A STUDY OF THE I. Q. CONSISTENCY, INTERNAL CONSISTENCY, AND CORRELATIONS WITH CERTAIN ACADEMIC GRADES OF THE CALIFORNIA TEST OF MENTAL MATURITY-SHORT FORMS

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A STUDY OF THE I.Q. CONSISTENCY, INTERNAL CONSISTENCY, AND CORRELATIONS WITH CERTAIN ACADEMIC GRADES OF THE CALIFORNIA TEST OF MENTAL MATURITY - SHORT FORMS

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TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

CHAPTER I

THE INVESTIGATION AND METHOD OF STUDY

The purpose of this investigation was to make a statistical analysis of the scores obtained from the administration of the California Test of Mental Maturity - Short Form[1] (referred to as the CTMM for the remainder of this paper in the interest of brevity) to students in the public schools of Lansing, Michigan. This study examined the consistency of the I.Q.'s as measured by two forms of the test when administered to the same students with a three year interval between administrations of the forms. The relationship of these I.Q.'s to certain academic grade averages earned during the three year interval was also examined. It was a further purpose of this study to measure and evaluate the internal consistency of two forms of the test.

The CTMM was used throughout the Lansing public school system and was regularly administered to all students as follows: Elementary form - fourth and sixth grades; Intermediate form - ninth grade; and Advanced form - twelfth grade. The tests were administered by teachers and scored by machine. The I.Q.'s were calculated by trained personnel and sent to the teachers to be recorded in the pupil's permanent record folder.

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[1]Elizabeth T. Sullivan, Willis W. Clark, and Ernest W. Tiegs, California Short-Form Test of Mental Maturity (Los Angeles: California Test Bureau, 1947 and 1950).

The basic approach of this study is the normative survey method involving processes of measurement and evaluation. Chapter II is concerned with the background of studies and literature preceding this investigation. Chapter III covers the first part of the study itself. This part of the study is based on the results of administering the 1942 edition of the CTMM forms. The intermediate form of the CTMM was administered to 169 pupils in the ninth grade in 1951 and the advanced form to these same students in twelfth grade in 1954. The I.Q.'s thus obtained were compared by product moment correlations. Also, their correlations with grade averages were obtained in four academic subject areas, covering courses taken during the three-year period between the administrations of the two tests. The latter correlations were biserial coefficients. Chapter IV covers the second part of the study which involved measurement of the internal consistency of the elementary and the intermediate forms, 1950. Successes on each item for upper and lower 27% were used as a basis for determining coefficients of discrimination by means of a Flanagan chart. This index gives a measure of their demonstrated ability to discriminate between the highest and lowest scorers on the total test. Chapter V consists of a summary and conclusion of this report.

The data for Part 1 of the study (Chapter III: Consistency of the I. Q.) were taken from permanent record folders of the twelfth grade pupils in the three public high schools in Lansing, Michigan. All of the CTMM forms referred to in this study were administered on the basis of one hundred percent coverage of the grades involved. The data for

Part 2 (Chapter IV: Internal Consistency of Two CTMM Forms) were taken from the individual answer sheets for the elementary and the intermediate forms.

The CTMM purports to be a test of mental ability consisting of seven subtests each of which is purported to be a test of an aspect of an element of mental ability. These subtests combined to make four groups of subtests purport to measure four major factors involved in intelligence.

The first group, called "Spatial Relationships," contains two subtests - "Sensing Right and Left" and "Manipulation of Areas". The first consists of twenty items each with a picture of an object from a symmetrical pair. The subject is to discriminate between left and right. The second consists of fifteen items each with pictures of geometrical forms in various positions. Given a figure the subject is to select the same figure in another position from among three views of similar figures.

The second group, called "Logical Reasoning," contains two subtests - "Similarities" and "Inference". The first consists of fifteen items each with seven picture situations. The subject is to determine how the first three are alike then select one more with this characteristic from among the other four. The second consists of fifteen items each with a major and a minor premise and three conclusions. The subject is to select the correct conclusion.

The third group, called "Numerical Reasoning" contains two subtest - "Number Series" and "Numerical Quantity". The first consists of

fifteen items each with an increasing or decreasing number series. The subject is to select the number that does not belong in the series from five offered for each of the first ten items and is to select three numbers missing from the series from five offered groups for each of five items. The second contains fifteen items each with an arithmetical story problem. The subject is to solve the problem and select the correct answer from four offered.

The fourth group, called "Verbal Concepts," contains one subtest - "Total Verbal Concepts". This subtest consists of fifty items each with a given word and four offered synonyms. The subject is to select the correct synonym.

These seven subtests are also regrouped to obtain a "Language Factors" score which is the sum of the scores of three subtests (Inference, Numerical Quantity, and Total Verbal Concepts) and to obtain a "Non-Language Factors" score which is the sum of the remaining four subtests (Sensing Right and Left, Manipulation of Areas, Similarities, and Number Series). The sum of all seven subtest scores is called the "Total Mental Factors" score. An I.Q. score is calculated from each of these factor group scores.

CHAPTER II

REVIEW OF LITERATURE

The CTMM short forms were devised as one period tests from a longer parent test. The 1950 editions were prepared on five levels: preprimary, primary, elementary, intermediate, and advanced. Subtests purport to offer specific measures in spatial relationships, logical reasoning, numerical reasoning, and verbal concepts. The seven subtests involved in these measures are rearranged to offer two composite scores. One group purports to measure language factors of intelligence and the other purports to measure non-language factors of intelligence. Finally a total score is obtained by adding the language factor and non-language factor scores. Three I.Q.'s are computed; one each from the language factor, non-language factor, and total factor scores and are so named. These various scores are claimed useful for prognosis and diagnosis in education, guidance, personnel administration, clinical diagnosis, and research.[1]

The test was published in 1937 and subsequent revised editions in 1942, 1947, and 1950. Cursory comparison of the 1947 and 1950 forms indicated changes in norms, format, color, timing, examples, stems, and foils. The vocabulary subtest, for example, had twelve changes in

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[1] James C. Coleman, Summary of Investigations Number Three: California Test of Mental Maturity (Los Angeles: California Test Bureau, 1956), p. 5.

foils. Comparison of the 1942 and 1950 forms revealed changes in the order of the subtests, and the adition of one entire subtest, namely "Number Series".

Though information from one study using a particular edition of the forms may be quite similar to information from a comparable study using another edition of the forms, there was little evidence found that such similarities of information could be consistently expected. This is important in the evaluation of material concerning the CTMM because, although more than one hundred studies have been published concerning the CTMM, only a small percentage used the 1950 (to date the latest) edition of the forms.

Correlations in the .90's for language factor and total factor I.Q.'s and in the .70's and .80's for non-language factor I.Q.'s between the long and short forms were reported in an early study using the first edition.[2]

Reliability coefficients in the .90's for the CTMM elementary, intermediate, and advanced short form I.Q.'s were published in the prospectus for the 1947 edition and in more complete form by Coleman.[3] These coefficients were based on from 250 to 1,000 cases using the split-halves method corrected by the Spearman-Brown formula.[4] Sections

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[2]Ibid., citing Daniel Belden, Factor Analysis of the California Tests of Mental Maturity (an unpublished study by the Los Angeles County schools, 1938).

[3]Ibid., p. 10, Table 13.

[4]Elizabeth T. Sullivan, Willis W. Clark, and Ernest W. Tiegs, California Test Bureau Manual California Short-Form Test of Mental Maturity Advanced - Grades 9 to Adult - 1950 S-Form (Los Angeles: California Test Bureau, 1950), p. 4.

of this same table appear on page four of each of the manuals as reliability coefficients for these three forms of the newer, 1950, edition of the test. On this same page a correlation of .524 was given for the CTMM - Advanced S-Form language factor scores with non-language factor scores for 600 cases in grades nine to twelve. Several early studies involving the first edition were referred to as having found evidence that these scores can distinguish between reading deficiency and mental deficiency.[5, 6, 7]

Sheldon and Manolakes with a 422 pupil sample found a correlation of .702 of the CTMM with the Stanford-Binet, Revised Form L.[8] To date other studies correlating these two tests have used older editions of the CTMM or the parent long form and have used considerably smaller samples.

Plumb, using a sample containing 370 males in Nebraska State Reformatory for Men, correlated I.Q.'s from a CTMM - 1947 form with I.Q.'s from the Wechsler Bellevue Intelligence Scale. His correlations ranged up to .725 (Wechsler Bellevue total scale with CTMM total

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[5]Arthur E. Traxler, "A Study of the California Test of Mental Maturity, Advanced Battery," Journal of Educational Research, 32: 329-335, January, 1939.

