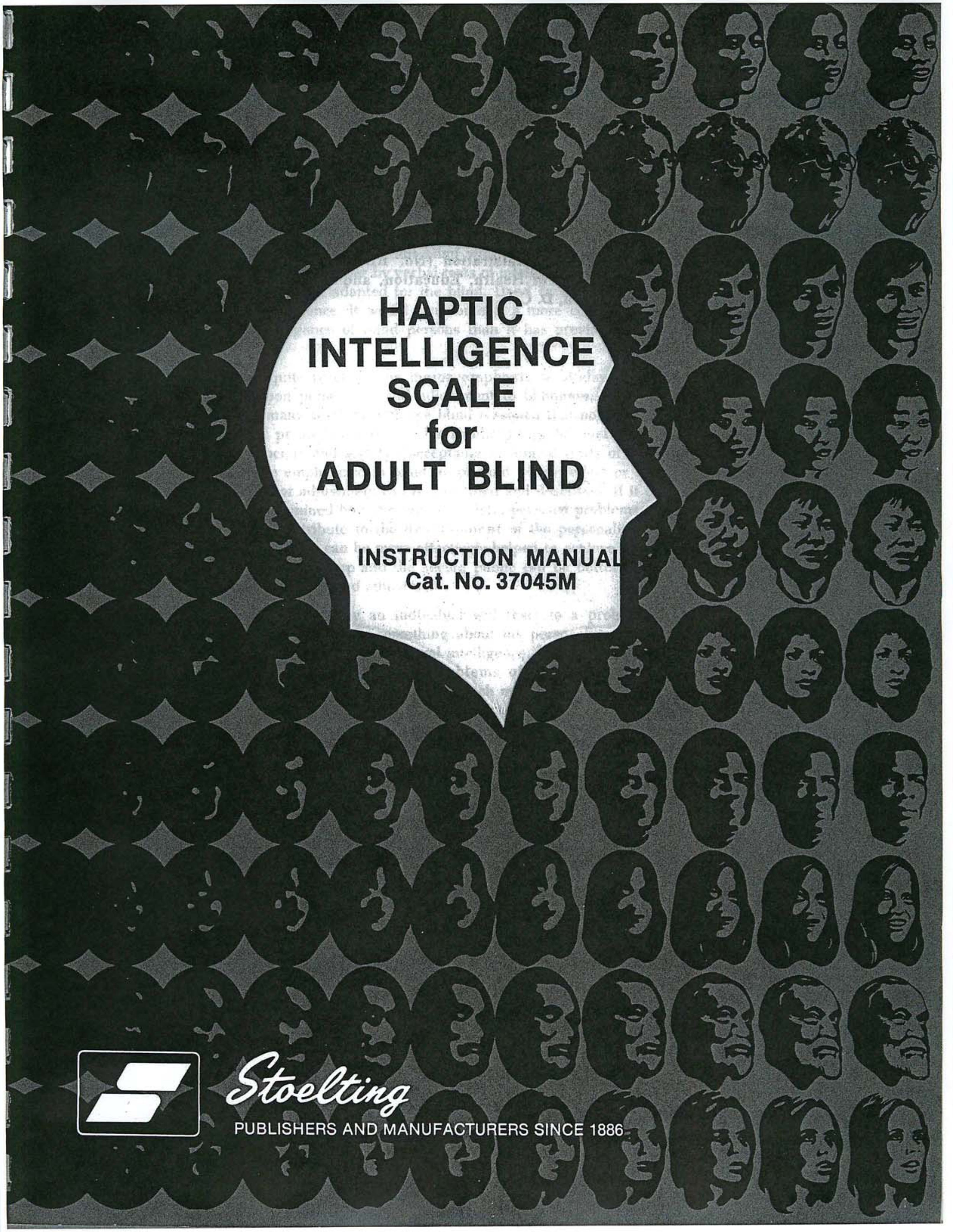

HAPTIC INTELLIGENCE SCALE for ADULT BLIND

INSTRUCTION MANUAL
Cat. No. 37045M

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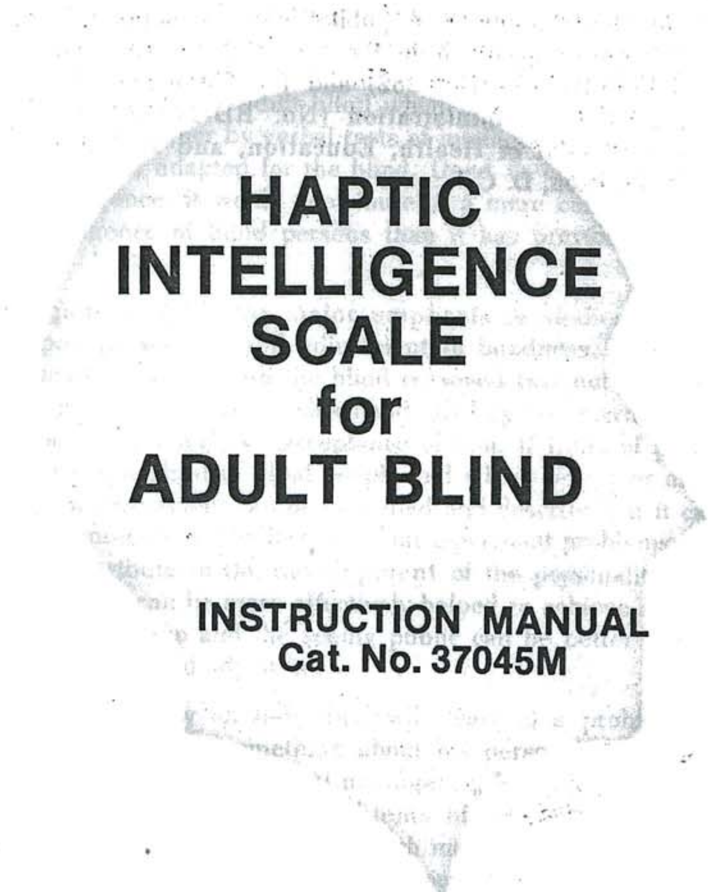

HAPTIC INTELLIGENCE SCALE for ADULT BLIND

INSTRUCTION MANUAL
Cat. No. 37045M

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PREFACE

The purpose of the project reported here was to develop and standardize a performance scale for adult blind which would measure abilities not adequately assessed either by verbal tests of intelligence or existing performance tests designed or adapted for the blind. Used in conjunction with a verbal test of intelligence, it would contribute to a more comprehensive evaluation of the intelligence of blind persons than it has previously been possible to obtain.

Until quite recently, the major emphasis in studies of adult blind was placed upon personality and adjustment to blindness. This may have been because many workers with the blind reasoned that not blindness *per se* but the blind person's reaction to his handicap largely determined his ability to fit into society and society's acceptance of him. If traits of personality which tend to be emphasized in blind people and which reflect or are conducive to good or poor adjustment can be identified and described, if it can be to some extent determined how the inter- and intra-personal problems associated with blindness contribute to the development of the personality structure of the blind person, he can be more effectively helped to achieve satisfactory adjustment to his handicap and the seeing public can be better educated to assist him in achieving good adjustment.

In predicting how an individual will react to a problem situation, one ideally knows not only something about his personality and experience but also something about his general intelligence, his special abilities, aptitudes, and skills. In approaching the problems of adjustment to blindness, it is important to measure the abilities which make solution of problems possible, for whether or not and how the blind person has been able to solve his problems will have affected the development of the modes of adjustment which may now be problems in themselves. Tools for measuring abilities of the blind are therefore doubly important, for they not only show what the blind person can do now but also suggest how he came to be the person he now is.

The need for a test which would measure the intelligence of blind persons on the basis of non-verbal factors was specifically mentioned in a survey of research in work for the blind published by The American Foundation for the Blind in 1953 (Raskin & Weller). In an effort to supply such a test, H. C. Shurrager, P. S. Shurrager, and S. B. Watson, a graduate student in the Department of Psychology and Education at Illinois Institute of Technology, began in 1954 the development of a performance scale for adult blind which was based upon, but not precisely an adaptation of, the Performance Scale of the Wechsler-Bellevue Intelligence Scale. An experimental form of the scale for the blind was administered to blind and partially sighted persons in the Chicago area. Results are reported in a dissertation submitted to Illinois Institute of Technology (Watson, 1956). The acute need for a standardized haptic scale to measure visually handicapped performance prompted H. C. Shurrager to prepare a proposal for submission by Illinois Institute of

Technology to the Office of Vocational Rehabilitation for a grant to assist in the further development and standardization of the scale with a national sample of blind adults. A grant was awarded, effective September 1, 1958. The report which follows is an account of the work done under the grant.

The contributions of the United States Office of Vocational Rehabilitation and of Illinois Institute of Technology made this study possible; to them primary thanks are due. The personnel of every agency, public or private, which was approached received us courteously, listened patiently, and gave advice and cooperation beyond what could be reasonably expected or optimistically hoped for. We wish it were possible to mention by name the many people, blind and sighted, who were generous with time and help. We are particularly grateful to the blind persons in Chicago who welcomed us into their homes and served as subjects. The generosity of John Moss, of Eastwood Industries, Inc., in Chicago, whose interest in the project led him to produce the experimental test kits in his plant, thereby materially reducing costs which might otherwise have been excessive, is also gratefully acknowledged.

HARRIETT C. SHURRAGER

PHIL S. SHURRAGER

June, 1964

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CHAPTER 1

INTRODUCTION

DEVELOPMENT AND ADAPTATION OF PERFORMANCE TESTS FOR ADULT BLIND

Little serious effort was made to develop performance tests for the adult blind prior to 1942. In the early 1930's, Samual P. Hayes carried on limited experimental work at Mt. Holyoke College, preparing adaptations of the tapping and card sorting tests from the Minnesota Mechanical Ability Tests, the Kohs Block Design test, Whipple's Aiming and Steadiness tests, and the O'Connor Finger Dexterity Test. Stevenson Smith was approached by the Division for the Blind in the State of Washington in 1940 and asked to work out some non-verbal tests which could be used in the selection of blind candidates for industrial placement. The work of both Dr. Hayes and Dr. Smith came to a standstill without opportunities to validate the tests in industry. These early investigations showed that blind people have abilities which cannot be measured by verbal testing, that these abilities may be very important to job placement, that various forms of concrete tests are appropriate for assessing these abilities, and that a kinesthetic and orientation factor is especially important to blind people (Bauman, in Donahue & Dabelstein, 1950).

In 1942, work was begun with blind adults at the Trainee Acceptance Center in Philadelphia. The core of the manual skills testing program for blind persons was the Minnesota Rate of Manipulation Test and the Pennsylvania Bi-Manual Worksample. These two tests proved to have the greatest predictive value for routine manipulative jobs. Also used were the Tool-sample (although rarely with women), the O'Connor Finger Dexterity Test, and the Purdue Pegboard. The last two proved useful only with clients retaining some vision. Various original tests were devised, none of which had predictive value for placement (ibid).

In *A Manual for the Psychological Evaluation of the Adult Blind* (Bauman & Hayes, 1951), four tests are described in the section on manipulative and performance tests. These are Minnesota Rate of Manipulation, Pennsylvania Bi-Manual Worksample, Small Parts Dexterity Test (Part II), and Non-Language Learning Test. The first three had been adapted for use with the blind by Bauman, and no reports on reliability or validity with the blind had then been published. With respect to the first two tests, Bauman found that few successfully employed blind persons obtained scores below the mean for the blind population. The Non-Language Learning Test, a formboard test developed for the blind by Bauman, was reported to show, in studies then under way, low positive correlation with Wechsler Verbal IQ and rather clear differentiation between successfully employed and unemployed blind groups.

Bauman (1958) published norms for totally blind persons and those retaining some useful vision for the three tests which had been adapted for the blind. Time scores on all the tests showed significant negative correlations, ranging from —.24 to —34, with Wechsler Verbal IQ.

Other psychologists and psychometrists at schools and training centers for the blind have adapted tests (as, for example, the Hand-Tool Dexterity Test, the Detroit Manual Ability Task, the Small Parts Assembly Test, and the Wiggly Block at the New York Institute for the Education of the Blind) and have devised various tests of their own. The work is difficult to summarize, but most of these efforts seem to have been directed toward developing or adapting tests which rather specifically measure manual dexterity and motor skill. The reasons for this are clear, for it seems logical that this kind of test should predict success in the kinds of jobs most often open to blind people.

