correlation between this test and the Wechsler-Bellevue Verbal I.Q., and noted a clear differentiation between successfully employed and unemployed blind groups.

Bauman points out that major original work in performance test development for the blind did not begin until the 1950's with Shurrager's attempt to adapt the Wechsler Performance Scale for the visually disabled. In 1954 the Performance Scale for the Adult Blind (PSAB) (Watson, 1956) was developed by H. Shurrager, P. Shurrager, and S. Watson, which led to the present form of the Haptic Intelligence Scale for the Adult Blind (HIS) (Shurrager; 1961, 1964). The PSAB was administered to sighted, partially sighted and totally blind subjects, all of whom wore masks. Blind subjects scored highest and sighted subjects scored lowest when all groups worked tactually. Correlations between PSAB and WAIS verbal subtest scores range from .74-.78 and reliability ranged from .73-.97 for blind and sighted samples. The present HIS consists of six subtests which are described below:

Digit Symbol: subject must identify raised geometric forms by their appropriate numbers found on a key column of sample forms.

Object Assembly: subject must put together pieces of a block, a doll, a hand and a ball.

Block Design: four cubes with rough and smooth surfaces are assembled to match various patterns appearing on plates of the same materials.

Object Completion: the missing parts of various familiar objects must be identified.

Pattern Board: a pattern formed by pegs must be reproduced by the subject after the pegs are withdrawn from the board.

Bead Arithmetic: an abacus is used to solve various addition problems.

A seventh test, plan-of-search, was eliminated from the battery because of its low reliability and high standard deviation.

The correlation between HIS and WAIS verbal subtest total scores is .65; intercorrelations among HIS subtests is high (.53-.71) indicating the existence of a common factor in all the scale subtests. The scale would be improved by the inclusion of easier items in several tests, particularly the pattern board. This would lower the relatively high standard error of measurement which results from the high intercorrelations of the subtests and the moderate reliability coefficients. The reliability of the scale as a whole is good and it is well standardized for subjects whose vision does not exceed 5/200 in the better eye with proper correction (Shurrager, 1964). Shurrager found a significant triserial correlation between test scores on the HIS and three vision groups: fully sighted, partially sighted and totally blind. The highest scores were made by the last group, when the sighted groups were blindfolded. This effort to control the level of vision enables the totally blind subjects to make use of their greater tactual experience. The use of a blindfold clearly creates an unnatural disadvantage for the partially sighted. Therefore, the HIS needs to be interpreted with caution, and applicability to partially sighted people is limited.

Progress in test development for the blind has been made abroad as well as in the United States. In 1956, Ohwaki and his associates in Japan adapted the Kohs Block Design Test for use with the blind and standardized their instrument on children in residential schools, between the ages of six and twenty-one (Ohi, et al. 1956; Ohwaki, et al. 1960). The blocks and patterns are larger than the original Kohs test and time limits are three or four times as long. Various fabrics with different textures were substituted for the original four colors used in Kohs blocks and patterns. Ohwaki found a bimodal distribution of intelligence in his study, with low scorers most frequent, high scorers next in frequency and a general mean I.Q. of 84.6-- relatively few subjects scored in the middle range of intelligence. Reliability of the test is .82, with some practice effect noted. Scores increased with age and the correlation of test score and school achievement is moderately high.

The result of the use of the Ohwaki-Kohs test with Italian children aged 13-22 was reported by Bozzo and Zecca (1964). They found the test useful in offering information which verbal intelligence scales cannot give, and therefore they feel the test is useful for evaluating intelligence of the blind. Italian subjects scored lower than Japanese subjects on the Ohwaki-Kohs, although the Italians showed higher mean Wechsler-Bellevue verbal scores than Ohwaki-Kohs scores. Thus the Ohwaki-Kohs I.Q. for the Italians was 77 whereas their W-B I.Q. was 110, and the Ohwaki-Kohs I.Q. of the Japanese was 84. Males tended to perform better than females on the Ohwaki-Kohs (85 vs. 60 I.Q. on the Ohwaki-Kohs). The authors noted the personality traits of unsteadiness, impatience, poor orientation, and a tendency to be discouraged and to give up in the face of obstacles among those who performed poorly.

Schlegel in France used the Ohwaki-Kohs in a study of blind adults and recommends its use as a valid and well differentiated test on intelligence (1963).

Juurmaa, at the Institute for Occupational Health in Helsinki, Finland (1965) is utilizing the block design principle in a two dimensional format. The designs are produced on metal surfaces by means of different types of scoring. They are reproduced by assembling triangular segments in a recessed formboard. There appears to be an absence of the tactile spatial factor in this version of the test (Davis, 1965).

In Wattron's (1956) experiment with an adaptation of the Kohs Block Design Test a correlation of .84 was found between block test scores and mental age on the Hayes-Binet. No significant difference in blind and sighted subjects' performance was noted although the blind tended to do better than the sighted when the latter worked tactually.

Newland (1961) became aware of the necessity for other than verbal tests in 1930 and began active work toward development of the Blind Learning Aptitude Test (BLAT) in 1952. He seems to have felt that the Hayes-Binet and the Wechsler instruments adequately measured learning aptitude so far as verbal modalities were concerned. He made what he seems to consider a natural and spontaneous choice of the tactual modality to approach the non-verbal sphere.

He states "A second consideration contributing to a need for a conceptualization of learning potential such as this is the possibility that the acculturation of blind children is discernibly more diverse than among children with no such sensory impairment. While the effects of the auditory stimulation of blind children may not differ markedly from those of non-blind children, the adequacy of their tactual stimulation has been a source of continuing concern to those interested in the blind. As a part of this, overprotective attitudes on the parts of the responsible adults in the environments of blind children are believed to be such as to contribute to a significant diversity in the experiential backgrounds of blind children. This complex of acculturation diversity, or wide range of experiential background, appeared to make particularly necessary the development of behavior sampling which placed a minimum of emphasis upon what the child already had learned". While he does not detail all of the exploration and experimentation leading up to the final selection of and reproduction of the stimulus items composing his test, he implies some diligence was required before the final choice of items on which he reports data (1961). Molded plastic seems to have been used to reproduce three dimensional sheets with imposed patterns. Included were the following series of behavior samplings:

1. Discovery of differences. Given six stimulus elements in a test item, to identify the one which was different from the other five.

2. Discovery of identities. Given a stimulus element, to locate one just like it among five response elements in each test item.

3. Proportion completion. Given stimulus A and B associated in some manner, to find which of six response elements would be similarly associated with stimulus element C. This was, in effect, a four-figure matrix.

4. Progression completion. Given three stimulus elements associated in some progressive manner (size, completeness, position, composition), to discover which of six response elements would come next in the stimulus progression.

5. Gross figure or pattern completion. Given a partially complete stimulus figure or pattern (a broken circle or square, or a pattern of lines or dots), to identify which of six response elements properly completes the figure or pattern.

6. Nine-figure matrix completion. Given a matrix with eight of the nine interrelated component elements present, to identify which of six response elements properly completes the matrix.

Newland reported his data to be only partially analyzed but he offered the following results and conclusions based on subjects who had reportedly lost their vision by the age of three and who did not have enough vision to utilize it in the performance of the test. For 256 subjects, ranging in chronological age from 5 to 17, the Binet-BLAT product moment correlation coefficient was .537. For 146 subjects, ranging in chronological age from 5 to 16, the Wechsler-BLAT correlation was .455. These results are high enough to suggest the possibility of a reasonable psychological commonality, but also low enough to suggest the sampling of something somewhat different from the nature of the total behavior sampled by the Hayes and Wechsler approaches.

In 1957 Purdue researchers undertook a study of the potentialities and abilities which are related to the vocational success of the blind. Although tests of performance intelligence were constructed in an effort of measure ability to deal with abstract relationships apart from verbal abstractions, the major interest of the Purdue team was in predicting to vocational criteria. Tiffin at Purdue, and later Teare at Wichita, both attempted to relate their tests to indices of successful employment and utilized a common sample of 632 legally blind persons between the ages of 20 and 50 who were allowed to use whatever vision they had, in an effort to match the test situation to an actual work situation (Teare, 1962; Tiffin, 1960). Categories of employment location (competitive, shop, agency, vending, or unemployed) and job hierarchy were developed, and subjects were categorized according to high, mid or low vision groups. Although Bauman reported a strong positive correlation between scores on the Wechsler verbal subtests and adjustment when employment versus non-employment was defined as the main criterion for adjustment (1954), it appeared logical to the Purdue group to include measures of non-verbal ability in a test battery for the blind since the greatest proportion of jobs available to the blind were industrial ones consisting of manual manipulation (Jones, 1960). The two major performance tests developed for the study were the Vocational Intelligence Scale for the Adult Blind (VISAB) and the Tactual Reproduction Pegboard (TRP) (Gruber; 1961, 1963).

The VISAB is composed of forty-three items each consisting of four geometric figures, three of which are related to each other. The figures are raised, and the subject is required to select the least related figure. Scoring was developed to differentiate between high and low scorers on the WAIS verbal subtests and high and low scorers on the VISAB itself. Normative data was developed on 537 subjects. White subjects scored significantly higher than non-whites. A correlation of .63 was found between the VISAB and the WAIS verbal scale. In addition, the VISAB differentiates between level of employment groups, salary levels, and supervisory ratings. The author concludes that the VISAB reliably measures one aspect of intelligence. The VISAB appears to be superior to the WAIS in predicting to industrial settings; however, the WAIS does remain a better predictor of the overall dimension of vocational achievement.

The TRP was developed to measure tactual perceptiveness, that is, the ability to tactually identify, discriminate, and locate relationships, and to utilize manipulative skills. A pegboard divided into two identical halves consisting of thirteen rows and seven columns is utilized. Geometric patterns made with pegs on one half must be reproduced by the subject on the other half. A measure of rate of placement is available by requiring the subject to insert as many pegs as possible in the board in a given time. The TRP was found to be superior to the WAIS verbal scale in predicting success of workshop employees. However, the test does not differentiate well among outside employed, shop employed, and unemployed groups. Partially sighted persons achieved higher scores on the TRP than the totally blind. As remaining vision decreases, scores on the TRP were found to reflect more of a "tactual perceptive" ability as opposed to manual dexterity. Two major objections to the test include the greater advantage of the partially sighted over the totally blind in performing the task--this would argue for two sets of norms--and the necessity of weighing the speed of manual manipulation in scoring (Gruber, 1963).

The Purdue researchers found the WAIS to be the single most valid test in their battery, although the TRP and the VISAB correlated higher with supervisory ratings than did the WAIS. Within the group of workshop employed blind, the TRP correlated highly with supervisory ratings. The above findings support the hypothesis of the researchers that a non-verbal instrument will show greater predictive efficiency with industrial workers than a verbal scale will. Although several other instruments were developed for the study the authors conclude that they require further investigation before their usefulness can be ascertained.

In 1959 Anderson adapted the Raven's Progressive Matrices for use with the blind as a measure of performance intelligence (1964). The test apparatus consists of selected patterns from the ink print version reproduced in three dimensions with a portion "cut out" that the subject is required to complete. Correct inserts must be determined by extrapolation of size or shape trends, or by deduction from the permutation of two or three variables, such as texture, shape, ground, number or size. Anderson developed an observational system for noting subjects' various approaches to problem solving. Both a children's form and an adult's form of the test exist (Rich, 1963; Rich and Anderson, 1965). The adult version of the Tactual Progressive Matrices (TRPM) correlates .49 with the WAIS verbal scale and reliability is .93-.95. Correlation between the children's version and the WISC verbal scale is .31. Possession of any useful vision raises the subject's score on the TRPM. There is some suggestion based on clinical observations that test performance shows observable relationships with personality variables. Anderson concluded from multiple correlation data that the TRPM did not add predictive power to the WAIS used alone, but recommends its use as a helpful tool for observation of task orientation with blind subjects.

The standardization of the Perkins-Binet Tests of Intelligence is underway. This test includes verbal as well as non-verbal items, the latter having been developed to facilitate appraisal of tactile perception and discrimination of the blind. Tests consist of whole year age levels, three through fourteen, as well as average adult and three superior adult levels (Davis, 1964).

Zander (1966) reports on the comparative abilities of blind and sighted adults to learn a tactual task. Using a shortened version of the Stanford-Kohs Block Design Intelligence Test for the Blind, she found no significant difference in number of designs completed by sighted and blind groups when both groups were blindfolded.

In summary, several points regarding performance tests of intelligence for the blind can be made. Partially sighted subjects tend to perform poorly in comparison with the totally blind when both groups are blindfolded. To enable the partially sighted to make use of their remaining vision without thereby penalizing the totally blind, two sets of norms should be developed by researchers. When there are no separate norms available, caution must be used in interpreting test scores for the partially sighted. Many of the tests could be improved by the inclusion of easier or harder items, thereby becoming more reliable measures of intelligence. One is struck by the recurrence of the same types of tests appearing over the years: pegboards, digit symbol tests, block design tests. The test apparatus often proves difficult and expensive to mass produce, and new types of tests thereby become discouraging to develop because of the many practical problems involved. Repeated handling of hand-made test models causes great wear and tear, and so more durable materials are sought.

Over the past twenty years various performance tests have used as criteria WAIS verbal scores, vocational success, or school achievement. These tests provide a good beginning for those researchers who will continue to perfect past test instruments and develop new ones to improve performance testing of the blind.

II. METHODOLOGY

PHASE ONE: Modifying and applying the Ohwaki-Kohs Tactile Block Design Intelligence Test for the Blind

A. Work on Ohwaki test apparatus: When the Ohwaki apparatus was received from Japan the differences in texture, which were used to form the designs and surfaces of the blocks, were indiscriminable by touch as the result of compression during storage and shipment. However, the unique characteristics of the fabrics were restored and emphasized by brushing or stiffening as required. In spite of the restorative treatment, many adults reacted with frustration when they attempted to "read" the design plates and complained that the plates were more like tests of discrimination rather than tests of perception. When the apparatus was restored and periodically maintained, it was serviceable for no more than an average of 50 test administrations per set. No suitable method of performing major repairs of restorations to the apparatus seemed feasible after it was worn out. The Ohwaki test is currently more readily available through a distributor in the United States; Western Psychological Services.

B. Work on the Ohwaki test instructions: Dr. Ohwaki (undated) provides an English version of his manual. Unfortunately the English translation is somewhat awkward and cannot be used literally so far as either the normative data or the instructions to the subjects are concerned. For our study, Ohwaki's overall test administration methods were adhered to precisely, but the instructions were modified into a more suitable form of English.