[6]Ruth Strang, "Relationships Between Certain Aspects of Intelligence and Certain Aspects of Reading," Educational and Psychological Measurement, 3:355-359, Winter, 1943.

[7]Esther Grace Nolan, "Reading Difficulty vs. How Mentality," California Journal of Secondary Education, 17:34-35, January, 1942.

[8]William D. Sheldon and George Manolakes, "A Comparison of the Stanford-Binet, Revised Form L, and the California Test of Mental Maturity (S-Form)," The Journal of Educational Psychology, XLV (December, 1954), 500.

factors) and to .726 (Wechsler Bellevue verbal scale with CTMM total factors).[9] This study also states that Dr. Willis W. Clark of the California Test Bureau reported to Plumb that a seventy-two case study in a private school population in Devereant, Pennsylvania, found correlations of .71 (Wechsler Bellevue verbal scale with CTMM language factors), .69 (Wechsler Bellevue performance scale with CTMM non-language factors), and .84 (Wechsler Bellevue total scale with CTMM total factors).[10]

Numerous studies have reported that the CTMM correlates as well with other group tests of intelligence as they do with each other. This information is of no particular importance to this study so the interested reader is referred for further information to the manuals for the various forms, Coleman[11] and Buros.[12]

Coleman reported intercorrelations of test sections on the CTMM advanced short form ranging between .178 and .487 based on 600 high school students.[13] These intercorrelations lend some support to the

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[9]Galen R. Plumb, The Evaluation of the Mental Characteristics of a Reformatory Population as Revealed by the Wechsler-Bellevue Intelligence Scale and the California Tests of Mental Maturity, (Doctor's thesis, University of Nebraska, Lincoln, Nebraska, 1951), p. 49, Table 33.

[10]Ibid., Appendix A, Table 8.

[11]Coleman, op. cit., p. 7, Table 7, and pp. 27-30.

[12]Oscar K. Buros (Editor), The Nineteen Fifty-Three Mental Measurements Yearbook (Highland Park, New Jersey: The Mental Measurements Yearbook, 1953).

[13]Coleman, op. cit., p. 8, Table 8.

claim that the subtests measure different factors, but identification of the factors involved has not been settled.

In an extensive statistical analysis in this area, Nelson based a study of scores from administration of an early CTMM primary form to 183 third grade pupils and of an early CTMM elementary form to 193 fifth grade pupils correlated with scores on the Progressive Achievement Tests (Reading and Arithmetic Batteries). He suggested that the memory and spatial relationships subtests of the CTMM might be eliminated from the test since they do not contribute greatly either to diagnosis or to prognosis of achievement.[14] For all types of achievement involved, higher critical ratios were found for the CTMM language mental age than for the non-language mental age.[15]

Schellenberg found the language components of the CTMM most useful in predicting scores on the Progressive Achievement Tests.[16] Sister Mary Rosilda found a correlation of .42 between the CTMM advanced form and the Cooperative Elementary Algebra Test Forms R, S, and Q, Revised Series, when administered to 635 high school freshmen.[17]

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[14]A. Gordon Nelson, The Value of Certain Tests of Differentiated Abilities for Diagnosis and Prognosis of Achievement (Unpublished Doctor's Thesis, New York University, New York, 1943) p. 153, and p. 125, Table 36.

[15]Ibid., p. 102-106, Table 29.

[16]Ernest D. Schellenberg, A Study of the Relationships of the Progressive Achievement Tests and the California Tests of Mental Maturity Subtests (Master's thesis, University of Southern California: Los Angeles, 1948), p. 120-121.

[17]Sister M. Rosilda, "Is an I.Q. an Index to Algebra Ability?" Journal of Educational Research, 44: 391-393, January, 1951.

Dejmek reported a correlation of .327 of the CTMM non-language scores with scores on the Minnesota Paper Form Board - Revised Series AA.[18] Heston described the success of scores of twenty-three non-verbal test variables in predicting academic success. He reported that a correlation of .5450 of the Ohio State Psychological Examination (a verbal test) scores with ratios of grade points to credit hours was increased to a maximum "shrunken" multiple correlation (using the Wherry shrinkage formula) of .6543 by the addition of six non-verbal variables, namely R and L Hands (Time), Minnesota Rate of Manipulation-Placing, Knox Cubes, Feature Profile, R. and L Hands (Rights), and Dot Estimation (Rights).[19] Though this reference to Heston does not involve CTMM non-language scores it does indicate a way in which the non-language elements of the CTMM may be increasing the correlation of the CTMM total factors scores with academic success. Lanier reported that students dropping out of high school scored significantly higher on the CTMM non-language score than on the language score. Non drop-outs scored significantly higher on CTMM language scores than on non-language scores.[20] The evidence from these studies appears to indicate that

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[18]Frank W. Dejmek, "A Study of Relationships Among Scores on the Minnesota Paper Form Board - Revised Series AA, the Non-Language Section of the California Tests of Mental Maturity, and Test Two of the Non-Language California Test of Mental Maturity," Journal of Educational Research, 42: 307-311, December, 1948.

[19]Joseph C. Heston, "The Use of Non-Verbal Tests in the Prediction of Academic Success," The Journal of Educational Psychology, 33:609-612, 1942.

[20]J. Armand Lanier, "A Guidance Faculty Study of Student Withdrawals," Journal of Educational Research, 43:205-212, November, 1949.

the use of CTMM scores for prediction of achievement test scores is of value primarily in determining group levels and relationships.

Kenezevich found the correlation between the CTMM intermediate and advanced forms and grade point averages was .47 for twenty-eight sophomores and twenty seniors in a high school. Upward shifts in the I.Q.'s from the sophomore to the senior year for the same students were noted but the difference of the means was not statistically significant.[21]

Bolton reported the coefficients of correlation of CTMM I.Q.'s with marks (over two semesters) in various courses, including those covered in this study, and found the standard errors of estimate all too high for prediction of grades.[22]

In reference to an elementary form of the CTMM, Ordahl said, "Item validities were established by the method of biserial correlation." She also stated that items were arranged in each section by difficulty, the percent passing each item.[23]

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[21]Stephen J. Kenezevich, "The Constancy of the I.Q. of the Secondary Pupil," Journal of Educational Research, 39:506-516, March, 1946.

[22]Floyd B. Bolton, "Value of Several Intelligence Tests for Predicting School Achievement," Journal of Educational Research, 41: 133-138, October, 1947.

[23]Vida Ellison Ordahl, "An Intercomparison of the Otis Self Administering Test of Mental Ability, Intermediate Form A; the Stanford-Binet, Form L; and the California Test of Mental Maturity, Elementary S-Form" (Unpublished Master's thesis, University of Southern California: Los Angeles, 1946), p. 9-10, citing "a personal interview with the co-author, Dr. Willis W. Clark, Director of Research and Guidance, Los Angeles County Schools, (November, 1943)."

Many of the early studies concerning the CTMM involved the parent long form. The studies referred to in this chapter were selected because most of them dealt with the short forms. They were the most extensive studies found or were the only ones found concerning a particular area of the investigation. It may have been noted that usually the only clue to the particular edition of the forms involved has been the date of the study itself.

In all cases the letters CTMM have been used to refer to the short forms unless specifically stated otherwise.

In summary, the CTMM forms in addition to the total I.Q. give a language factor I.Q. and a non-language factor I.Q. which have been shown to measure different factors. Scores of subtests and scores of groups of subtests have been purported to measure certain factors of intelligence. Studies have been inconclusive concerning support of the factor identification. The reliability coefficients from CTMM I.Q. scores have been as high as for other group tests of intelligence. More recent and comprehensive studies have shown correlations of the CTMM total factor and language factor I.Q.'s with Stanford-Binet and Wechsler Bellevue individual intelligence test I.Q.'s have ranged in the low seventies. The CTMM total factor and language factor I.Q.'s have been shown to correlate well with measures, such as school grades or test scores, that depend upon reading ability as an important variable. The CTMM non-language factor I.Q.'s have not been shown to have consistently high correlations with anything but have not been thoroughly investigated.

CHAPTER III

CONSISTENCY OF THE I.Q.

The first part of the study involves I.Q. obtained from administration of the CTMM Intermediate and Advanced S-Forms, 1942 edition, to secondary pupils in the public schools of Lansing, Michigan. It was standard procedure in the Lansing public schools for CTMM forms to be administered to all pupils as they reached certain appropriate grade levels. In the 1954-1955 school year the advanced form was administered to 936 twelfth grade pupils in the city's three public high schools. These pupils constitute the population for this part of the study.