In 1957, Dr. Joseph Tiffin (1960), with the assistance of Robert J. Teare, began an extensive project at the Purdue Research Center, sponsored by the United States Office of Vocational Rehabilitation and titled "An Investigation of Vocational Success with the Blind." Its major purpose was the development of a personnel selection battery for adult blind validated against available indices of employment success. In all, 626 subjects were included in the study, all between the ages of twenty and fifty, and all legally blind [i.e., vision not exceeding 20/200].

With the exception of the Verbal Scale from the Wechsler Adult Intelligence Scale (WAIS), the tests used in the study were developed for the project. They included:

(1) Vocational Intelligence Scale for the Adult Blind (VISAB), consisting of a series of forty-three sets of four geometric patterns in raised form, arranged in order of ascending difficulty. Subject was to identify that one of the four patterns which was most unlike the other three.

(2) Tactual Reproduction Pegboard (TRP), consisting of an aluminum plate divided in half with an equal number of holes drilled in each half. Subject was to reproduce on one half of the board patterns constructed by the examiner on the other half. A Rate of Placement score was also obtained.

(3) Asher-Frohman Maze (A-F), consisting of a finger maze with a pivotal pointer at the terminal point. Subject was to rotate the pointer to show the direction of the starting point. Score was recorded in degrees of deviation from the true line.

(4) Sentence Completion Test (SC), consisting of forty-five incomplete sentences (presented orally) intended to pose problems that might arise in everyday activities. Responses were scored on a six-point scale, from zero for an inappropriate response to five for a completely adequate one.

With the exception of the A-F, subjects used such vision as they had while taking the tests.

The criteria of employment success were (1) Supervisory Ratings (for sheltered shop workers only), (2) Criterion Grouping (outside employed, shop employed, unemployed, etc.), (3) Salary (gross weekly), and (4) Job Hierarchy (vocational achievement, ranging from professional practice with a scale value of sixty-nine to packaging without tools with a scale value of thirty-three).

In differentiating among the blind as a composite group, the WAIS was found to be the most valid single test. It yielded higher correlations with Job Hierarchy and Salary criteria than any other test for high, mid, and low vision groups. Biserial correlations of the WAIS with Outside Employed vs. Unemployed and Outside Employed vs. Sheltered Shop were higher than those obtained with TRP or VISAB. When Supervisory Ratings served as criteria, both TRP and VISAB were more predictive than the WAIS, yielding correlations ranging from .42 to .69 in five sheltered shops. Low, positive, and significant (at .01) correlations were obtained between the SC test and Job Hierarchy (.16) and SC and Salary (.19). Multiple correlations computed to determine the relationship of the tests as a battery to Job Hierarchy yielded coefficients of .54, .43, and .46 for high, mid, and low vision groups. Variables included the WAIS, TRP, VISAB, A-F, Rate of Placement, and Age at Onset.

This phase of the study is reported in considerable detail because its objective was similar to that of the project described in the present report [i.e., to meet the existing need for a non-verbal intelligence scale for the blind] and because two of the tests developed for the study were quite predictive of vocational success of the blind. Certain other interesting facets of the Purdue study (Tiffin, 1960), such as a factor analysis of variables and an analysis of interrelationships among age at onset, vision loss, and parental occupation, have not been touched upon here.

PRELIMINARY RESEARCH WITH THE PSAB

In 1954, H. C. Shurrager, P. S. Shurrager, and S. B. Watson devised a performance scale for adult blind which consisted of five tests. Four of these tests, Digit Symbol, Block Design, Object Assembly, and Object Completion, were more or less analogous to Digit Symbol, Block Design, Object Assembly, and Picture Completion of the Wechsler-Bellevue Intelligence Scale. The fifth test, Plan-of-Search, was an attempt to adapt for blind subjects the Ball and Field test of the Stanford Binet. This scale, called "Performance Scale for the Adult Blind (PSAB)," and the Verbal Scale of the WAIS were administered to thirty-nine blind and forty partially sighted persons in the Chicago area. Correlations of .74 between the PSAB and the WAIS Verbal Scale were obtained for both blind and partially sighted groups. The work is described in a dissertation submitted to Illinois Institute of Technology (Watson, 1956).

The Performance Scale for Adult Blind was the basis for the Haptic Intelligence Scale (HIS) whose development and standardization are described in this report. Because the intercorrelations of the five tests which comprised the scale suggested that a common factor was involved to a large extent in all of them, two additional tests which appeared to require less fine tactile discrimination and skillful manipulation of parts were devised and included in the scale administered to the research sample in the present study. These two tests are called *Bead Arithmetic* and *Pattern Board.*

RESEARCH FORM OF THE HIS

The form of the HIS used with the research sample [i.e., all blind subjects tested] was composed of seven tests. These, in the order administered, were:

(1) *Digit Symbol,* consisting of a plastic plate embossed with simple geometric forms. A column down one side of the plate included one sample of each of the six forms used. Raised dots (not braille) superimposed on each sample form indicated a number with which that form was to be associated. Forty forms arranged in eight rows of five had no dots on their surfaces. Subject was to identify these forms by the appropriate numbers, referring at will to the samples. The plate was divided between the key column and the test items, so that the two parts of the plate could be interchanged; thus, each subject could explore the test items with his preferred hand, using his non-preferred hand to check the key column.

(2) *Object Assembly,* consisting of a block, doll, hand, and ball, each of which was dissected into several pieces. Objects were to be assembled by putting the pieces together.

(3) *Block Design,* consisting of four 1½ inch cubes, each of which had two smooth sides (formica), two rough sides (rubber treading), and two sides diagonally bisected into half rough, half smooth. The four blocks were to be arranged to form patterns identical to those appearing on plates prepared from the same materials.

Wattron (1956) reported on an experiment with an adaptation of Koh's Blocks (one inch square, having smooth, knurled, and diagonally divided surfaces). His subjects were twenty persons between the ages of seven and seventeen, totally blind or with light perception only, matched for sex and age with twenty sighted subjects. He obtained correlations of .84 with Mental Age on the Interim Hayes-Binet. There was no difference significant at .05 between performance of blind and sighted subjects, but he reports a "tendency" toward better performance by the blind.

(4) *Plan-of-Search,* consisting of a sheet of paper placed over an eleven by twelve inch smooth surface. Subject was instructed to search with a pencil for a small hole (size demonstrated) under the paper.

Porteus (1913) made early reference to a plan-of-search test as a measure of practical judgment and suggested that it be used to "round out" a comprehensive scale of ability. Terman (1916) employed a plan-of-search test in the Stanford Revision of the Binet-Simon Intelligence Scale. The item was called "Ball and Field" and was placed at ages VIII and XII, with an "inferior" pattern acceptable at VIII and a "superior" pattern required at XII. Percentages passing on the Ball and Field item increased steadily with age. No differences as a function of education were found in performance of adults on the test. In the 1937 Revision of the Stanford Binet (Terman & Merrill, 1937) the plan-of-search item was used only at Level XIII. McNemar (1942), in his analysis of the 1937 Revision, reported biserial correlations of .46 for Form M and .57

for Form L with the plan-of-search item. The Third Revision of the Stanford Binet (Terman & Merrill, 1960) again places the plan-of-search item at Level XIII. A biserial correlation of .47 with total test score at fifty-four percent passing is reported.

(5) *Object Completion*, consisting of sixteen familiar objects from which one important part had been removed (e.g., comb with a missing tooth). Subject was to identify the missing part.

(6) *Pattern Board*,[1] consisting of a 7½ inch square board with twenty-five round holes, half an inch in diameter, arranged in rows of five. Pegs could be inserted in the holes to form patterns. A fixed peg in the center hole served as a reference point. Subject was asked to examine a pattern with his fingers and then reproduce it after pegs were withdrawn.

Pattern Board is similar in some respects to a test used by James Drever (1955) at the University of Edinburgh for investigating space perception abilities of blind subjects. One piece of apparatus consisted of a board containing holes in which pegs could be inserted to produce designs. Drever's subjects were required to reproduce designs after the pegs were withdrawn and the board rotated 180°.

(7) *Bead Arithmetic*,[1] consisting of an abacus, approximately ten by eleven inches, with one broad horizontal divider. Five spokes were set in the frame, each with five large beads below the divider and two above. Level of difficulty of items varied from reading one-digit numbers entered by the tester to solving addition problems entered by the subject.

So far as we know, the abacus has not been previously used as a device for testing intelligence in either blind or sighted subjects. Learning to use and understand the principles of an abacus seem to be problem-solving processes. Its validity as a testing device would be vitiated by previous training in its use.

THE PLAN-OF-SEARCH TEST

In a plan of search test, the problem is usually presented in the following manner: A piece of paper upon which a circle, rectangle, or diamond is drawn is placed before the subject. The figure represents an area in which something of value is lost. With a pencil, the subject draws the path he would follow to search the area for the valuable object. The pattern which results is evaluated by raters as to its logical approach to the problem.

The test appears to lend itself readily to adaptation for the blind. As administered to the research sample in the present study, it consisted of asking the subject to search with a pencil for a hole under a sheet of paper marked in one-inch squares and placed over the Digit Symbol board. **Use 1-inch square wood block to demonstrate hole. Instructions were these:**

---

[1]Not included in the PSAB (Watson, 1956).

> You have before you a sheet of paper covering a tray. (Time was allowed for subject to examine tray.) Somewhere under the paper is a hole one-fourth inch in diameter. (A block of wood with a quarter-inch hole bored in it was given the subject to examine.) I want you to move this pencil around the paper in any way you wish but find the hole as quickly as possible. (Thirty seconds allowed for search.)

Actually, there was no hole to find and the subject utilized the entire trial period in searching.

The final scoring system took into account both the thoroughness with which the subject covered the area and whether or not he used a plan. The number of squares in which a pencil mark appeared was determined and the count doubled if the search was judged to be logical. No specific criteria for judging a pattern as logical or illogical were followed. If the subject had used a discernible plan of any sort rather than moving his pencil over the paper at random, he was credited with "logic."

By this scoring procedure, and using an N of 399, Plan-of-Search was found to correlate .37 after correction for contamination with a sum of seven HIS tests and .22 with WAIS Verbal Score. Its correlations with other HIS tests were low, all being between .27 and .33. The standard deviation was very large (5.6 in scaled score units). Test-retest reliability after a minimum lapse of six months was only .57 (N of 136). Retention of the test in a standardized scale was therefore considered to be unjustified.

It was hypothesized that providing specific criteria for evaluating the adequacy of patterns would increase the intra- and inter-reliability of raters and that greater reliability of raters would be associated with increased correlations between Plan-of-Search scores and the two criterion variables, HIS Total and WAIS Verbal Scores. A study to test these hypotheses was therefore undertaken (Padzensky, 1962).

Ten raters, all of whom had successfully completed at least two courses in psychological testing, were divided into two groups of five. Group I raters were told to rate patterns on a four point scale, 0 indicating no discernible plan at all and 1, 2, and 3 indicating relative degrees of adequacy. Group II raters were instructed to rate patterns as either logical or illogical [i.e., a dichotomy]. They were provided with specific criteria which followed in general the criteria for judging the logic of plans from the Third Revision of The Stanford Binet (Terman & Merrill, 1960). Such reasonable modifications as were necessary for blind subjects were made. For example, with the blind, intersections of the path were permitted if the intent was clearly to follow a pattern which did not include intersections or if the intersections were systematic. On two occasions, separated by two weeks, each rater judged 792 Plan-of-Search patterns drawn by blind subjects from the research sample.

Intra-reliabilities for Groups I and II raters were determined by correlating the first and second rating scores for each rater. Inter-reliabilities for Group I were obtained by correlating each rater's summed first and second judgments with each other rater's summed judgments. Inter-reliabilities for Group II were obtained for correlating the first trials of each rater with the first trials of each other rater. A comparison of Group I with Group II was made by transforming the correlations to Fisher's z's, summing and averaging, and testing the reconverted averages of Groups I and II for significance of differences. The average intra-reliability of Group I raters was .90; that of Group II raters, .96. The average inter-reliability of Group I raters was .72; that of Group II raters, .85. Both differences are significant at .01. The data therefore support the hypothesis that structuring criteria for judging patterns increases the reliability of raters.

