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Prediction of School Achievement in the Primary Grades

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Prediction of School Achievement in the Primary Grades

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Bonnie Kay Hanley

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Introduction

In recent years there has been much interest on the part of psychologists and educators concerning factors that are important in achieving academic success in school. This stems at least in part from an increasing concern for the individual child. Attempting to understand why school is easy for some children while others have much difficulty with the same tasks has led researchers to look for answers concerning what types of skills or other factors are essential for learning and what types of deficiencies can be predicted to make learning difficult.

Prediction is directly related to the importance of early identification of school children with special problems and special needs. These children must be identified so that special educational planning may begin early.

A number of different kinds of screening tests are used by school districts to try to determine which children may need help if they are to succeed in academic tasks of the school. Most of these devices fall into one of two groups, first grade readiness tests and group intelligence tests. Teachers, administrators, and other school personnel use the results of these tests, assuming that they will tell them which children can be expected to do well and which children can be expected not to do as well.

Thus, the major question with which this paper deals is: Are these two devices, group intelligence tests and readiness tests dependable predictors of school success as they are assumed to be by those who use them.

Specifically, the major questions considered were:

1. Is the Otis-Lennon Mental Ability Test given at the end of the first grade a good means of predicting how a child will achieve in reading and math during his first two primary years?

2. Is the Metropolitan Readiness Test given at the end of kindergarten a good means of predicting how a child will achieve in reading and math during his first two primary years?

3. Are the Otis-Lennon Mental Ability Test and the Metropolitan Readiness Test when used together in a multiple correlation a good means of predicting primary achievement.

4. Are the Metropolitan Readiness Test subtests; word meaning, copying, matching, and numbers used individually or in combination good predictors of primary achievement?

Review of the Literature

As a result of the interest in the prediction problem, a number of studies have been done assessing various factors which are thought to contribute to academic achievement. Among these factors are general intelligence, perceptual-motor skills, linguistic or language skills, social and emotional factors, family socio-economic background, and age of entrance into first grade. These factors have been explored singly, and in combination with varying age groups, with special children and with normal school populations.

Prior to the 1960 s most of the research done in predicting school success was done in predicting success in college curriculums, or special training schools, or occassionally success in high school. Little attention was devoted to the problems of elementary age children. A noteworthy exception was the work done by Edmiston (1946). He conducted a study in the Dayton, Ohio schools with 115 first graders, the purpose of which was to demonstrate the possibility of the use of a group of measures which might be used to govern either entrance to school or to differentiate entrants. He used a number of measures which included tests of mental ability, readiness, and personality, as correlated with achievement. The results showed that mental ability, as measured by the Detroit Beginners Intelligence Test correlated .57 with the Metropolitan Achievement

Test scores. The other tests correlated with achievement as follows: Alice and Jerry Readiness Test .59; California Personality Test .50; and the Metropolitan Readiness Test .54. Using a multiple correlation formula, three tests in combination showed a correlation of .66 with first grade achievement. These tests were the Detroit Beginners Intelligence Test, the Alice and Jerry Readiness Test, and the Californai Personality Test.

Koppitz(1959) published results of her studies with 143 first graders in the Columbus, Ohio schools in which she used her evaluation scales of human figure drawings and the Bender Gestalt Visual Motor Test as predictors of achievement as measured by the Metropolitan Achievement Test, Primary I. She found that her human figure drawings correlated with achievement .46, but when she added the Bender Gestalt Visual Motor Test with the human figure drawings, the two together correlated with achievement .65.

During the 1960's there developed more interest in elementary age children and their academic life. A number of studies dealing with prognosis of school success in elementary school were conducted. Some of the more significant were studies by (Shipp and Loudon,1964; Ames and Walker,1964; Vilscek,1964; Abbott, 1963; Mullis, 1965; and Scott,1965).

The study by Shipp and Loudon (1964) used the Goodenough Evaluation Scale to evaluate the childrens' drawings and the Gray-Votaw-Rogers Primary Achievement Test to evaluate achievement. They found that the Goodenough Evaluation Scale had a correlation of .51 with achievement and that it predicted about equally well for boys and girls.