A sample was drawn from this population by examining the records[1] of every third pupil starting with the first in each school. Of these only 169 had records sufficiently complete to be used in this study. The completeness of the records depended upon the record keeping procedures of each school and of various teachers. The pupils were assigned to teachers in alphabetical order so no selective factors were identified.

Language factor, non-language factor, and total factor I.Q.'s were found in the records of these 169 pupils from the advanced form. These pupils had been administered the CTMM Intermediate S-Form, 1942

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[1] See pages 1, 2 of this report.

edition, when they had been in the ninth grade in the 1951-1952 school year three years earlier. The records of all 169 pupils contained the total factor I.Q.'s from the intermediate form but only eighty of the records contained the language factor and non-language factor I.Q.'s from the intermediate form.

Means of the three I.Q.'s for both forms administered to the sample cases and the three population medians for the advanced form are given in Table I. The difference of sample means for non-language factor I.Q.'s was not statistically significant but the differences of sample means for the language factor and total factor I.Q.'s were significant at the one percent level of confidence. The data in this Table indicate a general increase in I.Q. from the intermediate to the advanced form.

The I.Q.'s obtained from the administration in 1951 of the CTMM Intermediate S-Form, 1942 edition, were correlated by the product-moment method with the I.Q.'s obtained from the administration in 1954 of the CTMM Advanced S-Form, 1942 edition. These correlations are given in Table II.

These correlations were considered high enough to be useful in the evaluation of group levels and differences but low for prediction and evaluation based on individual scores. The diagnostic and prognostic powers claimed for the various subtest scores[2] relative to the

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[2]Elizabeth T. Sullivan, Willis W. Clark, and Ernest W. Tiegs, California Test Bureau Manual California Short-Form Test of Mental Maturity Advanced - Grades 9 to Adult - 1950 S-Form (Los Angeles: California Test Bureau, 1950), pp. 6-8.

TABLE I

SAMPLE I.Q. MEANS AND POPULATION I.Q. MEDIANS
FROM ADMINISTRATION OF THE CTMM INTERMEDIATE
AND ADVANCED S-FORMS, 1942 EDITION
TO THE SAME PUPILS AND WITH A
THREE YEAR INTERVAL

I.Q.	No. of Cases	Pop. Median Adv. Form (1954)*	Sample Mean Int. Form (1951)	Sample Mean Adv. Form (1954)	Significance Level Difference of Means
Total Factor	169	104	102	106	1%
Lang. Factor	80	104	98	105	1%
Non-Lang. Factor	80	103	103	106	Nil

*From an unpublished report by Bernard W. Ansley, Director Tests and Measurements, Lansing Public Schools, Lansing, Michigan, 1954.

TABLE II

CORRELATIONS OF THE I.Q.'S FROM ADMINISTRATION OF THE CTMM INTERMEDIATE AND ADVANCED - S-FORMS, 1942 EDITION, TO THE SAME PUPILS WITH A THREE YEAR INTERVAL

Factor I.Q.	N	r
Total Factor	169	.66
Language Factor	80	.57
Non-Language Factor	80	.58

mental ability factors for which they have been named have not been adequately supported or refuted by the evidence in the studies mentioned.

Inconsistencies in the I.Q.'s from one form to another may have involved one or more of several possible variables. The obvious possibility is that the two forms do not measure the same factors in the same amounts with equal accuracy. A strong possibility, especially for this and older age levels, is that the basic assumption in the construction of the CTMM that the average terminal age of mental growth is sixteen years was causing measurable inaccuracies in those individual cases which varied from this average. Another possibility is that individual rates of mental growth changed resulting in changes in the true I.Q.'s. This study discloses evidence that these differences may exist but makes no attempt to discover why.

It is interesting to note that not only were there some significant differences of the means but also there were statistically significant differences of dispersion. The standard deviations of the three factor group I.Q.'s, their differences, and the significance levels of those differences are given in Table III.

The three CTMM I.Q.'s from each of the forms were correlated with the grade averages in four academic subject areas covering courses taken during the three year period between administrations of the CTMM forms. Courses in other subject areas were elected by too few pupils in the sample for correlations to be meaningful. Coefficients were obtained from biserial correlations using I.Q.'s as the primary con-

TABLE III

STANDARD DEVIATIONS OF I.Q.'S FROM CTMM INTERMEDIATE AND ADVANCED - S-FORMS, 1942 EDITION, ADMINISTERED TO THE SAME PUPILS AND WITH A THREE YEAR INTERVAL

I.Q.	N	Inter-mediate Form 1951	Advanced Form 1954	Difference	Significance Level of Difference
Total Factor	169	11.2	11.6	+.4	Nil
Lang. Factor	80	14.8	11.4	-3.4	1%
Non-Lang. Factor	80	13.9	19.2	+5.3	1%

tinuous variable and grade averages as the divided continuous variable. The upper portion of grade averages included A and B averages and the lower portion included C, D, and E averages and those who failed to elect courses in the subject area. The subjects included were English, mathematics, social studies, and science. English and social studies included courses required of all pupils.

The coefficients obtained when grade averages were correlated with I.Q.'s from administration of the intermediate form in 1951 are shown in Table IV. Coefficients from correlation of grade averages with I.Q.'s from administration of the advanced form in 1954 are shown in Table V.

For both CTMM forms correlations of grade averages with total factor I.Q.'s and language factor I.Q.'s were high enough to indicate that these I.Q.'s might be quite useful in evaluation of group levels and comparisons. The non-language factor I.Q.'s did not appear to be measuring the same factor or factors measured by these grade averages. This further supported the fairly well established observation that the so-called language factor and non-language factor groups of tests measure different factors.[3]

The difference of the 1951 and 1954 correlations of grade averages in science with total factor I.Q.'s was .24. No other correlation differences were this large. Because chance may have caused

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[3] Ibid., p. 4.

TABLE IV

CORRELATIONS OF I.Q.'S FROM ADMINISTRATION IN 1951 OF THE CTMM INTERMEDIATE - S-FORMS, 1942 EDITION, WITH GRADE AVERAGES OBTAINED IN THE NEXT THREE YEARS

Subject	Factor I. Q.		
	Total	Language	Non-Language
English	.60	.51	.10
Mathematics	.55	.44	-.05
Social Studies	.63	.60	.11
Science	.47	.44	.08
N	169	80	80

TABLE V

CORRELATIONS OF I.Q.'S FROM ADMINISTRATION IN 1954
OF THE CTMM ADVANCED S-FORM, 1942 EDITION,
WITH GRADE AVERAGES OBTAINED
IN THE PREVIOUS THREE YEARS

Subject	Factor I. Q.		
	Total	Language	Non-Language
English	.58	.59	.06
Mathematics	.52	.53	-.03
Social Studies	.66	.72	.30
Science	.71	.65	.13
N	169	80	80

such a change, to attempt to infer from this single sample would be unjustified. It is interesting to note, however, that forty-six pupils in the high science grade series averaged a 7.1 I.Q. score increase in the three year interval as opposed to a 4.6 I.Q. score increase for forty-seven pupils who did not take science and a 2.7 I.Q. score increase for seventy-three pupils who had low science grade averages.

Evidence found in this part of the study involved CTMM forms in the 1942 edition and, therefore, can at best be considered roughly indicative of what might be found with forms from the latest (1950) edition.

CHAPTER IV

INTERNAL CONSISTENCY OF TWO FORMS OF THE CALIFORNIA TEST OF MENTAL MATURITY, ELEMENTARY AND INTERMEDIATE S-FORMS

The forms involved in this part of the study were the CTMM Elementary and Intermediate S-Forms, 1950 edition. The elementary form was administered on a one hundred percent basis to the pupils in the fourth and sixth grades of the public elementary schools of Lansing, Michigan. In these grades the test was administered to 2,547 pupils. The answer sheets were machine scored in the system's scoring office then were returned to the schools for recording. A request from the scoring office that these answer sheets be returned to that office for the purposes of this study resulted in the return of approximately 1500 answer sheets. By selecting every third sheet from this group (arranged in class groups) a sample of five hundred was obtained for this study.

Intermediate forms were administered to 1323 pupils in the city's public junior high schools. These were machine scored and processed in the manner described for the elementary form. Of these about one thousand were administered on a one hundred percent basis to the ninth grade classes. These answer sheets were returned to the scoring office by the respective schools as requested. By selecting every other sheet from this group (arranged by class groups) a sample of five hundred was obtained for this study.

