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A learning index for the Midget Wiggly Block Test for mechanical ability

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A LEARNING INDEX FOR THE MIDGET WIGGLY BLOCK TEST FOR MECHANICAL ABILITY

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CHAPTER I

INTRODUCTION

The writer became interested in testing mechanical ability while taking a course in the 1957 summer session at the Iowa State Teachers College dealing with problems of teaching industrial arts. The teacher of this course was Dr. Howard O. Reed who had devised the Midget Wiggly Block Test for Mechanical Ability,[1] which will be referred to hereafter in this report as the Midget Wiggly Block Test. During a class presentation, Reed stated that there may be a learning process involved in the repeated assembling of the Midget Wiggly Block Test and presented a simple formula for computing a score which he termed "learning index". He further indicated that this learning index had not been tested experimentally.

I. THE PROBLEM

The purpose of this study is to establish the relationship of this learning index to other measures of pupil performance. These other measures consist of mental ability, grade point average, and pupil ratings by teachers.

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[1] Howard O. Reed, The Midget Wiggly Block Test for Mechanical Ability, (Mimeograph, Iowa State Teachers College Cedar Falls, Iowa), 1951. (See Appendix B, p. 35.

Specifically, this thesis provides data to determine whether a relationship exists between the learning index as computed from information derived from the Midget Wiggly Block Test and selected factors of pupil performance. In analyzing the problem, consideration was given to the following questions:

1. Does a relationship exist between the scores of the Midget Wiggly Block Test and the spatial relations percentiles of the California Short-Form Test of Mental Maturity?[2]

2. Does a relationship exist between the scores of the Midget Wiggly Block Test and the total mental factors intelligence quotients derived from the California Short-Form Test of Mental Maturity?

3. Does a relationship exist between the first trials of the Midget Wiggly Block Test and the total mental factors intelligence quotients of the California Short-Form Test of Mental Maturity?

4. Does a relationship exist between the learning indexes and the total mental factors intelligence quotients of the California Short-Form Test of Mental Maturity?

5. Does a relationship exist between the learning indexes and the non-language factors intelligence quotients of the California Short-Form Test of Mental Maturity?

6. Does a relationship exist between the learning indexes and the spatial relations percentiles of the California Short-Form Test of Mental Maturity?

7. Does a relationship exist between the learning indexes and the grade point averages?

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[2]Elizabeth T. Sullivan, Willis W. Clark, and Ernest W. Tiegs, California Short-Form Test of Mental Maturity, Intermediate, (Los Angeles: California Test Bureau), 1950. (See Appendix C, p. 33).

3. Does a relationship exist between the learning indexes and the pupil ratings by mathematics teachers?

II. LIMITATIONS OF THE STUDY

This study will be limited as follows:

1. To the ninth grade boys who were enrolled in the industrial arts classes.

2. To first semester school grades only.

3. To the use of the California Short-Form Test of Mental Maturity.

4. To the use of a pupil rating scale marked by the teachers of mathematics.

III. DEFINITIONS OF TERMS USED

Learning Index. Throughout this study, the learning index will refer to the number obtained by dividing the test score by the first trial of the test. This quotient was subtracted from 1.00. The learning index was computed by the following formula:

$$\text{Learning Index} = 1.00 - \frac{\text{Test Score}}{\text{First Trial}}$$

If a student assembles the test, for example, in six minutes on the first trial and in three minutes on each of two succeeding trials, his learning index would be .50. It was computed as follows:

$$\text{Learning Index} = 1.00 - \frac{3.00}{6.00}$$

$$= 1.00 - .50$$

$$= .50$$

A high positive index (.80) reveals that the subject has substantially improved his performance. An index of .00 would indicate that no improvement of performance had taken place for a particular subject. It is possible to obtain a negative learning index but this would likely be brought about by the element of chance.

Midget Wiggly Block Test for Mechanical Ability. This test consists of four small wooden blocks. Three of these have been cut lengthwise into irregular shapes; one cut into four pieces, one into six pieces, and one into nine pieces. All of the pieces have been dyed black.

Midget Wiggly Block Test Trial. The manual defines a "test trial" as follows: "Keep time, from the time the subject reaches for the first piece and stop the watch when the nine-piece block is finished. Record the time in minutes and hundredths for each trial."[3]

Midget Wiggly Block Test Score. The test score is an average of the two most consistent trials for assembling the

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[3]See p.32, Appendix B, p. 3.

Midget Wiggly Block Test.

Grade point average. The grade point average was determined by averaging the letter grades achieved by a pupil in four subjects; English, science, mathematics, and industrial arts. These letter grades were taken directly from the permanent school records of each pupil. For the purpose of this study it was necessary to compute a numerical grade point average. The letter grades were assigned the following numerical values: A - 4 points, B - 3 points, C - 2 points, D - 1 point, U or Incomplete - 0 points. The grade points earned in each of the four courses were added and the sum divided by four to obtain the grade point average for each pupil.

The sample. The sample of 100 pupils was selected from 120 ninth grade boys who were enrolled in the industrial arts classes in West Junior High School, Waterloo, Iowa. Those selected had complete permanent records. The pupils in the sample ranged in age from fourteen to sixteen years. Of this sample only ninety-two pupils were rated on the teacher rating forms.

IV. RELATED LITERATURE

Wiggly Block Test. Read designed the Midget Wiggly Block Test after examining the Wiggly Block Test which was

derived by O'Connor from an old Chinese puzzle. The assembly time for this Wiggly Block Test varied from thirty seconds to thirty minutes. Of 4,000 tests given to experienced adults, those who scored three minutes or less were successful in business, while of those who scored six minutes or over only a few were considered successful.[4] The test should be given to children from fourteen to sixteen years of age to obtain the most reliable scores because they are not conditioned by experience.[5] An experiment using 109 high school shop pupils to evaluate reliability and validity of the Wiggly Block Test was conducted by Remmers and Scholl.[6] The criterion was shop grades for one semester. It was found that (1) the reliability of the test for the population in question was .57 which is generally considered low for an estimate of reliability; (2) validity coefficient obtained from machine shop grades was found to be .98 which is an unusually high value. This validity coefficient may indicate that the function measured by the Wiggly Block Test and one semester shop grades are practically identical. Remmers and Scholl recommend that the

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[4]Johnson O'Connor, Born That Way (Baltimore: Williams and Wilkins, 1928), p. 10.