The study by Ames and Walker (1964) was unique in that it used the Rorschach test along with the Weschler Intelligence Scale for Children to predict later reading ability. They gave 54 kindergarten children both of these tests, then gave them a reading achievement test when they reached fifth grade. Their sample was above the average of the national norm with a mean I.Q. 113 and the fifth grade reading mean of 8.2. Thus, the group tested was not typical of most school populations. The results of their study showed a Rorschach correlation with achievement of .53 and a Weschler Intelligence Scale for Children correlation of .57. The multiple correlation with achievement was .73 which seem to indicate that with the average or higher level child, that these two measures have a high predictive value.

Vilscek (1964) studied the effect of mental age and socio-economic levels on reading achievement in first grade. He used 402 children in six experimental groups, based on mental age levels and socio-economic levels. He found that significant differences in achievement were evident between pupils from the upper and lower socio-economic levels and between pupils at the different mental age levels. He concluded that both mental age levels and socio-economic levels are powerful independent variables affecting first grade reading success.

Abbott (1963) explored a number of predictor variables. He was concerned with predicting number and reading achievement. He tested 51 first grade pupils in Rutherford county

in Tennessee with the Stanford Binet Intelligence Test, the Bender Gestalt Visual Motor Test, the Hunter-Pascal Concept Formation Test, and the McGuire Index of Social Status, and the Metropolitan Readiness Test subtests of reading and numbers. Using multiple regression equations, he found the numbers subtest and the Stanford Binet Intelligence Test were the best predictors for reading achievement and that the reading and numbers subtests of the Metropolitan Readiness Test were the best predictors for numbers.

Mullis(1965) explored the problem from a different standpoint. He was concerned with predicting fifth grade achievement from first grade predictors. His purpose was to develop and cross-validate prediction equations for fifth grade achievement using the following first grade predictor variables: the Metropolitan Readiness Test; the Metropolitan Achievement Test, and teacher grades. He used fifth grade scores from the California Achievement Battery and teacher grades for major subjects taught in fifth grade. He concluded that this procedure was very successful in indicating probable achievement.

One study conducted by Scott (1965) was an attempt to evaluate the predictive value of one particular intelligence test, the Detroit Beginning First Grade Intelligence Exam. This test was used with the Stanford Achievement Test. Scott(1965) concluded that while a beginning intelligence exam may serve to predict learning to some extent, school success cannot be predicted from mental tests alone. There are many other contributing factors that influence learning.

Most of the studies done in the 1960's were concerned with evaluating more global measures as predictors, such as total I.Q. scores, or a total readiness score, or a total draw-a-man score, with school schievement. In most cases the measures evaluated were correlated positively with achievement, although they frequently correlated better as multiples rather than single factor correlations.

The research thus far in the 1970's seems to have more emphasis on learning factors within test scores. Some interest still persists in evaluating human figure drawings (Strahl, 1972). Studies have been conducted with a view of predicting children who will have learning problems (Keogh, 1970 and McKnab, 1972). Major research projects evaluating learning factors as predictors of achievement have been conducted by (Egeland, 1970; Duffy,1972; Lowell, 1971; Henderson,1973; and Rudolph,1973).

Strahl (1972), like Shipp and Loudon (1964), and Koppitz (1959) studied the human figure drawing for prediction of learning performance in first grade. He used the drawings of 61 children and evaluated them with the Human Figure Evaluation Scale. Results suggest that the Human Figure Evaluation Scale should provide usable data concerning childrens' developmental growth.

Keogh and Smith(1970) conducted a study designed for the early identification of educationally high risk and high potential children. The Bender Gestalt Visual Motor Test and teacher evaluations were used for predictor variables

and the California Achievement Test was used as a measure of achievement. They found that the teacher evaluations were very accurate predictors of high risk and high potential children and that the Bender Gestalt Visual Motor Test was a good means of identification of high potential children.

Another study attempting to select high risk children was conducted by McKnab(1972). This study was to evaluate a particular instrument, The Vane Kindergarten Test. He concluded that its correlation with the Stanford Binet Intelligence Test was high, but its ability to predict individual achievement scores was quite limited.