For ease of administration, the experimental version of the test instructions were prepared in two colors. The specific instructions and cautions directed to the examiner appeared in red ink while the balance of the material was in blue. A new recording schedule was designed which incorporated timing for the various phases of the problem solving process. It also borrowed from the Anderson study of the TRPM in that the "Approach to problem" was recorded as observed and judged by the examiner for each design problem. (see appendix, Form E-2)

C. Development of instruments for collecting criteria information

1. Essentially following Anderson's format, an "INFORMATION RECORD" (Form A) was designed. Some thirty essential bits of information are recorded, falling into eight significant categories as follows: identifying information, family status, employment data, educational exposure, ethnic factors, ophthalmalogical and general medical data, family influence, and braille achievement. The selection of items was relevant to future groupings of subjects for standardization purposes as well as the search for possible correlates of performance intelligence. (See appendix Descriptive Statistics)

2. Work for the blind has one unique characteristic in that specialized services have been developed to meet the needs of various sub-groups covering most of the major chronological and activity periods of the life span. It seemed important to deal with the factor of exposure to specialized services in this investigation so far as exposure might be expected to maximize the development of performance ability among blind persons. "RECORD OF SPECIALIZED SERVICES OFFERED TO THE BLIND ONLY" (Form B), makes a special effort to identify and record the services to which the research subjects have, at least, been exposed. The form grossly identifies those services considered by professionals to be essential to the group's welfare but not always necessary for each individual. It is assumed that not all the items listed from (1) "Preschool parent-child guidance" to (18) "Talking book service" are of equal significance, or necessarily all inclusive, or constituting an unbroken continuum.

The hypothesis is generally that persons of approximately equal physical, intellectual, emotional and social status will perform better as "Functional adults" and will perform better on "performance tests for the blind" depending upon the amount of specialized services they have received. The quality of the service, the timeliness of the service, the intensity and duration of the service, and the readiness of the subject cannot adequately be assessed. However, it is recognized that these factors are crucial to the relevance of the effect of service on the performance of the individual.

As to the manner of recording and scoring: Those activities which normally extend over a period of months or years in a more or less continuous fashion, such as parent-child guidance, and educational programs (items 1 through 14) the number of months and/or years during which the subject was a recipient of the service were recorded. Items 15 through 18 were recorded as "yes" or "no" indicating whether or not home teaching, counseling, recreation or library services had been utilized. The total score value of the services recorded was equal to the sum of the years and months for items 1 through 14, plus one additional month for each "yes" answer for items 15 through 18. (See appendix form B)

3. In the absence of an objective measure of performance with regard to adaptive behavior in activities of daily living and mobility, "THE STANFORD REHABILITATION SOPHISTICATION SCALE FOR USE WITH BLIND YOUTHS AND ADULTS" was developed. The original idea of the project was to attempt to actually observe the real-life performance of blind subjects in dealing with their social and physical environments and to attempt to correlate observed performance with the results on the Ohwaki-Kohs instrument. However, it became evident that the experimenters would have greater difficulty standardizing a test of real-life activities of daily living, physical orientation, and social adequacy, and other such dimensions, in a population of any significant size and available for only short periods of observation. While small groups, such as those involved in various forms of rehabilitation training or treatment, may well be subject to objective measures observational of performance and reasonably consistent ratings by professional judges, some type of easily administered test would have to be devised for research subjects.

Several hypotheses were then formulated: (a) there is a certain body of knowledge which has to do with the most effective way for blind people to meet everyday living problems; this knowledge can be acquired independently through experience over a considerable period of time or by learning with the help of professional rehabilitation services; (b) the amount of learning of this nature can be roughly measured by a carefully constructed objective verbal test; (c) the items on such a test will tend to fall along a continuum representing degrees of knowledge. The zero point represents only knowledge concerning blindness and blind people which is assumed to be a common part of the culture and thus shared by most people. The middle of the continuum represents some level of practical knowledge acquired through approximately two years of trial and error living with blindness. The upper terminus of the continuum is assumed to represent the most sophisticated "knowledge" or set of concepts concerning the most effective techniques for living in contemporary society; (d) it was hypothesized that the correct verbal responses to these questions will bear a positive relationship to the individual's actual effectiveness in society as measured by such relatively objective factors as educational achievement, occupational success, participation in family and other social activities, etc.

The experimental instrument of 120 items was compiled from an inspection of the literature on blindness, the items in the Vineland Social Maturity Scale, and certain unpublished experimental instruments designed by Helen Sargent, Ph.D. These items were accumulated on cards. Duplicates were eliminated. The remaining items were then transcribed into a homogeneous form which required the respondent to answer "true", "false", or "don't know". The questions were then reevaluated by the project director in view of his experience as a blind person and a specialist in the rehabilitation of blind adults. The research assistant and nine other sighted colleagues then responded to the "questionnaire" providing a further opportunity for the elimination of ambiguities and superfluities. Inspection of the staff responses confirmed our assumption that the items represented various levels of sophistication with regard to behavior associated with the degree of "rehabilitation". Items in the lower third of the continuum were answered correctly most frequently by this atypical group of sighted people whose contact with the blind is somewhat more intense and frequent than for the average sighted person. They also tended to miss more items in the midsection of the continuum and had their highest number of wrong answers for the group of questions which are construed to tap the highest levels of sophistication with regard to techniques of daily living for the blind.

A format for the administration of the questionnaire was developed providing the alternatives of reading the questions to the subject or using tape recorded questions. (See appendix Form C and tables 1-17)

4. In that this research is basically concerned with performance intelligence testing of adults whose tactile sensitivity is known to vary, the "SANDPAPER SORTING TEST - A TEST OF TACTILE DISCRIMINATION" (see appendix, Form D) was developed. Ohwaki's population is described as being from 6-21 years of age, "full blinds", and students in Japanese schools for the blind; all of which would seem to describe a group with maximum tactile sensitivity.

With particular regard to the Ohwaki test, the instructions imply that there is a learning period before the actual test begins during which the subject will have an opportunity to identify the various textures and to learn to discriminate among them. However, the administrator does not actually pursue this line of investigation beyond establishing that the subject is able: (a) to understand that there are different textures involved; (b) to respond verbally in an affirmative manner indicating that he does differentiate; (c) to perform the initial elementary patterned recognition and duplication. The administrator then concludes that the subject either can or cannot discriminate well enough to perform the test. This was considered to be inconclusive and subject to further investigation; hence, the addition of the sandpaper sorting test as a more discriminating and differentiating procedure.

This test requires the subject to discriminate between two grades of sandpaper on six levels of difficulty. The test was used as a means of identifying any impairment of the sense of touch which might influence the performance of the subject on subsequent tests or in an occupational activity. Persons having average sensitivity of their fingertips have no difficulty making all the discriminations presented.

Using this test, the following experimental propositions were studied: a. The subjects who are able to perform the three most difficult discrimination tasks of the six tasks presented in the sandpaper sorting test would have no difficulty differentiating among the textures presented by the Ohwaki-Kohs Block Design Intelligence Test for the Blind, b. Persons who are blind and who are unable to discriminate well enough to pass the three "easier" tasks in the sandpaper sorting test would probably manifest other signs of physical, intellectual, or emotional disability indicating the need for: (1) medical confirmation, (2) the elimination of the need for fine manual discrimination in future occupational activities, (3) the exclusion of psychological tests which involve tactual discrimination of a fine order, and (4) the individual would specifically perform poorly on the Ohwaki-Kohs Block Design Test. The use of this screening device was subsequently discontinued since no individuals were found during the initial year who were unable to perform the most difficult discriminations. (Further work with this or a similar test of discrimination may become relevant as clinical applications increase with service to blind diabetic patients who might also be suffering from neuropathology of the extremities.)

5. In considering the various factors or abilities which might be necessarily possessed by a blind subject to perform a tactile block design test, imagery was hypothesized to be important. Further, it was also hypothesized that the Ohwaki-Kohs test might be a good measure of imagery ability. The importance of imagery with regard to performance intelligence is assumed to be critical for the blind person who is attempting to master the physical environment which he cannot see. He may not be able to touch much of which concerns him and will learn of many important configurations in the environment only through verbal descriptions or other inferential experiences.

Therefore, it was decided to create the "STANFORD MULTI-MODALITY IMAGERY TEST FOR THE BLIND" as a part of the experimental test battery which would be correlated with the Ohwaki and other criteria measures of performance. The original concept was incorporated in the "Michigan Imagery Test" which had been introduced into work for the blind by J.R. Dunham, Ph.D., to evaluate travel pattern understanding and retention potentialities among totally blind trainees in several rehabilitation centers. For the purposes of the current study it was deemed necessary to introduce several "learning phases" which were designed to reduce the advantage some subjects might have as a result of previous experience with the manipulation of geometric figures.

The test has three phases, the first of which involves the subject in the construction of simple three-sided and four-sided figures by placing a rubber band around a piece of fiberboard. The second phase involves him with the use of the same materials in the construction of four more complex designs. For the final phase, the model building materials are taken from the subject and he is given only the verbal descriptions necessary to construct a mental image. He is then asked to respond to the question, "how many three-sided and how many four-sided figures are created in this geometric pattern?" Twelve patterns are described verbally ranging from a simple rectangle with one diagonal to a rectangle divided into sixteen three-sided and two four-sided figures.

The data showed a strong relationship between performance ability on this instrument and all other measures used. The multi-modality aspect of the test implies that "visual imagery" is not the only significant imagery modality available to the blind for solving such problems. This premise was supported by the data gathered on the congenitally blind. (See appendix form F and Tables 1, 2, 5, 14, and 16)

D. Selection of WAIS has become an accepted clinical instrument for the measurement of intelligence, and by virtue of its wide usage and high correlation with such valued achievements as education, occupational status and level of income, it is also considered a reliable research tool. While its virtues are numerous, a most important characteristic is its internal subtest reliability which justifies using appropriate parts of the test when it is inappropriate or impossible to administer all of the sub-scales. Clinicians and researchers working on psychological problems relevant to blindness have utilized the verbal scales of the WAIS with adults whose visual acuity is too low to offer any validity to the use of the full scale. This practice has simultaneously built up clinical confidence in the verbal scales as a measure of "general intelligence" and at the same time has stimulated several projects, including this one, designed to develop scales of performance intelligence which would complement verbal measures when used with blind persons.

Essentially some accepted measure of intelligence was desired as a correlate of the experimental instrument. The WAIS remains, for the present at least, the most logical one since it could be combined with whatever performance scales are developed for use with blind persons. The research problem of greatest interest is that of developing a performance scale which measures "general intelligence", correlates significantly with verbal tests, and yet can be demonstrated to measure and predict behavioral characteristics not adequately ascertained by the use of verbal measures alone.

E. The Examination of Research Subjects:

In order to portray the procedure followed during the initial phase of the research, pertinent extracts from the "examiner's manual" are presented verbatim.

Population Characteristics

"Subjects should be between the ages of 16 and 65. If subjects 14 to 16 years of age are tested the examiner will need to provide himself with the verbal scale of the Wechsler Intelligence Scale for Children, since this is not a regular part of this kit. Persons whose visual acuity has been determined by an ophthalmologist to qualify him as 'legally blind' are appropriate subjects for this research. Differences in visual ability will be accounted for statistically and reflected in the 'standardization groups'. The subjects should be in 'reasonably good health' upon the occasion of the testing experience. Chronic diseases such as diabetes and heart diseases should not exclude a subject as long as he is not acutely ill at the time of the examination. Particular care should be taken, so far as is possible, to obtain a good cross section of the population so far as intellectual ability is concerned. In other words, we would prefer that the examiner or his supervisor select as broad a range of individuals as is available to him. When it is possible to test an entire population identified in a certain group situation this procedure is most desirable. When the population is too large, either random sampling or a representative sampling will be most acceptable. In any event, the researchers will appreciate a statement as to the method used in the selection of subjects. When appropriate test behavior can be elicited, subjects with emotional problems may be included and should be specifically identified as to this characteristic."

Vision - Health - Fatigue Test Considerations

"The standard test administration does not involve the use of any blindfold, occluder, or other means of controlling the subject's use of sight. He is allowed to use whatever sight is available to him in the performance parts of this test battery. The examiner will simply record carefully, in the appropriate spaces and in his narrative comments, the methods used by the subject to perform the test. If the subject is ill or fatigued, or if the subject becomes ill or fatigued, the examination should be postponed or discontinued until a more appropriate occasion...."

Observation and Reporting of Significant Subject Behavior

"The investigators will appreciate the reports from the examiners as to the reactions of subjects to the various research instruments and to the overall testing experience. Their approaches to the solving of problems, their efforts to elicit assistance, their expressions as to self-regard, and any unusual observable or verbalized emotional responses to the test items, test instruments or the test battery all may contribute valuable insights to the future development of the instruments and suggest areas for further investigations."

Recording Specific Data

"Information Record" - Form A

As soon as the subject appeared to be comfortable and oriented to the situation, the "Information Record" was completed as carefully as possible using the best interview techniques known to the examiner.

"Record of Specialized Services Offered to the Blind Only" - Form B

The second item to be completed was the "Record of Specialized Services" which was merely the continuation of the interview with the specific goals of ascertaining whether or not the subject had the advantage of the specified services and the duration of the service.

"Sandpaper Sorting Test - A Test of Tactile Discrimination" - Form D

The third step in the examination was the administration of the Sandpaper Sorting Test. The examiner read the attached specific instructions for this test carefully before attempting its administration.

"The Ohwaki-Kohs Tactile Block Design Test" - Stanford Modification 1964

The fourth step in the examination was the administration of the Ohwaki-Kohs Block Design Test. The instructions to the administrator and the subject appeared in detail and in two colors for easy reference and administration. (See Part Two, "Manual for Stanford-Ohwaki-Kohs Block Design Test for the Blind")

"Stanford Multi-Modality Imagery Test for the Blind" - 1964

The fifth step in the examination procedure was the administration of the Multi-Modality Imagery Test. This test had three distinct phases and was provided with detailed instructions to the examiner and the subject which were followed precisely. Visual aids provided for the convenience of the administrator and tactual apparatus was provided for the subject. (see Form F2)

"The Stanford Rehabilitation Sophistication Scale for Use with Blind Youths and Adults" - 1964

The sixth phase of the procedure was the administration of the Rehabilitation Sophistication Scale - See Form C (sample items from the total of 120). The stimulus statement was judged as true, false, I don't know. The subject's verbal response was recorded by the examiner. (For the detailed instructions, see Form C-1)

"The Wechsler Adult Intelligence Scale" (WAIS) or "The Wechsler Intelligence Scale for Children" (WISC) - 1955

The seventh and final step in the data collecting procedure was the administration of the verbal scale of the WAIS or the WISC. If the subject had taken this test recently and if the scores were available, it was not necessary to readminister the test, merely record the scores and other pertinent data on the forms provided.

Other Test Data

In the event that the "Vineland Social Maturity Scale" had been administered, the data on this test was requested. (No responses to the Vineland were received.) In the event that the subject participated in Dr. Robert Anderson's study of the "Tactile Raven's Progressive Matrices", that information was also requested. Otherwise the examiner disregarded references to these instruments.