[5]Johnson O'Connor, "Study of Human Nature," Atlantic Monthly, 150 (December, 1932), p. 126.

[6]H. H. Remmers and J. W. Scholl, "Testing the Wiggly Block," Personnel Journal, 12 (October, 1933), p. 155.

Wiggly Block Test be given up to twenty times to one person to determine a reliable scoring.[7]

Midget Wiggly Block Test. Reed reported that the construction of the Midget Wiggly Block Test to measure mechanical ability presented four problems which were:

> "(1) To construct a test which would require some manipulative skill as well as the ability to see relationships of the pieces. (2) To construct a test so the subject would start with a simple job and proceed to the more complex. (3) To construct a test so the shapes of the pieces could be detected to eliminate trial and error as far as possible. (4) To construct a test which would not have any two pieces alike."[8]

Reed reported the reliability coefficients of the test as follows:

> "A correlation between the two most consistent of the three and four trials gave 'r' a value of plus .90, P. E. ± .012. A correlation between the first score and a second score, obtained in the same manner two months later, for 64 cases gave 'r' a value of plus .82, P. E. ± .027."[9]

In validating the Midget Wiggly Block Test, Reed computed the correlation between the test scores of 103 senior high school shop pupils and their intelligence quotients obtained from the Otis Intermediate Thirty-Minute Test. He found r to be .014. To further validate the test,

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[7] Ibid., p. 159.

[8] Howard O. Reed, "The Midget Wiggly Block Test for Mechanical Ability," Industrial Arts and Vocational Education Magazine, (April, 1941), p. 153.

[9] Ibid., p. 154.

a correlation was computed between the test scores of 125 high school pupils and the mean of four high school grades. This r was found to be .17 ± .059. Similarly, the general shop grades for 121 cases were correlated; and r found to be .47 ± .05. The machine shop grades for 26 cases were correlated; and r found to be .70 ± .07.[10]

As a portion of a master's thesis, Henry A. White computed the relationship between the Midget Wiggly Block Test and the Detroit Mechanical Aptitude Examination and found r to be .40 ± .07. He also computed the relationship between the Midget Wiggly Block Test and the Stenquist Mechanical Aptitude Test, Part I and Part II, and found r to be .27 ± .07 for Part II. White also correlated the Midget Wiggly Block Test scores with the intelligence quotients obtained from the Otis Self-Administering Test, Form A, and found r to be .18 ± .07. Ninety cases were studied.[11]

Learning Index. The learning index employed in this study has not been reported in the literature surveyed by the writer. Reed has reported some evidence to the effect that learning takes place when a subject repeats the test. He gave the test ten different times to 21 boys with a mean time

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[10] Reed, loc. cit.

[11] Howard O. Reed, "Further Experiments With the Midget Wiggly Block Test," Industrial Arts and Vocational Education Magazine, (June, 1945), p. 242.

being obtained on the first test trial of 5.44 minutes. The mean time obtained on the tenth trial was 2.07 minutes. A decline was noted in the ten means except for the mean of the eighth trial, which increased .07 of a minute over the mean of the seventh trial.[12]

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[12]Reed, "The Midget Wiggly Block Test for Mechanical Ability", op. cit., p. 154.

CHAPTER II

PROCEDURE AND MEASURING DEVICES

This chapter is concerned with a description of the system for recording the data, the administration of tests, and the method of obtaining teacher ratings of the subjects.

Recording the data. The data obtained for each pupil in the sample were recorded on a separate file card and were alphabetized. A case number was assigned each pupil for the sake of confidential recording of data. The data on each file card included the pupil's name, case number, age, classification, home room number, letter grades in each of the four subjects, grade point average, three scores from the California Short-Form Test for Mental Maturity, and trials, score and learning index for the Midget Wiggly Block Test.

California Short-Form Test of Mental Maturity. The California Short-Form Test of Mental Maturity was administered at the beginning of the school year to every pupil by the guidance director. This test consists of sub-tests (the sub-tests on the California Short-Form Test of Mental Maturity are referred to as factors in the manual) measuring language, non-language, total mental factors, and four other intelligence

factors; spatial relations, logical reasoning, numerical reasoning, and verbal concepts. This test yields three intelligence quotients consisting of language, non-language, and total mental factors; the latter two being used in this investigation. The other factor of the test with which this study was concerned was the spatial relationships expressed in percentiles. The derivation of the intelligence quotients may be found in the test manual.[1]

Kidgot Wiggly Block Test. The Kidgot Wiggly Block Test was administered to each pupil in the sample. The test was administered according to the directions in the test manual.[2] The pupil was timed by a stop watch and the time recorded in minutes and hundredths. Each pupil completed a minimum of three trials. If the trials were not sufficiently consistent, a fourth trial was given. The trials were recorded on the file card of each pupil in the order given, the first trial being at the top of the list to enable quick reference when determining the learning index. The test score was computed for each pupil and recorded. Subsequently, the learning index of each pupil was also computed and recorded.

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[1]See p. 33, Appendix C, p. 6.

[2]See p. 32, Appendix B, p. 3.

Teacher rating form. In addition to the tests a teacher rating form was designed and used in this study.[3] A copy of the rating form was presented to each mathematics teacher who was requested to rate the pupils in three areas: (1) routine computation facility, (2) perception of abstraction, and (3) problem solving. The rating was repeated by the same teachers one week later to provide a means for checking the reliability of the rating form. A tabulation of these two ratings is presented in Table I.

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[3] See Appendix A, p. 30.