Of the studies which attempt to evaluate specific factors, the study by Egeland(1970) and the follow-up by Duffy(1972) would appear to be the most comprehensive. Egeland(1970) used 82 students randomly selected from nine elementary schools in Iowa City, Iowa. He studied the relationship of intelligence, visual-motor skills, psycholinguistic ability, and reading readiness skills with achievement, using the Weschler Intelligence Scale for Children, the Illinois Test of Psycholinguistic Ability, the Bender Gestalt Visual Motor Test, The Harrison Stroud Reading Test, and the Metropolitan Achievement Tests. A multiple regression program was used to determine which combination of test scores given in the first grade could best predict first and third grade achievement. His results indicate that valid predictions of first and third grade achievement can be made by evaluating a child's perceptual-motor skills, linguistic and intellectual

behavior in first grade. However, correlations involving the Weschler Intelligence Scale for Children and the Illinois Test of Psycholinguistic Ability composite scores with achievement were low, as were the multiple correlations involving I.Q. and Illinois Test of Psycholinguistic Ability subtest scores. According to Egeland(1970):

> It would appear that the use of a global and total score is not the most efficient way to predict achievement because it fails to take into account some aspects of perceptual and linguistic functioning which seem to be important determinants of early academic success and the combination of subtests that predicted achievement in one area was not necessarily the same as in another. The readiness subtests contributed most to the multiple correlations using first grade achievement. At the end of the third grade level, reading readiness continued to contribute while certain subtests from the Illinois Test of Psycholinguistic Abilities and the Weschler Intelligence Scale for Children increased in importance p.458 .

In his follow-up to the Egeland(1970) study, Duffy(1972) concluded that the relationship between the Illinois Test of Psycholinguistic Ability subtests and achievement shows that visual motor association is the only test which significantly correlated across the primary grades. Adequate functioning for each grade calls for the subject to be flexible.

Another major research project designed to evaluate reading readiness factors as predictors of success in first grade reading was conducted by Lowell(1971). The factors which he chose to evaluate were; visual discrimination, auditory discrimination, visual memory, knowledge of ABC letter names, concepts, word learning ability, and mental ability, as predictors of success in acquiring 1)initial reading vocabulary and 2) reading achievement at the end of the first grade.

Two hundred beginning first graders were used. The results of his study suggested the following conclusions; knowledge of letter names emerged as the best single predictor with a coefficient of .65, and all other mentioned factors were not importantly enough related to reading achievement to warrant recommendation in a reading readiness test.

Henderson (1973) conducted a study in which he explored the possibility that previous achievement tests could predict future success, as well as, the Weschler Intelligence Scale for Children, the Bender Gestalt Visual Motor Test, and the Illinois Test of Psycholinguistic Ability:Auditory Association subtest. He concluded that if prediction of reading achievement is the aim, then previous achievement tests were obviously more effective than any other predictors.

A somewhat related study was done by Rudolph (1973). His purpose was to compare the Cooperative Pre-School Inventory with selected measures of intelligence and readiness. The part of his study which seems germane to the present study, however, is the correlation between Metropolitan Readiness Test subtests and intelligence as measured by the Slosson Intelligence Test. The listening and copying subtests were significantly correlated with the Slosson Intelligence Test at the .05 level, and the numbers subtest correlated with the Slosson Intelligence Test scores for non-disadvantaged children.

In summary, there are a number of studies into the various aspects of predicting school success at the early elementary level. Although, most studies tend to agree that there are multiple factors influencing success, there is some difference of opinion as to which factors are the most important. Most studies use achievement test scores as a criteria of achievement. This seemed to be the best means of measuring achievement or at least the most convenient. A few of the studies use a good sized number of children, but many seem to use a small number of subjects and did not reflect a cross-section of the population.

Method

Nature of the Approach

This was a correlation study using both single and multiple correlation coefficients, developed from the data, to evaluate certain predictor variables as factors in school achievement.

The predictor variables used were: intelligence, as measured by the Otis-Lennon Mental Ability Test administered to each child in May of their year in first grade; and school readiness, as measured by the Metropolitan Readiness Test at the end of kindergarten.

The criterion variable used as a measure of the child's achievement was the Metropolitan Achievement Test-Primary II, given to the third graders in October, so that essentially what it measured was the child's achievement in the first and second grades.

Subjects Used

The subjects used were 112 third graders in classes in four of the public schools of Mattoon, Illinois.