Each sample of five hundred answer sheets was divided into three groups according to total factor I.Q. score. Two groups contained the upper and lower twenty-seven percents of these scores. The middle group had no further purpose in the study. For the upper and lower twenty-seven percent groups the answers selected for each item were counted by machine in the scoring office of Michigan State University. The counts obtained for each choice with the scores for the correct answers underscored are recorded in Tables VII and VIII in the Appendix. The percentage of each group selecting the correct answer and the average of these percentages have also been recorded in these Tables. In the last column of these Tables has been recorded a correlation coefficient interpolated from a Flanagan Table to measure the relationship of the correct choices to the total factor I.Q.'s. A frequency count of these correlations is given in Table VI.

If a given item samples one factor of intelligence it should not be expected to correlate perfectly with a composite measure of all factors of intelligence nor does greater item complexity guarantee a better correlation with the composite measure. It was observed, however, that many items on both forms had high correlations with the grouped total factor I. Q. scores. On the other hand, assuming that correlation coefficients below twenty may reflect indifference to the total measure, there were twenty-seven items found on the elementary form and forty-six items found on the intermediate form that possibly are not contributing to the test except by chance effect. The large number of omits for these items would seem to be a major factor in

TABLE VI

FREQUENCY OF CORRELATIONS OF ITEM SCORED TO TOTAL FACTOR I.Q. SCORED FROM ADMINISTRATION OF THE CTMM ELEMENTARY AND INTERMEDIATE S-FORMS, 1950 EDITION, TO FIVE HUNDRED PUPILS FOR EACH FORM, IN LANSING, MICHIGAN

Flanagan r	Frequency	
	Elementary Form	Intermediate Form
60 - 69	7	0
50 - 59	24	11
40 - 49	28	21
30 - 39	34	31
20 - 29	20	36
10 - 19	10	28
0 - 9	11	15
Negative	6	3

these low correlations.

Examining the indexes of difficulty, the average percent answering the item correctly, it was observed that in this study the pupils found the first three subtests very easy and the last four subtests progressively more difficult. A check of the Flanagan correlations of the items in the elementary form subtest seven (a vocabulary test) with indexes of difficulty below thirty (very difficult) showed that this group of items included sixty-three percent of the total number of items on the form with correlation coefficients below twenty. Further examination of the items in this subtest disclosed that of the thirty-six foils in the last twelve items eighty-three percent worked negatively in discriminating between the upper and lower twenty-seven percent groups in the sample.[1]

This was at least in part a result of the much larger number of pupils in the upper group attempting each of these items. This could be expected to cause a higher index of discrimination for the correct choice than might be expected with an equal number in each group attempting the item.

For comparison an index of discrimination was calculated for each of these twelve items using the method proposed by Davis. This method accounts for the number of testees who did not reach the item and also accounts for the number of testees who reached the item but

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[1] See Table VII, Appendix, pp.

did not select an answer. Machine item count data includes these two types of omits in one total. This could cause the index of discrimination to be spuriously high. After conversion of these indexes to product-moment correlation coefficients comparable to the Flanagan coefficient, using Davis' Table I (page 13), eleven of the twelve items had coefficients lower than obtained from the Flanagan chart and one had a coefficient only slightly higher than the Flanagan coefficient. In this case the proportion of successes in the lower group was negative after correction for chance and was replaced by a low positive proportion, from Davis's Table II (page 35), because if the signs of the proportions are different there is no straightforward way of using Davis's chart.[2]

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[2]Frederick B. Davis, Item-Analysis Data - Their Computation, Interpretation, and Use in Test Construction (Cambridge, Massachusetts: Harvard University, 1946), pp. 30-37.

The formula used to determine the estimated proportions of successes in each group is as follows:

$$P = \frac{R - \frac{W}{K - 1}}{N - NR}$$

Where P = estimated proportion of the sample that knows the answer to an item
N = number of testees in 27% portion of sample
R = number of testees in 27% portion of sample that answer the item correctly
W = number of testees in 27% portion that answer incorrectly
NR = number of testees in 27% portion that do not reach the item in the time limit
K = number of choices in the item

A chart is used to determine the discrimination index from the P's calculated for the highest and lowest 27% groups.

These differences found between the coefficients determined by Davis's method and the corresponding coefficients determined by Flanagan's method appeared to indicate that the large number of omits on these items did not cause the Flanagan coefficients to be spuriously low. These differences also appeared to be of too low a magnitude to be significant themselves.

Further investigation would be needed to examine the possibility that items such as these are effective discriminators at very high levels of mental capacity but are rendered ineffective in a test of this type because of chance effects from the guessing of the much more numerous pupils with less mental ability. This weakness is avoided in the individually administered I.Q. tests, such as the Stanford-Binet, because the subject is stopped when it is clear that he has reached and exceeded his capacity level. The alternative to scaled item difficulties of limiting the range of item difficulties offers the prospect of measuring higher levels of capacity by volume of average difficulty answers rather than by power discriminating answers. This method might suffice for purposes of general classification but would be less useful for prognostic and diagnostic use at higher mental capacity levels.

These and other problems that rise from the data of this study must be held with some reservations because of limitations in the study itself. For example, the study is limited to one city so its data can not be applied to other cities with equal confidence. The test differentiations between intelligence levels are less valid than

for the population as a whole because the samples are more homogenous as a result of their being drawn from specific educational levels.

CHAPTER V

SUMMARY OF THE INVESTIGATION

The first part of the study, covered in Chapter III, involved comparisons of I.Q.'s from administration of CTMM forms to the same pupils before and after three years of high school. The CTMM Intermediate and Advanced S-Forms, 1942 edition, were used respectively for the two administrations. Contained in the sample were the I.Q. scores of 169 pupils in the public schools of Lansing, Michigan.

The means of the language factor and total factor I.Q.'s increased significantly. The mean of the non-language factor I.Q.'s increased but not significantly.

Correlations of the language factor, non-language factor, and total factor I.Q.'s on the intermediate form with the corresponding I.Q.'s on the advanced form ranged from .57 to .66. The total factor I.Q.'s from both forms were correlated with grade averages accumulated in four academic subject areas during the three years of high school. Language factor and total factor I.Q. correlations with grade averages were moderately high. Non-language factor I.Q. correlations with grade averages were not statistically significant. The greatest difference in correlations of grade averages with the I.Q.'s of one form and with those of the other form was .24, in science.

The difference between dispersions of the total factor I.Q.'s from the two forms was not significant. The decrease in dispersion of

language factor I.Q.'s and the increase in dispersion of non-language factor I.Q.'s were significant at the one percent level of confidence.

The second part of this study involved the CTMM Elementary and Intermediate S-Forms, 1950 edition. A sample of five hundred elementary form machine scored answer sheets was obtained from administration of the test to fourth and sixth grade pupils in the public schools of Lansing, Michigan. Another sample of five hundred intermediate form machine scored answer sheets was obtained by administration of the test to ninth grade pupils in the same system. The upper and lower twenty-seven percent of the answer sheets in each sample were chosen on the basis of total factor I.Q. scores. The answers selected for each of the items were machine counted and tabulated. The scores obtained were compared.

These comparisons included the following: comparison of answer selections of the upper and lower twenty-seven percent groups on each item, calculation of difficulty indexes for all the items, and calculation and summarization of correlations of the item count scores with the grouped total factor I.Q. scores.

Most of the items in both forms were shown to be effective discriminators but twenty-seven items in the elementary form and forty-six items in the intermediate form were shown to be poor discriminators. Closer examination of the elementary form showed that a majority of the poor discriminators were among the more difficult items in subtest seven (vocabulary). It was noted that these items had been omitted by large numbers of pupils.

Examination of the indexes of difficulty for the items on both forms indicated that both samples found the first three subtests in their respective forms very easy and the last four subtests progressively more difficult.

The CTMM forms examined were shown in this study to be relatively consistent in their measurements of group levels and differences in mental ability. There were definite indications that the language factor I.Q.'s and non-language factor I.Q.'s involve measurement of different factors. Moderately high correlations were found of total factor and language factor I.Q.'s with certain academic grade averages. Certain changes in the dispersion of I.Q.'s were found when the intermediate and advanced forms were administered to the same subjects with a three year interval. Though most individual items on the elementary and intermediate forms (1950 edition) were shown to be effective discriminators between high and low total scores, a substantial proportion of the items were shown to be poor discriminators. Further item analysis appears constructively promising.