TABLE I

COMPARISON OF TWO RATINGS COMPLETED ONE WEEK APART OF NINETY-TWO INDUSTRIAL ARTS PUPILS BY FOUR MATHEMATICS TEACHERS

First Rating	Second Rating								
	0 to .99	1.00 to 1.99	2.00 to 2.99	3.00 to 3.99	4.00 to 4.99	5.00 to 5.99	6.00 to 6.99	7.00 to 7.99	Total
0 - .99									0
1.00 - 1.99		5	2	1					8
2.00 - 2.99		1	11	5					17
3.00 - 3.99			3	9	8				20
4.00 - 4.99				1	14	4			19
5.00 - 5.99				1		19	1		21
6.00 - 6.99					1	3	2	1	7
Totals	0	6	16	17	23	26	3	1	92

*The scores for five pupils who were rated by their teachers were within the 1.00-1.99 interval on both the first and second ratings. The rating scores for two pupils were within the 1.00 - 1.99 interval on the first rating but the rating scores for these same two pupils on the second rating were within the 2.00 - 2.99 interval.

CHAPTER III

ANALYSIS OF DATA

This chapter is devoted to the presentation of the data, analyses of these data, and their interpretation. The correlations given are all Pearson Product-Moment coefficients of correlation.

I. TOTAL SAMPLE

Relationships of Midget Wiggly Block Test scores and first trials with other measures. It seemed reasonable to make a comparison, using the total sample, between the Midget Wiggly Block Test scores and (1) the scores of the pupils on the California Short-Form Test of Mental Maturity spatial relations; and, (2) the California Short-Form Test of Mental Maturity total mental factors intelligence quotients. It also seemed reasonable to compare the first trials of the Midget Wiggly Block Test with the California Short-Form Test of Mental Maturity total mental factors intelligence quotients.

The Midget Wiggly Block Test scores and the spatial relations factor percentiles were correlated and r found to be -.274. The Midget Wiggly Block Test scores also were correlated with the total mental factors intelligence quotients and r found to be -.195. These data are shown in Table II. A correlation was computed between the first trial

of the Midget Wiggly Block Test and the total mental factors intelligence quotients and r was found to be -.218, which is shown in Table III.

On the sample studied, the correlation (-.274) between the scores on the Midget Wiggly Block Test and the California Short-Form Test of Mental Maturity spatial relations factor percentiles was statistically significant at the one per cent level, the minimum value for r being .254 at the one per cent level.[1] The correlation (-.195) between the scores on the Midget Wiggly Block Test and the California Short-Form Test of Mental Maturity total mental factors intelligence quotients was just statistically significant at the five per cent level, the minimum value for r being .195 at the five per cent level. The correlation (-.218) between the scores on the first trial of the Midget Wiggly Block Test and the California Short-Form Test of Mental Maturity total mental intelligence quotients was statistically significant at the five per cent level.

Relationships of learning indexes with intellectual measures. In order to determine whether the learning index was related to measured intellectual ability, correlations were computed between the learning indexes and the total

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[1] Francis G. Cornell, "One Percent and 5 Percent Levels of Significance for the Correlation Coefficients," Table 9.1, The Essentials of Educational Statistics (New York: John Wiley and Sons, Inc., 1956), p. 179.

mental factors intelligence quotients, non-language intelligence quotients, and the spatial relations percentiles of the California Short-Form Test of Mental Maturity as reported in Table IV.

As a partial answer to the problem of this study, the correlation between the learning indexes and the total mental factors intelligence quotients was found to be -.195 ± .096. This correlation was just statistically significant at the five per cent level.

Since the learning indexes are based on a non-language test, they were correlated with the non-language factors intelligence quotients and r found to be -.210 ± .099. This correlation was statistically significant at the five per cent level.

The spatial relations factor percentiles were correlated with the learning indexes to identify the existence of any common visual perception relationships and r was found to be .000 ± .100. This correlation was not statistically significant.

The learning indexes were correlated with the grade point averages in an effort to identify the relationship between the learning index and the achievement in school subjects and r was found to be .003 ± .099; which is also reported in Table IV. This correlation was not statistically significant.

TABLE II

COMPARISONS OF THE MIDGET WIGGLY BLOCK TEST SCORES WITH THE SPATIAL RELATIONS FACTOR PERCENTILES AND THE TOTAL MENTAL FACTORS INTELLIGENCE QUOTIENTS OF THE CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

Measures	Number Cases	Means	SD	r
Test Score	100	4.10 ± .221	2.21	
Spatial Relations Factor	100	54.74 ± 2.426	24.26	-.274
I. Q.	100	106.20 ± 1.058	10.58	-.195

TABLE III

RELATIONSHIP BETWEEN THE MIDGET WIGGLY BLOCK TEST FIRST TRIALS AND THE TOTAL MENTAL FACTORS INTELLIGENCE QUOTIENTS OF THE CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

Measures	Number Cases	Means	SD	r
First Trial	100	6.77 ± .356	3.56	
I. Q.	100	106.20 ± 1.058	10.58	-.218

TABLE IV

COMPARISON OF THE LEARNING INDEXES WITH THE CALIFORNIA TEST AND THE GRADE POINT AVERAGES

	Learning Index	California Test			Grade Point Average
		Total I. Q.	Non-Language I. Q.	Spatial Relations	
N	100	100	100	100	100
Mean	.33±.027	106.20±1.058	103.16±1.256	54.74±2.426	1.38±.06
SD	.27	10.58	12.56	24.26	.60
r		-.195±.096	-.210±.099	.000±.100	.003±.099

II. TRUNCATED SAMPLE

Since preliminary analyses of the correlation coefficients between the learning indexes and the other measures of pupil performance of the total sample had revealed either low or negative relationships, it was decided to truncate the distribution and restrict the range of scores. This was done under the assumption that selection of the extremes of the distribution should reveal whether any relationship existed between the learning indexes and other outside measures of intellectual factors. Such relationship might be masked if the unrestricted total range of scores were utilized in computing the correlation coefficients. The correlation coefficients here presented, therefore, were based on the upper and lower quarter of the learning indexes.