F. Demography and Acquisition of the Sample

The initial group consisted of individuals who lived in the Bay Area and who had volunteered as subjects for the "Tactual Raven's Progressive Matrices" project. Some were counseling clients at the Stanford Medical Center and still others were acquaintances of the staff. In addition, the names of blind persons in the San Francisco-Bay Area who qualified as potential subjects for the study were obtained through contacts with state and local agencies, private organizations, other researchers, and nearly any resource which might possibly be fruitful for recruiting. Once names were obtained, a systematic procedure was started for contacting the blind person, making a testing appointment, and arranging for transportation.

Of the 155 from California a substantial group were tested with the cooperation of the California State School for the Blind. The next largest group was recruited with the assistance of the officers and members of the Associated Blind of California and the California Council of the Blind. A significant number were recruited with the aid of several special education teachers in the public schools of Northern California. The balance of the population was obtained from the clientele of two regional rehabilitation centers of the blind; 27 from The Northwest Rehabilitation Center for the Blind, Seattle, Washington; and 20 from The Southwest Rehabilitation Center for the Blind, Little Rock, Arkansas. Thus, the group represented students, adults, employees, employers, retirees, and the unemployed with a wide age range and visual acuity ranging from totally blind to 20/200, all of whom had been blind for at least a year. (See appendix one, Nature of the Sample.)

G. Description of the Data

(1) Although over 200 Ss were tested, computer analysis was restricted to 159 of these Ss with regard to all of the criteria measures.

(2) Ss were subgrouped according to age, onset of blindness, degree of functional vision, cause of blindness, employment status, travel aid. Thus, it was possible to look up results on such persons as: all congenitally blind Ss, all Ss age 16 and over, all totally blind Ss, all congenitals who are totally blind, etc. Sample sizes were good for the major subgroups, but of course became small for each time a subgroup is in turn subdivided. Sample sizes for the major subgroups of subjects with usable test data (N=159) were:

Age Group:

	N
Adults (16 and over)	132
Children (less than 16)	27
Total	159

Amount of Remaining Vision:

	N
Totally Blind	104
Uses sight and touch	32
Uses sight only	23
Total	159

Age of Onset:

	N
Congenitally Blind	91
Adventitiously Blind	68
Total	159

H. Statistical Procedures:

1. Means and Standard Deviations on the test scores and biographical information for all Ss and for all subgroups of Ss (there were some 70 subgroups). About 1,030 Means were calculated.

2. Correlations of two types represented by two types of matrices:

(a) r's between test scores and biographical information: represented by 15 x 15 rectangular matrices for all Ss and all subgroups.

(b) r's among the tests' scores: represented by 14 x 15 triangular matrices.

These correlations represented about 22,610 r's which provided information as to what criteria variables each instrument predicts and how well, the relationship between a S's characteristics in terms of which subgroup he belongs to and the ability of the test to predict the characteristics and structure of the tests themselves, etc. In general, the information provided:

(a) Data on the value of the tests for prediction.

(b) Data on the relationship between scores on the Ohwaki on our sample as compared with Ohwaki's original Japanese sample of children.

(c) Insights into the nature of the tests.

(d) Insights into the characteristics of subgroups of blind persons.

(e) Problems relevant to testing of the blind.

The full treatment of the data pertaining to the "Stanford-Ohwaki-Kohs Block Design Test for the Blind" is not being reported in this section since the final data processing and interpretation was completed during "Phase Two" of the project. (See Statistical Methods under Phase Two)

PHASE TWO: Developing and Studying The Stanford-Kohs Block Design Test for the Blind

Methodological Modifications:

In response to the recommendations of the funding agency the data collecting format was limited to the Ohwaki-Kohs test or its modified form (hereafter called the Stanford-Kohs Block Design Test for the Blind), the verbal portion of the Wechsler Adult Intelligence Scale, and the collection of biographical information.

The essential changes required the discontinuance of the use and study of the three experimental devices which had been designed as "criteria variables" in lieu of observational data concerning performance criterion on the blind research subjects. The biographical data would henceforth provide the only correlates to be used with the experimental block design test and the standardized verbal test. The work on the "Record of Specialized Services Offered to the Blind Only", "The Stanford Rehabilitation Sophistication Scale for Use with Blind Youths and Adults", and "The Stanford Multi-Modality Imagery Test for the Blind" was therefore terminated.

The Stanford-Kohs Block Design Test for the Blind:

Although the work on the new form of the block design test emerged out of and began during the initial year at the project, the current form of the apparatus was adopted and put into use as the "research instrument" during the second year of the study. Approximately 370 legally blind persons took the experimental test with 22 different examiners participating in the data gathering. At the time of this report the effort to modify the materials and examine the validity and reliability of the test appears to have had satisfactory results. (See Part Three, Manual for Stanford-Kohs Block Design Test for the Blind)

Description of the test materials:

The Stanford-Kohs test has 22 embossed designs using two colors and two textures. One simplified pattern was added as a "training exercise" for subjects who might encounter difficulty in conceptualizing the nature of the problems. Three more difficult designs were added to extend the possible level of difficulty. The simplified design requires the use of only two blocks in order for the subject to reproduce the pattern, whereas earlier block design tests began with a four block pattern. The three more difficult designs were achieved by repeating patterns 15, 16 and 17 with the outline of the pattern removed so that the white-smooth areas of the design are not delineated from the background material as is the case in design No. 17 of the original Kohs Block Design Test (an intelligence test for sighted persons).

The size of the basic unit of the test materials was standardized to $1\frac{1}{2}$" square. This unit is the size of the cubes. The designs are all multiples of this basic unit; (i.e., 2 block pattern = 3" x $1\frac{1}{2}$", 4 block patterns = 3" square, 9 block patterns = $4\frac{1}{2}$" square and 16 block patterns = 6" square). This consistency and one to one ratio differs from the original Kohs Block Design Test which utilizes a 1" cube and design units of $\frac{1}{2}$". The original Kohs four-block designs are only 1" square and therefore entirely too small for satisfactory tactual perception. The Ohwaki-Kohs apparatus, while enlarged, is unexplainably inconsistent. Ohwaki uses 4 cm. cubes (approximately 1-9/16"). However, his first three designs are constructed of units 2/3 as large as the cubes; whereas the remaining 16 designs utilize units equivalent to the dimensions of the cubes.

A. History of Construction Attempts

Before our final construction process evolved, many methods were tried and discarded for one reason or another. As in the cases of the Kohs and the Ohwaki designs and blocks, the objective was to produce a finished apparatus in which the textures and colors utilized on the design cards and blocks would be comparable if not identical.

Several tentative objectives were formulated. The first objective was to have the three-dimensional design patterns reproducible by a simple manual or machine method rather than by hand assembling of small pieces. The current popularity and wide usage of embossed plastic for braille literature, maps, and diagrams led to the decision to use the thermoform machine and brailon. The second objective was to produce apparatus which would be usable by both blind and partially sighted subjects. Although Kohs and Ohwaki both use several colors, Kohs advised that more than two colors did not seem to have any particular significance in the test construction. Therefore, the idea of using two highly contrasting colors was agreed upon for the sake of simplicity of construction and to avoid possible complications relating to color blindness. Although it is known that certain other color combinations have higher discriminability for the normal eye, black and white were chosen for this project upon the assumption that variations in eye pathology might be minimized as functional inhibitors with regard to test performance. There remained the problems associated with painting contrasting patterns which would coincide accurately with the embossed patterns on the plastic sheets. A brief outline on our construction attempts follows:

1. Master Plate Construction:
   a. Sample design made using coarse sandpaper mounted directly on board - objection: unpleasant to the touch because it was too grainy in texture and there was not enough definition of the edges.
   b. Sample design of sandpaper mounted on cardboard, remounted on another cardboard the size of the pattern which in turn was mounted on a larger cardboard backing - objection: much too high for the thermoform machine and the edges of the pattern collapsed.
   c. Sample design made of sandpaper mounted on cardboard backing; this combination in turn was mounted on another larger cardboard backing - objection: too high, pattern still collapsed too easily when thermoformed.

      An added drawback to the sandpaper was the difficulty in reproducing the patterns exactly without the grains coming off. The above steps were also attempted with sanded metal screening. The screening frayed when cut to points and was equally unsatisfactory.
   d. Search for other possible materials:
      1. Various upholstery fabrics - objection: not definitive when in thermoform reproduction, tendency to fray.
      2. Scouring cloth materials - objection: too high, edges of patterns collapsed when thermoformed.
      3. Sanded scouring cloths - objection: not well defined when reproduced.
      4. Flint sandpaper - objection: fast deterioration of material when used repeatedly as a master copy in thermoforming.
      5. Awning fabrics - objection: differentials in textures did not come through when thermoformed.
      6. Dotted Swiss mounted on thin cardboard - objection: internal pattern regular rather than random.
      7. Various rubber floor coverings - objection: most of them were too high for the thermoform and the edges of patterns collapsed.
      8. The eventual choice was a black rubber carpet matting, 3/32" thick, having a random embossed pattern that could easily be cut with scissors. The only objection is the scuffing of the black onto other surfaces. This, however, is largely controlled by lacquering. The combination of characteristics presented a workable compromise.

2. Printing Processes:
   a. Sample design made on a lithograph plate; inking done with a small hand roller - objection: too costly, time consuming, and the ink coverage on brailon was not uniform.
   b. Silk screen process - a possibility, but too time consuming for the quantity needed.
   c. The eventual choice was an off-set printing process, using a special ink, that is described in full on our construction direction pages. It was necessary to obtain a black and white image from which off-set printing plates could be made. Xerox was first attempted as a means of copying the hand-made three dimensional two-colored master plates - objection: xerox reproduces gray instead of black in this case and the edges are fuzzy. Ordinary photographic processes were used successfully although some hand taping of negatives was necessary to increase the definition of the edges.

3. Block Construction:
   a. Block materials and surfaces presented numerous problems. Having decided upon brailon on which the designs would be reproduced, an investigation was made of the processes by which a homogeneous plastic block could be manufactured. Such a molding process was located but would have required the manufacture of the block in two pieces united by hand. The tooling for the dies and assembly, in addition to the manufacturing cost for our requirements, exceeded our budget. The search for suitable materials was then redirected to the utilization of rubber, and plastic coverings for a wooden block which would most nearly simulate the tactual and visual characteristics of the printed, embossed brailon.
   b. The eventual choice was the black, rubber carpet matting which was used for the textured areas on the master plates and could also be used on the wooden blocks. The only final problem was the choice of an off-white smooth surface for the remaining sides of the block. Painting was first considered and discarded because of possible chipping. Mystik tape was next tried and accepted. It has many advantages; it comes in easily handled rolls, it has an adhesive backing, and it is washable. The only objection is the possible discoloration with use.

B. <u>Preparation of Test Instructions</u>

(The general instructions governing the research contact were essentially the same during this phase of the study as reported above for Phase One.)

With the apparatus significantly modified from that designed by Ohwaki and in view of experience gained during the use of the Ohwaki test, a new set of instructions for the administration of the test was prepared. Selected excerpts are presented here as they appear in the test manual.

"RECORDING PERFORMANCE
(STARTING WITH DESIGN 1)

1. BEGIN TIMING AS SOON AS THE EXAMINER SAYS, 'READY, BEGIN!' END TIMING WHEN SUBJECT INDICATES HE HAS FINISHED. <u>RECORD THIS AS ARRANGEMENT TIME</u> ON THE SCORING SHEET.
2. IF DESIGN IS INCORRECT, GIVE DIRECTIONS FOR INCORRECT TRIALS FOR FIRST TWO FAILURES. AFTER THAT DO NOT INDICATE TO SUBJECT THAT A CORRECTION IS NEEDED...
3. RECORD <u>APPROACH TO PROBLEM</u> FOR EACH DESIGN. FOR SOME SUBJECTS THERE WILL

BE MORE THAN ONE APPROACH NOTICED BY THE EXAMINER. RECORD THE DOMINANT APPROACH USED BY THE SUBJECT. AN APPROACH REFERS TO THE WAY THE SUBJECT ARRANGES THE BLOCKS TO FORM THE DESIGN..."

"We are interested in the abilities and skills which a person has. You will be given some blocks to use to copy a pattern, just like solving a puzzle.

First let me describe one of the blocks we will be using. The block has 6 sides which have been covered with rubber or plastic tape.

Here is a block. Please examine each side. Notice that the surface of each side is either completely rough, completely smooth, or half-rough and half-smooth...

(IF SUBJECT RESPONDS CORRECTLY, PROCEED. IF NOT, REPEAT ABOVE PROCEDURE. IF SUBJECT FAILS AGAIN, DISCONTINUE TESTING)

****

Now I am going to give you three more of these blocks. You will notice that they are exactly the same as the first block...

(HAND BLOCKS ONE BY ONE ALLOWING SUBJECT TO FINISH EXAMINING EACH BEFORE PRESENTING HIM WITH THE NEXT BLOCK).

You understand that they are all alike. Do you have any questions about the blocks?

I am going to place in front of you a page that has a design on it. Please examine the design.

Notice that the design is just like the blocks since there are smooth and rough parts on it...

Now the next thing we are going to do is arrange the four blocks so that when they are placed side by side they will make up the same design as the design on the page. First I will complete the design with the blocks, then I will give you a chance to copy the design...

Here is the design I just made with the blocks. And here is the design on the page. Will you examine them both? As you compare them you will notice they are both alike. Do you have any questions?...

Now when I tell you to begin, I want you to make the same design using these four blocks. When you have completed copying the design say 'Finished'.

Ready, Begin!

(IF CORRECT PROCEED TO DIRECTIONS FOR DESIGN 1)

(IF INCORRECT SAY: I want you to compare the design you made with the one that's on the page. Can you tell they are not quite alike?..."

C. Data Collecting

The examiners who participated in Phase One also collected data on 129 in the Bay Area, 24 in Seattle, Washington and 13 in Little Rock, Arkansas. In addition, several examiners working in Southern California collected data on 146 subjects. Additional data was gathered by examiners who recruited volunteer subjects at schools for the blind, rehabilitation centers, workshops, and various other social centers and agencies in the following cities; New York (N=27), Topeka, Kansas (N=15), Columbus, Ohio (N=3), Tucson, Arizona (N=6), St. Louis, Missouri (N=10). Approximately 56 "Phase One Subjects" were re-examined on the Ohwaki instrument and given the Stanford-Kohs instrument. Fifty-four of the 373 new subjects were re-examined on the Stanford-Kohs instrument bringing the total number of contacts with subjects during Phase Two to approximately 483.