The data did not support the hypothesis that increasing the reliability of raters would be associated with increased correlations between Plan-of-Search scores and the two criterion variables. Point-biserial correlations of Group I raters' judgments were .21 with WAIS and .34 with HIS scores. Group II raters' judgments correlated .21 with WAIS and .43 with HIS scores. Applying Fisher's z-test for significance of difference showed that averaged validity coefficients did not significantly increase when specific criteria for judging logic of patterns were followed.

It is interesting that a plan of search test, which purports to measure (and apparently does measure) in sighted subjects practical reasoning ability in problem solving, should yield such low correlations with a measure of general intelligence when performed by blind subjects. It is true that the blind subject in the present study was looking for something he expected to find, a hole located somewhere in an area approximately a foot square. The sighted subject is looking for a hypothetical object in a hypothetical field. The apparent similarity of the tasks may be only superficial and the important difference may be that one is concrete, the other symbolic.

FINAL FORM OF THE HIS

The final form of the HIS consists of six tests. Numbers of items in the tests, maximum raw scores, and time limits of these tests are given in Table I.

For reasons explained in the preceding section, Plan-of-Search was deleted from the scale. Other items were modified as a result of item analysis and time limits and time bonuses for some items were changed.

TABLE 1

NUMBER OF ITEMS, MAXIMUM RAW SCORES, AND TIME LIMITS OF THE SIX TESTS OF THE HIS

Test	*Items*	*Maximum Score*	*Time Limit Minutes*
Digit Symbol	40	44	2
Block Design	7	21	21
Object Assembly	4	28	20
Object Completion	15	30	15
Pattern Board	10	22	19
Bead Arithmetic	14	24	14-3/4
Total	90		91-3/4

With a less able and very compulsive subject who is allowed full time for every item, test time (including instruction) can run close to two hours. In practice this very rarely happens, for subjects either achieve a solution (not necessarily correct) or give up in less than the time limits on most items.

CHAPTER 2

STANDARDIZATION OF THE HIS

SAMPLING PROCEDURE

The verbal test most widely used with blind adults is the Verbal Scale of the WAIS.[2] Since the Performance Scale of the WAIS was, to some extent, the model for the Haptic Intelligence Scale, and since it seemed likely that the HIS would be most often used in conjunction with the WAIS Verbal Scale, Wechsler's procedure was followed both with respect to establishing age categories and the statistical treatment of data. This, it was thought, would make possible a more direct comparison of scores obtained on the two scales and, as the Wechsler Scales are so well known, their use as a paradigm would simplify the problem of interpreting scores for the non-statistically minded user of the new test.

Wechsler (1955) divided his subjects into seven age categories, 16-17, 18-19, 20-24, 25-34, 35-44, 45-54, and 55-64. Subjects between the ages of twenty and thirty-four generally obtained the highest scores among the age groups in the sample. These subjects were therefore used as the reference group.

We proposed to test 900 subjects between the ages of sixteen and sixty-four, divided into the same age categories as Wechsler's subjects. In the age groups 20-24 and 25-34, 200 subjects were to be tested, since these subjects were to serve as the reference group. It was hypothesized that their performance would be superior to that of older and younger persons. In each of the five other age groups, 100 subjects were to be tested. Equal numbers of males and females were to be included in each age group.

The population sampled consists of those individuals in the continental United States between the ages of sixteen and sixty-four who have vision not exceeding 5/200 central visual acuity in the better eye with proper correction, excluding those with other sensory handicaps.

The last attempt by the U. S. Census Bureau to include figures on incidence of blindness in the population in the General Census was in 1930. It was then decided that the figures were so inaccurate because of the lack of a uniform definition of blindness and the reluctance of respondents to report blind family members (among other reasons) that statistics on blindness should be discontinued because they were misleading.

In 1956, Congress established the U. S. National Health Survey, a program of the National Center for Health Statistics. It is a continuing program of surveys based on interviews conducted by the U. S. Bureau of the Census under contract to the Public Health Service. In April, 1959, a report was published which included rates per thousand in the United States of blindness and other visual impairment by sex, age, and gross major activity (school and preschool, usually

[2] In its earlier form, the Wechsler-Bellevue Intelligence Scale.

working, keeping house, retired, other). A person was classified as blind, as distinct from "other visual impairment," if (a) he was six years old or older and a negative response was given to the question "Can you read ordinary newspaper print with glasses?", or (b) he was under six years of age (or was over six but had never learned to read) and was reported as blind or in terms indicating that he had no useful vision in either eye. The rate shown for blindness was 5.7 per 1,000 persons (Health Statistics, Series B-9, p. 4). While this report contains much interesting material, the lack of precision in defining blindness would have negated its usefulness as a source of information in establishing quotas for a sample of the totally blind population even had it been available when the present study was begun.

Two additional reports, both published in March, 1961, include references to visual impairments as related to geographic regions and urban-rural residence (Health Statistics, C-5) and geographic regions and large metropolitan areas (Health Statistics, C-6).

Hurlin (1953) estimated the incidence of "economic blindness" in the United States by a method based on the age of the population, its non-white component, and the health standards of the states. In 1958, the American Foundation for the Blind made available mimeographed material bringing the estimates up-to-date. These estimates, however, refer to all the legally blind, not to the segment of this population whose vision is so limited that they are classified as totally blind, as are the subjects in the present study.

Since information about the totally blind population was insufficient to permit the use of simple random or stratified random sampling procedures, a quota sampling system based upon the total population of the United States as reported in the 1950 Census was employed. This involved stratification of the experimental population on variables related to intelligence and selection of subjects for the strata in proportion to their frequency in the total population. The stratification variables selected were region, race, and urban-rural residence. Tables were worked out to assign cases to the four geographic regions of the country (Northeast, Northcentral, South and West) in proportion to their populations, to include whites and non-whites in the proportions given in the 1950 Census, and to maintain proper urban-rural representation.

Since it can be assumed that both occupation and education are related to intelligence in the blind, their exclusion may be questioned. To base proportional representation in a blind sample upon occupations according to their incidence in the general population, in addition to being almost impossible, would undoubtedly bias the blind sample with respect to ability. Although persons without useful vision are employed in all fields, many specific jobs are closed to them. There is some evidence that totally blind persons require more mental ability than persons with useful vision in sales, rural, and service occupations. A large number of higher IQs among employed blind persons in factory-trade occupations has also been reported (Bauman, 1954).

Educational opportunities are clearly not equivalent for the blind and the sighted, and blindness affects years of schooling completed in various ways.

The blind person of average ability may drop out of school because of his handicap or remain in school longer than he otherwise would because he has nothing else to do.

SOURCES OF SUBJECTS

Most persons tested were selected from the files of cooperating agencies or industries, such as Workshops belonging to the National Industries for the Blind, State vocational rehabilitation agencies, companies employing the blind, agencies administering vending stands, and welfare agencies administering aid to the blind.

Naturally, the files of cooperating agencies were not opened to us. The administrator of an agency in a given area was asked to suggest someone on his staff or known to him personally, experienced in testing, who would be willing to give tests to blind subjects in the area. The contact between tester and subject was then made through the agency or in a manner authorized by it.

Some subjects were obtained by the simple expedient of asking one subject if he had blind friends or acquaintances who would be willing to serve as subjects.

SELECTION AND TRAINING OF TESTERS

In Chicago and Northern Illinois, tests were with few exceptions given either by staff members or graduate students in the Department of Psychology and Education of Illinois Institute of Technology. All testers associated with the Institute had had graduate training in psychology and were familiar with general testing procedures. They were required to administer the HIS at least twice to blind subjects under supervision before giving unsupervised tests.

Elsewhere in the United States, testers were chosen on the recommendation of directors of agencies in the area. These testers, too, had invariably had some formal training in psychology, although not always at the graduate level, and were familiar with routine testing procedures. All of them were, or had at some time been, engaged in work with the blind. This was an advantage, for some sighted persons who have had no experience with blind people tend initially to be ill at ease with them and this is not conducive to establishing the rapport which contributes to valid testing.

Test kits and manuals giving detailed instructions were delivered to field representatives by a member of the project staff, who first gave one or more test demonstrations and then observed the administration of the HIS by the trainee to at least two subjects. The need for strict adherence to standard testing procedures was repeatedly emphasized.

The WAIS Verbal Scale was administered to all subjects according to directions in the WAIS Manual (Wechsler, 1955), with two minor modifications. Question 5 of *Comprehension* reads, "What should you do if while in the movies you were the first person to see smoke and fire?" This was changed to ". . . first person to discover a fire?" Bauman and Hayes (1951), Dishart (1959), and

Rothschild (1959) have suggested substituting Wechsler Form I Alternates for Questions 5 and 9 of WAIS *Comprehension* (2 and 7 in the Wechsler Bellevue Intelligence Scale). We did not find that blind subjects have disproportionate difficulty in understanding and answering Questions 5 and 9.

Naturally, the printed vocabulary list was not offered to the subject, since he could not read it. Each word was pronounced distinctly, several times if necessary, and spelled at request.

THE RESEARCH SAMPLE

In all, tests were administered to 994 blind adults. When testing was terminated and the distributions of WAIS Verbal IQs for the seven age groups were compared, it was found that mean WAIS IQs differed significantly. They are shown in Table 2.

TABLE 2

MEANS AND STANDARD DEVIATIONS OF WAIS VERBAL IQS OF 994 BLIND SUBJECTS COMPRISING THE RESEARCH SAMPLE

Age Group	*N*	*Mean IQ*	σ
16-17	100	102.55	16.67
18-19	100	102.50	16.75
20-24	197	105.43	19.21
25-34	202	108.72	18.37
35-44	159	112.53	18.49
45-54	127	106.00	17.69
55-64	109	102.40	16.52
	994		
20-34	399	107.10	18.78

The difference between the mean WAIS Verbal IQ of the 16-17 year olds and the 25-34 year olds is 6.17. The critical ratio of this difference is 2.48, significant at .02. The mean of the combined 20-24 and 25-34 year olds is 107.10, with a standard deviation of 18.78. The critical ratio of the difference between this mean and that of the 16-17 year olds is 2.37, also significant at .02. The difference between the means of the 16-17 and 35-44 year olds is significant at .001.

These results posed a serious problem. In the age range 20-54, selection had obviously played a distorting role in the blind sample. Judged on the basis of the distributions of WAIS IQs, the only criterion available, the 20-34 year olds were as a group superior to the 16-19 and 55-64 year olds and were themselves inferior to the 35-44 year olds.

It was therefore decided to match the age groups in the following manner: for every subject in the 16-17 year old group, subjects were selected from the 20-24, 25-34, 35-44, and 45-54 year old groups who were of the same sex, came from the same region, and deviated in WAIS Verbal IQ by no more than four points. The resulting sample of 700 cases is hereafter referred to as the *normative sample* to distinguish it from the total group tested (the research sample).

Among the 294 subjects rejected for the normative sample were included those about whom there was any doubt as to their meeting the criteria of the study with respect to level of vision and freedom from other sensory defects or conditions such as, for example, arthritic crippling of the hands (presumed to be an invalidating handicap).

It can be argued that matching subjects from different regions on a test, even though it is not the test to be standardized, negates the purpose of regional quota sampling. The method was resorted to only as the lesser of two evils. Because of the method of selecting subjects, the representativeness of the normative sample cannot be established statistically nor can estimates be made of the parameters of the population from which it was drawn.

THE NORMATIVE SAMPLE

Ability, Measured by WAIS Verbal IQ

Means and standard deviations of WAIS Verbal IQs of the seven age groups of the normative sample are shown in Table 3. Subjects in four of these groups (20-54) were selected by the method described in the preceding section.

TABLE 3

MEANS AND STANDARD DEVIATIONS OF WAIS VERBAL IQS OF 700 BLIND SUBJECTS COMPRISING THE NORMATIVE SAMPLE

	No. of Subjects				
Age Group	*M*	*F*	*T*	*Mean IQ*	σ
16-17	50	50	100	102.55	16.67
18-19	50	50	100	102.50	16.75
20-24	50	50	100	102.25	16.84
25-34	50	50	100	102.20	16.58
35-44	50	50	100	102.25	16.54
45-54	50	50	100	102.55	16.81
55-64	50	50	100	102.35	16.49
Total	350	350	700		

The difference between mean IQs and standard deviations of the 55-64 year olds in Tables 2 and 3 are due to discarding nine cases.