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APPENDIX

TABLE VII

ITEM COUNT OF ANSWERS CHOSEN BY THE UPPER AND LOWER 27% OF TOTAL FACTOR I.Q. SCORES FROM ADMINISTRATION OF THE CTMM ELEMENTARY S-FORM, 1950 EDITION, TO FIVE HUNDRED PUPILS IN LANSING, MICHIGAN

Item No.		No. of Each Response						% Correct Choice	Average % Correct	U%–L%	Correlation Item to Total Test (Flanagan)
		1_R	2_L	3	4	5	Omit				
Test 1											
1	U	*122	12				1	90.4	78.2	24.5	.34
	L	89	38				8	65.9			
2	U	11	124				0	91.9	80.1	23.7	.37
	L	37	92				6	68.2			
3	U	11	124				0	91.9	76.3	31.2	.43
	L	46	82				7	60.7			
4	U	125	10				0	92.6	75.6	34.1	.47
	L	79	46				10	58.5			
5	U	12	122				1	92.4	75.5	33.9	.46
	L	49	79				7	58.5			
6	U	129	6				0	95.6	76.7	37.8	.56
	L	78	48				9	57.8			
7	U	11	123				1	91.1	73.4	35.5	.45
	L	53	75				7	55.6			
8	U	12	123				0	91.1	77.1	28.1	.39
	L	42	85				8	63.0			
9	U	10	125				0	92.6	74.8	35.6	.47
	L	48	77				10	57.0			
10	U	122	13				0	90.4	77.4	26.0	.37
	L	87	33				15	64.4			
11	U	121	13				1	89.6	67.0	45.2	.51
	L	60	52				13	44.4			

*Correct choices are underscored.

TABLE VII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
12	U	11	122				2	90.4	71.9	37.1	.47
	L	40	72				13	53.3			
13	U	122	12				1	90.4	72.3	36.3	.46
	L	73	34				28	54.1			
14	U	33	102				0	75.6	55.2	40.8	.42
	L	49	47				39	34.8			
15	U	15	118				2	87.4	68.9	37.0	.44
	L	30	68				37	50.4			
16	U	34	97				4	71.9	53.8	36.3	.37
	L	35	48				52	35.6			
17	U	118	14				3	87.4	59.3	56.3	.59
	L	42	36				57	31.1			
18	U	26	105				4	77.8	52.6	50.4	.50
	L	37	37				61	27.4			
19	U	116	12				7	85.9	61.1	49.6	.53
	L	49	23				63	36.3			
20	U	13	113				9	83.7	60.0	47.4	.50
	L	21	49				65	36.3			
Test 2											
21	U	0	1	0	134		0	99.3	93.8	11.1	.44
	L	2	4	6	119		4	88.2			
22	U	0	0	135	0		0	100.0	90.8	18.5	.58
	L	6	7	110	10		2	81.5			
23	U	10	1	121	3		0	89.6	77.4	24.4	.34
	L	25	11	88	10		1	65.2			
24	U	11	122	2	0		0	90.4	78.6	23.7	.35
	L	27	90	12	4		0	66.7			
25	U	0	0	134	0		1	99.3	90.8	17.1	.52
	L	8	7	111	9		0	82.2			

TABLE VII (cont.)

Item No.		No. of Each Response 1	2	3	4	5 Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
26	U	135	0	0	0	0	100.0	90.0	20.0	.60
	L	108	9	6	7	5	80.0			
27	U	2	2	3	128	0	94.8	80.8	28.1	.45
	L	7	26	10	90	2	66.7			
28	U	2	132	1	0	0	97.8	83.7	28.2	.54
	L	19	94	8	8	6	69.6			
29	U	24	8	13	90	0	66.7	50.7	31.9	.33
	L	53	16	11	47	8	34.8			
30	U	1	4	1	129	0	95.6	78.9	33.4	.52
	L	11	15	15	84	10	62.2			
31	U	37	73	21	5	-1	54.1	38.9	30.4	.32
	L	39	32	33	19	12	23.7			
32	U	16	42	68	10	-1	50.4	34.9	31.1	.34
	L	32	44	26	20	17	19.3			
33	U	13	93	4	21	4	68.9	55.2	27.4	.28
	L	29	56	13	16	21	41.5			
34	U	11	9	13	97	5	71.9	55.6	32.6	.34
	L	17	15	26	53	24	39.3			
35	U	9	7	56	55	8	41.5	27.1	28.9	.36
	L	7	16	17	65	30	12.6			
Test 3										
36	U	0	0	3	132	0	97.8	94.1	7.4	.28
	L	2	6	5	122	0	90.4			
37	U	1	0	130	1	3	96.3	88.5	15.6	.36
	L	10	8	109	8	0	80.7			
38	U	1	131	3	0	0	97.0	88.9	16.3	.40
	L	4	109	12	3	7	80.7			
39	U	0	1	134	0	0	99.3	91.9	14.9	.50
	L	4	8	114	4	5	84.4			

TABLE VII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
40	U	132	1	3	0		-1	97.8	91.1	13.4	.38
	L	114	8	9	5		-1	84.4			
41	U	4	12	4	115		0	85.2	72.6	25.2	.32
	L	19	19	16	81		0	60.0			
42	U	2	0	124	9		0	91.9	80.4	23.0	.36
	L	6	7	93	20		9	68.9			
43	U	0	0	2	133		0	98.5	86.7	23.7	.54
	L	4	6	14	101		10	74.8			
44	U	2	124	5	2		2	91.9	78.6	26.7	.39
	L	12	88	8	17		10	65.2			
45	U	0	3	0	131		1	97.0	84.1	25.9	.50
	L	4	15	4	96		16	71.1			
46	U	0	0	134	0		1	99.3	87.1	24.5	.60
	L	0	5	101	11		18	74.8			
47	U	0	1	0	134		0	99.3	84.1	30.4	.64
	L	6	10	4	93		22	68.9			
48	U	3	131	0	0		1	97.0	81.5	31.1	.54
	L	9	89	6	7		24	65.9			
49	U	0	133	0	0		2	98.5	83.4	30.3	.59
	L	4	92	6	5		28	68.2			
50	U	3	2	104	23		3	77.0	64.8	24.4	.27
	L	11	5	71	17		21	52.6			
Test 4											
51	U	24	23	86			2	63.7	54.5	18.5	.19
	L	27	45	61			2	45.2			
52	U	7	119	9			0	88.2	70.8	34.9	.42
	L	26	72	33			4	53.3	70.8		
53	U	2	8	126			-1	93.3	78.2	30.3	.44
	L	16	26	85			8	63.0			

TABLE VII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
54	U	16	113	6			0	83.7	69.3	28.9	.34
	L	27	74	28			6	54.8			
55	U	16	9	108			2	80.0	61.1	37.8	.40
	L	29	35	57			14	42.2			
56	U	42	89	3			1	65.9	48.9	34.0	.35
	L	55	43	22			15	31.9			
57	U	8	9	120			-2	88.9	75.2	47.4	.52
	L	21	38	56			20	41.5			
58	U	87	10	39			-1	64.4	47.8	33.3	.34
	L	42	30	39			24	31.1			
59	U	22	101	14			-2	74.8	55.6	38.5	.40
	L	22	49	33			31	36.3			
60	U	26	41	63			5	46.7	37.1	19.3	.21
	L	23	39	37			36	27.4			
61	U	99	21	11			4	73.3	47.8	51.1	.51
	L	30	36	30			39	22.2			
62	U	42	73	10			10	54.1	41.5	25.2	.26
	L	21	39	24			51	28.9			
63	U	26	78	17			14	57.8	46.3	23.0	.24
	L	12	47	19			57	34.8			
64	U	12	7	102			14	75.6	48.6	54.1	.54
	L	19	23	29			64	21.5			
65	U	13	24	76			22	17.8	14.9	5.9	.11
	L	23	16	26			70	11.9			
Test 5											
66	U	0	1	1	0	132	1	97.8	90.4	14.8	.40
	L	3	1	7	12	112	0	83.0			
67	U	2	98	16	11	5	3	72.6	56.7	31.9	.33
	L	14	55	22	13	25	6	40.7			