D. Statistical Methods

The standard techniques for psychological test construction and analysis were used. The validity of the instrument was investigated by: (1) Pearson product-moment correlations or correlation ratio coefficients (eta) with criteria variables such as WAIS I.Q., number of years of education, and occupational level; (2) analysis of variance and tests of the significance of the difference between mean scores of different groups; and (3) graphs to determine whether the trends theoretically expected of intelligence tests did in fact appear, e.g., the expected early peak of scores at age 22 followed by a rapid decrement with increasing age. Reliability figures represent test-retest reliability coefficients with the mean time elapsing between testing also reported.

Since the original version of the test (the Kohs Block Design Test) relied upon an intricate scoring method involving points for speed and accuracy, separate analyses were obtained to study the scoring system. A scatter diagram was obtained showing the relationship between total test score and time for completion of an item. Scattergrams were completed for each test item identifying the people who passed the item, those who failed it, and showing the relationship between time and total score. The time limit for each item was the time interval beyond which there was no difference in total scores between the persons who passed and the persons who failed the item. The cut-off time for adding bonus points was the time interval beyond which the slope of the best fit line showed a downward trend. Upon the advice of Lee Cronbach, Ph.D., two points were assigned to items passed with times faster than the cut-off interval, and one point was assigned for items passed slower than the cut-off interval. This maximizes the differences between the Ss by rewarding speed, while still keeping the value of accuracy. Separate correlations between these new scores and criteria variables were then caluclated and compared with the correlations obtained when only accuracy was scored.

Interpretive tables were constructed as aids for the interpretation of the raw scores. Standard statistical methods were relied upon to formulate percentile scores, expectancy tables, and I.Q. equivalents.

E. Scoring

The scoring system rewards accuracy and speed. A single point is assigned for each item correctly assembled within the established time limits, while two points are given for items correctly assembled within specified bonus times. The rationale* for deriving the cutoff times for assigning bonus points was as follows: scoring should be based upon the identification of those critical time intervals, which, when properly weighed, maximize the test items' ability to discriminate between Ss who ultimately score high on the test from those who score low. To accomplish this, several steps were taken: (1) scatter diagrams were printed for each item representing the time intervals against total test score (number correct) for all Ss taking the item, (2) the time limit for discontinuing testing on an item was identified as; that time interval beyond which the mean total score of those Ss who passed the item was found to be similar to the mean of the Ss who failed the item, and lower than the Ss who took less time to pass the items. In other words, although the extra time was needed by some Ss to pass the item, nevertheless, this extra success did not appreciably influence their overall standing, (3) the bonus time interval was identified as; that time interval

*The authors gratefully acknowledge the contribution of Dr. Lee J. Cronbach, Professor of Education and Psychology, Stanford University. His recommendations as to the statistical derivation of the scores resolved a critical aspect of test construction. It will be noted that the method he recommended for adoption makes maximum use of the data with minimal loss of statistical information. This is of special merit since it is not the case for scoring methods which rely solely on standard deviation figures for assigning points.

beyond which the slope of the best fit curve showed a downward change in direction. In other words, the overall test performance of the Ss who took less time were all uniformly high and tended to cluster together to make them different from the overall performance of the Ss who took more time.

Since statistically significant differences were found between performances of clients with different levels of functional vision, separate norms are used for the Functionally Blind and the Functionally Partially Sighted. No such differences were found between scores of the adventitiously blind and the congenitally blind.

III. RESULTS

The significant products of this two year study are the manuals for the two versions of the block design test. The apparatus for the Ohwaki version was available and our study involved only the slight modification of it to improve its discriminability and durability. However, the apparatus for the new version was developed with entirely different materials and processes in order to achieve the best possible discriminability and durability. Unfortunately, simplicity and economy were not possible to achieve in the production of the 100 sets of the new apparatus. However, the materials and the methods are available and the product can be reproduced faithfully without undue difficulty.

Phase One: "Stanford-Ohwaki-Kohs Block Design Test for the Blind"

The sample was comprised of 202 legally blind persons 14 years of age and older. The normative data was based on 170 individuals 16 years of age or older. Three geographical areas, Northern California, Washington, and Arkansas were represented. The typical person examined was an adult male, married, with no children. He had been totally blind since adolescence from either developmental or traumatic causes. Since then, he has lived a competent life, having completed high school and then turning either to further schooling or responsible positions in the working world. In general, the subject has acquired independence of mobility, with over 50% utilizing the cane as an aid in travel.

A functional definition was used regarding the breakdown of subjects into two groups according to whether they utilized only touch in the performance of the experimental test or utilized sight or sight and touch. Thus, the "Functionally Blind" may or may not have residual sight but did not use it to perform on the experimental test. "The "Partially Sighted" are subjects who used their residual vision and may or may not have also used touch in the performance of the test.

The construct validity of the test was demonstrated by an increment with a peak between ages 20 and 24 followed by a decrement with advancing age which conforms with expectations regarding mental growth based on accepted experimental findings. The test items are assumed to be of increasing levels of difficulty. This was confirmed by a definite inverse relationship between the percentage of subjects passing and the level of the item attempted.

The concurrent validity of the test was demonstrated by statistically significant correlations with Wechsler Verbal IQ scores as follows: All Adults $r = .33$ ($p < .0001$, $N=167$), Congenitally Blind $r = .27$ ($p = .02$, $N=82$), Adventitiously Blind $r = .41$ ($p < .001$, $N=85$), and Functionally Blind $r = .59$ ($p < .0001$, $N=107$). On all Ss significant correlations were found between the experimental test scores and WAIS subtests as follows: Arithmetic and Comprehension (the two correlating the highest with performance scores), then Information and Similarities, and finally Digit Span and Vocabulary (the two lowest). The correlations were in general highest for the Functionally Blind Ss, and lowest for the Partially Sighted Ss.

Data on 27 subjects who also took "The Tactual Raven Progressive Matrices" yield correlations of .68 ($p = < .0001$) for All Adults, .74 ($p = .05$, $N = 9$) for the Congenitally Blind, .58 ($p = .02$, $N = 18$) for the Adventitiously Blind, .68 ($p = < .001$, $N = 21$) for the Functionally Blind, and .86 ($p = .05$, $N = 6$) for the Partially Sighted. The data on 60 partially sighted subjects indicated no significant statistical relationship between the experimental test and WAIS Verbal IQ. Thus, a significant relationship is demonstrated with regard to a verbal measure of intelligence with a stronger relationship shown with the TRPM, another performance test of intelligence.

Educational criteria analyses indicate significant correlation with number of years of schooling completed for the Functionally Blind ($r = .26$, $p = \leq .01$ level), and the Congenitally Blind ($r = .22$, $p = .05$ level). In addition, test scores were significantly correlated with educational diploma or degree earned by the Functionally Blind ($r = .30$, $p = \leq .01$ level).

Test-retest reliability data for All Adults yielded a $r = .90$ ($N = 51$), for the Functionally Blind $r = .86$ ($N = 33$), for the Partially Sighted $r = .90$ ($N = 18$). The mean time elapsed between the first and second test was 33 days.

Non-significant group differences were found between performance test scores of Men versus Women ($F = 0.68$), and between the Adventitiously Blind versus the Congenitally Blind ($F = 0.03$).

Highly significant group differences were found between the Functionally Blind versus the Partially Sighted ($F = 71.71$, $p = \leq .0001$ level). The mean score for the Functionally Blind subjects was 7.46 items correct (S.D. = 5.99, N = 110), while the mean for the Partially Sighted subjects was 15.03 (S.D. = 4.08, N = 60).

Occupational group differences were analyzed along three dimensions. All occupational variables calculated seemed to yield non-linear correlations indicating the use of "correlation ratio correlation" (eta), none of which reached the 5% level of significance. For current occupations, "The Dictionary of Occupational Titles" job classification codes and test scores produced appropriately negative correlations in which $\eta = -.50$, $N = 12$ for the Congenitally Blind, $\eta = -.48$, $N = 41$ for the Adventitiously Blind, $\eta = -.51$, $N = 36$ for the Functionally Blind, and $\eta = -.36$, $N = 17$ for the Partially Sighted. Annual salaries and test scores showed the following relationships: $\eta = .54$, $N = 12$ for the Congenitally Blind, $\eta = .63$, $N = 41$ for the Adventitiously Blind, $\eta = .58$, $N = 36$ for the Functionally Blind, $\eta = .44$, $N = 17$ for the Partially Sighted. An employment ratio was calculated by dividing the total number of years a person could have accepted employment by the number of years he had actually been employed. That ratio correlated with test scores as follows: Congenitally Blind ($\eta = .63$, $N = 22$), Adventitiously Blind ($\eta = .41$, $N = 67$), Functionally Blind ($\eta = .44$, $N = 65$), and Partially Sighted ($\eta = .73$, $N = 24$).

Rehabilitation achievement group differences were measured along three dimensions. Scores on the "Stanford Rehabilitation Sophistication Scale" presumably a measure of rehabilitation knowledge, were correlated with the Stanford-Ohwaki-Kohs test scores: All Subjects ($r = .15$, $p = .05$ level, $N = 167$); the Congenitally Blind subjects ($r = .21$, $p = .05$ level, $N = 82$) and Functionally Blind subjects ($r = .36$, $p = \leq .001$ level, $N = 107$). The data for the "Partially Sighted" group is essentially irrelevant since the current form of the Sophistication Scale is not appropriate for use with individuals who have functional residual vision. The "grade" of braille read (grade one, one and a half, two, or three) showed a significant relation to the test scores of the Partially Sighted ($r = .35$, $p = .05$ level, $N = 31$), but not for the Functionally Blind nor the group as a whole. When the total sample was divided into subgroups on the basis of "travel aid used", significant differences were found ($F = 11.51$, $p = \leq .0001$ level). Their scores were as follows: No travel aid used, mean = 12.51 (S.D. = 6.45); Guide Dog, mean = 11.25 (S.D. = 5.12); Cane, mean = 8.06 (S.D. = 6.51); and Human Companion, mean = 5.24 (S.D. = 5.64).

Quantitative interpretation of raw scores can be derived in four ways. The subject's raw score can be compared with the mean score (see Table 12, 13 - Part Two, Manual for the Stanford-Ohwaki-Kohs Block Design Test for the Blind) obtained by subjects in the normative sample broken down as to functional vision and age groupings. The mean scores for All Adults was 10.15 (S.D. = 6.51, N = 167); Functionally Blind 7.46 (S.D. = 5.99, N = 107); and Partially Sighted 15.03 (S.D. = 4.08, N = 60).

The median scores for the three major groups were; 11 items correct for All Subjects combined, 8 for the Functionally Blind subjects, and 16 for the Partially Sighted subjects. Nearly one-third of the Functionally Blind had less than 3 items correct (a skewness towards the low end), while over half of the Partially Sighted received scores of 17 correct or better (a skewness toward the high end). Thus, a high score by a client is especially significant if he is Functionally Blind since most subjects in this group tend to score low. On the other hand, a low score is particularly significant if the client is Partially Sighted since most subjects in this group tend to score high.

Percentile equivalents were calculated and a table prepared for "All Subjects - Functionally Blind - Partially Sighted". (Suinn, Dauterman 1966b; see Table 14 in Part Two, Manual for the Stanford-Ohwaki-Kohs Block Design Test for the Blind)

Expectancy data yielded tables (see Tables 15-18, Part Two, Manual for the Stanford-Ohwaki-Kohs Block Design Test for the Blind) showing the relationship of the raw score to the percentage of the group in regard to three criteria variables - educational level, employment status, type of travel aid.

I.Q. equivalents were calculated and tables provided (see Table 19 in Part Two, Manual for the Stanford-Ohwaki-Kohs Block Design Test for the Blind) for all groups by converting the Stanford-Ohwaki-Kohs scores into standard scores with a mean equal to the mean WAIS I.Q. for all subjects, and a standard deviation equal to the standard deviation for all subjects. Caution in the use of this data is indicated since the relationship between verbal and performance scores is not thoroughly understood and since the standardization group achieved I.Q.'s "above average" on the verbal measure — Mean = 116.24 for All Subjects (S.D. = 18.01), 116.58 for the Functionally Blind subjects (S.D. = 19.41), and 115.60 for the Partially Sighted subjects (S.D. = 15.19). The superior verbal performance of the standardization group may be a function of the previously discussed "verbal veneer" of the blind, some unidentified factor also encountered by other experimenters, or the sampling method used in this study.

Non-significant findings — variables which were not significantly related to "performance ability" as measured by the experimental test were numerous. No statistically significant relationships were found between the "Stanford-Ohwaki-Kohs Block Design Test for the Blind" and the following biographical data: Sex of the subject, occupational level before blindness, father's occupation, years employed before blindness, age of onset of blindness, duration of blindness, number of pages of braille read, number of years in special education, or rehabilitation services.

Phase Two: "Stanford-Kohs Block Design Test for the Blind"

The sample was comprised of 428 legally blind persons. The normative data was based on 425 individuals 16 years of age or older. Four geographical areas; Northeast, North Central, South, and West were represented. While the group was heterogeneous in most characteristics they had all been legally blind for at least one year. A typical person was an adult male, aged 39, married, childless, and totally blind since late adolescence from a congenital defect. He has completed high school having earned good grades. He was employed in a managerial or professional occupation, coordinating data or supervising people, and earns $4000 annually.

The group definitions previously established were retained for "Functionally Blind" and "Partially Sighted". In addition, those subjects having residual vision were grouped as follows: Low Remaining Vision (light perception but not including form perception), Mid Remaining Vision (form perception or acuity up to 10/200), and High Remaining Vision (10/200 or better). All subjects were legally blind.

Construct validity was consistent with theory and expectations based on other standardized tests. The data showed an increment with a peak between ages 25-34 followed by a rapid drop with advancing age. The data showed a definite inverse relationship between the percent of subjects passing and the level of item attempted. (See figures 1 and 2 in the Manual for the "Stanford-Kohs Block Design Test for the Blind")

Concurrent validity was demonstrated by the relationship between the experimental test, the WAIS, an earlier form of the test, and life achievements were examined statistically. Correlational results with the WAIS were all highly significant. The correlation is higher for those subjects who used residual vision in taking the test than for those subjects who used only touch. However, when subjects were classified in terms of level of visual acuity, the correlations were all equally high. Statistically significant correlations between the Stanford-Kohs and the WAIS were ($p = < .001$ level for all groups): Partially Sighted $r = .40$ ($N = 208$); Functionally Blind $r = .21$ ($N = 217$); Adventitiously Blind $r = .23$ ($N = 250$); Congenitally Blind $r = .26$ ($N = 175$); All Subjects $r = .24$ ($N = 425$); High Vision $r = .54$ ($N = 123$); Mid Vision $r = .40$ ($N = 104$); Low Vision $r = .41$ ($N = 191$).

For 51 subjects, the correlation with the Stanford-Ohwaki-Kohs and the Stanford-Kohs test scores was .87 ($p = < .0001$ level). The average time elapsed between the two tests administrations was 33 days.