Geographic Region and Race

Matching subjects resulted in some distortion of the normative sample with respect to regional representation. For example, of females aged 16-17, thirty six percent live in the South; of females aged 20-34; thirty-three percent live in the South (according to the 1950 Census). When every female in the correctly constituted 16-17 year old group is matched for region and IQ with a 20-24 year old female, there are two extra Southerners in the 20-24 year old group. The degree of distortion of regional representation is, it is thought, so slight as to be unimportant.

Table 4 shows the composition of the normative sample by geographic region and age level. In this table, it can be compared with the general population reported in the 1950 Census. Proportional representation of whites and non-whites was maintained.

TABLE 4

NORMATIVE SAMPLE BY GEOGRAPHIC REGION[a]

		Northeast		*Northcentral*		*South*		*West*	
Age Group	*Sex*	*% in U. S. Pop.*	*% in HIS Sample*	*% in U. S. Pop.*	*% in HIS Sample*	*% in U. S. Pop.*	*% in HIS Sample*	*% in U. S. Pop.*	*% in HIS Sample*
16-17	M	24	24	28	28	36	36	12	12
	F	24	24	28	28	36	36	12	12
18-19	M	24	24	27	28	36	36	13	12
	F	25	24	29	30	35	34	11	12
20-24	M	25	24	29	28	33	36	13	12
	F	26	24	29	28	33	36	12	12
25-34	M	26	24	29	28	31	36	14	12
	F	27	24	29	28	31	36	13	12
35-44	M	27	24	29	28	30	36	14	12
	F	28	24	29	28	30	36	13	12
45-54	M	29	24	30	28	28	36	13	12
	F	29	24	30	28	29	36	12	12
55-64	M	29	30	32	32	26	26	13	12
	F	30	30	31	32	26	26	13	12

[a] Percentages in the U. S. Population are according to the 1950 Census.

Urban-Rural Representation

Urban areas were defined as communities with more than 2,500 inhabitants or suburban fringes of large cities; smaller communities were considered rural. As the study progressed, it became apparent that to control urban-rural representation was almost impossible. Totally blind subjects in the numbers needed are hard to find, particularly when restrictions as to age, sex, and race are imposed.

There was also a problem of classification. A number of subjects had lived in rural areas until they became blind and had then moved to cities for training, because they hoped to find employment, or for other reasons. Rural subjects in the 16-19 age range are often sent to cities where they can attend schools for the blind.

The rule followed was to classify as rural, in addition to those living in rural communities, those subjects who gave as their permanent address a rural community, even though tested in an urban community, and those who had come to an urban from a rural community within the past three years for reasons attributed to blindness.

The degree of precision in urban-rural classification does not warrant including a table showing percentages of urban and rural subjects in the seven age groups. Approximately thirty percent of the subjects in the normative sample were rural by the criteria adopted.

Education

No attempt was made to establish quotas of blind subjects by educational level. Field representatives were asked to select a group of subjects who were, they thought, a representative sample of the blind population in their areas with respect to education and occupation. They tended, however, to include among their subjects too many of their friends and acquaintances from among the blind personnel of agencies and these were, in general, a superior group. When it became apparent that the sample was being distorted by the inclusion of too many subjects of superior ability, testers were instructed to include no more persons with college training. No other restrictions were imposed.

The composition of the normative sample with respect to years of formal schooling is shown in Table 5.

TABLE 5

NORMATIVE SAMPLE BY EDUCATION[a]

		Years of School Completed									
		8 or less		*9-11*		*12*		*13-15*		*16 or more*	
Age Group	*Sex*	*% in U.S. Pop.*	*% in HIS Sample*	*% in U.S. Pop.*	*% in HIS Sample*	*% in U.S. Pop.*	*% in HIS Sample*	*% in U.S. Pop.*	*% in HIS Sample*	*% in U.S. Pop.*	*% in HIS Sample*
16-17	M	32		64		4		*		*	
	F	22	35	72	55	6	10	*	*	*	*
18-19	M	25		34		33		8		*	
	F	18	16	32	32	41	48	9	4	*	*
20-24	M	26		24		29		16		5	
	F	20	17	23	19	40	44	12	14	5	6
25-34	M	30		22		29		10		9	
	F	26	30	22	18	38	38	8	7	6	7
35-44	M	44		20		20		8		8	
	F	39	37	21	17	25	31	9	8	6	7
45-54	M	58		16		13		6		7	
	F	53	38	17	22	17	26	8	7	5	7
55-64	M	67		12		11		5		5	
	F	63	52	14	15	13	21	6	9	4	3

* Less than 1%.
[a] HIS Sample percentages include both males and females.

Among the 16-17 year olds, thirty-two percent of the males and twenty-two percent of the females in the United States have had eight years or less of schooling and thirty-five percent of the blind sample have not gone beyond the eighth grade. From the age of eighteen on, proportionately more of the blind have gone beyond the eighth grade. If individuals who have reached the twelfth grade are considered, at every age level the percentage of the blind exceeds those of the sighted.

It will be recalled that the average WAIS Verbal IQ at every age level in the normative sample is approximately 102. Because there is reason to believe that the blind have some slight advantage on verbal tests, it can be assumed that the average intelligence of the blind at different levels of age and education is about the same or lower than the average intelligence of the segments of the general population with which they are being compared. So it is unlikely that superior ability is responsible for more blind than sighted getting through high school.

It is true many factors may have distorted the results obtained in the normative sample. It may be, for example, that the blind person with more education is more disposed to contact agencies than the blind person of equal ability but less education. More than half the subjects in the normative sample were recruited through agencies in some way involved with services to the blind. Therefore, we cannot conclude that the blind in general go farther in school than sighted people of equal ability. It can only be said that this tendency was evident in the blind sample of this study.

It is also true that at each level as age increases more subjects are included who became blind after the age at which school attendance is normally over. In many of these cases, then, blindness did not affect length of school attendance, unless they returned to school after blindness occurred.

In view of all these uncertainties, aside from showing what the characteristics of the normative sample were with respect to years of schooling, the data presented in the table give rise to speculations but permit no conclusions.

Occupation

Since the number of persons in the United States with vision not exceeding 5/200 has not even been determined, it is clearly impossible to estimate with any degree of precision how they are employed. Therefore whether or not the occupations reported by the subjects in the normative sample, shown in Table 6, are representative of the occupations of the population from which they were drawn cannot be established. There are no figures with which to compare the percentages shown in the table.

TABLE 6

OCCUPATIONAL DISTRIBUTION OF SUBJECTS IN THE NORMATIVE SAMPLE

Occupation	*% of Sample*
Professional, technical, and kindred workers	4.5
Managers, officials, and proprietors (including farm)	2.6
Clerical, including dictaphone and switchboard operators	3.2
Stand operators	1.6
Other sales	1.7
Piano tuners	.1
Weavers, reed workers, broom makers	4.2
Power machine operators, foremen (sheltered shop)	1.3
Bench assembly workers	5.3
Housewives	12.0
Service workers	2.5
Domestic workers	.2
Laborers	1.3
Trainees in Rehab. Centers	2.8
Lighthouse employees, miscellaneous	1.7
Students (full and part-time)	28.0
Unemployed	27.0
	100.0

Age at Onset of Blindness

Ages at which subjects in the normative sample reported that defective vision was first observed are shown in Table 7. These are not necessarily the ages at which total blindness occurred. Among the 16-17 year olds, seventy percent were congenitally blind or became blind during the first month of life, while among the 55-64 year olds defective vision by the age of one month was reported by only seven percent. Between these two extremes, the percentages decrease with increasing age, although both the 35-44 and 45-54 groups include twenty-five percent in whom defective vision had been observed by the age of one month.

TABLE 7

AGE AT WHICH DEFECTIVE VISION WAS FIRST OBSERVED IN THE NORMATIVE SAMPLE

	Age Groups						
Age at Onset	*16-17* %	*18-19* %	*20-24* %	*25-34* %	*35-44* %	*45-54* %	*55-64* %
Congenital to 30 Days	70	68	51	34	25	25	7
1 Month — 1 Year	3	2	4	6	2	6	6
1 - 2 *Years*	3	....	4	6	1	3	2
3 - 5	....	5	6	5	4	5	4
6 - 10	11	9	8	10	5	2	7
11 - 15	13	12	10	11	6	6	5
16 - 20	....	3	12	8	6	3	9
21 - 25	....	....	5	12	6	2	6
26 - 30	....	....	....	6	11	3	2
31 - 35	....	....	....	2	11	9	3
36 - 40	....	....	....	....	17	5	12
41 - 45	....	....	....	....	6	15	5
46 - 50	....	....	....	....	....	11	6
51 - 55	....	....	....	....	....	5	21
56 - 60	....	....	....	....	....	....	4
61 - 64	....	....	....	....	....	....	1

About two-thirds of the eye diseases that cause blindness occur most frequently among older persons (Hurlin, 1953). The younger subjects in the sample had not reached the age when these diseases begin to be major causes of blindness. Infectious disease, once a major cause of blindness among younger people (and still so in many countries), is less and less a causative agent of blindness in the United States. For these reasons, the younger the age of the blind subjects to be sampled, the higher will be the percentage of congenitally blind among them.

There is evidence that age at onset of blindness affects performance on non-verbal tests. Worchel (1951) obtained high and significant correlations between age at blinding and tactual form reproduction, description, and the manipulation of space relations. Tiffin (1960) reports that as onset occurs earlier, speed of performance is increased and speculates that an observed drop in average performance level as vision decreased (high, mid, and low vision groups) may be partially due to the fact that, among his subjects, blindness occurred significantly later in life among lower vision subjects. Of his 626 subjects, however, none was younger than twenty and seventy-four percent were thirty years old or older.

It may be suggested that, since age at onset of blindness affects performance on non-verbal tests, some attempt should have been made to achieve a more equitable representation of congenitally blind subjects in the various age groups of this sample. Without laboring the difficulties which would have been encountered in such an attempt, if it had been successful, the biases introduced might have been more serious than the one controlled, for the aim of sampling was to select a group at each age level as representative as possible of all totally blind subjects that age. Among the totally blind, the percentage of those born blind or blinded by the age of one month does decrease as age increases.

Cause of Blindness

Field representatives who had access to medical diagnoses in the records of agencies or schools copied these on HIS record sheets but in many cases it was necessary to accept the subject's own report. The more intelligent subjects who had had medical attention were probably fairly accurate in reporting diagnoses. Among the poorer, less well educated, less intelligent, and older subjects, cause of blindness was often unknown or attributed to "wrong medicine in eyes," being dropped in infancy, a "cold," etc. (no doubt sometimes true).

Causes of blindness entered on record sheets of the subjects in the normative sample are shown in Table 8.

TABLE 8

CAUSES OF BLINDNESS REPORTED BY SUBJECTS IN THE NORMATIVE SAMPLE[a]

Reported Cause	*% of Sample*
Accidents gunfire, explosion, automobile, poison, various childhood	14
Cataract, including congenital	12
Hypertension, including infantile glaucoma	10
Infectious disease scarlet fever, measles, chicken pox, meningitis, syphillis, tuberculosis, septicemia, other	10
Optic atrophy, retinal degeneration	9
Detached retina	5
Retinitis pigmentosa	4
Anopthalmos, micropthalmos	3
Tumors eye, optic nerve, brain	3
Micellaneous conditions of diabetic origin	3
Retrolental fibroplasia	2
Retinal or vitreous hemorrhage	1
Miscellaneous choreoretinitis, ulcers of cornea, aphakia, nystagmus, retinitis proliferens, muscular degeneration, keratitis, myopia, albinism, other	12
Unknown	12

[a] Taken from medical records when available.

DERIVATION OF HIS SCALED SCORES

When the distributions of sums of raw scores of the six tests retained in the final form of the HIS were examined, the mean score of subjects in the age range 20-34 was found to be higher than that of subjects in the other age groups, although the difference between means of the 16-19 year olds and the 20-24 year olds was negligible. The original plan, to use the 20-34 year olds as the reference group, was therefore followed. For each test of the HIS, the distribution of scores of the 200 subjects in the normative sample between the ages of twenty and thirty-four was converted to a scale with a mean scaled score of ten and a standard deviation of three. This was accomplished by the method used by Wechsler (1955, p. 18), in which a cumulative frequency distribution of raw scores is prepared and each percentile point established at its appropriate standard score value on a theoretical normal curve. Scaled score equivalents of raw scores are shown in Table 13, p. 41.