Instruments Used

Instruments used were the Otis-Lennon Mental Ability Test, the Metropolitan Achievement Test-Primary II, and the Metropolitan Readiness Test. The scores of the individual children on these tests were obtained from school records.

Procedures for Statistical Analysis

These procedures were used in the statistical analysis of the data.

A. The following data was collected for each child:

1. Otis-Lennon I.Q. scores
2. Metropolitan Readiness Test composite score and subtests scores
3. Metropolitan Achievement Test scores, total math and total reading

B. Next a frequency distribution of scores was compiled for:

1. I.Q. scores
2. readiness test composite scores
3. readiness test subtest scores in word meaning, numbers, matching, and copying
4. achievement test math scores
5. achievement test reading scores

From the frequency distributions discussed above, a mean and a standard deviation were determined for each set of scores, by using the formulaes: (Bloomers and Lindquist, 1960, pages 102 and 140)

(mean) $\bar{X} = \frac{\Sigma X}{N}$ (standard deviation) $S.D. = \sqrt{\frac{\Sigma(X-\bar{X})^2}{N}}$

After determining the above, simple correlation coefficients (r) by the Pearons' Product Moment Correlation, were computed for the following variables:

1. Otis-Lennon I.Q. and math achievement
2. Otis-Lennon I.Q. and reading achievement

3. Metropolitan Readiness Test composite score and reading achievement

4. Metropolitan Readiness Test composite score and math achievement

5. Otis-Lennon I.Q. and Metropolitan Readiness Test composite score

6. readiness test subtest scores on numbers subtest and math achievement

7. readiness subtest scores on the matching subtest and reading achievement

8. readiness subtest scores on the copying subtest and reading achievement

9. readiness subtest scores in word meaning and reading achievement

10. readiness subtest scores in matching and subtest scores in copying

11. readiness subtest scores in word meaning and subtest scores in matching

The formula used for these correlations was: (Bloomers and Lindquist, 1960, page 389)

$$r = \frac{\sum x_i y_i}{N s_x s_y}$$

where: $x_i = X_i - \bar{X}$

$y_i = Y_i - \bar{Y}$

s_x = standard deviation of the X distribution

s_y = standard deviation of the Y distribution

N = number of subjects in the population

After the correlation coefficients for the above 11 combinations of simple variables were computed, multiple correlations for certain of the variables were computed.

A multiple correlation (R) was determined for the following combinations:

1. I.Q. with readiness composite score to predict reading achievement.
2. I.Q. with readiness composite score to predict math achievement
3. readiness subtest matching with readiness subtest copying to predict reading achievement
4. readiness subtest matching and readiness subtest word meaning to predict reading achievement

In determining multiple correlations it was first necessary to determine the weights to be assigned to each factor or variable in order to achieve maximum predictability. These weights then became a number by which each variable was multiplied in the final equation. The following was the method used for determining weights: (Fergeson, 1971)

B_2 = weight assigned for factor 2 (predictor variable)

B_3 = weight assigned to factor 3 (predictor variable)

$$B_2 = \frac{r_{12} - r_{13} r_{23}}{1 - r^2_{23}}$$

$$B_3 = \frac{r_{13} - r_{12} r_{23}}{1 - r^2_{23}}$$

where: r_{12} = correlation between variables 1 and 2

r_{13} = correlation between variables 1 and 3

r_{23} = correlation between variables 2 and 3

To determine B_2 and B_3 the above equations were used.

After determining the appropriate weights to be given to each variable, the following equation was used to determine (R) which is the multiple correlation coefficient.

$$R = \sqrt{B_2 r_{12} + B_3 r_{13}}$$

After the (r)'s and (R)'s had been determined, prediction or regression equations were developed for predicting achievement from the raw scores of predictor variables.

To predict an unknown from a known variable, the formula which follows was used.

$\hat{Z}_1 = r_{12} Z_2$ for example: variable 1 is math achievement and variable 2 is I.Q. To predict Achievement in math, $\hat{Z}$, from the standard score[1] of the I.Q., Z_2, using r_{12} which was the correlation found between the two variables.

To convert the raw score to Z_2, $Z = \frac{X-\bar{X}}{s}$

To convert $\hat{Z}_1$ to a raw score, $\hat{X} = s\hat{Z} + \text{mean}$

By using this regression equation, it was possible to predict the criterion variable from the predictor variable. This was the procedure used in developing the prediction tables, Table 15 and Table 16.