TABLE V

COMPARISON OF THE UPPER TWENTY-FIVE PER CENT AND THE LOWER TWENTY-FIVE PER CENT OF THE LEARNING INDEXES AND THE TOTAL MENTAL FACTORS INTELLIGENCE QUOTIENTS OF THE CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

	I. Q.		Learning Index		
	Mean	SD	Mean	SD	r
Upper 25%	102.32±2.274	11.37	.67±.012	.06	.284±.016
Lower 25%	107.00±1.674	8.37	-.04±.028	.14	-.106±.002

The difference in the mean learning index of the upper twenty-five per cent and the lower twenty-five per cent was .71. With forty-eight degrees of freedom, the t value was 22.9 which gave a significance beyond the one per cent level.

The difference between the standard deviations of the upper twenty-five per cent and the lower twenty-five per cent of the learning index was .08. The t value computed for this difference was 4.000 which signifies a significant difference in variability beyond the one per cent level.

The difference in the mean I. Q. of the upper twenty-five per cent and the lower twenty-five per cent was 4.76. With forty-eight degrees of freedom, the t value of this difference was .94. This value for t does not give a significant level of confidence at the ten per cent level.

The difference between the standard deviations on I. Q. of the upper twenty-five per cent and the lower twenty-five per cent was 3.00. The t value of this difference was 1.197 which does not give a significant level of confidence at the ten per cent level.

The significance of the difference between the correlation between I. Q. and the learning index (.284) of the upper twenty-five per cent and the correlation between I. Q. and the learning index (-.106) of the lower twenty-five per cent was computed by converting the r's into Fisher's z

function. This computation gave a C. R. of .621 which is not large enough to indicate significance.[2]

The relationship analysis was confined to the learning indexes and the total intelligence quotients on the California Short-Form Test of Mental Maturity without analysing part scores on the test since the part scores contribute to the total scores.

TABLE VI

COMPARISON OF THE UPPER TWENTY-FIVE PER CENT AND THE LOWER TWENTY-FIVE PER CENT OF THE LEARNING INDEXES AND THE SPATIAL RELATIONS PERCENTILES OF THE CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

	Spatial Relations		Learning Index		
	Mean	SD	Mean	SD	r
Upper 25%	46.40±4.50	22.5	.67±.012	.06	.128±.003
Lower 25%	57.6 ±5.60	28.04	-.04±.028	.14	.211±.0009

The difference in the mean spatial relations of the upper twenty-five per cent and the lower twenty-five per cent was 11.20. With forty-eight degrees of freedom, the t value of this difference was 1.53. This value for t does not give a significant level of confidence at the ten per cent level.

The C. R. of the r's between the upper twenty-five per cent and the lower twenty-five per cent was .232. This was not significant at the five per cent level.

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[2]The formulas used for computation taken from Henry E. Garrett, Statistics in Psychology and Education, (New York: Longmans, Green and Co., 1953), p. 239 ff.

TABLE VII

COMPARISON OF THE UPPER TWENTY-FIVE PER CENT AND THE LOWER TWENTY-FIVE PER CENT OF THE LEARNING INDEXES AND THE GRADE POINT AVERAGES

	Grade Point Average		Learning Index		
	Mean	SD	Mean	SD	r
Upper 25%	1.77±.100	.50	.67±.012	.06	.150±.0045
Lower 25%	1.74±.106	.53	-.04±.020	.14	.421±.035

The difference in the mean grade point averages of the upper twenty-five per cent and the lower twenty-five per cent was .03. With forty-eight degrees of freedom, the t value of this difference was .207. This value for t does not give a significant level of confidence at the ten per cent level.

The C. R. of the r's between the upper twenty-five per cent and the lower twenty-five per cent was .987. This did not give an accepted level of significance.

TABLE VIII

COMPARISON OF THE UPPER TWENTY-FIVE PER CENT AND THE LOWER TWENTY-FIVE PER CENT OF THE LEARNING INDEXES AND THE TEACHER RATINGS FOR THIRTY-TWO PUPILS

	Teacher Ratings		Learning Index		
	Mean	SD	Mean	SD	r
Upper 25%	3.49±.226	1.13	.67±.012	.06	.006±.000
Lower 25%	3.88±.284	1.42	-.04±.020	.14	.383±.029

The difference in mean teacher ratings of the upper twenty-five per cent and the lower twenty-five per cent is .39. With forty-eight degrees of freedom, the t value was 3.391 which is significant beyond the one per cent level.

The C. R. of the $\frac{1}{2}$ between the upper twenty-five per cent and the lower twenty-five per cent was 1.31. This did not give an accepted level of significance.

It will be noted that restricting the range of the distribution of scores for analyzing the upper and lower quarters does not appreciably change the correlation coefficients.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDY

It was the specific objective of this study to draw conclusions regarding the learning index. This was done by interpreting the data presented in Chapter III.

Conclusions were made recognizing the following assumptions and limitations:

1. The sample included in this study was a group of pupils enrolled in industrial arts at the West Junior High School, Waterloo, Iowa.

2. The methods used in analyzing the data depended upon statistical computations as a basis for conclusions.

3. It was assumed that the test factors of the California Short-Form Test of Mental Maturity were sufficiently reliable to be used in this study.

I. CONCLUSIONS

Based on the statistical findings in this study, the following conclusions are presented:

1. Does a relationship exist between the scores of the Midget Wiggly Block Test and the spatial relations percentiles of the California Short-Form Test of Mental Maturity?

The correlation of -.27 between the Midget Wiggly Block Test scores and the spatial relations percentiles of

the California Short-Form Test of Mental Maturity indicates that there is not a significant relationship between these two criteria.

2. Does a relationship exist between the scores of the Midget Wiggly Block Test and total mental factors intelligence quotients derived from the California Short-Form Test of Mental Maturity?

The correlation of -.195 between the Midget Wiggly Block Test scores and the total mental factors intelligence quotients of the California Short-Form Test of Mental Maturity indicates that there is not a significant relationship between these two criteria.