The Stanford-Kohs correlated with years of education for the various groups as follows ($p = < .001$ level for all groups): Partially Sighted $r = .27$ ($N = 208$); Functionally Blind $r = .28$ ($N = 217$); Adventitiously Blind $r = .25$ ($N = 250$); Congenitally Blind $r = .21$ ($N = 175$); All Subjects $r = .25$ ($N = 425$); High Vision $r = .31$ ($N = 123$); Mid Vision $r = .30$ ($N = 104$); Low Vision $r = .25$ ($N = 191$). Analysis of variance was calculated for subjects grouped according to years of education and showed a highly significant difference among the groups ($F = 6.82$, $p = < .001$ level).

Correlations between test scores and grades (as reported by subjects) and the results of analyses of variances were generally low or non-significant. However, an inspection of the distribution of scores suggests that some important relationships do exist. For example, when subjects were grouped into thirds, on the basis of test performance 70% of all subjects in the top third achieved a grade average of "A" or "B", as compared with 62% of the middle third, and 53% of the bottom third.

Reliability information was obtained by retesting fifty subjects. Test-retest reliability coefficients were as follows: $r = .86$ for All Subjects ($N = 50$), $r = .82$ for the Partially Sighted subjects ($N = 29$), and $r = .82$ for the Functionally Blind subjects ($N = 21$). The average time which elapsed between testing was $2\frac{1}{2}$ months for all groups.

Non-significant group differences were found. Analysis of variance figures were computed on Stanford-Kohs scores:

1) Men versus Women ($F = 0.03$)
2) American born versus Foreign born ($F = 0.02$)
3) Geographic locale of testing ($F = 1.50$)
4) Adventitiously Blind versus Congenitally Blind ($F = 0.75$)
5) Cause of blindness ($F = 0.80$)

Significant group differences were found for those of different ethnic backgrounds ($F = 3.08$, $p = .05$ level). The mean scores were as follows: Caucasians = 17.10 (S.D. = 12.96); Spanish-Mexican-Latin-American = 14.57 (S.D. = 11.42); Chinese-Japanese = 12.00 (S.D. = 4.87); Negroes = 9.72 (S.D. = 9.93). Significant differences were also found between the Partially Sighted and the Functionally Blind ($F = 65.55$, $p = < .001$ level). The mean score for the Partially Sighted subjects was 21.16 (S.D. = 12.40), while the mean for the Functionally Blind subjects was 11.83 (S.D. = 11.35). Because of this difference, separate time limits, scoring systems, and interpretive norms were provided in the manual.

Occupational group differences were analyzed along several dimensions. The current occupation of each subject and his occupation prior to blindness were grouped into the seven major occupational levels according to the Dictionary of Occupational Titles (1949). Negative correlations indicate a high relationship with test performance and occupational level since a D.O.T. code of "0" indicates professional and managerial levels--Partially Sighted subjects $r = -.45$ ($p = < .001$ level, $N = 92$), Functionally Blind subjects r = n.s. ($N = 100$), All Subjects $r = -.18$ ($p = .05$ level, $N = 192$), High Vision $r = -.53$ ($p = < .001$ level, $N = 50$), Mid Vision r = n.s. ($N = 51$), Low Vision r = n.s. ($N = 90$).

Advancement potential was calculated by subtracting algebraically the code number for the subjects' occupation before blindness from the code for the subjects' current occupation. Negative correlations are associated with high test scores and advancement following blindness. Significant correlations were found for the Partially Sighted subjects $r = -.33$ ($p = < .001$ level, $N = 92$), All Subjects $r = -.18$ ($p = .05$ level, $N = 192$), Mid Vision subjects $r = -.40$ ($p = < .01$ level, $N = 51$).

Data, People, and Things were coded occupational characteristics as defined by the 1965 Dictionary of Occupational Titles. The only significant correlations were for the High Vision subjects (10/200 or better) $r = -.33$ ($p = .05$ level, $N = 50$) for "Data" and "People" and $r = -.31$ ($p = .05$ level, $N = 50$) for "Things", and the Partially Sighted subjects (any degree of functional vision) $r = -.23$ ($p = .05$ level, $N = 92$) for "Data" only.

Earned income correlated with test scores significantly for all subgroups except "Mid Vision" (form perception or acuity up to 10/200). For the employed subjects the correlation was .35 ($p = < .001$ level, $N = 192$).

"t" tests were calculated on test score means for the subjects of different employment status. The competitively employed subjects achieved a significantly higher test score than either the unemployed subjects or the sheltered shop subjects ($t = 2.30$, $p = .02$ level for competitively employed versus the unemployed; $t = 2.59$, $p = .02$ level for the competitively employed versus the sheltered shop).

Rehabilitation data yielded some significant results. Analysis of variance showed significant differences between test scores among the Partially Sighted ($F = 6.66$, $p = < .001$ level) and among the Mid Vision subjects ($F = 4.24$, $p = .01$ level) as a function of type of travel aid employed. Test scores were the highest for those subjects who reported that they used a guide dog. Next highest were those subjects who travel with no aid or with the aid of a cane. The poorest scores were obtained by those Ss who were the poorest travelers in the sense that they required a human companion to lead them. Although the results did not reach the 5% level of statistical significance, the same rank ordering of test performance characterized the Functionally Blind and the Low Vision Ss.

Subjects were classified into two groups, braille readers and non-readers. There were statistically significant differences in test scores between readers and non-readers for the Functionally Blind Ss ($F = 4.31$, $p = < .05$ level), and the Low Vision Ss ($F = 3.91$, $p = .05$ level). For the Partially Sighted, High, and Mid Vision Ss, the Stanford-Kohs Test did not differentiate between Ss who read braille and Ss who were unable to read braille.

Problem solving approach used by the subject was recorded by the examiner during the standardization study: Systematic, Trial and Error, or Misperception. The first involves any systematic assembly technique, the second involves the use of random, trial and error placement of the blocks during assembly, and the third involves an approach which reflects a complete misperception by the subject of the design, e.g., placement of the blocks to form a single row instead of a square design.

As would be expected, there was a significant interaction between type of approach to problem solving and mean test performance ($F = 25.82$, $p = < .001$ level). The mean for the Ss using a systematic approach was 18.044 (S.D. = 12.49), the mean for the trial and error Ss was 7.21 (S.D. = 6.88), and the mean for the Ss who misperceived the designs was 1.25 (S.D. = 1.39).

The relationship between approach to problem solving and intellectual, educational, occupational, and rehabilitation variables was also examined by means of analyses of variances. Significant differences were found in WAIS I.Q. ($F = 7.13$, $p = < .001$ level) with a systematic problem solving approach being associated with above average intelligence (mean WAIS I.Q. = 115.76) (S.D. = 16.75). Trial and error approach and misperception were used by Ss of average verbal intelligence (Trial and error Ss, Mean I.Q. = 107.90, S.D. = 16.16; Misperception Ss, Mean = 102.93, S.D. = 12.90).

Quantitative interpretive procedures of raw scores were developed in several ways:

1) Mean scores can be found in tables for all Ss by functional vision groupings and by specific age groupings. The median scores for the five major groups were: 14 for All Ss, 19 for the Partially Sighted, 8 for the Functionally Blind, 29 for the High Vision Ss, 14 for the Mid Vision Ss, and 8 for the Low Vision Ss. With the exception of the Mid Vision Ss, the distributions of scores were skewed: 35% of the Functionally Blind and 35% of the Low Vision Ss had scores of 4 or less; 20% of the Partially Sighted and 28% of the High Vision had scores of 36 or more. Therefore, a high score is especially significant if the subject examined is in the Functionally Blind or Low Vision group, since most Ss in these groups tend to score low. On the other hand, a low score is particularly significant if the subject is in the Partially Sighted or High Vision group, since most Ss in these categories tend to score high.

2) Percentile scores are provided for each of the major groups of Ss and indicate the percentage of Ss who fall at or below each raw score.

3) The expectancy tables provide information of the relationship between Stanford-Kohs Test performance and certain variables of interest to examiners, counselors, and clinicians. Included are expectancy tables for years of education, grade average, employment status, and occupational level. With the exception of occupational level, the tables indicate the per cent of Ss within each test score group who have attained certain educational, occupational, or rehabilitation levels. For example, of the Functionally Blind Ss with a test score in the top quartile, 67% continued schooling beyond the high school years. On the other hand, only 34% of the Ss in the bottom quartile were able to progress as far. Thus, Functionally Blind Ss with scores in the bottom quartile are poorer educational risks. The table referring to occupational level represents the per cent of Ss within each test performance group. For example, of the Partially Sighted Ss employed in professional/managerial positions, 67% had achieved a test score within the top third, 13% within the middle third, and only 20% in the bottom third. Thus, a Partially Sighted client who is interested in professional/managerial employment should show a Stanford-Kohs Test performance that places him within the top third.

4) I.Q. equivalents were derived by the standard score technique which has been used successfully by other psychological test authors. By this particular method, the Mean Stanford-Kohs score is statistically set equal to 100, with the Standard Deviation being made equal to 15. Thus, the distribution of scores is made comparable to the distribution of WAIS I.Q. scores.

The apparatus durability for the "Stanford-Kohs Block Design Test for the Blind" was satisfactorily demonstrated. During the data gathering period 16 sets of blocks and designs were in use by 18 examiners. None of the equipment returned was damaged or showed wear through usage. Several cigarette burns were in evidence on the brailon designs and some sets of blocks were ready for another soap and water washing. The examiners had utilized the materials for as few examinations as 3 to as many as 125 without the materials showing significant differences. One additional colleague, who did not actually submit any data, had several criticisms to offer on the basis of his inspection of the materials, i.e. the blocks tended to rock when resting on the diagonal pattern and they made a somewhat uneven surface pattern when various combinations were put together.

The subjects' scores on the Stanford-Kohs test and the Ohwaki-Kohs test showed a correlation of .87 ($p = < .001$ level, $N = 51$) substantiating the belief that the two tests are essentially measuring the same characteristics. However, the Stanford-Kohs version might not be a better version if it had proved to be a subjectively unpleasant test for the blind person to take. (Bauman, for example, reports that her subjects found the "Vocational Intelligence Scale for the Blind" and the "Tactual Reproduction Pegboard", two ordinarily well constructed tests, very "frustrating" and difficult to "comprehend"). In order to assess the subjects' reactions, a brief structured interview was conducted with the Ss who had completed both the Ohwaki-Kohs and the Stanford-Kohs tests. The table below summarizes the results:

Ss' Reactions to the Ohwaki-Kohs
and the Stanford-Kohs Tests

	Stanford-Kohs	Ohwaki-Kohs	Both same
Which test do you prefer?	22	11	4
Which is easier to take?	25	4	9
Which is less frustrating?	20	1	19

Twice as many Ss expressed a preference for the Stanford-Kohs than for the Ohwaki-Kohs test; and the Stanford-Kohs test was clearly judged the easier and less frustrating of the two tests. In general, Ss preferred the Stanford-Kohs test because the patterns were easier to "read" tactually, because the two-textures on the blocks simplified the amount of searching when a specified surface was being sought, and because it was "less exasperating" but equally challenging. It is interesting that the 11 Ss who preferred the Ohwaki test stated similar reasons for their choice. These reasons were either (1) it was more difficult to "read or identify the surfaces of the blocks, and this task was challenging in and of itself", or (2) the subject felt more comfortable with the Ohwaki test because he had previously been examined with it in the earlier part of the research. The first of these reasons was also given by many Ss who preferred the Stanford-Kohs version, perceiving the Ohwaki-Kohs as more frustrating because of the lack of clarity of the fabrics to the touch.

IV. SUMMARY AND CONCLUSIONS

A. Summary

From September of 1964 to August of 1966 one or two full time investigators were employed and many part time research assistants gathered data from several regions of the United States. The first year of the study was primarily concerned with reviewing the literature on performance tests for the blind, rewriting the instructions for the administration of the Ohwaki-Kohs Tactile Block Design Intelligence Test for the Blind, administering the Ohwaki test to approximately two hundred legally blind subjects and doing some preliminary analysis of the data.

The second year of the project afforded additional data on the Ohwaki Test and eventually the preparation of the "Manual for the Stanford-Ohwaki-Kohs Block Design Test for the Blind". The major task of the second year, however, was the redesigning of the test apparatus, the collection of data on 425 subjects and the preparation of the "Manual for the Stanford-Kohs Block Design Test for the Blind".

In addition to Dr. Ohwaki's work, that of several other investigators have been published on the use of three dimensional performance tests with blind subjects. Unfortunately, when the present study was proposed Dr. Ohwaki's apparatus and manual, based on blind students in Japanese residential schools, was the only "standardized test" on the market. Since it was obvious that the normative data could not be applied literally to an American population, new standardization studies were indicated. Furthermore, the project director felt a personal concern regarding the adequacy of the Ohwaki apparatus and its tactual characteristics. This concern was supported by the reaction of several other blind persons and led to the decision to improve or replace the apparatus. The Ohwaki blocks and designs which present different textures by using various textiles were pleasant enough to the touch but too ambiguous if tactile discrimination were not to be a factor in the test and if a sharp delineation of the design pattern was to be assumed as possible for blind persons using touch alone. These problems were minimized during the first year study by brushing the textures and stiffening some of the facades with lacquer. Unfortunately, most of the ambiguities remained as did the fragileness. The apparatus was usually worn out after fifty administrations.

A new "look" and new "feel" were developed for the block design apparatus. Wooden blocks were covered on four sides with white plastic tape. The fifth side was covered with heavy textured black rubber matting and the sixth side was divided into two triangles, one of which was the smooth white plastic and the other, the textured black rubber. Thus, a two color and two texture system replaced Ohwaki's four color, four texture system. The designs were reproduced by an offset printing process using black ink on brailon sheets which were then embossed by the thermoform process.

Subsequently the new apparatus was judged to be more satisfactory by those blind subjects who had an opportunity to work with both tests. As to durability, one test set was used to examine 125 subjects. It suffered no damage other than several cigarette burns and was indistinguishable from unused sets after a good washing with soap and water. None of the twenty sets in use in the field were observed or reported to have suffered any damage from normal usage. Statistically, the tests appear to be comparable: The correlation between scores on both tests on the 51 adult subjects who took both tests was .87.

425 subjects were examined with the new instrument. Appropriately modified instructions, both to the subject and to the examiner, as well as several additional designs were used. A simplified "two block" learning phase was provided for those subjects who might have difficulty comprehending the nature of the task being presented to them when the "four block" pattern was initially

used. The upper level was extended by the addition of three "more difficult" designs. Since the simplified learning phase was not "scored", although performance was recorded, the current data does not indicate its actual usefulness in getting "slow subjects" started. However, the availability of this lower level of difficulty design may demonstrate its usefulness in future studies. The data definitely indicates that the three additional high level of difficulty designs are in proper order, and extend the distribution of the scores.