Results

Presentation of Data

The following tables contain the statistical data as gathered and processed in this study.

Table I presents the number of children from each of the four schools included in the study: Bennett School; Hawthorne School; Lowell School; and Washington School. All children involved in the study were third graders in the schools mentioned. Not all third graders in the schools were included in the study. Only those children who had test scores available on the Otis-Lennon Mental Ability Test, the Metropolitan Readiness Test, and the Metropolitan Achievement Tests were used.

The total number of third graders in each school at the time of data collection is shown in column two, the adjoining column shows the number of third graders from each school included in the study, and the final column contains the percentage of total third graders per school and total involved in the study.

As seen from Table I, the study involved approximately 70% of the third graders in the four schools used. The remaining 30% not included in the study were children who either moved into the school after kindergarten or after first grade, and thus either did not take the Metropolitan Readiness Test or did not take the Otis-Lennon Mental Ability Test, or children who were absent during the period of time when the Metropolitan Achievement Tests were given.

Table 1

Number of Children per School in the Study

School	Number of Students in the Study	Total 3rd Graders in the School	% of 3rd graders in the Study
Bennett	39	51	76%
Hawthorne	30	45	67%
Lowell	21	35	60%
Washington	22	31	71%
Total	112	162	69%

Table 2 is a summary of the childrens' scores on the Otis-Lennon Mental Ability Test. The scores of these children range from 85 to 147, a range of 63 I.Q. points. Theoretically, according to the norms of the test, scores could range from 50 to 150+. The mean I.Q. score was 112.57, about 12-13 points higher than the mean D.I.Q. of 100 with which the test was normed. Thus, the sample of scores in the study has more scores in the upper range and fewer in the lower range.

The standard deviation of the scores in the study was 13.31, approximately three smaller than the standard deviation of 16 used in the norming of the test. This is as would be expected when the lower extreme, scores below 85, are absent from the distribution.(Most children who would have scored below 80 are in special education classes and would not have been given these tests.)

Thus, the study is based upon a sample which has proportionately more I.Q. scores in the upper than in the lower ranges with about 65% of the scores between 100-125.

Table 3 is a frequency distribution of the composite scores on the Metropolitan Readiness Test of the children in the study. They range from 19-94. Since there are 102 possible points on this test, theoretically scores could range from 0-102. However, in the groupings used by the authors, scores 77 and above are grouped together as superior and scores below 24 are grouped together as low.

The mean of the sample was 63.99. The mean of the norm group was 53.21 approximately 10 points less than the

Table 2

Summary of Scores on Otis-Lennon Mental Ability Test

Score	Frequency	Score	Frequency	Score	Frequency
85	2	106	1	127	3
86	1	107	2	128	0
87	0	108	4	129	1
88	1	109	1	130	0
89	0	110	5	131	2
90	3	111	5	132	3
91	0	112	1	133	2
92	1	113	1	134	3
93	2	114	4	135	2
94	0	115	4	136	1
95	0	116	4	137	0
96	2	117	1	138	0
97	2	118	5	139	1
98	2	119	1	140	0
99	2	120	4	141	0
100	4	121	2	142	0
101	1	122	2	143	0
102	4	123	3	144	0
103	3	124	4	145	0
104	4	125	0	146	0
105	4	126	1	147	1

Note.- Mean = 112.57 Standard Deviation = 13.31

Table 3

Summary of Scores on Metropolitan Readiness Test

Score	Frequency	Score	Frequency	Score	Frequency
19	1	44	3	69	2
20	0	45	3	70	4
21	0	46	2	71	5
22	0	47	0	72	3
23	0	48	0	73	3
24	0	49	0	74	3
25	1	50	2	75	3
26	0	51	1	76	3
27	0	52	0	77	2
28	0	53	1	78	2
29	0	54	1	79	1
30	3	55	0	80	3
31	0	56	4	81	4
32	1	57	1	82	3
33	0	58	5	83	0
34	0	59	3	84	1
35	0	60	2	85	2
36	1	61	2	86	2
37	1	62	3	87	1
38	1	63	0	88	0
39	1	64	7	89	0
40	1	65	2	90	1
41	0	66	5	91	0
42	0	67	2	92	0
43	1	68	3	93	0
				94	1

Note.- Mean = 63,99. Standard deviation = 15.36

mean of the sample. This is as was expected in view of the fact that scores from the lower extremes are missing from the sample.