The raw scores of all other subjects in the normative sample were then converted to scaled scores based on the reference group. The mean sums of scaled scores and their standard deviations for the seven age groups are shown in Table 9. This table shows that beyond the age of thirty-four, mean test performance on the HIS begins to decline appreciably with age.

TABLE 9

MEANS AND STANDARD DEVIATIONS OF SUMS OF HIS SCALED SCORES BY AGE GROUPS: NORMATIVE SAMPLE

Age Group	*N*	*Mean*	σ
16-17	100	58.95	18.69
18-19	100	59.00	19.01
20-24	100	59.14	18.57
25-34	100	60.88	19.47
35-44	100	57.15	18.39
45-54	100	53.38	17.73
55-64	100	49.85	18.01
	700		

CONSTRUCTION OF IQ TABLES

Since the scaled score value of a given raw score is based on a reference group and does not vary with age, scaled scores make it possible to compare a subject's test performance with that of the reference group but not with the age group to which he belongs. On many tests, the average performance of subjects begins to fall as age increases beyond maturity. On such tests, a given sum of scaled scores may mean, for example, that a sixty year old subject performed as well as the average twenty-five year old subject but much better than the average sixty year old subject on the test in question. The performance of a subject must therefore be compared with that of other subjects approximately his age if we want to obtain an estimate of the relative goodness of his performance among his age peers. This can be done by taking the average performance of subjects in a given age range as a reference point and then expressing in some convenient way the extent to which each possible score deviates from the mean of that age range. A conventional way of doing this is to employ the IQ concept, arbitrarily setting the mean score at 100, the standard deviation at 15, and converting every possible score on a test to this scale. In very simple words, an IQ of 100 then means that its possessor has shown as much ability on that test as the average person his age.

It was first established that no difference significant at even .10 existed between the mean HIS Total scores of men and women in any of the seven age groups. Bartlett's test for homogeneity of variance was then applied to the HIS variances shown in Table 9. The obtained B value of 1.19 has a chi square probability of approximately .97 associated with it. Therefore a single estimate of the standard deviation was computed (Guilford, 1936, p. 56) and used in the construction of IQ tables for all seven age groups. This value was 18.72.

The IQ distribution for each age group was constructed by setting the mean sum of scaled scores for that age group at 100 and the estimated standard deviation of 18.72 at 15 and converting every possible sum of scaled scores to an IQ.[3] These distributions are shown in Table 14, p. 42. The IQs associated with sums of scaled scores were identical for 16-17 and 18-19 year olds; these age groups were therefore combined.

RELIABILITY OF THE HIS

Both test-retest and odd-even reliabilities of the tests and the full scale were determined. As would be expected, odd-even reliabilities are higher than test-retest. The true reliabilities no doubt lie somewhere between the two sets of obtained values.

Test-Retest Reliability

A group of 136 subjects, twenty from the South and 116 from the North-central area, were retested after a minimum time lapse of six months. Each subject included in the group had been blind at least two years prior to initial testing. It was thought that this would rule out a possible effect of improved adjustment to blindness which might have occurred in more recently blinded subjects between the first and second test administrations. Otherwise, subjects were chosen for the reliability study because they were easily accessible and willing to cooperate. Because these subjects were among those first recruited and modifications of procedures in the administration of certain tests were introduced between initial test and retest, N is not 136 for all correlations.

Table 10 gives the test-retest reliabilities and standard errors of measurement (in scaled score units) of the tests.

TABLE 10

TEST-RETEST RELIABILITY COEFFICIENTS AND STANDARD ERRORS OF MEASUREMENT[a] OF HIS TESTS

Test	*N*	*r*	σm
Digit Symbol	136	.77	2.16
Block Design	126	.77	2.06
Object Assembly	136	.70	2.30
Object Completion	126	.76	1.66
Pattern Board	125	.81	1.96
Bead Arithmetic	36	.75	1.60

[a] In scaled score units.

Full scale test-retest reliability is not included in Table 5 because only 36 of the group retested had the final form of the Bead Arithmetic test when they were tested for the first time. Test-retest reliability for the sum of five tests (excluding Bead Arithmetic) was .91, with an N of 124.

3 By the formula $X_2 = \frac{\sigma_2}{\sigma_1}(X_1 - M_1) + M_2$, where

M_1 = Mean of the sum of scaled scores
σ_1 = Standard deviation of sum of scaled scores
X_1 = Any sum of scaled scores
M_2 = 100
σ_2 = 15
X_2 = IQ

Odd-Even Reliability

Odd-even reliabilities of five of the HIS tests and the full scale were calculated from the scores of 399 subjects aged 20-34. These subjects comprise the entire group of 20-34 year olds in the research sample. This group is not to be confused with the 20-34 year old group in the normative sample, although subjects comprising the normative sample are included in it.

Odd-even reliabilities and their associated standard errors of measurement are shown in Table 11. Standard errors of measurement are in scaled score units for the tests and in IQ units for the full scale. The correlations have been corrected for full length of the test by the Spearman-Brown formula. Digit Symbol is not included in the table because, as a test of both accuracy and speed, it does not meet the requirements for a split-half technique.

TABLE 11

ODD-EVEN RELIABILITY COEFFICIENTS AND STANDARD ERRORS OF MEASUREMENT[a] COMPUTED FROM SCORES OF 399 SUBJECTS FROM THE RESEARCH SAMPLE AGED 20-34

Test	r_{II}	σ_m
Block Design	.93	1.14
Object Assembly	.79	1.92
Object Completion	.85	1.32
Pattern Board	.84	1.80
Bead Arithmetic	.94	.78
HIS IQ	.95	3.35

[a] In scaled score units for the tests and IQ units for the HIS IQ.

INTERCORRELATIONS OF HIS AND WAIS VERBAL TESTS

The intercorrelations of the six tests of the HIS and the six tests of the WAIS Verbal Scale are shown in Table 12. Correlations were computed from the scores of 399 subjects from the research sample in the age range 20-34. Correlations of the WAIS tests with WAIS Verbal Score and HIS tests with HIS Total Score were corrected for contamination, using the formula recommended by McNemar (1949, p. 139).

The intercorrelations among the HIS tests suggest that all six tests, while unique to some extent, contain a relatively large common factor. It may be that ability to solve concrete problems by perception and manipulation of objects and relationships without the aid of sight will always involve to a large extent a common factor. Bauman mentions that intercorrelations among tests of motor skills used with blind persons are higher than among the same tests used with sighted persons (1946; 1958, p. 25). The intercorrelations among WAIS Verbal tests in the present study show the same tendency [i.e., to be higher for blind subjects than those elsewhere reported for sighted subjects].

Intercorrelations among the performance tests were also high (higher than those reported here) for scores obtained from thirty-nine totally blind subjects in the preliminary study (Watson, 1956). It was in an attempt to achieve more uniqueness of measurement that Pattern Board and Bead Arithmetic were introduced into the scale. Neither of these appears to require fine tactile discrimination or skillful manipulation of parts to the extent required by the four other tests. While these two tests tend to correlate higher with WAIS Verbal tests, the anticipated tendency toward lower correlations with other HIS tests is not shown.

Table 12, giving the intercorrelations of WAIS Verbal and HIS tests for blind subjects aged 20-34, can be compared with Table 8 in the WAIS Manual (Wechsler, 1955, p. 16), which shows intercorrelations of WAIS tests for subjects aged 25-34.

TABLE 12

INTERCORRELATIONS OF WAIS VERBAL AND HIS TESTS COMPUTED FROM THE SCORES OF 399 SUBJECTS FROM THE RESEARCH SAMPLE AGED 20-34

	WAIS Tests							HIS Tests						
	Inf	*Comp*	*Arth*	*Sim*	*D.Sp*	*Vocb*	*V.Sc.* [a]	*D.Sy*	*Bl.D*	*ObjA*	*ObjC*	*P.Bd*	*B.Ar*	*HIS Sc.* [a]
Information		.77	.67	.73	.54	.82	.80	.39	.39	.26	.31	.41	.51	.45
Comprehension			.65	.74	.48	.83	.81	.41	.42	.34	.41	.42	.55	.51
Arithmetic				.61	.60	.66	.71	.51	.46	.33	.33	.54	.60	.55
Similarities					.50	.75	.75	.41	.45	.37	.38	.47	.53	.52
Digit Span						.55	.58	.41	.36	.17	.20	.42	.42	.40
Vocabulary							.85	.38	.36	.22	.30	.38	.47	.42
Verbal Score[a]								.50	.46	.32	.37	.50	.61	.65
Digit Symbol									.66	.58	.55	.68	.63	.74
Block Design										.71	.66	.68	.61	.82
Object Assembly											.60	.61	.53	.73
Object Completion												.54	.55	.69
Pattern Board													.65	.75
Bead Arithmetic														.73
Mean	11.2	11.9	10.6	11.2	11.6	10.6	66.9	10.5	10.2	10.4	10.5	9.6	10.4	61.7
σ	3.6	4.5	3.6	3.4	3.6	3.9	19.4	4.5	4.3	4.2	3.4	4.5	3.2	20.7
Correlation of WAIS tests with Verbal Score and HIS tests with HIS Score before correction for contamination:	.86	.88	.80	.82	.70	.90		.83	.88	.82	.77	.84	.80	

[a] Verbal Score, sum of 6 WAIS tests; HIS Score, sum of 6 HIS test. Coefficients with these variables in the main body of the table have been corrected for contamination.

With respect to WAIS Verbal tests, coefficients from the blind sample are consistently higher than those from the sighted sample. With respect to correlations between Verbal tests and Verbal Score, five of the six comparisons showed differences of .04 or less. The correlation of Comprehension with Verbal Score is .71 for the sighted and .81 for the blind.

Examination of the two tables shows that the Performance tests of the WAIS have generally higher correlations with WAIS Verbal Score (ranging from .48 to .67) than the HIS tests with WAIS Verbal Score (ranging from .32 to .61). The WAIS Performance Score correlates .77 with WAIS Verbal Score. The HIS Total Score correlates .65 with WAIS Verbal Score. Considering individual verbal tests rather than Verbal Score, the correlations between WAIS Performance tests and WAIS Verbal tests tend to be higher than the correlations between HIS tests and WAIS Verbal tests. In effect, WAIS Performance tests administered to sighted persons are better predictors of verbal performance than are HIS tests administered to blind persons.

The intercorrelations of WAIS Performance tests with each other (ranging from .44 to .62) and with Performance Score (ranging from .58 to .71) are generally lower than the intercorrelations of the HIS tests. These latter range from .53 to .71 between the tests and from .69 to .82 between the tests and the HIS Score. This indicates that the WAIS Performance tests are less alike in what they measure than are the HIS tests. Whether this is due to the nature of the tests or the nature of the subjects is a moot question.

Any implication that HIS tests measure in the blind the same factors that WAIS Performance tests measure in the sighted is not intended. They may or they may not. It seems reasonable to suppose that the two scales do assess to some extent the same abilities, but to what extent can never be determined with precision, for the blind cannot take the WAIS Performance Scale.

Inferences could be drawn from administering both scales to a sighted population, blindfolded for the HIS, and factor analyzing the results but generalizations from such a study would need to be cautious, for a blindfolded sighted population cannot be assumed to be comparable to a blind population. Nevertheless, such a study would be interesting, for it may be that a "haptic" test performed without vision can contribute something to a test of general intelligence which is not contributed by verbal tests or non-verbal tests performed with vision.

EFFECTS OF AGE AT ONSET AND DURATION OF BLINDNESS ON HIS SCORES[4]

Kamin (1964) investigated the effects of age at onset and duration of blindness upon HIS performance, using scores of 751 subjects from the research sample of the HIS standardization population. Specifically, he hypothesized:

[4]For a review of the literature on effects of age at onset and duration of blindness on test performance, see Kamin, H. S. Onset and duration of blindness: affectors of Haptic Intelligence Scale performance. Unpublished doctoral dissertation, Ill. Inst. Tech., 1964.

(1) Ss who became blind later in life have higher HIS scores, and (2) Ss who have been blind for a shorter time have higher HIS scores. Other variables which affect HIS performance were identified and controlled by statistical procedures while age at onset and duration were related to HIS scores.

Centroid factor analysis with orthagonal rotation and distribution comparisons identified two independent variables, verbal intelligence (represented by WAIS Verbal Scaled Score) and age, which should be controlled. Education, level of vision (none, light perception, over light perception to 5/200), sex, and race were not significantly related to HIS scores. Marital status and occupational information were not included in the analyses, since they are not continuously distributed.