3. Does a relationship exist between the first trials of the Midget Wiggly Block Test and the total mental factors intelligence quotients of the California Short-Form Test of Mental Maturity?

The correlation of -.218 between the first trials of the Midget Wiggly Block Test and the total mental factors intelligence quotients of the California Short-Form Test of Mental Maturity indicates that there is not a significant relationship between these two criteria.

4. Does a relationship exist between the learning indexes and the total mental factors intelligence quotients of the California Short-Form Test of Mental Maturity?

The correlation of -.195 between the learning indexes and the total mental factors intelligence quotients of the California Short-Form Test of Mental Maturity indicates that there is not a significant relationship between these two criteria.

5. Does a relationship exist between the learning indexes and the non-language factors intelligence quotients of the California Short-Form Test of Mental Maturity?

The correlation of -.210 between the learning indexes and the non-language factors intelligence quotients of the California Short-Form Test of Mental Maturity indicates that there is not a significant relationship between these two criteria.

6. Does a relationship exist between the learning indexes and the spatial relations percentiles of the California Short-Form Test of Mental Maturity?

The correlation of .000 between the learning indexes and the spatial relations percentiles of the California Short-Form Test of Mental Maturity indicates that there is not a significant relationship between these two criteria.

7. Does a relationship exist between the learning indexes and the grade point averages?

A correlation of .003 between the learning indexes and the grade point averages indicates that there is not a significant relationship between these two criteria.

8. Does a relationship exist between the learning indexes and the pupil ratings by mathematics teachers?

A correlation of .006 between the upper twenty-five per cent of the learning indexes and the ratings by mathematics teachers indicates that there is not a significant relationship between these two criteria.

A correlation of .383 between the lower twenty-five per cent of the learning indexes and the pupil ratings by mathematics teachers indicates that there is not a significant relationship between those two criteria.

II. RECOMMENDATIONS FOR FURTHER STUDY

Some thoughts have arisen during the course of the study which might profitably be pursued further.

1. Further validating studies might be conducted which might include such criteria as other mechanical aptitude tests, selected groups of shop students, and a revised learning index.

2. An investigation of the Minnesota Manual Dexterity Test might be conducted to identify the factor or factors which the test measures other than those reported in this study.

3. The significance of the learning index could be further explored by comparing it with a measure of learning in a controlled situation involving some common operations taught in the school shop such as soldering, planing or filing.

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APPENDIX A

RATING OF STUDENTS' INSIGHTS AS OBSERVED BY MATHEMATICS TEACHERS (FORM)

RATING OF STUDENTS' INSIGHTS AS OBSERVED BY MATHEMATICS TEACHERS

Instructions:

From the attached list select only the students that you know well enough to rate. In each of the three areas rate the pupils using a scale ranging from one for very poor, four as the mid-point for average, and seven for unusually high.

The three areas are:

(1) Routine Computation Facility - which relates to the students ability to do routine exercises with fundamental processes of fractions, whole numbers, and decimals. As an example, a series of similar multiplication problems.

(2) Perception of Abstractions - the ability to recognize mathematical problems from written or word description problems. As an example, find the area, in square yards, of a room 24 feet wide and 30 feet long.

(3) Problem-Solving Accuracy - regardless of speed of work. As an example, the student who has four correct answers of five problems worked would score higher than a student who has two correct answers of ten problems worked.

NAME	(1) ROUTINE COMPUTATION FACILITIES	(2) PERCEPTION OF ABSTRACT	(3) PROBLEM SOLVING ACCURACY
Alldredge, J.			
Augustson, F.			
Ayers, B.			
Ayers, L.			
Backens, K.			

APPENDIX B

MANUAL OF THE MIDGET WIGGLY BLOCK TEST FOR MECHANICAL ABILITY

THE MIDGET WIGGLY BLOCK TEST FOR MECHANICAL ABILITY

Plans for Making
and
Directions for Administering
by

Howard O. Reed, Ed.D.
Head of Department of Industrial Arts
Iowa State Teachers College
Cedar Falls, Iowa

FOREWORD

The Midget Wiggly Block Test was designed, constructed, and used for the first time in 1937. It has been used to test many individuals in various occupations. It has proved quite useful for testing shop students. The results may be used as a means of selection for more homogeneously grouping of the shop students. The results may also be used to bring about a better understanding of a student's ability to do shopwork whether the students are grouped or not.

By offering detailed plans for the construction of the test, along with the manual for administering, it is thought that Industrial-arts teachers could construct their own set of blocks much more economically than if they were produced commercially. Counselors who desire a set of blocks should be able to obtain the cooperation of the Industrial-arts teacher, a student, or someone who does woodworking of this type to make them. The instructions for administering, scoring, and interpreting the results should be followed carefully when using the test.

Howard O. Reed, 1951

PLANS FOR MAKING THE MIDGET WIGGLY BLOCK TEST

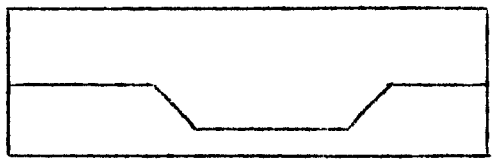
Specifications:
A fine, straight-grained, soft wood should be used for the blocks. Soft pine has been found to be most desirable. Four blocks make up the set. One of the four pieces is jig-sawed lengthwise into four pieces; one into six pieces; one into nine pieces; and one is left whole. After the rough corners are sanded, each piece is dyed black with a non-wax shoe dye.

Equipment:
- Jack Plane
- Cross Cut saw
- Rip saw
- Ruler
- Jig saw in good condition fitted with a blade .010" x .025".