The standard deviation of the norm group was 17.75, approximately two points larger than the standard deviation of the sample which was 15.36. This was expected due to the absence of the lower extreme scores.

The authors of the Metropolitan Readiness Test offer a grouping of scores into five groups. They are: above 76, superior; 64-76, high-normal; 45-63 average; 24-44, low-normal; and below 24, low.

Based on this grouping the following are the percentages of the sample group in each classification group: superior, 23%; high normal, 38%; average, 26%; low-normal, 12%; and low, 1%. The lower ranges seem to be under-represented by the sample, while the upper ranges are over-represented.

The Tables 4-7 present the data for the sample on four of the Metropolitan Readiness Test subtests; word meaning, matching, numbers, and copying. These four subtests were selected for study because it was felt that they would be better predictors of achievement singly or in combination than the two remaining subtests listening and alphabet.

The authors of the Metropolitan Readiness Test(Manual of Directions, 1969) describe the word meaning subtest as follows, "word meaning measures the child's store of verbal concepts... permits the child to indicate the breadth of his oral vocabulary."

The frequency distribution of scores on the word meaning subtest is presented on Table 4.

Table 4

Summary of Scores on the Metropolitan Readiness Test subtest-Word Meaning

Score	Frequency	Score	Frequency
0	0	8	19
1	0	9	13
2	0	10	21
3	2	11	8
4	0	12	10
5	1	13	11
6	5	14	10
7	9	15	3

Note.- Mean = 9.99 Standard Deviation = 2.60

The range of scores in the sample was 3-15. A range of 0-16 was possible, as this subtest had 16 items. The mean of the sample on this test was 9.99. The mean of the norm group was 8.67. Thus, the sample average is about one point higher than that of the norm group.

The standard deviation of the subtest sample is 2.60. The standard deviation of the norm group was 3.10, slightly larger than that of the sample in the study.

The sample scores for this subtest seem to be most heavily concentrated in the average to high normal range which corresponds to the distribution of composite scores.

The matching subtest seeks to get at visual-perception skills much like those used in discriminating word forms in beginning reading. The range of scores on this subtest is from 1-14. The possible range is 0-14, so the sample contains nearly the full range of scores.

The mean of the sample group is 8.56. The mean of the norm group is 7.49. Thus, once again the sample mean is about one point higher than the mean of the norming group.

The sample standard deviation is 3.31. The standard deviation of the norm group is 4.04, slightly larger than the standard deviation of the sample. Once again the scores seem to be heavily concentrated in the average to high normal range.

Table 5 contains the data on the matching subtest scores. Scores for the sample on the numbers subtest are presented on Table 6.

Table 5

Summary of Scores on the Metropolitan Readiness Test subtest-Matching

Score	Frequency	Score	Frequency
0	0	8	7
1	2	9	13
2	2	10	13
3	7	11	16
4	8	12	12
5	6	13	8
6	4	14	3
7	11	15	0

Note.- Mean = 8.56 Standard Deviation = 3.31

Table 6

Summary of Scores on the Metropolitan Readiness Test subtest-Numbers

Score	Frequency	Score	Frequency	Score	Frequency
3	1	10	5	17	4
4	2	11	8	18	2
5	1	12	7	19	6
6	5	13	11	20	4
7	5	14	14	21	2
8	3	15	10	22	4
9	6	16	10	23	2

Note.- Mean = 13.43 Standard Deviation = 4.54

The numbers subtest is an inventory of the child's stock of number concepts, number knowledge, ability to manipulate quantative relationships, recognition of and ability to produce number symbols, and related knowledge such as concepts of money.

The range of scores in the sample was 3-23. There are 26 items on the test so a range of 0-26 was possible. The mean of the sample group was 13.43. The mean of the norm group was 12.02, about 1 point lower than the sample.

The standard deviation of the sample was 4.54. The standard deviation of the norm group was 4.70, slightly larger than that of the sample. The scores of the sample on this subtest were concentrated heavily in the average to high-normal range, particularly between the scores of 13-16.