To determine the effect of age at onset of blindness on performance for each HIS test and the Full Scale Score while holding verbal intelligence and age constant, three-way analysis of variance designs with non-repeated measurements as described by Walker and Lev (1953) were programmed in an IBM 7090 computer after the procedure developed by Sorkin, et. al. (1964). For these designs the experimental variable, age at onset, was broken into five levels: birth, 1 to 5, 6 to 10, 11 to 15, and 16 years or older. Subjects were controlled by three levels of WAIS Verbal Scaled Score: 62 or less, 63 to 76, and 77 or higher.

The procedure for evaluating the effect of duration of blindness was exactly the same as that used for age at onset except that the experimental variable was length of time blind: less than 5 years, 5 to 9, 10 to 14, 15 to 19, and 20 years or longer.

Age at onset was found to be related at the .05 significance level to scores on three HIS tests — Block Design, Object Assembly, and Pattern Board — and at the .01 level to the Full Scale Score. On Block Design and Object Assembly, Ss who became blind after age five performed better than the earlier blind. On Pattern Board, Ss who lost their sight during ages six through ten were superior both to the younger and to the sixteen and over age-at-onset groups. In general, for the Full Scale Score, Ss who became blind after age five were superior to the younger age-at-onset groups. The six through ten age-at-onset Ss were superior to the sixteen and over group.

Duration of blindness was not found to be related to scores on any HIS test or to the Full Scale Score at the .05 level of significance.

There were no significant interaction F's between any of the variables, experimental or control. The effect of any variable was therefore assumed to be the same at any level of the other variables.

INTERPRETATION OF HIS SCORES

Although a great deal of work has already been done with the HIS, it is not represented as a perfected test in its present form. While the reliability of the full scale is good, the tests which comprise it show relatively high intercorrelations and relatively large standard deviations which, in combination with moderate reliability coefficients, result in high standard errors of measurement. It should be administered and interpreted with caution, with much of its current value being in the clinical cues it provides the trained psychologist using it.

The norms which have been developed are based upon a legally totally blind population. Their applicability to partially sighted subjects who take the scale blindfolded has not been established. In the preliminary study (Watson, 1956), a triserial correlation of .21 (significant at .05) was computed between full score on the preliminary form of the scale and amount of vision for totally blind, partially sighted, and sighted subjects, the partially sighted and sighted being blindfolded. As vision decreased, the quality of performance improved. It therefore appears that level of vision has some slight effect on test performance, even though vision is not utilized.

Those who administered the scale in the standardization study, most of whom were engaged in work with the blind, in general agreed that it provided, in addition to a measure of intelligence, an enlightening opportunity to observe the way a blind subject approached the solution of problems involving performance rather than verbal response.

Dr. Jacob Rothschild,[5] who cooperated in the standardization study by administering the scale to blind subjects at the Long Island Rehabilitation Center, mentions in an article in *New Outlook* that experimentation with the scale indicates that it will be a valuable complement for the completion of a test battery and will enable the examination of an area of intelligence in the blind which could not previously be tested by standardized methods (Rothschild, 1959, p. 250).

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[5]We are also indebted to Dr. Rothschild for helpful suggestions for clarifying instructions for Bead Arithmetic.

CHAPTER 3

ADMINISTRATION OF THE HIS

GENERAL PROCEDURES

Seat the subject at a table wide enough to accommodate the test materials without crowding but not so wide that the examiner cannot easily reach across to guide the subject's hands in giving instructions. It is convenient to have a second small table at hand upon which test materials can be laid out before testing begins. Standard conditions for valid test administration should be observed [i.e., a quiet room, freedom from interruptions, etc.]. Fill in the information requested on the front of the record form before beginning the test.

Directions in this manual should be followed explicitly. Adhere to exact wording of instructions to the subject. Friendly and non-committal remarks are sometimes in order, but much depends on the experience and good judgment of the examiner. He must decide when the subject should be allowed to concentrate and when he should be encouraged by sympathetic comment. The implication must always be that the subject is doing well. He should never, however, be told that he is right (or wrong).

Order of test administration is:

- Digit Symbol
- Block Design
- Object Assembly
- Object Completion
- Pattern Board
- Bead Arithmetic

If for some reason one of the tests is omitted or spoiled, the sum of the scaled scores for the five other tests is multiplied by 6/5 to obtain a Full Scale Score. This is appropriate when a subject is encountered who is so familiar with the abacus that Bead Arithmetic does not represent a learning task for him. "Familiar" does not mean that he has a general idea that an abacus is an apparatus composed of rods with beads on them and that the beads represent numbers and are moved to solve problems. It means a degree of skill which gives him such an obvious advantage over the naive subject that the norms for the test are invalidated.

USE OF THE HIS WITH THE PARTIALLY SIGHTED

There are no norms for the partially sighted and the exercise of useful vision invalidates norms established with the totally blind. The test can nevertheless provide some information about the non-verbal abilities of partially sighted subjects when it is administered by a trained examiner who has had considerable experience with the performance on the HIS of totally blind subjects. At the discretion of such an examiner, the partially sighted subject may be blindfolded for the test and his scores compared with the established norms. His ability, however, is not to be interpreted as equivalent to that of the totally blind subject who makes an identical score.

BLOCKING ON HIS TESTS

Subjects will occasionally be encountered who earn average or above average ratings on verbal tests but cannot score on one or more of the HIS tests. It sometimes seems that they give up without trying because they are convinced they will do badly or are so nervous at the prospect of performing the tests under close observation that they cannot understand the instructions. The possibility also exists that the pre- or post-natal accident or disease that caused blindness also caused other damage which has been overlooked because all the adaptive difficulty these persons experience has been attributed to blindness.

At any rate, blind persons will sometimes be found with whom the HIS in its present form cannot be used, and it is doubtful that it would be feasible to extend the lower end of the scale far enough to obtain a distribution of scores from subjects who find too difficult the easiest items from the tests as they now are. The HIS may, however, have some clinical usefulness with such subjects in demonstrating that a condition exists — whether motivational, functional, or organic — which prevents their performing tasks which most blind persons can perform, albeit with varying degrees of effectiveness.

CONVERTING RAW SCORES TO SCALED SCORES

The *raw score* for each test is the sum of the points earned on that test. These sums are transferred to the Summary section on the front of the record form. Scaled score equivalents of raw scores are read from the Table of Scaled Score Equivalents at the left of the Summary and entered in the spaces provided. These scaled scores are then summed to give a Full Scale Score.

FINDING THE IQ

Table 14, p. 42, gives the IQ equivalents of sums of scaled scores by age groups. The subject's age is his age at his last birthday. Locate the Full Scale Score in the left-hand column (Sum of Scaled Scores) of Table 14 and read the IQ in the column under the appropriate age group.

DIRECTIONS
FOR ADMINISTERING
HISAB TESTS

NOTES

DIGIT SYMBOL

DIRECTIONS Place the two sections of the test board in the tray with the polished rivet in the corner of the larger section at the top. The smaller section is placed so that the oblong form (with one dot on the surface) is at the top. For a right-handed subject, the smaller section is placed at the left of the larger section; for a left-handed subject, it is at the right. The intent is that the subject use his non-preferred hand for the key column.

Say, "**Move your left hand** (or right hand if the subject is left-handed) **down this column of forms.**" Place S's hand on the top form and guide it slowly down, allowing ample time for exploration. Say, "**Notice that in addition to each form's having a different shape or position, it also has a particular number of dots on it. These are not braille symbols.**" Pause again, as S may wish to examine the forms. Say, "**Now, with your right hand, feel these forms along this row.**" Guide S's right hand across the first row. Say, "**You will notice that the shapes are the same as those you felt with your left hand, but there are no dots on them. I want you to feel this first form** [i.e., circle] **with your right hand and with your left hand find the same form and tell me how many dots are on it.**" Continue across the first row, then drop down to the circle and return on the second row. Be sure that S identifies each form correctly. If he makes an error, ask "**Are you sure that is right?**" If he does not correct himself, place his left hand on the correct form and say, "**That is the right form. How many dots are there on it?**" The key for the practice trial is: 5 - 4 - 6 - 1 - 3 - 5 - 3 - 1 - 2 - 6. When S has correctly identified these ten forms, reverse the larger section of the board so that the bright rivet is at the bottom (nearest the subject). Say, "**When I tell you to begin, start at the top again and go back and forth across the board until I tell you to stop. When you come to the last form in a row, drop down to the form just below it in the next row and go back across that row. Tell me the number of dots for each form. From now on I won't help you.**" Guide S's hand to the first form (circle) in the top row and say, "**Start.**"

Watch attentively to be sure that S goes to the end of each row before dropping down to the next row and that he reverses direction when he changes rows. If he fails to do either of these things, guide his hand to the correct form and repeat the instructions.

TIME LIMIT 2 Minutes

SCORING 1 point for each correct item within 120"

Time bonuses are allowed if all 40 items are correct:

	Bonus Points			
	1	2	3	4
Completed in	100"-109"	90"-99"	80"-89"	1"-79"

Maximum score: 44

BLOCK DESIGN

DIRECTIONS Place the tray in front of S and lay the four blocks on it. Put one block in S's hand and say, "**Here is a block which has two smooth sides, two rough sides, and two sides which are half rough and half smooth.**" Allow time for S to examine block. Say, "**There are three more blocks exactly like that one on the tray in front of you. They can be put together so that the top surface makes a pattern that feels like this.**" Place Sample Plate in the lower left corner of the tray and guide S's hand to it. Arrange the four blocks to make the sample design and let S examine them. Say, "**Now I'm going to mix the blocks and you put them back together to make the design. Leave the pattern in the corner of the tray where you won't lose it and put the four blocks together to make a design just like it.**" If after three minutes S has not completed the sample design, move the blocks into the correct positions. Say, "**That's the way to make the design,**" and again allow time for S to examine it. Say, "**Now I'm going to give you other designs to copy. Make the design as quickly as you can and tell me when you are finished.**" Place Plate No. 1 in the lower left corner of the tray. Start timing at the moment S touches the plate.

All plates are to be placed so that the number on the corner of the back is in the corner of the tray. If S misplaces the plate, return it to the corner and say, "**It's easier to follow the pattern if you keep it here in the corner where it won't slip.**"

After each arrangement, mix the blocks, place the next plate in the corner of the tray, and say, "**Now try this one.**"

Reversals (top to bottom or left to right) are considered errors.

TIME LIMIT 3 minutes for each design

DISCONTINUE After three consecutive failures

SCORING For each correct design:

	Points		
	1	2	3
Completed in	61"-180"	31"-60"	0"-30"

Maximum score: 21 (no credit allowed for sample design)

OBJECT ASSEMBLY

DIRECTIONS The order of presentation of the items is: doll, block, hand, ball. The pieces are arranged on the tray in front of S according to the diagrams on p.   Before arranging them, say "**Don't touch the tray until I tell you to.**"

When the pieces of the doll have been placed on the tray, say "**There are six pieces on the tray in front of you. When they are put together right they make something. I want you to put them together as quickly as you can. Start now.**"

Lay out the pieces for the other items according to the diagrams, saying "**This time there are** (correct number) **pieces on the tray. Put them together as quickly as you can.**"

TIME LIMITS 5 minutes for each assembly

SCORING No credit is allowed for reversals [i.e., head of doll backward, etc.]. If, however, the doll is completely assembled and only the body is reversed, allow 4 points but no time bonus. Time bonuses are allowed only for complete perfect assemblies.