Although not usually a matter of concern to psychologists regarding intelligence tests, "face validity" seems to be important when testing blind subjects. Many subjects seem to experience a great deal of anxiety regarding ambiguous psychological tests. The block design technique seems obviously to be a "puzzle", a "challenge", a "problem" or, as the most sophisticated subjects occasionally observed, a "test of intelligence". Regardless of how it is done, testing does tend to raise anxieties in some individuals while with others it seems to be more comfortable to feel that they understand what abilities are being tested and how it is being done. It is interesting that many subjects actually expressed satisfaction with the test and their performance.

Validity data was based on construct and concurrent validity methods. Regarding the former, results showed the expected increments in test scores up to age 34 followed by a rapid decrement. Regarding the latter, significant correlations were found between the Stanford-Kohs scores and performances on other intelligence tests. Furthermore, significant relationships were also found between the Stanford-Kohs results and educational achievement.

Various tables were prepared displaying the mean and standard deviation of test scores for various sub-groupings of the research population. Interpretive tables were based on sub-groupings divided as to degrees of visual acuity and the sensory modality or modalities used by the subject in the test performance. These tables enable an examiner to determine the educational, occupational or rehabilitation potential of a client.

Reliability was satisfactorily demonstrated on 50 subjects with a mean time lapse of $2\frac{1}{2}$ months between tests: $\underline{r} = .86$ for all subjects.

A rather straightforward scoring system has been devised in which two points are awarded for a design correctly completed within certain time limits and one point for correct completions beyond these established times. Although the data was analyzed with the view of devising a more discriminative system, none of the elaborate weighting devises utilized made any improvement over the two point system. A "record form" was prepared on which performance can be recorded, scores calculated, and a place for the examiners' "remarks" provided.

The project concluded with the preparation of the "Manual for the Stanford-Ohwaki-Kohs Block Design Test for the Blind", the "Manual for the Stanford-Kohs Block Design Test for the Blind", the Final Report on the project and the fabrication of 100 sets of the apparatus for the Stanford-Kohs Block Design Test for the Blind.

The "Stanford-Ohwaki-Kohs Block Design Test Manual" is designed for use with Ohwaki apparatus which is available directly from Japan or through Western Psychological Corporation, Los Angeles, California, the United States distributor.

The "Stanford-Kohs Block Design Test for the Blind" is self-contained, currently available only to interested investigators from the Vocational Rehabilitation Administration and the authors who share copyright privileges. Both manuals were prepared by the Principal Investigator, Richard M. Suinn, Ph.D., with the help of the Project Director, William L. Dauterman, M.A., and the two Research Assistants, Emily Garfield, B.S. and Bernice Shapiro, M.A.

The complete version of the Final Report will contain a review of the literature, the methodology and the findings. It also includes an up-to-date bibliography on performance tests for use with the blind. Detailed descriptions of several criteria measurement instruments are given. Extensive "recommendations" are included for further work toward the application of the initial findings, the exploration of implications drawn from the data and suggestions for related studies. The reader is oriented to the report by the Foreword by Daniel Sinick and the Preface by Samuel C. Kohs. The "Introduction", "Methodology" and the "Findings" were prepared by the Project Director, William L. Dauterman, M.A., with the help of the Principal Investigator, Richard M. Suinn, Ph.D., and the two Research Assistants, Bernice Shapiro, M.A. and Emily Garfield, B.S.

B. Recommendations

1. Implications for Further Investigation

There is considerable need for further research to clarify some issues:

a. Are there differences between the performance of male versus female blind persons? Our data does not show any significant differences although other studies report such differences.

b. Does the age of onset of blindness have any effect on the performance of the blind person? Our data showed no significant differences in performance between the adventitiously blind (who had been blind for a minimum of one year) and the congenitally blind Ss. When duration of blindness in years is correlated with test performance, the result is not significant. If the test performance is interpreted as a crude measure of the S's ability to adapt to stress, it would appear that the age of onset of blindness has no effect on this ability. If the test performance is interpreted as a measure of the S's ability to utilize tactually received information, then duration of blindness does not seem to contribute to such ability.

c. Is there a "verbal veneer" shown by the blind? Our results show an above average mean WAIS Verbal IQ score, but such results may represent a sampling bias, a "veneer", or even some other as yet undetermined factor.

d. Why do the totally blind Ss show consistently lower performances on both block design tests than the partially sighted Ss although the WAIS IQ's were equivalent? It is difficult to settle on a single meaningful explanation. There are several interpretations possible: (1) the total loss of vision leads to poorer analytic reasoning ability; (2) the total loss of vision prevents the development of an articulated cognitive style (see Witkin); (3) the difficult items in a tactual block design test are difficult because they include a combination of reasoning and concentration which a sighted person is more able to cope with than a totally blind person.

2. Implications for Related Investigations

a. Standardization of the Stanford-Ohwaki-Kohs and the Stanford-Kohs tests on other populations.

1) A research project using the Stanford-Kohs with children and youths between the ages of 6 and 21 seems desirable. Groups from American residential schools for the blind, special education programs for the blind in local public schools, post high school students, high school graduates--employed and unemployed, and blind children who are school dropouts.

2) A research project based on the "mentally retarded" blind population which would compare their performance on the

Stanford-Kohs with that of "normal" blind subjects.

3) A research project to establish normative data for the Stanford-Kohs on a sample of fully sighted subjects which could be compared with the "blind" and other specialized groups.

b. Modifications of the Stanford-Ohwaki-Kohs and the Stanford-Kohs tests.

1) A research project should be designed to explore the feasibility of the use of the "Stanford-Kohs Block Design Test for the Blind" by partially sighted and blind research and clinical examiners using standardized methods which would not invalidate the test findings because of any necessary deviations in the technique of administration.

2) A future study might well explore the usefulness in eliminating or adding either easier or more difficult designs depending upon the performance anticipated for the particular population under study even though there is not now statistical evidence to warrant alteration in the number (20) of designs in the Stanford-Kohs test.

3) A study should be made of the advisability of allowing extra credit for speed of performance of the Stanford-Ohwaki-Kohs test. Other tests seem to have done well by adding extra points for rapid performances, yet the Stanford-Ohwaki-Kohs appears to do a competent job without a time bonus scoring system.

4) Studies should be made of the design sequence of both tests. The Ohwaki-Kohs designs 5, 11, and 14 may be out of order in terms of level of difficulty. The designs as presented to Ss in the standardization of the Stanford-Kohs test also seemed to have been out of order with regard to the level of difficulty in two instances. Designs 5 and 6 and 13 and 14 have been reversed as demonstrated by the per cent of Ss who attempted the problem and solved it.

c. Relationships between tests and other variables.

Longitudinal Studies:

1) Longitudinal studies should be designed to elaborate on the validity data thus far demonstrated for the Stanford-Ohwaki-Kohs test regarding prediction as to educational and vocational achievement.

Cross-Sectional Studies:

2) A further study should be designed to ascertain the usefulness of the Stanford-Ohwaki-Kohs test as a measure of "imagery ability" as it relates to the S's performance of activities of daily living, mobility as a blind person and/or various types of occupational activities.

3) A study using the Stanford-Ohwaki-Kohs test should be designed to ascertain its usefulness as a detector of, or a measure of personality characteristics, emotional factors and/or psychopathology.

4) A research study into the use of the Stanford-Kohs test as an instrument for the assessment of brain damage may be desirable. Block assembly type tests have long been considered helpful in such cases.

d. Establishment of a test battery.

A consideration should be given to the desirability of developing a performance test battery to measure intelligence. Thus, in addition to the Stanford-Kohs test itself, other items from such tests as the "Raven Progressive Matrices for Presentation to the Blind", "The Vocational Intelligence Scale for the Adult Blind", and the "Haptic Intelligence Scale for Adult Blind" should be included.

e. Study of articulation or cognitive style.

The Stanford-Kohs test may have utilization as a measure of "articulation style"--the concept reflecting Witkin's theory that style of thinking or perception are as characteristic of individuals as level of intellect. Several experimental tests involving tactual block designs have been used in this type of research. A standardized test like the Stanford-Ohwaki-Kohs test or the Stanford-Kohs test might be a better instrument. Either test could be used to study the development of cognitive style in the sighted, or to examine influence of the loss of sight on cognition by comparing the sighted with the blind, or to study the relationship between age at loss of vision and cognition by comparing the adventitiously blind with the congenitally blind. (see Witkin, also Suinn, 1966)

Since block design tests have been accepted as measures of analytic ability of cognitive style, they can be utilized to examine all of the premises offered by Witkin including the applications to personality, pathology, identification and perception. The factors contributing to the normal development of body-image or cognitive style has already been studied by Witkin with the use of an experimental block design test on blind children. Other clues to normal development might also be investigated by careful use of one of "nature's control groups"--the blind. The Stanford-Kohs test, with its norms, could serve as the basic reference point for evaluating performance.

f. Study of concept.

The concept of "verbal veneer" should be re-examined. The project data shows an above average performance by the blind Ss on the WAIS verbal scale. However, it has not been determined whether this reflects the verbal veneer or real verbal capability. There is sufficient ambiguity surrounding this issue to require further study.

g. Study of characteristics of Ss with various test battery profiles.

The corollary traits of Ss who show discrepancies between their verbal intelligence performance and their block test performance should be examined. What characterizes the person who achieves a high verbal score but a low block test score? Conversely, what characterizes the person who achieves a low verbal but a high block test score?

h. Study of the mentally retarded.

It has been suggested by Witkin that there are many "mentally retarded" persons who suffer from misclassification because of the heavy reliance upon verbal measures of intelligence. If measures of analytic competence, such as block design tests, are used, such retarded persons would show higher level performances. For example, a sample of institutionalized retarded boys with Wechsler Verbal IQs of 71.1 were shown to have analytic IQs of 80.8. There is reason to believe that many blind youngsters are being classified as retarded on the basis of verbal performances. With the availability of the Stanford-Kohs test, it may be possible to investigate the analytic competency of such youngsters as a guide for determining which of these children could profit from further education.

Another research direction is the exploration of those persons who "though not classified as retarded by the standards currently used in our society...may be as handicapped in their cognitive and personality functioning as those now labelled 'retarded', but in different ways." (Witkin, pg. 329 in J. Abnorm. Soc. Psychol.: Psychological Differentiation and Forms of Pathology, 1965, 70). In other words, a study should be made of those whose verbal comprehension scores are average or better but whose analytic (block design) scores are below average.

i. Study of the nature of intelligence.

The theoretical questions regarding the development of intelligence could be re-examined. Some doubt is being raised regarding the age at which mental growth ceases, plateaus, or declines. Does sight, or the lack of it, have any effect on this age? Do the performance scores of the blind decline as rapidly as their verbal comprehension scores? How does this compare with the sighted?

3. Production and Distribution of Stanford-Ohwaki-Kohs and Stanford-Kohs materials.

A method for mass reproduction of both the blocks and designs should be sought. This would involve the location of a prime manufacturer and distributor who would be willing to make available the apparatus and manual in a suitable compact form at a reasonable price. With the exception of the copyright privileges retained by the Vocational Rehabilitation Administration, United States Department of Health, Education and Welfare, the prime distributor should be assigned limited "copyright privileges" with the usual royalty accruing to the "endowment fund" of Stanford University.

Public and private grants should also be awarded to any organization devoted to psychological research which is interested in gathering additional population data on the Stanford-Kohs test. This would allow for periodic revised normative data.

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APPENDIX

RD-1625-S: Form A
12/64

INFORMATION RECORD

Subject #:	Date:
Name:	Age: M-F
Marital Status:	Number of Children:
Occupation:	Salary:
Previous Occupations: Before:	After:
Number of Years Employed: Before:	After:
Years of Education: Total:	
Degrees:	
Nationality:	Native Language:
Number of Years in U.S.:	Number of Years English Speaking:
Cause of Blindness:	
Age of Onset:	Duration to Present:
Amount of Remaining Vision:	
Father's Occupation:	
Family History of Blindness	
Other Disabilities:	
State of Health:	
Special Circumstances:	
Current Address:	
Locality where tested:	
Weather and Temperature:	
Other Test Scores:	
Other Performance Scores:	
Braille Reader: Yes No	Grade: 1 1½ 2 3
Travel Aid Employed: Cane Guide Dog Human Other None	

RD-1625-S:Form B
12/64

Record of Specialized Services Offered to the Blind Only

Name ______________________ Date ______________

	Years and Months
1. Pre-school parent-child guidance.	
2. Nursery school for the blind.	
3. Elementary school for the blind - residential.	
4. Elementary school for the blind - day school.	
5. Elementary school - resource teacher.	
6. Elementary school - itinerant teacher.	
7. Secondary school for the blind - residential.	
8. Secondary school for the blind - day school.	
9. Secondary school for the blind - resource teacher.	
10. Secondary school for the blind - itinerant teacher.	
11. Correspondence courses for the blind.	
12. Rehabilitation Center for the blind - residential.	
12a. Guide Dog Training.	
13. Rehabilitation Center for the blind - day program.	
14. Sheltered employment (Workshop for the Blind).	

15. Home teaching (teacher counselor).	Yes	No
16. Vocational rehabilitation counseling.	Yes	No
17. Recreation for the blind (community agencies).	Yes	No
18. Talking book service.	Yes	No

SUBJECT:

DATE:

MULTI-MODALITY IMAGERY TEST - Recording Form

Phase I - Learning and Comprehension of Insturctions

Total Time -

Comments -

Phase II - Conceptualizing Spatial Relations - (The correct answer is underlined)

ITEM	ANSWER	TIME	NO. OF CORRECTIONS	COMMENTS
1	3-4-<u>both</u>			
2	3-4-<u>both</u>			
3	<u>3</u>-4-both			
4	3-4-<u>both</u>			

Comments:

Phase III - The Multi-Modality Imagery Test

ITEM	NO. OF REPETITIONS	ANSWER	TIME	COMMENTS
A		3- 2 4- 0		
B		3- 4 4- 0		
C		3- 4 4- 1		
D		3- 2 4- 1		
E		3- 2 4- 2		
F		3- 8 4- 0		
G		3- 8 4- 0		
H		3- 16 4- 0		
I		3- 10 4- 1		
J		3- 10 4- 0		
K		3- 20 4- 0		
L		3- 16 4- 2		

Comments:

STANFORD-OHWAKI-KOHS

NATURE OF THE SAMPLE - DESCRIPTIVE STATISTICS

I.

	All Ss (N=162)	Adults (N=135)	Children (N=27)
Average Age	29.0	31.7	15.1
Average Years Education	12.4	13.0	9.0
Average Age of Onset of Blindness	9.7	11.5	.8
Average No. Pages Braille Read	300-400	200-300	500-600
Most Common Causes of Blindness	Develop./Trauma	Develop./Trauma	Develop./Trauma
No. Ss Totally Blind	105	93	21
No. Ss Partially Blind	57	42	6
No. Adventitiously Blind	70	67	3
No. Congenitally Blind	92	68	24

II.