The last of the tables with data on the Metropolitan Readiness Test subtest scores is Table 7 which contains the distribution of scores on the copying subtest. The copying subtest is a combination of visual perception and motor control similar to what is required for learning handwriting.

The range of scores for the sample on this subtest was 0-14. Since there are 14 items on this subtest, this represented the full possible range.

The mean for the sample group was 9.52. The mean for the norm group was 6.82. Thus, the sample group scored between two and three points higher than the mean for the norm group on the test.

Table 7

Summary of Scores on the Metropolitan Readiness Test subtest-Copying

Score	Frequency	Score	Frequency
0	2	8	11
1	2	9	10
2	5	10	9
3	1	11	14
4	3	12	21
5	3	13	15
6	6	14	7
7	3		

Note.- Mean = 9.52 Standard Deviation = 3.55

The standard deviation of the sample was 3.55, while the standard deviation of the norm group, 3.88, was slightly larger. The sample scores were heavily concentrated in the 8-13 range which compares to the high normal grouping of the authors of the Metropolitan Readiness Test.

Table 8 is included because references have been made previously to the broad classifications of the authors of the Metropolitan Readiness Test regarding the level at which concentrations of scores exist. Table 8 is the readiness test status on the four subtests corresponding to score ranges on each of the four subtests.

Previously, the data presented in this chapter have pertained to the study samples distribution of scores on the various predictor variables. Tables 9 and 10 present sample data for the two criterion variables, reading achievement and math achievement.

The scores on the Metropolitan Achievement Test are reported by year and by month. Second grade level is represented by 2, third grade level is represented by 3, etc. The month levels are represented by .0 for September or 0 months achievement to .9 for June, or 9 months achievement. Thus, a child who is achieving at beginning third grade level would have a score of 3.0 and one achieving at the level of the average third grader at the beginning of June would have a score of 3.9.

Table 8

Readiness Test Status on Four Subtests Corresponding to Score Ranges on Each of Four Subtests

Readiness Status	Word Meaning	Matching	Numbers	Copying
Superior	14-16	14	19-26	13-14
High Normal	11-13	11-13	15-18	10-12
Average	8-10	6-10	10-14	5-9
Low Normal	4-7	1-4	5-9	1-4
Low	0-3	0	0-4	0

Note.- The data on the above table is taken from Table 4 of the Manual of Directions for the Metropolitan Readiness Test, p.12.

Raw scores on the Metropolitan Achievement Test are converted to achievement level equivalents based on years and months. On both the total reading and total math achievement scores on level primary II (the test used in this study) it would theoretically be possible for a child to score as low as 1.0 which is beginning first grade to 9.9 which is the 9th month of the 9th grade.

In order to facilitate the processing of the raw data in this study, the scores of the children were converted to total months. Thus, a score of 3.9 became 29 months, a score of 1.0 (beginning first grade) became 0 months of achievement. This was done in each by subtracting 1.0 from the achievement level score and moving the decimal place one digit to the right. This was possible because in norming the test, the authors arbitrarily built into it ten months to the year as norms instead of either nine months or twelve months. Thus, in Tables 9 and 10, the scores are listed in total months.

Table 9 presents the data for the total reading achievement scores on the achievement test. On the reading achievement test it would have been possible to have scores between 0 months and 89 months, a rather large range when it is considered that these children have all had about the same number of months of formal classroom training in reading. The range of the sample was from 4 months to 73 months.

The mean of the sample was 27.33 months. The expected mean for third graders tested at the beginning of October

Table 9

Frequency Distribution of Scores
Metropolitan Achievement Test-Reading

Score	Frequency	Score	Frequency	Score	Frequency
4	1	28	0	52	0
5	0	29	3	53	0
6	0	30	0	54	0
7	1	31	0	55	0
8	0	32	0	56	0
9	0	33	6	57	0
10	0	34	1	58	0
11	3	35	9	59	4
12	4	36	0	60	0
13	4	37	0	61	0
14	1	38	0	62	0
15	8	39	0	63	0
16	2	40	0	64	0
17	1	41	0	65	0
18	4	42	12	66	0
19	4	43	0	67	0
20	5	44	0	68	0
21	6	45	0	69	0
22	6	46	0	70	0
23	2	47	0	71	0
24	5	48	0	72	0
25	6	49	0	73	1
26	3	50	5	74	0
27	5	51	0	75	0

Note.- Mean = 27.33 Standard Deviation = 12.97

would be 21 months. Thus, the sample was slightly above the average as would be expected from this particular sample.