Pieces fitted together:	Within Time Limit Points			
	Doll	Block	Hand	Ball
2	1	2	1	2
3	2	3	2	3
4	3	4	3	4
5	4		4	5
6	5		5	
Time Bonuses				
61"-120"	1	1	1	1
31"-60"	2	2	2	2
0"-30"	3			
Maximum score:	28			

OBJECT ASSEMBLY

Doll

Block

Hand

Ball

OBJECT COMPLETION

DIRECTIONS Place the tray in front of S and say, **"I'm going to hand you a number of different objects one at a time. Each object has one important part missing, and I want you to tell me what it is. After you decide what is missing, lay the object on the tray in front of you."** Put each object in S's hand and start timing when he grasps it. Stop timing when he identifies the missing part. For the first three items, if he names an unessential part or names more than one missing part, say **"Yes, but what is the most important thing that is missing?"** After Item 3, make no comment. If S asks what the object is, say **"I want you to figure out what it is and tell me what part is missing."**

Present the objects in the following order:

Item No.	Object	Missing Part
1.	comb	tooth
2.	auto	wheel
3.	animal	tail
4.	pistol	trigger
5.	watch	stem
6.	lock	key
7.	telephone	dial stop
8.	beads	half of clasp
9.	strap	pin
10.	shoe	lace
11.	pen	clip
12.	chair	back rest
13.	plug	prong
14.	supporter	button
15.	jar top	inside thread

TIME LIMIT 1 minute for each item

DISCONTINUE after six consecutive failures

SCORING 2 points for each correct response given in 1"-10"
1 point for each correct response given in 11"-60"

Maximum score: 30

PATTERN BOARD

DIRECTIONS Patterns for the sample and for the ten items of the test are shown on p. 37.

Place the board in front of S. Say, "**There is a board in front of you that I want you to examine. Notice that there are five rows of holes in the board and in the center there is a fixed peg.**" Allow time for S to examine the board. Say, "**I am going to put pegs in some of the holes to make patterns. You are to study the patterns and after I take the pegs out you put them back in the same holes. This is a simple pattern.**" Put pegs in B2 and D4. After S has studied the pattern, take the pegs out and put them in his non-preferred hand. Say, "**Now put the pegs back in the same holes.**" Allow him to transfer the pegs to the other hand if he chooses, but most subjects prefer to hold them in the non-preferred hand, find the holes with the preferred hand, and place the pegs one at a time with the preferred hand. Do not allow the subject to remove the pegs from the board at the end of a trial. Give all necessary help with the sample pattern, even to putting the pegs back in the holes and allowing the subject to examine them again. Do not, however, suggest a way to remember the positions of the pegs.

When S has completed the sample pattern, withdraw the pegs and say, "**I'm going to make a pattern with two pegs, including the center one. You study it and tell me when you are ready to make it.**" Hand him the peg when he indicates that he is ready to try and say, "**Tell me when you have finished the pattern.**" After each pattern has been prepared by the examiner, say "**Now try this one. There are** (number of loose pegs plus one) **pegs in the pattern, counting the center one.**"

For the study period, time from the moment S touches the pegs and stop him at the time limit if he has not already indicated that he is ready to reproduce the pattern by saying, "**That's long enough. Now let's see if you can make the pattern.**" For the reproduction period, time from the moment pegs are placed in S's hand.

TIME LIMITS as indicated below

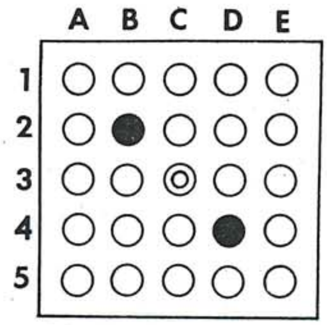
DISCONTINUE after four consecutive incorrect reproductions

SCORING as indicated below. Allow no credit for mirror images

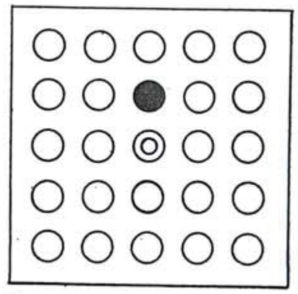
Pattern No.	Time Limits		Points for Correct Patterns Completed		
	Study	Reprod.	Within Time L.	16"-30"	0"-15"
1.	30"	30"	1		
2.	60"	60"	1		
3.	60"	60"	1		
4.	60"	60"	1	2	
5.	60"	60"	1	2	
6.	60"	60"	1	2	3
7.	60"	60"	1	2	3
8.	60"	60"	1	2	3
9.	60"	60"	1	2	3
10.	60"	60"	1	2	3

Maximum score: 22

PATTERN BOARD



SAMPLE



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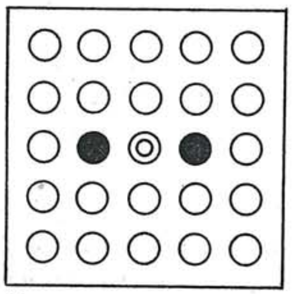

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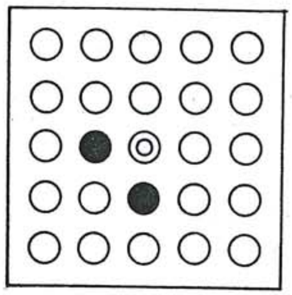

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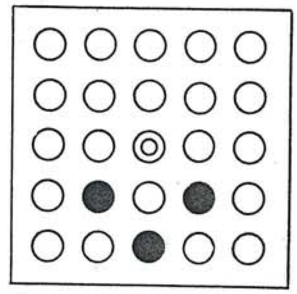

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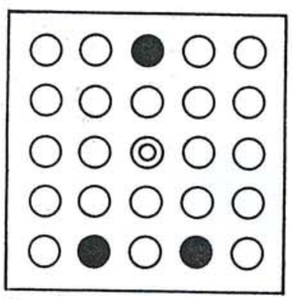

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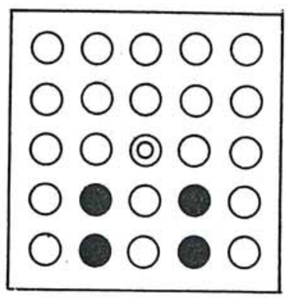

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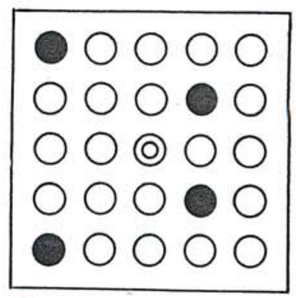

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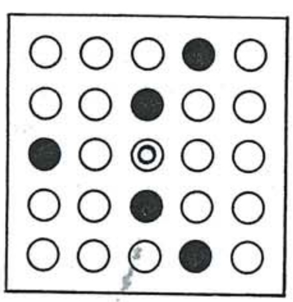

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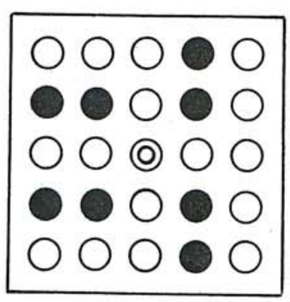

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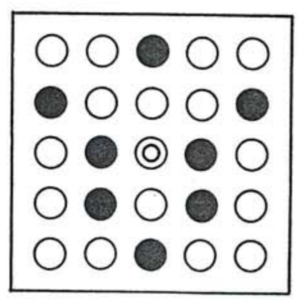


10.

BEAD ARITHMETIC

DIRECTIONS Place the abacus on the table so that the five-bead section is nearer the subject. The ***Divider*** is the horizontal strip which separates the five-bead section from the two-bead section. ***Spoke 1*** is the spoke on the user's extreme right; ***Spoke 2*** is the second from the right, etc.

Say, "**I have put a board in front of you which I want you to examine.**" After S has explored it, say, "**Notice that the board is divided into two parts and that there are two beads above the Divider on each spoke and five beads below the Divider. This is the Divider.**" Guide S's hand to Divider. "**Below the Divider each bead on the first spoke to the right is worth one, each bead on the second spoke is worth ten, each bead on the third spoke is worth one hundred, and each bead on the fourth spoke is worth one thousand. When a bead is pushed toward the outer frame, it does not count. It only counts when it is pushed against the Divider. Now I am going to show you '2' on the board.**" (Note that '2' is entered by pushing the top two beads of the lower five beads on Spoke 1 up against the Divider.) Guide S's hand to the beads. Say, "**Now I will show you '22'.**" Then, "**This is '333'.**" It is important that S understand the examples, so give all necessary help.

Say, "**Above the Divider, each bead on the first spoke is worth five, each bead on the second spoke is worth fifty, each bead on the third spoke is worth five hundred, etc. Now I will show you '555'.**" Allow time for examination.

Say, "**Now I will put a number on the board and you tell me what it is.**" Put the first test item on the board. Say, "**Now read this number.**" Start timing at the moment S touches the beads and stop when he gives his answer. For the first three items, if S gives a wrong answer, correct him and explain (e.g., for Item 3, say, "**There are two beads on the third spoke, so we know that is '200' and there are three on the second spoke, which makes '30'. There is one bead above the Divider on Spoke 1, so the number is '235'.**") If S fails all of the first four items, discontinue the test.

1.	4
2.	10
3.	235
4.	16
5.	2,175
6.	31,432

Say, "**Now I want you to show me some numbers. Use the fewest possible beads to make the number. For example, if I ask you to show me '5', put one bead down above the Divider instead of five beads up below the Divider. Now show me '25'.**" Time from the moment E reads the number till S indicates he has finished. If S fails all three of Items 7-9, discontinue the test.

7. 25

Credit only for one bead down to show '5'. Repeat instructions if wrong.

8.	144	
9.	245	
		If S pushes forward five beads below the Divider on Spoke 1, ask "**Is there a better way to show '5'?**" Show him if he hesitates. Credit only if the original response used one bead above the Divider on Spoke 1.
10.	612	
11.	2,089	

Say, "**You can add numbers by putting one number in first, leaving those beads in place, and then putting in another number. You can read the sum of the two numbers from the beads. I will read a number and you put it on the board. Then I will read a second number and you use the remaining beads to make that number. When you have put in both numbers, read me the answer. This is the first number: 231.**" When S has moved the beads, say "**Now add this number,**" and read the second number (213). Time from the moment E reads the first number till S gives his oral answer. Prompt him if he does not give an oral answer after he seems to have finished by asking, "**What is the answer?**" For problems 12-14, repeat each number once if asked, but only once.

12.	231 + 213 (444)
13.	552 + 135 (687)
14.	3,519 + 120 (3,639)

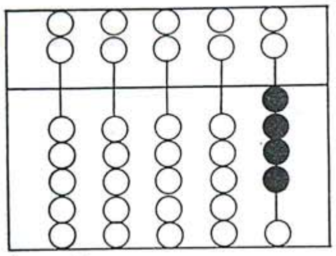
TIME LIMITS as given below

DISCONTINUE as indicated in DIRECTIONS

SCORING Never credit for a right oral answer if the beads are not correctly placed. The correct arrangements of beads for Items 1 - 14 are shown on p. 40.

Item No.	Time Limit	Points for Correct Responses Within Time Limit	0"-60"
1.	45"	1	
2.	45"	1	
3.	45"	1	
4.	45"	1	
5.	90"	1	2
6.	90"	1	2
7.	45"	2	
8.	45"	2	
9.	45"	2	
10.	60"	2	
11.	60"	2	
12.	90"	1	2
13.	90"	1	2
14.	90"	1	2

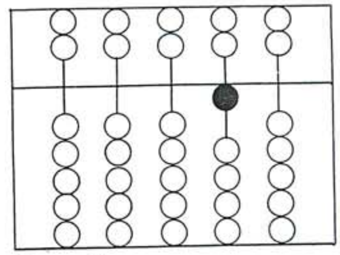
Maximum score: 24



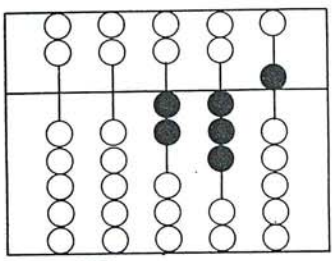
1. 4

BEAD ARITHMETIC

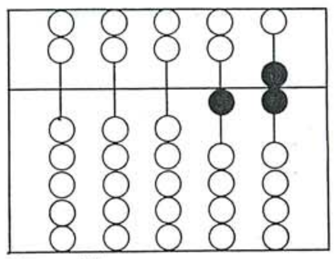
Correct Placement of Beads



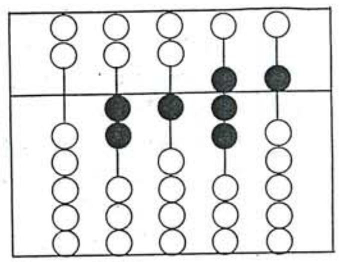
2. 10



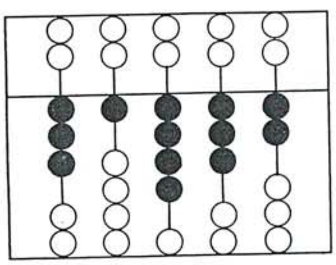
3. 235



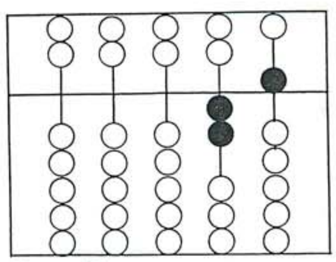
4. 16



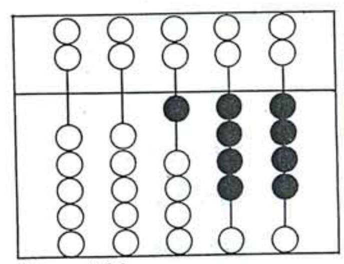
5. 2,175



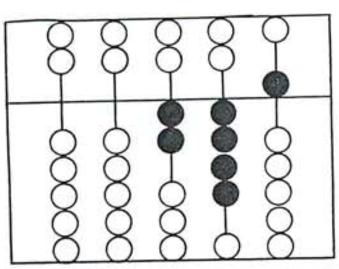
6. 31,432



7. 25



8. 144



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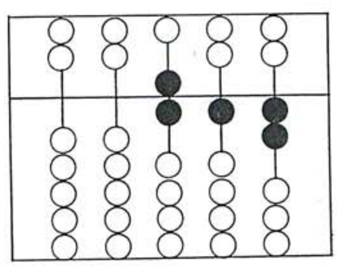