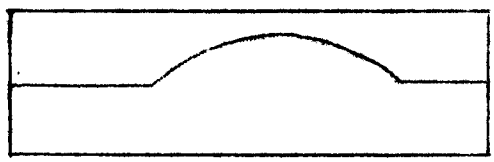
Materials:
- 4 pcs. 1"x1"x2 1/2" soft pine surfaced on four sides (will make pieces approximately 13/16"x13/16".)
- 00 sand paper
- Black shoe dye (non-wax)

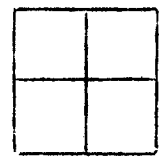
Procedure:
1. Select material with care.
2. Rip saw a piece about 12" long.
3. Plane rough surfaces square and to proper dimensions.
4. Saw pieces square and to length.
5. Sand rough corners lightly.
6. Use drawings on the next page with carbon paper to make the layouts on the blocks of wood. Great care should be used in doing this layout work in order to secure the correct layout.

Top View



Side view

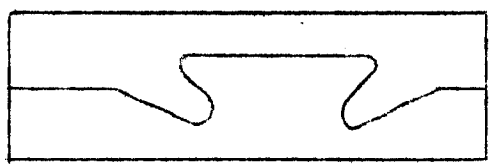




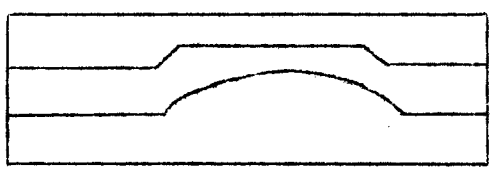
End view

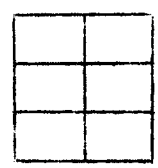
ACTUAL SIZE PATTERN FOR FOUR-PIECE BLOCK

Top view



Side view

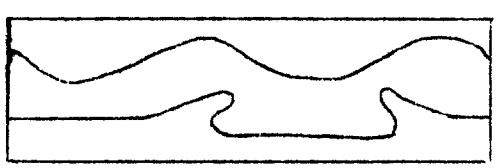




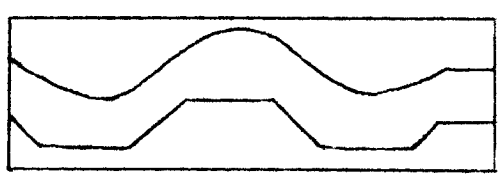
End view

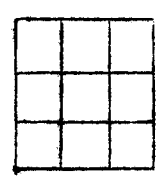
ACTUAL SIZE PATTERN FOR SIX-PIECE BLOCK

Top view



Side view





End view

ACTUAL SIZE PATTERN FOR NINE-PIECE BLOCK

7. Cut the blocks lengthwise on a jigsaw using care to follow the layout lines. The interlocking or dovetail shaped cuts on the top side should be cut first. After the cut or cuts have been completed on the top side, the pieces should be clamped together before making the cuts on the front side.
8. Sand the rough corners until they are smooth. If the interlocking cuts do not slide through freely, they should be sanded or filed so they will.

DIRECTIONS FOR ADMINISTERING, SCORING, AND INTERPRETING THE MDIGET WIGGLY BLOCK TEST

INTRODUCTION

This is an individual performance test of mechanical ability, or ability to do work in the school shops. There is no time limit.

DIRECTIONS FOR ADMINISTERING

The blocks should be arranged before the arrival of the subject to be tested. (If he is present, ask him to turn his head so he cannot see you arrange them.) The parts of each of the three blocks are to be laid in the order shown in Figure 2, keeping the parts of each block close together and about three inches between each group. The solid block should be placed a few inches back of the group of six pieces.

When the subject is seated at the desk say to him, "When these four pieces are placed together correctly, they will make a block like this." (Indicate, while speaking, first the pieces of the four piece block, then the solid block.)

Further explain, and indicate with your hand each part spoken of, "These six pieces will also make a block like this, and these nine pieces will also make a block like this; same shape and same size. You are going to be timed to see how quickly you can assemble these three blocks. The total time will count, so do not stop after you get one done. Do the four piece one first, then go right on to the six piece, and from it to the nine piece one." (Caution against breaking.)

When the subject indicates that he fully understands what he is to do, give the signal to start. It is permissable to answer any questions the subject may ask relative to his procedure, but do not reveal any helpful information that may give him a clue as to the shape of cuts, etc. Do not give help in any way, at any time other than making the directions clear.

Keep time, from the time the subject reaches for the first piece and stop the watch when the nine-piece block is finished. Record the time in minutes and hundredths for each trial.

The test should be assembled three times, and time kept separately for each time. If the difference between the two most consistent scores is greater than twenty-five per cent of the final score, give a fourth trial. (See information under scoring.) A third trial is needed about sixty per cent of the time and a fourth trial about twenty per cent of the time.

DIRECTIONS FOR SCORING

Average the two most consistent trials. (The 'two most consistent' being the two between which there is the least difference.) This average is the score the subject made on the test and can be compared with the norms.