TABLE VII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
68	U	17	10	64	30	7	7	47.4	33.0	28.9	.32
	L	35	22	25	31	13	9	18.5			
69	U	39	15	13	44	18	6	32.6	25.6	14.1	.18
	L	25	29	24	25	15	17	18.5			
70	U	5	9	4	23	81	13	17.0	15.6	2.9	.05
	L	23	7	16	19	48	22	14.1			
71	U	36	12	30	7	24	26	8.9	10.4	-3.0	-.07
	L	39	16	22	10	25	23	11.9			
72	U	11	14	20	11	50	29	14.8	13.7	2.2	.04
	L	21	16	17	8	36	37	12.6			
73	U	12	20	12	10	51	30	37.8	30.4	14.8	.17
	L	11	31	15	12	31	35	23.0			
74	U	15	24	19	15	26	36	11.1	11.9	-1.5	-.03
	L	17	24	18	15	18	43	12.6			
75	U	10	38	28	4	17	38	28.2	21.3	14.9	.22
	L	14	18	26	14	18	45	13.3			
Test 6											
76	U	0	0	135	0		0	100.0	97.8	4.4	.35
	L	3	0	129	2		1	95.6			
77	U	125	0	9	1		0	92.6	71.9	41.5	.53
	L	69	6	57	3		0	51.1			
78	U	11	4	1	119		0	88.2	59.3	57.8	.60
	L	68	9	13	41		4	30.4			
79	U	29	76	16	8		6	56.3	39.7	33.3	.35
	L	25	31	27	27		25	23.0			
80	U	97	22	6	5		5	71.9	49.7	44.5	.44
	L	37	13	55	17		19	27.4			
81	U	46	18	11	47		13	34.8	25.6	18.5	.24
	L	22	44	20	22		27	16.3			

TABLE VII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
82	U	54	6	53	12		10	39.3	27.8	23.0	.29
	L	45	17	22	10		41	16.3			
83	U	8	77	19	15		16	57.0	41.1	31.8	.33
	L	16	34	24	11		50	25.2			
84	U	18	58	16	21		22	43.0	30.0	26.0	.30
	L	7	23	25	25		55	17.0			
85	U	54	15	21	12		33	40.0	26.0	28.1	.36
	L	16	11	23	23		62	11.9			
86	U	38	23	26	7		41	19.3	14.1	10.4	.20
	L	17	21	12	12		73	8.9			
87	U	16	31	29	9		50	11.9	8.2	7.5	.21
	L	6	23	17	9		80	4.4			
88	U	15	20	17	22		61	16.3	11.1	10.4	.24
	L	7	17	16	8		87	5.9			
89	U	16	15	21	15		68	15.6	13.4	4.5	.09
	L	4	14	15	9		93	11.1			
90	U	19	12	14	21		69	14.1	12.7	3.1	.06
	L	15	4	6	15		95	11.1			
Test 7											
91	U	0	130	1	4		0	96.3	76.3	40.0	.58
	L	13	76	8	14		24	56.3			
92	U	126	6	3	0		0	93.3	69.3	48.1	.58
	L	61	26	22	14		12	45.2			
93	U	5	127	1	2		0	94.1	72.3	43.7	.56
	L	21	68	17	18		11	50.4			
94	U	3	4	1	126		1	93.3	70.0	46.6	.57
	L	18	19	14	63		21	46.7			
95	U	6	121	1	5		2	89.6	58.2	62.9	.64
	L	30	36	25	22		22	26.7			

TABLE VII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
96	U	6	2	122	4		1	90.4	59.3	62.2	.64
	L	30	19	38	21		27	28.2			
97	U	1	86	42	6		0	63.7	43.7	40.0	.41
	L	7	32	24	38		34	23.7			
98	U	1	120	10	4		0	88.9	60.8	56.3	.59
	L	12	44	26	16		37	32.6			
99	U	4	2	124	3		2	91.9	60.1	63.7	.66
	L	44	15	38	6		32	28.2			
100	U	4	3	20	104		4	77.0	54.8	44.4	.45
	L	8	12	27	44		44	32.6			
101	U	19	24	14	74		4	54.8	37.8	34.1	.37
	L	17	15	31	28		44	20.7			
102	U	17	70	8	32		8	51.9	34.1	35.6	.40
	L	19	22	17	29		48	16.3			
103	U	22	6	24	76		7	56.3	35.2	42.2	.47
	L	33	14	22	19		47	14.1			
104	U	12	55	34	29		5	40.7	28.2	25.1	.31
	L	17	21	32	22		43	15.6			
105	U	10	17	55	42		11	40.7	27.0	27.4	.35
	L	29	20	18	18		50	13.3			
106	U	17	21	9	78		10	57.8	42.3	31.1	.32
	L	8	42	17	36		32	26.7			
107	U	17	45	33	23		17	33.3	21.1	24.4	.35
	L	13	12	22	36		52	8.9			
108	U	45	16	36	25		13	11.9	10.8	2.3	.04
	L	28	13	18	18		58	9.6			
109	U	11	57	19	29		19	42.2	25.6	33.3	.43
	L	22	12	20	16		65	8.9			

TABLE VII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
110	U	17	19	76	11		12	56.3	37.4	37.8	.41
	L	9	21	25	14		66	18.5			
111	U	19	44	34	15		23	32.6	23.4	18.5	.25
	L	10	19	25	10		71	14.1			
112	U	17	43	41	20		14	30.4	21.2	18.5	.27
	L	11	27	16	14		67	11.9			
113	U	28	60	13	17		17	44.4	27.0	34.8	.44
	L	12	13	25	17		68	9.6			
114	U	9	64	30	11		21	47.4	28.2	38.5	.49
	L	23	12	17	9		74	8.9			
115	U	72	12	18	15		19	53.3	34.5	37.7	.42
	L	21	12	21	10		71	15.6			
116	U	14	34	43	18		26	31.9	23.4	17.1	.23
	L	10	20	20	11		74	14.8			
117	U	49	38	11	7		30	28.2	19.7	17.1	.26
	L	18	15	22	6		75	11.1			
118	U	15	26	32	22		40	19.3	14.5	9.7	.18
	L	11	13	17	14		80	9.6			
119	U	15	36	30	13		41	26.7	18.6	16.3	.26
	L	5	14	17	18		81	10.4			
120	U	5	18	30	43		39	31.9	24.1	15.6	.20
	L	8	7	11	22		87	16.3			
121	U	12	5	58	16		44	43.0	25.2	35.6	.47
	L	16	9	10	15		85	7.4			
122	U	13	19	49	7		47	36.3	23.0	26.7	.37
	L	13	16	13	8		85	9.6			
123	U	34	20	19	8		54	25.2	16.0	18.5	.33
	L	9	15	17	7		87	6.7			

TABLE VII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
124	U	15	19	31	13		57	23.0	16.1	14.1	.24
	L	10	13	12	12		88	8.9			
125	U	12	22	17	24		60	17.8	17.8	.0	.00
	L	5	7	10	24		89	17.8			
126	U	11	42	13	12		57	31.1	23.7	14.8	.19
	L	8	22	7	6		92				
127	U	14	16	24	14		67	17.8	16.0	3.7	.06
	L	5	6	19	7		98	14.1			
128	U	17	8	13	25		72	9.6	7.0	5.2	.16
	L	12	11	6	13		93	4.4			
129	U	15	14	13	21		72	15.6	11.9	7.4	.15
	L	8	9	8	11		99	8.2			
130	U	26	10	13	12		74	7.4	7.8	-.8	-.02
	L	19	11	5	6		94	8.2			
131	U	24	13	12	7		79	8.9	6.7	4.5	.15
	L	14	6	6	8		101	4.4			
132	U	7	6	29	9		84	6.7	4.1	5.2	.24
	L	3	10	16	2		104	1.5			
133	U	11	12	10	12		90	7.4	6.3	2.2	.07
	L	7	10	7	8		103	5.2			
134	U	9	13	21	7		85	5.2	5.2	.0	.00
	L	3	10	10	7		105	5.2			
135	U	15	4	18	8		90	5.9	5.2	1.5	.06
	L	12	5	6	6		106	4.4			
136	U	10	6	15	12		92	4.4	4.8	-.8	-.03
	L	7	7	9	8		104	5.2			
137	U	4	14	13	13		91	9.6	7.4	4.4	.13
	L	5	9	7	8		106	5.2			

TABLE VII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
138	U	11	8	12	11		93	5.9	5.9	.0	.00
	L	9	8	9	3		106	5.9			
139	U	18	9	5	10		93	3.7	6.3	-5.2	-.18
	L	5	12	12	2		104	8.9			
140	U	20	3	6	15		91	2.2	3.0	-1.5	-.09
	L	10	5	5	8		107	3.7			

TABLE VIII

ITEM COUNT OF ANSWERS CHOSEN BY THE UPPER AND LOWER 27% OF TOTAL FACTOR I.Q. SCORES FROM ADMINISTRATION OF THE CTMM INTERMEDIATE S-FORM, 1950 EDITION, TO FIVE HUNDRED PUPILS IN LANSING, MICHIGAN

Item No.		No. of Each Response 1 R	2 L	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
Test 1											
1	U	8	126				1	93.3	83.3	20.0	.35
	L	35	99*				1	73.3			
2	U	122	12				1	90.4	80.7	19.3	.30
	L	96	38				1	71.1			
3	U	127	6				2	94.1	88.5	11.1	.25
	L	112	22				1	83.0			
4	U	13	122				0	90.4	78.5	23.7	.34
	L	44	90				1	66.7			
5	U	126	9				0	93.3	88.5	9.6	.21
	L	113	21				1	83.7			
6	U	133	0				2	98.5	91.1	14.8	.45
	L	113	22				0	83.7			
7	U	25	108				2	80.0	74.8	10.4	.13
	L	41	94				0	69.6			
8	U	126	8				1	93.3	84.8	17.0	.31
	L	103	32				0	76.3			
9	U	6	128				1	94.8	84.8	20.0	.37
	L	32	101				2	74.8			
10	U	116	18				1	85.9	77.7	16.3	.23
	L	94	40				1	69.6			
11	U	18	116				1	85.9	72.9	25.9	.33
	L	50	81				4	60.0			
12	U	10	124				1	91.9	79.3	25.2	.38
	L	41	90				4	66.7			

*Correct choices are underscored.