Sex (All Ss)

Male	104
Female	58

Marital Status (Adults)

Single	81
Married	43
Divorced	8
Widowed	3

Number of Children (Adults)

None	95
One	9
Two	16
Three	8
Four	4
Five	2
Six	1

Average Income

Employed Adults = $5,400.00

Degrees (All Ss)

None	89
H.S. diploma	41
A.A.	2
B.A.	18
M.A.	11
Ph.D.	1

Employment Status (Adults)

Employed	39
Student	73
Housewife	1
Unemployed	16
Retired	6

Current Occupation (Adults)

Professional-Managerial	24
Clerical-Sales	4
Service	3
Agriculture-Fishery-Forestry	1
Skilled	8
Semiskilled	2
Student	72

Father's Occupation (Adults)

Professional-Managerial	34
Clerical-Sales	21
Service	15
Agriculture-Fishery-Forestry	17
Skilled	36
Semiskilled	7
Unskilled	4
Student	1

Travel Aid Usually Used (All Ss)

Cane	83
Dog	15
Human	17
None	46

STANFORD-OHWAKI-KOHS

TABLE 1

OHWAKI I.Q. MEANS AND STANDARD DEVIATIONS FOR SUBGROUPS

	Subgroup	M	S.D.	N	M	S.D.	N	Subgroup
A.	Total Ss	82.0	33.46	159	85.7	33.38	16	Unemployed
	Adult	86.8	32.61	132	88.0	30.57	42	Employed
	Children	58.7	27.63	27	63.2	23.16	6	Retired
	Totally Blind	68.5	29.04	104	68.4	28.57	101	Vision - none
	Visuals	115.1	21.19	23	113.1	21.71	24	20/200 Good Vision
	T + V	102.1	27.30	32	100.4	30.72	34	10/200-20/200 Poor Vision
	Congenitals	79.7	34.70	91				
	Adventitious	85.0	31.72	68				

	Subgroup	M	S.D.	N	M	S.D.	N	Subgroup
B.	Adult Totally	72.2	29.79	84	52.8	19.28	20	Child. Totally
	Adult Visuals	118.4	14.68	22	80.7	42.32	6	Child. Visuals
	Adult T + V	107.0	20.76	26			1	Child. T + V
	Adult Cong.	87.1	33.76	67	59.1	29.00	24	Child. Cong.
	Adult Advent.	86.4	31.65	65	54.9	15.16	3	Child. Advent.

	Subgroup	M	S.D.	N	M	S.D.	N	Subgroup
C.	Adult.Cong.Tot.	70.1	32.04	38	52.4	20.29	17	Ch. Cong. Tot.
	Adlt.Cong.Vis.	120.3	10.72	16			1	Ch. Cong. Vis.
	Adlt.Cong.T+V	95.9	22.18	13	80.7	42.32	6	Ch. Cong. T+V
	Adult Adv.Tot.	74.0	28.04	46	54.9	15.16	3	Ch. Adv. Tot.
	Adlt.Adv.Vis.	113.1	22.70	6				Ch. Adv. Vis.
	Adlt.Adv.T+V	118.2	11.75	13				Ch. Adv. T+V

STANFORD-OHWAKI-KOHS

TABLE 2

WECHSLER I.Q. - MEANS AND STANDARD DEVIATIONS FOR SUBGROUPS

	Subgroup	M	S.D.	N	M	S.D.	N	Subgroup
A.	Total Ss	115.5	17.12	162	110.5	19.25	17	Unemployed
	Adult	117.0	15.95	135	121.9	10.41	44	Employed
	Children	108.1	20.87	27	111.4	14.02	7	Retired
	Totally	116.14	17.63	107	115.1	18.44	107	Vision - none
	Visuals	113.9	15.39	23	114.0	15.60	24	20/200
	T + V	114.7	16.96	32	114.4	17.76	36	10/200 - 20/200
	Congenital	117.7	15.60	70				
	Adventitious	113.8	18.09	92				

	Subgroup	M	S.D.	N	M	S.D.	N	Subgroup
B.	Adult Totally	118.0	16.19	87	108.0	21.49	20	Child. Totally
	Adult Visuals	116.2	10.91	22			1	Child. Visuals
	Adult T + V	114.4	18.74	26	116.1	4.95	6	Child. T + V
	Adult Cong.	115.3	17.36	68	109.7	19.84	24	Child. Cong.
	Adult Adv.	118.7	14.31	67	95.6	29.56	3	Child. Advent.

	Subgroup	M	S.D.	N	M	S.D.	N	Subgroup
C.	Adlt.Cong.Tot.	117.3	17.33	39	110.1	20.15	17	Ch. Cong. Tot.
	Adlt.Cong.Vis.	113.6	11.18	16				Ch. Cong. Vis.
	Adlt.Cong.T+V	111.3	23.23	13	116.1	4.95	6	Ch. Cong. T+V
	Adlt.Adv.Tot.	118.5	15.37	48	95.6	29.56	3	Ch. Adv. Tot.
	Adlt.Adv.Vis.	123.1	6.82	6				Ch. Adv. Vis.
	Adlt.Adv.T+V	117.5	13.08	13				Ch. Adv. T+V

STANFORD-OHWAKI-KOHS

TABLE 3

TESTS - BIOGRAPHICAL DATA CORRELATIONS - TOTAL SAMPLE

Biographical Variable		OH Cor.	WAIS	Imagery	Soph.	Sp. Serv.
		Test Variable				
Total Education	(159)	.29*	.47*	.36*	.46*	-.19*
Current Occupation	(47)					
O + E Index	(120)					
Salary	(46)	-.02	.40*	.06	.36*	.04
Occupation Before Blindness	(30)					
Occupation After Blindness	(62)					
Employment Ratio	(73)	.13	.15	.24*	.28*	.11
Pages Braille Read	(72)	-.04	.08	-.08	-.03	.34*
Age of Onset	(159)	-.00	.06	.07	.09	-.60*
Duration of Blindness	(159)	.11	.15	.28*	.17*	.16*

*Significant at .05 level or better

TABLE 4

TESTS - BIOGRAPHICAL DATA CORRELATIONS - ADULTS

Biographical Variable		OH Cor.	WAIS	Imagery	Soph.	Sp. Serv.
		Test Variable				
Total Education	(132)	.12	.51*	.29*	.48*	-.16
Current Occupation	(47)	-.06	-.56*	-.20	-.31*	-.01
O + E Index	(94)	-.06	-.45*	-.26*	-.44*	-.21*
Salary	(46)	-.02	.39*	.06	.36*	.04
Occupation Before Blindness	(30)	-.29	-.10	.00	.23	.00
Occupation After Blindness	(62)	.09	-.20	.10	-.25*	.02
Employment Ratio	(73)	.13	.15	.24*	.27*	.11
Pages Braille Read	(48)	.10	.24	.02	.06	.36*
Age of Onset	(132)	-.11	.03	-.00	.07	-.60*
Duration of Blindness	(132)	.02	.12	.11	.15	.18*

*Significant at .05 level or better

STANFORD-OHWAKI-KOHS

TABLE 5

TESTS - BIOGRAPHICAL DATA CORRELATIONS - CONGENITAL

Biographical Variable		Test Variable: OH Cor.	WAIS	Imagery	Soph.	Sp. Serv.
Total Education	(91)	.42*	.45*	.43*	.46*	.03
Current Occupation	(11)					
O + E Index	(72)					
Salary	(10)					
Occupation Before Blindness	(2)					
Occupation After Blindness	(17)					
Employment Ratio	(20)	.08	-.14	.17	.22	-.09
Pages Braille Read	(44)	-.06	.11	.09	.03	
Age of Onset	(91)					
Duration of Blindness	(91)					

*Significant at .05 level or better

TABLE 6

TESTS - BIOGRAPHICAL DATA CORRELATIONS - ADVENTITIOUS

Biographical Variable		Test Variable: OH Cor.	WAIS	Imagery	Soph.	Sp. Serv.
Total Education	(68)	.15	.52*	.21	.48*	-.07
Current Occupation	(68)					
O + E Index	(48)					
Salary	(36)	.03	.46*	.06	.40*	-.01
Occupation Before Blindness						
Occupation After Blindness						
Employment Ratio	(53)	.14	.31*	.27*	.30*	.23
Pages Braille Read	(28)	.10	.09	.09	-.06	.69*
Age of Onset	(68)	-.14	-.03	-.19	.00	-.63*
Duration of Blindness	(68)	.04	.24*	.15	.22	.36*

*Significant at .05 level or better

Test 1: STANFORD - OHWAKI - KOHS

Subtest	Exploration	Arrangement	Correction	Card Reference	Approach to Problem	Comments
Sample 1A						
1B						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
TOTAL						

CODE: Reference to card - Col. 4
a.- Constantly keeps one hand on card
b - Looks back and forth (glances with one hand)
c - Two hand investigation

CODE: Approach to problem - Col. 5
1 - Braille - left hand finds position, works left to right then down.
2 - Systematic or methodical - search not dictated by Braille pattern.
3 - Trial & Error - places block in design for direct testing by feeling
4 - Restricted - boundedness - picks one element of pattern & looks for first part of block with same element.

COMMENTS:

STANFORD-OHWAKI-KOHS

TABLE 7

TESTS - BIOGRAPHICAL DATA CORRELATIONS - TACTUALS

		Test Variable				
ographical Variable		OH Cor.	WAIS	Imagery	Soph.	Sp. Serv.
Total Education	(104)	.44*	.49*	.42*	.50*	-.17
Current Occupation						
O + E Index						
Salary	(32)	.20	.45*	.22	.41*	.02
Occupation Before Blindness						
Occupation After Blindness						
Employment Ratio	(54)	.05	.20	.21	.24	..13
Pages Braille Read	(54)	.13	.15	-.04	.01	..40*
Age of Onset	(104)	-.00	.03	.20*	.12	-.68*
Duration of Blindness	(104)	.23*	.20*	.22*	.13	.16

*Significant at .05 level or better

TABLE 8

TESTS - BIOGRAPHICAL DATA CORRELATIONS - VISUALS

		Test Variable				
ographical Variable		OH Cor.	WAIS	Imagery	Soph.	Sp. Serv.
Total Education	(23)	.12	.48*	.12	.50*	-.21
Current Occupation						
O + E Index						
Salary	(5)					
Occupation Before Blindness						
Occupation After Blindness						
Employment Ratio	(5)					
Pages Braille Read	(6)					
Age of Onset	(23)	.05	.23	.09	.14	-.38
Duration of Blindness	(23)	.15	-.05	-.03	.15	.17

*Significant at .05 level or better

STANFORD-OHWAKI-KOHS

TABLE 9

TESTS - BIOGRAPHICAL DATA CORRELATIONS - TACTUAL AND VISUAL

Biographical Variable		OH Cor.	WAIS	Test Variable Imagery	Soph.	Sp. Serv.
Total Education	(32)	.14	.45*	.32	.43*	-.29
Current Occupation						
O + E Index						
Salary	(9)					
Occupation Before Blindness						
Occupation After Blindness						
Employment Ratio	(14)	.20	.07	.20	.39	.38
Pages Braille Read	(12)	-.38	-.14	.04	-.05	.42
Age of Onset	(32)	.34	.10	-.18	.03	-.57*
Duration of Blindness	(32)	-.02	.00	.16	.42*	.06

*Significant at .05 level or better

TABLE 10

TESTS - BIOGRAPHICAL DATA CORRELATIONS - ADULT ADVENTITIOUS

Biographical Variable		OH Cor.	WAIS	Test Variable Imagery	Soph.	Sp. Serv.
Total Education	(65)	.11	.51*	.18	.48*	-.05
Current Occupation	(36)	-.01	-.52*	-.13	-.43*	-.02
O + E Index	(45)	.06	-.47*	-.10	-.57*	.09
Salary	(36)	.03	.46*	.06	.40*	-.01
Occupation Before Blindness	(28)	-.29	-.12	.00	.25	.00
Occupation After Blindness	(45)	.04	-.30*	.07	-.15	-.15
Employment Ratio	(53)	.14	.31*	.27*	.30*	.23
Pages Braille Read	(25)	.18	.27	.21	.04	.65*
Age of Onset	(65)	-.19	-.10	-.24*	-.03	-.62*
Duration of Blindness	(65)	-.00	.22	.13	.21	.39*

*Significant at .05 level or better

STANFORD-OHWAKI-KOHS

TABLE 11

TESTS - BIOGRAPHICAL DATA CORRELATIONS - ADULT TACTUAL

Biographical Variable		OH Cor.	WAIS	Imagery	Soph.	Sp. Serv.
		Test Variable				
Total Education	(84)	.34*	.53*	.35*	.52*	-.16
Current Occupation	(33)	-.20	-.67*	-.34*	-.31	.00
O + E	(57)	-.25	-.50*	-.47*	-.49*	.26*
Salary	(32)	.20	.45*	.22	.41*	.01
Occupation Before Blindness	(21)	-.06	-.10	-.00	.29	-.09
Occupation After Blindness	(46)	.13	-.24	.15	-.16	.03
Employment Ratio	(54)	.05	.20	.21	.24	.13
Pages Braille Read	(36)	.27	.31	.08	.12	.42*
Age of Onset	(84)	-.11	-.03	.12	.08	-.70*
Duration of Blindness	(84)	.16	.17	.18	.10	.18

*Significant at .05 level or better

TABLE 12

TESTS - BIOGRAPHICAL DATA CORRELATIONS - CHILDREN

Biographical Variable		OH Cor.	WISC	Imagery	Soph.	Sp. Serv.
		Test Variable				
Total Education	(27)	.02	.03	.03	.23	.35
Current Occupation						
O + E Index						
Salary						
Occupation Before Blindness						
Occupation After Blindness						
Employment Ratio						
Pages Braille Read	(24)	-.05	-.17	-.17	-.32	.20
Age of Onset	(27)	.00	-.13	.13	-.04	-.45*
Duration of Blindness	(27)	.00	.08	-.10	.05	.53*

*Significant at .05 level or better

STANFORD-OHWAKI-KOHS

TABLE 13

INTERCORRELATION AMONG TESTS - TOTAL SAMPLE (N=159)

	OHWAKI COR.	WAIS V.S.	IMAGERY	SOPHISTICATION
WAIS V.S.	.39*			
Imagery	.70*	.53*		
Sophistication	.17*	.60*	.30*	
Specialized Services	-.18*	-.10	-.28*	-.06

*For N=159, r's of .156 are significant at .05 level

TABLE 14

OHWAKI TEST

I. Subgroup		A	B	C
N=159	Total sample	.30	Im .72	Com .35, Ar .32
132	16 and over (adult)	.30	Im .66	Ar .35, Com .29
27	Less than 16 (children)	.04	Im .85	
104	Totally blind	.49	Im .74	I .91, V .85, C .85
23	Visuals	.50	Im .77	Ar .53, Sim .42
32	Visuals + Tactuals	.03	Im .62	I .82, V .81
91	Congenitally blind	.18	Im .82	I .88, V .84, C .82, A .81
68	Adventitiously blind	.48	Im .55	Ar .52, D.S. .51