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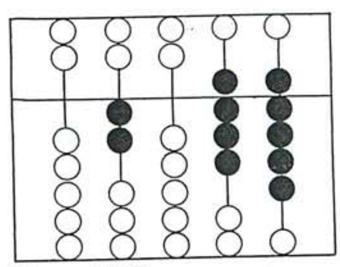
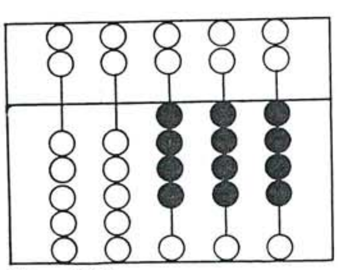


11. 2,089



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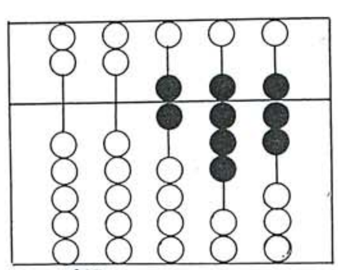

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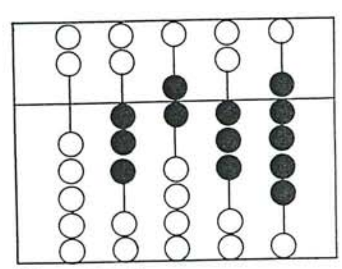

14. 3,639

TABLE 13

SCALED SCORE EQUIVALENTS OF RAW SCORES OF HIS TESTS[a]

Scaled Score	*Digit Symbol*	*Block Design*	*Object Assembly*	*Object Completion*	*Pattern Board*	*Bead Arithmetic*
			Raw Scores			
19	...	...	28	...	22	...
18	42-44	21	27	...	19-21	22-24
17	41	19-20	26	30	17-18	20-21
16	39-40	18	25	28-29	16	18-19
15	37-38	17	24	27	...	17
14	35-36	16	23	26	15	15-16
13	32-34	15	21-22	25	14	14
12	28-31	14	20	24	13	13
11	24-27	13	18-19	23	12	11-12
10	20-23	12	15-17	21-22	10-11	10
9	16-19	10-11	13-14	20	9	9
8	13-15	9	11-12	18-19	8	7-8
7	10-12	7-8	9-10	15-17	7	6
6	8-9	6	7-8	13-14	6	5
5	6-7	4-5	5-6	10-12	5	4
4	4-5	3	4	8-9	4	3
3	2-3	2	3	6-7	3	2
2	1	1	2	5	2	1
1	...	...	1	4	1	...
0	...	...	...	0-3	...	...

a. Based on scores of 200 subjects from the Normative Sample aged 20-34.

TABLE 14

IQ EQUIVALENTS OF SUMS OF SCALED SCORES OF HIS TESTS

Sum of Scaled Scores	Age Groups					
	16-19 IQ	20-24 IQ	25-34 IQ	35-44 IQ	45-54 IQ	55-64 IQ
109	140	140	138	141	144	147
108	139	139	138	141	144	147
107	138	138	137	140	143	146
106	138	137	136	139	142	145
105	137	137	135	138	141	144
104	136	136	134	137	140	143
103	135	135	134	137	140	143
102	134	134	133	136	139	142
101	134	133	132	135	138	141
100	133	133	131	134	137	140
99	132	132	130	133	136	139
98	131	131	130	133	136	139
97	130	130	129	132	135	138
96	130	129	128	131	134	137
95	129	129	127	130	133	136
94	128	128	126	129	132	135
93	127	127	126	129	132	135
92	126	126	125	128	131	134
91	126	125	124	127	130	133
90	125	125	123	126	129	132
89	124	124	122	125	128	131
88	123	123	122	125	128	131
87	122	122	121	124	127	130
86	122	121	120	123	126	129
85	121	121	119	122	125	128
84	120	120	118	121	124	127
83	119	119	118	121	124	126
82	118	118	117	120	123	126
81	118	117	116	119	122	125
80	117	117	115	118	121	124
79	116	116	114	117	120	123
78	115	115	114	117	120	122
77	114	114	113	116	119	122
76	114	113	112	115	118	121
75	113	113	111	114	117	120
74	112	112	110	113	116	119
73	111	111	110	113	116	118
72	110	110	109	112	115	118
71	110	109	108	111	114	117
70	109	109	107	110	113	116

(Table continued on next page)

TABLE 14 — Continued

Sum of Scaled Scores	Age Groups					
	16-19 *IQ*	*20-24* *IQ*	*25-34* *IQ*	*35-44* *IQ*	*45-54* *IQ*	*55-64* *IQ*
69	108	108	106	109	112	115
68	107	107	106	109	112	114
67	106	106	105	108	111	114
66	106	105	104	107	110	113
65	105	105	103	106	109	112
64	104	104	102	105	108	111
63	103	103	102	105	108	110
62	102	102	101	104	107	110
61	102	101	100	103	106	109
60	101	101	99	102	105	108
59	100	100	98	101	104	107
58	99	99	98	101	104	106
47	98	98	97	100	103	106
56	98	97	96	99	102	105
55	97	97	95	98	101	104
54	96	96	94	97	100	103
53	95	95	94	97	100	102
52	94	94	93	96	99	102
51	94	93	92	95	98	101
50	93	93	91	94	97	100
49	92	92	90	93	96	99
48	91	91	90	93	96	98
47	90	90	89	92	95	98
46	90	89	88	91	94	97
45	89	89	87	90	93	96
44	88	88	86	89	92	95
43	87	87	86	89	92	94
42	86	86	85	88	91	94
41	86	85	84	87	90	93
40	85	85	83	86	89	92
39	84	84	82	85	88	91
38	83	83	82	85	88	90
37	82	82	81	84	87	90
36	82	81	80	83	86	89
35	81	81	79	82	85	88
34	80	80	78	81	84	87
33	79	79	78	81	84	86
32	78	78	77	80	83	86
31	78	77	76	79	82	85
30	77	77	75	78	81	84

(Table continued on next page)

TABLE 14 — Continued

Sum of Scaled Scores	Age Groups 16-19 IQ	20-24 IQ	25-34 IQ	35-44 IQ	45-54 IQ	55-64 IQ
29	76	76	74	77	80	83
28	75	75	74	77	80	82
27	74	74	73	76	79	82
26	74	73	72	75	78	81
25	73	73	71	74	77	80
24	72	72	70	73	76	79
23	71	71	70	73	76	78
22	70	70	69	72	75	78
21	70	69	68	71	74	77
20	69	69	67	70	73	76
19	68	68	66	69	72	75
18	67	67	66	69	72	74
17	66	66	65	68	71	74
16	66	65	64	67	70	73
15	65	65	63	66	69	72
14	64	64	62	65	68	71
13	63	63	62	65	68	70
12	62	62	61	64	67	70
11	62	61	60	63	66	69
10	61	61	59	62	65	68
9	60	60	58	61	64	67
8	59	59	58	61	64	66
7	58	58	57	60	63	66
6	58	57	56	59	62	65
5	57	57	55	58	61	64
4	56	56	54	57	60	63
3	55	55	54	57	60	62
2	54	54	53	56	59	62
1	54	53	52	55	58	61

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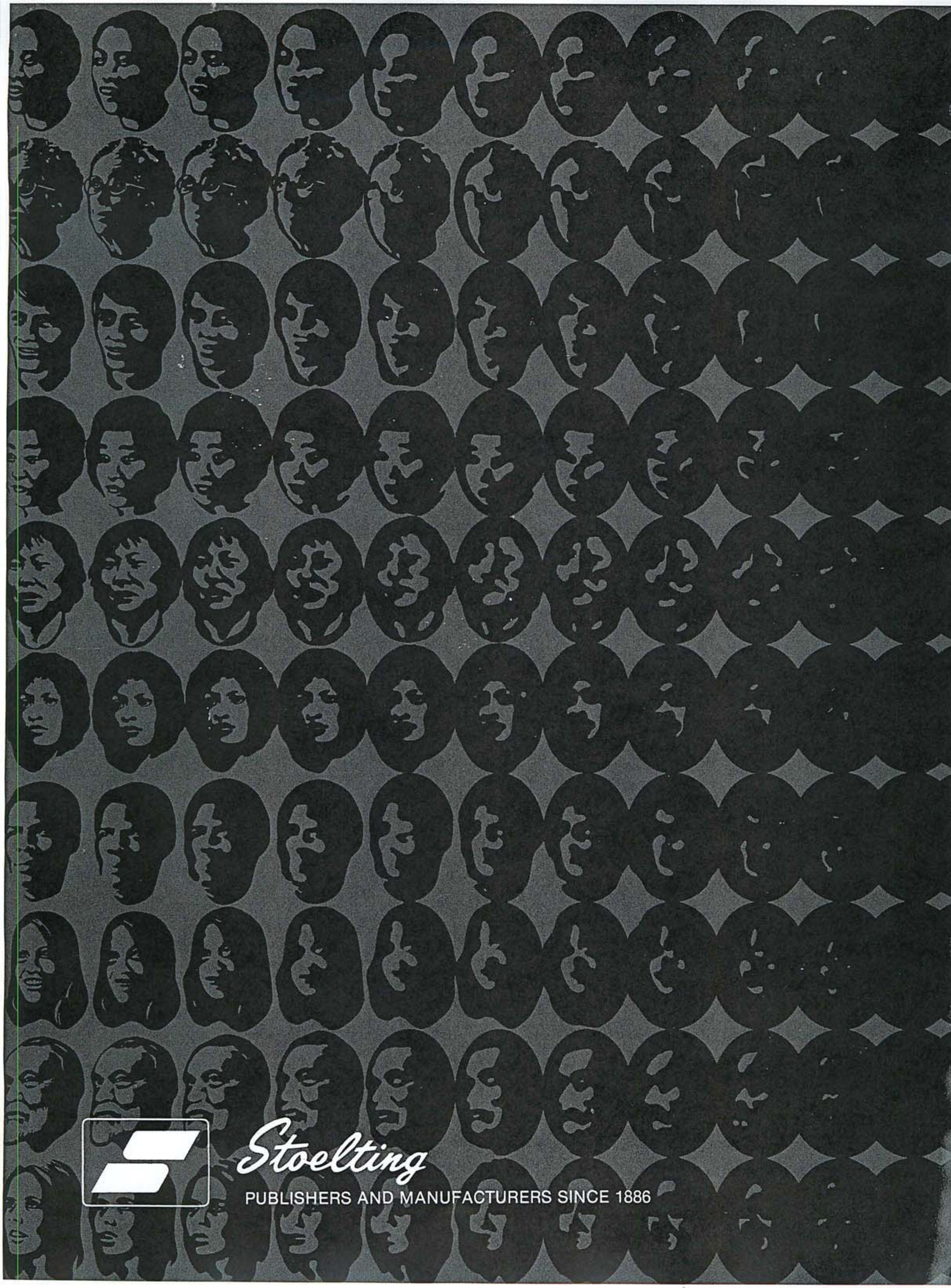
NOTES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