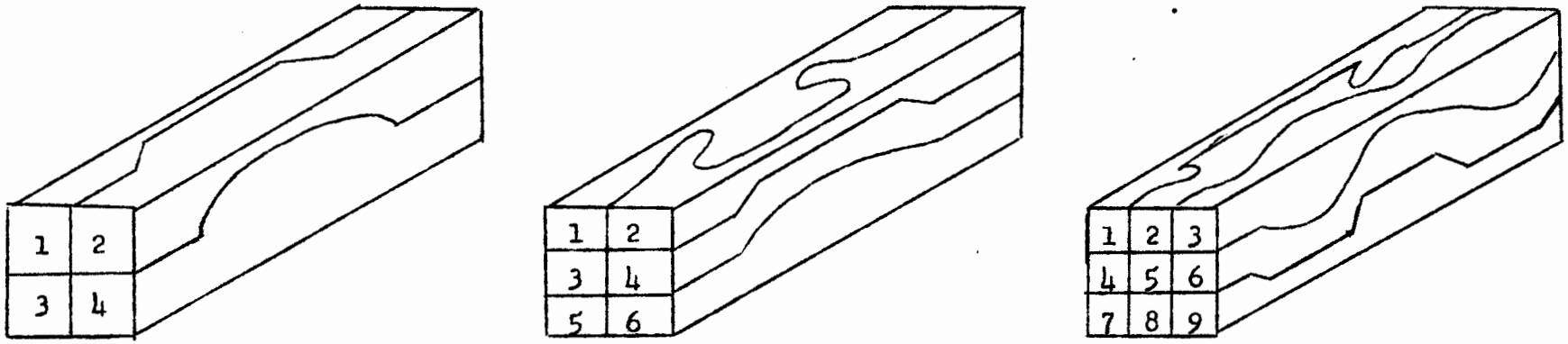


Fig. 1 - CORRECT POSITION OF BLOCKS BEFORE LAYING OUT

"T" means turn the block end for end

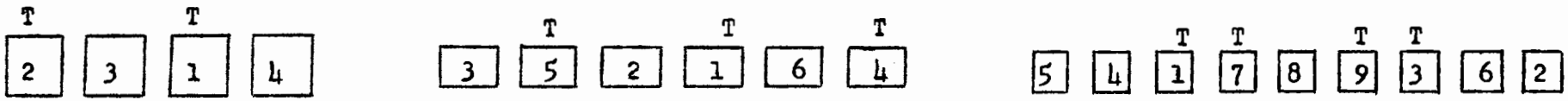


Fig. 2 - ORDER OF LAYING OUT THE BLOCKS.

If the difference between the two most consistent trials is greater than one-fourth of the final score, a fourth trial should be given, then score the subject on the two most consistent of the four trials.

Example of three trials:
1st trial.....4.12
2nd trial.....1.75
3rd trial.....2.33

Computing:
The difference between trials 1 and 2 is 2.37
The difference between trials 1 and 3 is 1.79
The difference between trials 2 and 3 is 0.58

Since trials two and three are the most consistent, the score would be 2.04, which is the average of 1.75 and 2.33.

Example where a fourth trial is needed:
1st trial.....7.33
2nd trial.....3.20
3rd trial.....4.35
4th trial.....3.22

Since trials two and three are the most consistent, the score would be 3.78, but since four times 1.15 (the difference) equals 4.60, a number somewhat larger than the score, a fourth trial was given. Now trials two and four are the most consistent, with a difference of .02, and the final score is 3.21. More than four trials is not recommended unless there is decided evidence of learning taking place; that is, a decided decrease in time required to do each trial. The final score should be noted to the effect that more than four trials were used. If the first two trials vary but just a few second, (less than one-fourth of score) the third trial may be omitted.

Twenty-two cases were tested where a fourth trial was given and eleven obtained a higher score than where it was computed on three trials and eleven obtained a lower score.

The following chart gives the decimal equivalent of a minute from the seconds. It will be found helpful when converting seconds to hundredths of a minute.

INTERPRETATION

A correlation was computed with four criteria to establish the validity of this test. A comparison was made with riveting hammers which thirty-three of the boys made in the metal shop, and a comparison was made with a rating by two of the shop teachers.

The following tables show the results of these studies:

TABLE SHOWING RESULTS OF CORRELATION OF BLOCK SCORES WITH VARIOUS CRITERIA FOR 15 YEAR OLD HIGH SCHOOL BOYS

Criteria	N	r	P.E.
Otis I.Q. Score	103	.014	± .066
Avg. of 4 Mks.	125	.17	± .059
Tapping	78	.052	± .075
Shop mark	121	.465	± .047