Column A = r between Ohwaki score & WAIS IQ
Column B = r representing the other test which the Ohwaki correlates highest
Column C = highest subtests which the Ohwaki shows correlations (WAIS subtests)

STANFORD-OHWAKI-KOHS

TABLE 15
CORRELATIONS BETWEEN WECHSLER IQ AND OTHER TESTS

Subgroup		Oh	Im	So	Sp	TR	I	C	A	S	D	V
N=160	Total Sample	.30*	.46*	.57*	-.05	.40*	.89*	.82*	.80*	.77*	.64*	.85*
135	16 and over (adult)	.30*	.51*	.52*	-.01	.40*	.87*	.83*	.78*	.78*	.64*	.83*
27	Less than 16 (children)	.04	.09	.74*	-.13		.93*	.81*	.90*	.91*	.70*	.89*
107	Totally blind	.49*	.49*	.67*	.00	.51*	.91*	.85*	.81*	.79*	.63*	.86*
23	Visuals	.50*	.60*	.32*	-.47*		.89*	.84*	.84*	.86*	.61*	.87*
32	Visuals + Tactuals	.03	.47*	.50*	-.03	-.17	.82*	.74*	.74*	.70*	.68*	.81*
92	Congenitally blind	.18	.35*	.51*	.03	.62	.88*	.82*	.81*	.77*	.74*	.84*
70	Adventitiously blind	.48*	.63*	.68*	-.02	.20	.90*	.84*	.78*	.80*	.52*	.87*

TABLE 16
CORRELATIONS BETWEEN IMAGERY AND OTHER TESTS

Subgroup		Oh	So	Sp	TR	I	C	A	S	D	V
N=160	Total Sample	.72*	.30*	-.28*	.62*	.42*	.50*	.47*	.31*	.20*	.41*
133	16 and over (adult)	.66*	.33*	-.24*	.62*	.46*	.51*	.54*	.47*	.24*	.40*
27	Less than 16 (children)	.85*	-.07	-.43*		.06	.06	.16	.05	-.05	.13
105	Totally blind	.74*	.30*	.27*	.69*	.44*	.54*	.51*	.34*	.21*	.46*
23	Visuals	.77*	.56*	.30		.43*	.53*	.77*	.44	.28	.33
32	Visuals + Tactuals	.62*	.23	.18	.36	.52*	.43*	.36*	.32	.26	.48*
90	Congenitally blind	.82*	.27*	-.31*	.90*	.31*	.44*	.36*	.20	.15	.31*
70	Adventitiously blind	.55*	.30*	.02	.07	.55*	.52*	.64*	.53*	.44*	.50*

TABLE 17
CORRELATIONS BETWEEN SOPHISTICATION AND OTHER TESTS

Subgroup		Oh	Im	Sp	TR	I	C	A	S	D	V
N=162	Total Sample	.17*	.30*	-.06	.42*	.54*	.54*	.51*	.46*	.38*	.56*
135	16 and over (adult)	.15	.33*	-.24	.42*	.51*	.51*	.48*	.47*	.32*	.54*
27	Less than 16 (children)	-.04	-.07	.16		.63*	.73*	.65*	.59*	.67*	.66*
107	Totally blind	.33*	.30*	-.12	.52*	.64*	.61*	.54*	.53*	.48*	.66*
23	Visuals	.24	.56*	.08		.23	.42*	.48*	.26	.05	.28
32	Visuals + Tactuals	-.14	.23	.03	-.46	.52*	.56*	.42*	.46*	.41*	.59*
92	Congenitally blind	.16	.27*	.08	.75*	.47*	.52*	.53*	.35*	.42*	.52*
70	Adventitiously blind	.15	.30*	-.10	.02	.66*	.58*	.48*	.71*	.38*	.63*

*Significant at .05 level or better.

STANFORD-OHWAKI-KOHS
TABLE 18

PERCENT OF Ss WHO PASSED EACH OHWAKI ITEM

	% Passing Item		
Design	Stanford (All Ss)	Ohwaki (Child.)	Kohs (Age 15)
1	89	91	100
2	69	81	99
3	71	80	99
4	65	72	97
5	58	50	94
6	60	60	93
7	54	41	93
8	53	43	88
9	54	39	65
10	49	28	55
11	47	30	73
12	45	23	55
13	39	20	65
14	39	19	64
15	39	17	61
16	32	17	43
17	32	16	38

FABRICATION OF THE STANFORD-KOHS TEST MATERIALS

When the manufacture of the Stanford-Kohs Block Design Test for the Blind was first contemplated, it was decided to use materials that were readily available, inexpensive and adaptable for a construction process by hand. Both a thermoform machine, which worked on the principle of heat and vacuum embossing, manufactured by the American Thermoform Co., Los Angeles, California, and a small punching and spiral binding machine were available for part time use. It was decided to try to adapt these machines to our purposes.

For the designs, the following steps were taken:

1) Master Plates: A complete set of master plates of all the designs was made. Since the thermoform machine is standardized for use on plastic sheets (brailon) measuring 11" x $11\frac{1}{2}$", this was the size used in each case. Lightweight poster board, (do not use press board), was cut 11" x $11\frac{1}{2}$"; the $\frac{1}{2}$" was marked off lightly on each board to allow room for the spiral binding. The patterns were then centered on the remaining 11" x 11" to scale (each block measured $1\frac{1}{2}$" square; therefore, each 4 block pattern measured 3" x 3"; each 9 block pattern measured $4\frac{1}{2}$" x $4\frac{1}{2}$"; and each 16 block pattern measured 6" x 6").

Textured Surface: The material used in both the designs and on the blocks was textured black rubber carpet matting, 3/32" thick, (available in 36" widths @ $3.80 per lineal yard from the Golden State Mat Co., 752 Folsom St., San Francisco, California--catalog no. 109). The patterns were measured, cut with a scissors and glued in place on each board (Super Weatherstrip Adhesive #8001, 3M Brand, in tubes).

Bordering: The borders were made from #18 gauge floral wire, cut with a wire cutter and carefully glued in position.

2) Photographic Process: Each completed three dimensional master plate underwent the following process:

a) A line negative-positive reversal was made.
b) The black areas on all sides were increased by 1/16" with litho tape to allow for stretching in the embossing process and to sharpen the contrast of the edges.
c) A contact on line film was made.
d) Each negative was masked and opaqued.
e) An aluminum plate was exposed and developed.

3) Printing:

a) The plates were run on an off-set press directly onto the 11" x $11\frac{1}{2}$" plastic sheets. Special care was taken to be sure that each design was centered in exactly the same relative position as on its master plate. Ample extra copies of each pattern were run to allow for errors.

b) A fast drying ink, suitable for printing on plastic was specially made up. The formula was:

1 oz. binding varnish
1 oz. two way drier
Mix with 1 lb. off-set black ink
CAUTION: On the press, hold the fountain solution to a minimum.

An alternative ink recommended by the American Thermoform Co. is Buckeye Offset Black Ink No. 14453.

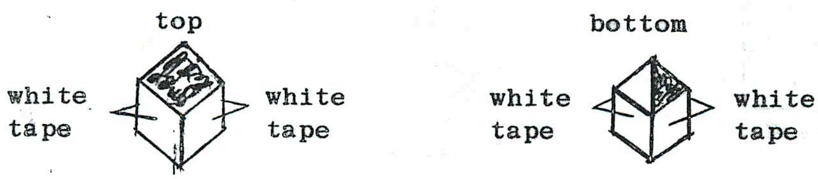
4) Embossing: The printed plastic sheets which were punched, (see paragraph following on binding), were thermoformed. Each master plate was placed on the machine with the spiral binding side to the front. The plastic sheet was placed over the master plate and the design placement double-checked for positioning before embossing. Each pattern could be rerun once in case of a slippage. To avoid damage by overheating, the master plates were rotated so that no more than six copies were made in sequence. Approximately three sets, embossed and bound, could be completed in an hour by one person.

5) Binding:

a) The plastic sheets were punched for their spiral binding before thermoforming for ease in handling. The press board covers were also punched at this time.

b) The embossed sets were bound with heavy press board and a spiral closure. An additional piece of press board was trimmed and inserted loose to act as a transferable backing for each design during the testing.

6) Lacquering: The final step was a precautionary spraying of each completed book with Grumbacher's Tuffilm Spray, or other comparable product, to insure against possible smudging of the black ink.



The blocks were constructed so that four adjacent sides were covered in white tape; the other two opposing sides had one full side covered in black textured rubber carpet matting, the other side (see diagram above) had two triangles, $\frac{1}{2}$ white tape, $\frac{1}{2}$ black textured rubber.

For the blocks, the following steps were taken:

1) Wood: Straight grain Douglas fir was cut into $1\frac{1}{2}$" square pieces. These pieces were cut into 1-5/16" blocks, (the difference in width was to allow for the thickness of the textured rubber).

2) Sanding: The blocks were lightly sanded.

3) Taping: The four sides, measuring $1\frac{1}{2}$" x 1-5/16" across, were covered with a continuous piece of off-white Mystik Tape (available in economy rolls of $1\frac{1}{2}$" x 36 ft., Mystik Tape, Inc., Northfield, Ill.) and one $1\frac{1}{2}$" side was also covered with the tape. The tape was put on the block directly from the roll; trimming was done afterwards with scissors.

4) Textured Material: Black rubber carpet matting, the same as used for the master plates, was cut with a large scissors into 1-5/8" strips.

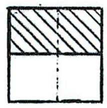
5) Textured Gluing: The taped block was placed with the uncovered side down on the rubber strip and a piece was cut off to size. This was glued into position and allowed to set. The glue used, again the same as on the master plates, was Super Weatherstrip Adhesive, #8001, 3M Brand, available in tubes. Any necessary trimming of the rubber was easily accomplished with a scissors. Any excess glue was removed with tweezers.

In making the half textured side, the block was again placed with the $1\frac{1}{2}$" side down on the rubber strip and a piece cut off to size. This piece was cut diagonally, making two triangles; one of which was glued into position, the other saved for the next block. The edges were trimmed where necessary and corners tapered slightly.

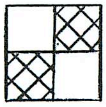
6) Lacquering: To eliminate excessive scuffing of the black rubber onto the white tape, a clear lacquer (any good quality brushing lacquer can be used) was brushed on all the rubber surfaces with special care given to coat all edges.

7) Washability: The completed blocks, 16 to a set, can be washed using a damp rag and soap.

STANFORD-OHWAKI-KOHS BLOCK DESIGNS



Sample



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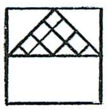

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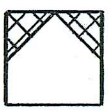

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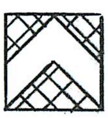

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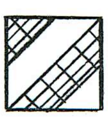

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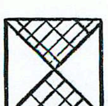

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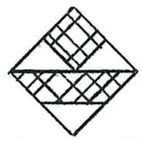

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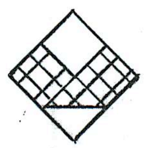

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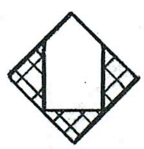

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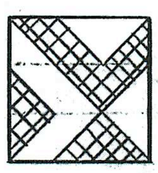

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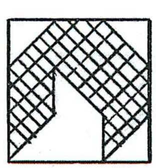

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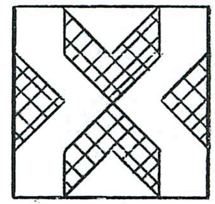

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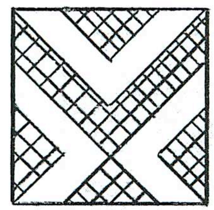

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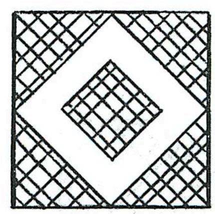

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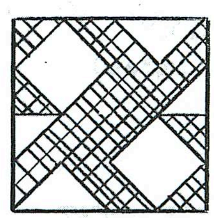

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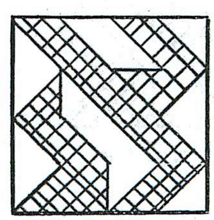

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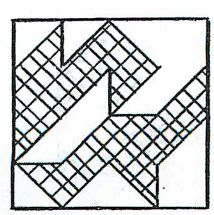
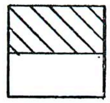


Design 17

STANFORD-KOHS BLOCK DESIGNS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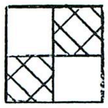
Sample B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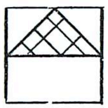
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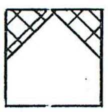
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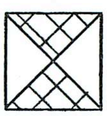
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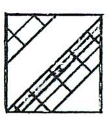
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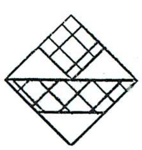
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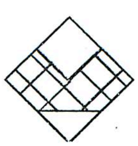
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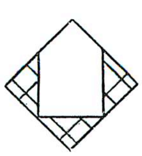
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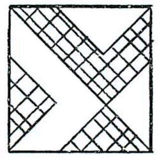
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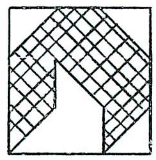
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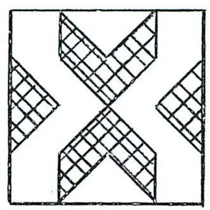
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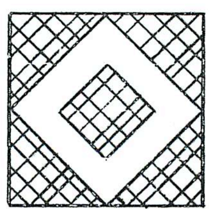
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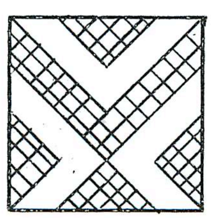
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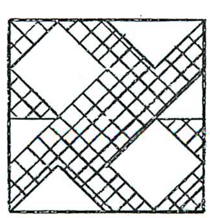
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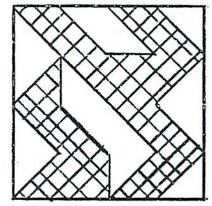
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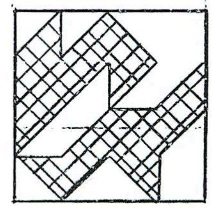
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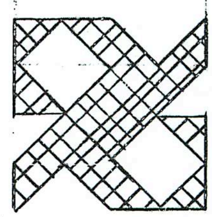
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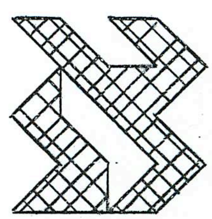
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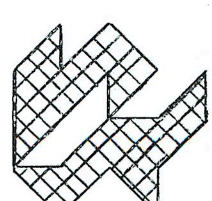
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