TABLE VIII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
13	U	115	12				8	85.2	74.8	20.8	.27
	L	87	37				11	64.4			
14	U	34	96				5	71.1	63.3	15.5	.17
	L	51	75				9	55.6			
15	U	121	13				1	89.6	80.3	18.5	.28
	L	96	26				13	71.1			
16	U	118	16				1	87.4	81.1	12.6	.19
	L	101	22				12	74.8			
17	U	66	54				15	40.0	36.3	7.4	.08
	L	64	44				27	32.6			
18	U	44	86				5	63.7	58.5	10.4	.11
	L	52	72				11	53.3			
19	U	32	91				12	67.4	55.5	23.7	.25
	L	49	59				27	43.7			
20	U	30	99				6	73.3	60.0	26.6	.28
	L	51	63				21	46.7			
Test 2											
21	U	13	9	94	17		2	69.6	55.9	27.4	.28
	L	24	32	57	19		3	42.2			
22	U	128	1	6	0		0	94.8	88.1	13.3	.30
	L	110	6	10	8		1	81.5			
23	U	1	2	21	111		0	82.2	71.4	21.5	.27
	L	5	6	42	82		0	60.7			
24	U	0	12	120	3		0	88.9	83.7	10.4	.18
	L	5	15	106	9		0	78.5			
25	U	12	55	11	55		2	40.7	28.8	23.7	.29
	L	23	23	18	69		2	17.0			
26	U	19	29	79	5		3	58.5	43.3	30.3	.31
	L	43	40	38	12		2	28.2			

TABLE VIII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
27	U	17	70	5	42		1	31.1	22.9	16.3	.22
	L	26	77	10	20		2	14.8			
28	U	12	19	34	45		25	33.3	25.1	16.3	.21
	L	23	13	48	23		28	17.0			
29	U	36	16	31	40		12	23.0	14.8	16.3	.30
	L	42	11	9	60		13	6.7			
30	U	21	15	2	93		4	68.9	60.4	17.0	.19
	L	45	8	7	70		5	51.9			
31	U	70	47	5	8		5	34.8	28.1	13.3	.16
	L	72	29	9	16		9	21.5			
32	U	6	28	27	64		10	47.4	32.9	28.9	.33
	L	30	42	22	25		16	18.5			
33	U	29	30	24	23		29	22.2	20.7	2.9	.04
	L	36	26	24	33		16	19.3			
34	U	40	20	28	16		31	20.7	14.4	12.5	.24
	L	48	26	11	17		33	8.2			
35	U	19	9	37	48		32	35.6	34.1	3.0	.03
	L	9	15	37	44		30	32.6			
Test 3											
36	U	0	4	90	36		5	66.7	57.8	17.8	.19
	L	3	11	66	51		4	48.9			
37	U	108	15	11	1		0	80.0	69.2	21.5	.26
	L	79	33	9	14		0	58.5			
38	U	35	18	9	69		4	51.1	34.8	32.6	.36
	L	79	13	14	25		4	18.5			
39	U	16	36	19	51		13	26.7	21.5	10.4	.15
	L	17	22	43	49		4	16.3			
40	U	14	56	51	10		4	37.8	28.5	18.5	.23
	L	18	66	26	18		7	19.3			

TABLE VIII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
41	U	12	116	0	7		0	85.9	83.3	5.2	.09
	L	16	109	2	5		3	80.7			
42	U	11	51	70	3		0	51.9	37.0	29.7	.33
	L	22	75	30	4		4	22.2			
43	U	25	67	10	24		9	49.6	43.7	11.8	.12
	L	32	51	17	21		14	37.8			
44	U	31	81	11	9		3	60.0	54.1	11.8	.12
	L	30	65	15	15		10	48.2			
45	U	24	64	12	17		18	47.4	35.5	23.7	.26
	L	43	32	21	17		22	23.7			
46	U	26	48	13	32		16	23.7	17.0	13.3	.24
	L	43	30	30	14		18	10.4			
47	U	56	26	8	21		14	19.3	18.9	.8	.01
	L	37	25	19	15		39	18.5			
48	U	9	69	15	12		30	51.1	43.3	15.5	.17
	L	5	48	17	17		48	35.6			
49	U	4	45	6	43		37	31.9	20.7	22.3	.33
	L	7	55	14	13		46	9.6			
50	U	11	31	24	28		41	17.8	11.8	11.9	.26
	L	21	30	8	22		54	5.9			
Test 4											
51	U	10	115	10			0	85.2	70.0	30.4	.36
	L	36	74	23			2	54.8			
52	U	121	8	5			1	89.6	71.1	37.0	.46
	L	71	53	11			0	52.6			
53	U	0	126	8			1	93.3	72.2	42.2	.54
	L	0	69	46			20	51.1			
54	U	20	20	95			0	70.4	55.9	28.9	.30
	L	29	45	56			5	41.5			

TABLE VIII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
55	U	1	103	29			2	76.3	55.2	42.2	.43
	L	13	46	76			0	34.1			
56	U	2	129	2			2	95.6	81.1	28.9	.48
	L	26	90	17			2	66.7			
57	U	13	12	110			0	81.5	64.4	34.1	.38
	L	33	32	64			6	47.4			
58	U	7	126	1			1	93.3	87.4	11.8	.25
	L	13	110	9			3	81.5			
59	U	121	7	6			1	89.6	80.0	19.2	.29
	L	95	15	23			2	70.4			
60	U	12	8	115			0	85.2	62.6	45.2	.49
	L	23	46	54			12	40.0			
61	U	4	121	8			2	89.6	70.3	38.5	.47
	L	13	69	40			13	51.1			
62	U	126	4	3			2	93.3	73.7	39.2	.52
	L	73	22	17			23	54.1			
63	U	16	39	73			7	54.1	43.3	21.5	.23
	L	24	27	44			40	32.6			
64	U	9	13	106			7	78.5	51.4	54.1	.54
	L	17	34	33			51	24.4			
65	U	35	14	74			12	54.8	44.0	21.5	.23
	L	16	15	45			59	33.3			
Test 5											
66	U	0	0	0	0	129	6	95.6	88.1	14.9	.34
	L	4	5	5	7	109	5	80.7			
67	U	1	104	19	2	8	1	77.0	64.4	25.1	.28
	L	11	70	21	13	15	5	51.9			
68	U	110	1	2	2	14	6	81.5	61.1	40.8	.43
	L	55	13	16	18	26	7	40.7			

TABLE VIII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
69	U	37	19	14	42	9	14	31.1	20.3	21.5	.32
	L	48	26	26	13	10	12	9.6			
70	U	14	11	66	13	11	10	48.9	37.8	22.2	.24
	L	27	21	36	5	27	19	26.7			
71	U	14	35	14	16	24	32	10.4	12.6	-4.4	-.09
	L	20	30	20	8	34	23	14.8			
72	U	11	26	25	25	13	35	18.5	16.6	3.7	.07
	L	15	32	22	20	20	26	14.8			
73	U	19	28	19	22	7	40	20.7	14.8	11.8	.22
	L	23	12	35	19	12	34	8.9			
74	U	25	11	13	9	38	39	28.2	21.1	14.1	.20
	L	28	19	11	22	19	36	14.1			
75	U	13	17	22	27	17	39	20.0	14.8	10.4	.19
	L	9	34	26	13	16	37	9.6			
76	U	28	46	14	2	3	42	34.1	20.7	26.7	.40
	L	39	10	16	8	7	55	7.4			
77	U	10	8	7	46	9	55	34.1	23.0	22.2	.30
	L	14	12	17	16	8	68	11.9			
78	U	13	3	25	4	10	80	18.5	14.4	8.1	.15
	L	7	9	14	6	14	85	10.4			
79	U	16	7	4	12	5	91	3.7	4.1	-.7	.0
	L	11	15	8	10	6	85	4.4			
80	U	14	8	10	4	3	96	10.4	8.1	4.5	.12
	L	8	19	7	6	8	87	5.9			
Test 6											
81	U	0	0	124	9		2	91.9	85.2	13.4	.24
	L	9	7	106	12		1	78.5			
82	U	5	124	2	1		3	91.9	74.8	34.1	.45
	L	15	78	15	24		3	57.8			

TABLE VIII (cont.)