HUNDREDTHS OF A MINUTE

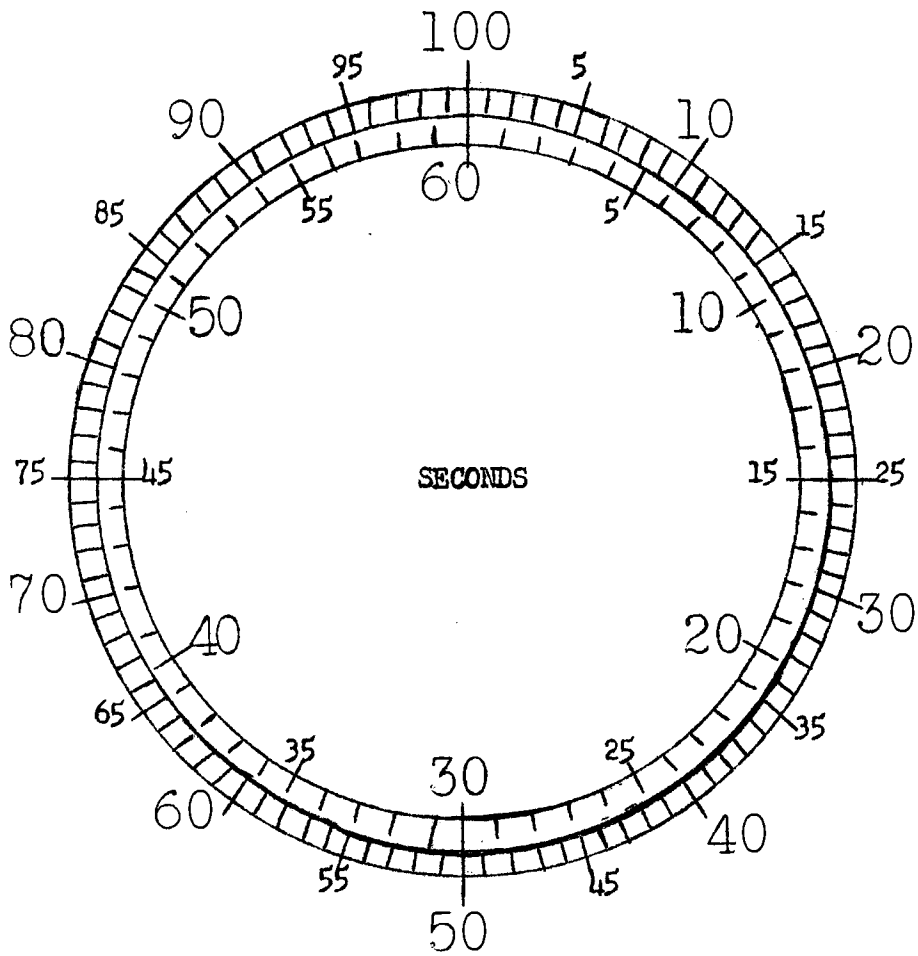


CHART FOR CONVERTING SECONDS TO HUNDREDTHS OF A MINUTE

TABLE SHOWING THE PERCENTILES FOR THE MIDGET WIGGLY BLOCK SCORES FOR MEN AND WOMEN*

Percentile Rank	Men N-340	Women N-100	Percentile Rank	Men	Women
100	1.10	1.50	50	3.71	4.64
99	1.26	1.68	49	3.75	4.68
98	1.38	1.86	48	3.77	4.72
97	1.52	1.95	47	3.79	4.75
96	1.71	2.06	46	3.80	4.79
95	1.88	2.14	45	3.86	4.88
94	2.05	2.22	44	3.90	3.97
93	2.13	2.34	43	3.95	5.10
92	2.21	2.43	42	4.01	5.19
91	2.26	2.50	41	4.06	5.30
90	2.30	2.58	40	4.10	5.41
89	2.33	2.66	39	4.17	5.50
88	2.37	2.72	38	4.20	5.60
87	2.45	2.80	37	4.27	5.72
86	2.52	2.86	36	4.30	5.82
85	2.58	2.91	35	4.32	5.93
84	2.60	2.98	34	4.33	6.03
83	2.62	3.05	33	4.39	6.14
82	2.64	3.12	32	4.43	6.24
81	2.67	3.17	31	4.48	6.34
80	2.70	3.24	30	4.53	6.45
79	2.72	3.30	29	4.56	6.55
78	2.76	3.36	28	4.60	6.65
77	2.79	3.40	27	4.66	6.76
76	2.82	3.45	26	4.71	6.86
75	2.86	3.49	25	4.77	7.00
74	2.90	3.52	24	4.91	7.11
73	2.93	3.54	23	5.04	7.22
72	2.97	3.61	22	5.20	7.35
71	3.01	3.67	21	5.26	7.44
70	3.04	3.71	20	5.33	7.53
69	3.07	3.78	19	5.40	7.65
68	3.09	3.83	18	5.47	7.78
67	3.12	3.87	17	5.56	7.89
66	3.17	3.94	16	5.65	8.06
65	3.21	3.99	15	5.78	8.20
64	3.25	4.04	14	5.93	8.34
63	3.26	4.10	13	6.08	8.50
62	3.27	4.15	12	6.27	8.61
61	3.28	4.20	11	6.48	8.76
60	3.28	4.20	10	6.67	8.93
59	3.30	4.31	9	7.32	9.88
58	3.31	4.37	8	8.04	10.87
57	3.40	4.40	7	8.75	12.10
56	3.47	4.42	6	9.94	13.24
55	3.55	4.45	5	11.82	15.62
54	3.59	4.49	4	14.70	18.38
53	3.62	4.52	3	16.35	20.46
52	3.64	4.54	2	19.06	22.93
51	3.68	4.59	1	23.74	26.88

*There was no age difference indicated above fourteen years.

TABLE SHOWING COMPARISON OF POOREST AND BEST HAMMERS WITH QUARTILE RANKING OF THE BLOCK SCORES

Hammers	P.R. 75 to 100	P.R. 50-74	P.R. 25-49	P.R. 0-24
10 Best	4	4	0	2
10 Poorest	1	1	3	5

The mean of the block scores of the ten best hammers was at the 91st percentile, and the mean of the ten poorest was at the 11th percentile.

TABLE SHOWING COMPARISON OF SHOP TEACHER RATING* WITH SCORES OF THE BLOCK TEST

Students	Above Avge.	Average	Below Average
10 from top 25 per cent	3	6	1
10 from bottom 25 per cent	0	3	7

*This rating was on the basis of teacher observation as to ability to do shop work and not on achievement as indicated by the shop mark.

From these limited data it appears that the Midget Wiggly Block Test measures mechanical ability to a certain extent. The results of the test may be used to assist the shop teacher to more fully understand his students, as well as for administrative and counselling purposes. It should be used with reservations, however.

Validating Information for Girls

The sewing instructor at Lockport Township High School, Lockport, Illinois, was asked to nominate some of her best and some of her poorest sewing students for this experiment. She was requested to use only information which designated the girls' ability to sew, and to eliminate influencing factors such as note book work, test grades, absences, etc. Sixteen girls were nominated; seven were rated above average; two were rated average, and seven were rated below average as to their ability to sew.

These girls were given the test in regular order. The mean score of the seven best was 3.82, and the mean score of the seven poorest was 9.77.

TABLE SHOWING SEWING-TEACHER RATING OF SIXTEEN GIRLS FROM SEWING CLASS AND THEIR QUARTILE PLACEMENT ON THE MIDGET WIGGLY BLOCK TEST

Block score ranking	Above average	Average	Below average
75 to 100	2	1	1
50 to 74	3	0	1
25 to 49	2	1	1
0 to 4	0	0	4

RELIABILITY

The reliability of this test is based on consistency as explained under "Scoring". When the reliability is calculated on the basis of the two most consistent of three or four trials "r" equals .90 ± .012. A correlation between the first score and a second score, obtained in the same manner two months later gave "r" a value of .82 with a P.E. of ± .027, where N equalled 64. The P.E. of the score is about ± .38, and this should be considered, when interpreting one's score.

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Reed, Howard O., THE MIDGET WIGGLY BLOCK TEST FOR MECHANICAL ABILITY, Industrial Arts and Vocational Education, 30:153-4, April, 1941.

Reed, Howard O., FURTHER EXPERIMENTS WITH THE MIDGET WIGGLY BLOCK TEST, Industrial Arts and Vocational Education, 35:241-3, June, 1946.

APPENDIX C

CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

I. Manual

II. Test

III. Answer Sheet

Rod Library Digital Scholarship Unit note:

Appendix C consisted of copyrighted material which is not being included with the open-access thesis text.