Item No.		1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
83	U	0	0	29	103		3	76.3	54.1	44.4	.45
	L	9	14	69	43		0	31.9			
84	U	4	128	3	0		0	94.8	72.2	45.2	.58
	L	30	67	17	14		7	49.6			
85	U	20	4	109	0		2	80.7	59.2	42.9	.45
	L	58	17	51	6		3	37.8			
86	U	7	0	108	17		3	80.0	59.6	40.7	.43
	L	21	11	53	46		4	39.3			
87	U	59	19	36	18		3	43.7	31.1	25.2	.29
	L	25	31	41	27		11	18.5			
88	U	6	19	29	69		12	21.5	16.3	10.4	.18
	L	14	24	15	71		11	11.1			
89	U	84	11	35	2		3	25.9	24.0	3.7	.05
	L	46	20	30	23		16	22.2			
90	U	29	50	7	42		7	37.0	24.8	24.4	.32
	L	49	17	22	24		23	12.6			
91	U	102	4	16	8		5	75.6	50.7	49.7	.50
	L	35	30	17	18		35	25.9			
92	U	4	107	10	1		13	7.4	7.0	.7	.02
	L	10	71	9	9		36	6.7			
93	U	17	84	22	7		15	62.2	38.1	48.1	.51
	L	16	19	29	20		51	14.1			
94	U	37	14	23	40		21	17.0	12.9	8.1	.16
	L	40	15	12	15		53	8.9			
95	U	27	21	19	29		39	21.5	21.5	-0-	-0-
	L	19	14	17	29						
Test 7											
96	U	0	6	0	128		1	94.8	91.5	6.6	.18
	L	3	3	5	119		5	88.2			

TABLE VIII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
97	U	0	127	0	7		1	94.1	86.7	14.8	.29
	L	10	107	10	6		2	79.3			
98	U	0	6	129	0		0	95.6	89.3	12.6	.30
	L	11	4	112	7		1	83.0			
99	U	2	126	7	0		0	93.3	80.0	26.6	.41
	L	13	90	17	12		3	66.7			
100	U	0	11	119	4		1	88.2	75.6	25.2	.33
	L	11	14	85	25		0	63.0			
101	U	39	67	5	18		6	13.3	12.9	.7	.01
	L	30	46	37	17		5	12.6			
102	U	23	44	21	40		7	29.6	24.0	11.1	.15
	L	13	45	33	25		19	18.5			
103	U	1	4	121	8		1	89.6	69.2	40.7	.48
	L	23	15	66	19		12	48.9			
104	U	0	120	2	11		2	88.9	74.4	28.9	.38
	L	11	81	16	18		9	60.0			
105	U	3	126	1	5		0	93.3	71.4	43.7	.55
	L	15	67	23	21		9	49.6			
106	U	0	0	130	5		0	96.3	86.6	19.3	.41
	L	8	10	104	9		4	77.0			
107	U	26	18	7	79		5	58.5	38.5	40.0	.44
	L	37	34	23	25		16	18.5			
108	U	7	107	8	10		3	79.3	58.1	42.3	.44
	L	15	50	30	32		8	37.0			
109	U	12	18	30	59		16	22.2	22.2	-0-	-0-
	L	17	29	30	36		23	22.2			
110	U	23	68	19	17		8	50.4	35.5	29.7	.33
	L	14	28	21	50		22	20.7			

TABLE VIII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
111	U	4	6	123	0		2	91.1	68.9	44.4	.54
	L	30	22	63	9		11	46.7			
112	U	8	6	2	119		0	88.2	66.3	43.8	.48
	L	28	20	10	60		17	44.4			
113	U	16	5	112	0		2	83.0	65.6	34.8	.39
	L	18	26	65	15		11	48.2			
114	U	34	45	14	29		13	33.3	26.3	14.0	.17
	L	29	26	20	36		24	19.3			
115	U	6	14	9	101		5	74.8	54.4	40.7	.42
	L	20	33	21	46		15	34.1			
116	U	5	12	112	4		2	83.0	57.8	50.4	.51
	L	14	27	44	26		24	32.6			
117	U	11	119	4	0		1	88.2	64.8	46.7	.52
	L	16	56	20	21		22	41.5			
118	U	10	13	4	104		4	77.0	49.2	55.5	.51
	L	27	23	25	29		31	21.5			
119	U	23	71	18	10		13	52.6	27.4	30.4	.33
	L	24	30	21	23		37	22.2			
120	U	36	35	37	13		14	27.4	24.0	6.7	.09
	L	13	36	28	29		28	20.7			
121	U	9	112	8	4		2	83.0	59.3	47.4	.49
	L	26	48	29	7		25	35.6			
122	U	40	16	3	75		1	55.6	41.9	27.4	.28
	L	29	23	19	38		26	28.2			
123	U	24	10	78	21		2	57.8	42.2	31.1	.32
	L	17	18	36	22		42	26.7			
124	U	23	23	50	26		13	37.0	26.3	21.4	.28
	L	18	39	21	22		35	15.6			

TABLE VIII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
125	U	17	31	30	45		12	23.0	19.3	7.4	.11
	L	22	21	32	25		35	15.6			
126	U	21	10	89	5		10	66.0	43.0	46.0	.47
	L	19	31	27	13		45	20.0			
127	U	8	56	4	59		8	41.5	28.9	25.2	.30
	L	20	22	16	38		39	16.3			
128	U	13	35	31	31		25	23.0	17.0	11.9	.20
	L	16	21	33	15		50	11.1			
129	U	20	58	18	21		18	43.0	34.8	16.3	.18
	L	17	36	22	15		45	26.7			
130	U	30	14	19	47		25	34.8	24.0	21.5	.29
	L	21	17	21	18		58	13.3			
131	U	36	13	44	22		20	32.6	24.4	16.3	.22
	L	22	20	22	14		57	16.3			
132	U	19	23	51	23		19	37.8	25.5	24.5	.32
	L	10	18	18	24		65	13.3			
133	U	6	104	7	7		11	5.2	8.9	-7.4	-.19
	L	12	40	9	17		57	12.6			
134	U	16	30	17	41		31	22.2	19.6	5.2	.08
	L	14	23	12	18		68	17.0			
135	U	15	23	42	24		31	31.1	22.6	17.0	.24
	L	12	22	19	7		75	14.1			
136	U	19	29	39	10		38	21.5	17.8	7.4	.11
	L	7	19	18	13		78	14.1			
137	U	16	20	53	13		33	39.3	27.4	23.7	.30
	L	5	20	21	12		77	15.6			
138	U	40	11	13	26		45	29.6	22.9	13.3	.18
	L	22	9	12	10		82	16.3			

TABLE VIII (cont.)

Item No.		No. of Each Response 1	2	3	4	5	Omit	% Correct Choice	Average % Correct	U%-L%	Correlation Item to Total Test (Flanagan)
139	U	24	11	27	25		48	20.0	15.2	9.6	.17
	L	10	20	14	10		81	10.4			
140	U	14	32	29	13		47	10.4	7.4	6.0	.18
	L	6	9	23	13		84	4.4			
141	U	22	16	27	24		46	17.8	12.6	10.4	.21
	L	13	15	10	10		87	7.4			
142	U	35	10	23	13		54	17.0	12.9	8.1	.16
	L	15	15	12	3		90	8.9			
143	U	8	11	17	52		47	8.2	8.2	-0-	-0-
	L	4	11	14	17		89	8.2			
144	U	14	17	39	15		50	12.6	12.6	-0-	-0-
	L	6	17	17	10		85	12.6			
145	U	34	20	5	23		53	14.8	11.5	6.6	.14
	L	16	11	17	7		84	8.2			

ROOM USE ONLY

Date Due

AUG 11 58			
Nov 7 58			
Dec 8 58			
3 Apr 59			
28 Jul 59			
DEC 4 1959			
MAR 22 1960			
NOV 24 1960			
AUG 3 1961			
NOV 15 1961			
FEB 27 1962			
JUN 8 1963			
DEC 2 1963			
MAY			

Demco-293

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