Table 10 presents the data for math achievement scores. On math achievement, like reading achievement it would have been possible to score in the range of 0 to 89 months. The range of the sample was 3-54, a rather large range, but not as large as the range of reading achievement scores.

The mean of the math achievement scores was 20.53 months. The expected mean for beginning of October would have been 21 months. The sample was very close to what would have been expected of beginning third graders, but perhaps a little lower than would be expected of this particular sample.

This concludes the presentation of raw data. The remaining tables deal with statistics derived from this raw data. Table 11 is a summary of statistics for means and standard deviations for the raw data presented previously.

Table 12 and Table 13 present the statistical data for the Pearson Product Moment Correlations derived between the variables in question. Table 12 depicts the relationships between variables for eight different correlations.

Table 13 contains three additional correlations between predictor variables. These additional correlations were needed for the multiple correlations derived between combinations of predictor variables and the criterion variables.

Table 10

Frequency Distribution of Scores on

Metropolitan Achievement Test - math

Score	Frequency	Score	Frequency	Score	Frequency
3	1	20	5	37	2
4	3	21	10	38	3
5	0	22	6	39	0
6	1	23	7	40	0
7	0	24	6	41	0
8	1	25	4	42	0
9	1	26	4	43	0
10	0	27	1	44	0
11	0	28	2	45	0
12	2	29	2	46	0
13	5	30	2	47	1
14	11	31	1	48	0
15	12	32	3	49	0
16	2	33	1	50	0
17	11	34	0	51	0
18	3	35	0	52	0
19	1	36	0	53	0
				54	1

Note.- Mean = 20.53 Standard Deviation = 8.56

Table 11

Table of Means and Standard Deviations

Test	Mean	Standard Deviation
Otis-Lennon Mental Ability Test	112.57	13.31
Metropolitan Readiness Test-Composite	63.99	15.36
Metropolitan Achievement Test-Reading	27.33	12.97
Metropolitan Achievement Test-Math	20.53	8.56
Metropolitan Readiness Test-Subtest Matching	8.56	3.31
Metropolitan Readiness Test-Subtest Word Meaning	9.99	2.60
Metropolitan Readiness Test-Subtest Numbers	13.43	4.54
Metropolitan Readiness Test-Subtest Copying	9.52	3.55

Table 12

Correlation Coefficients

Variables		Correlation
Predictor Variable	Criterion Variable	r
Otis-Lennon I.Q.	achievement-reading	.52
Otis-Lennon I.Q.	achievement-math	.54
MRT composite	achievement-reading	.69
MRT composite	achievement-math	.67
MRT numbers	achievement-math	.67
MRT matching	achievement-reading	.50
MRT copying	achievement-reading	.46
MRT word meaning	achievement-reading	.55

Table 13

Additional Correlation Coefficients Determined for Use in Multiple Correlation Study

Variables		Correlation
Otis-Lennon I.Q.	MRT composite	.63
MRT-matching	MRT copying	.51
MRT-matching	MRT word meaning	.49

Table 14 presents the multiple correlations which were derived from the simple correlations computed on the data in the study. There are four multiple correlations. They are an attempt to improve prediction by combinations of predictor variables. Three of the four were used to derive a predictor for reading achievement. The remaining multiple correlation was for math achievement.

This concludes the presentation of the data obtained from this study. The next section has been devoted to an interpretation of the data.

Table 14

Multiple Correlations Derived For Combinations of Predictor Variables

Predictor Variable 1	Predictor Variable 2	Criterion Variable	Multiple Correlation (R)
MRT Composite	Otis-Lennon I.Q.	Reading Achievement	.6986 = .70
MRT Composite	Otis-Lennon I.Q.	Math Achievement	.6869 = .69
MRT Subtest-Matching	MRT Subtest-copying	Raading Achievement	.5538 = .55
MRT Subtest-Matching	MRT Subtest-word Meaning	Reading Achievement	.5954 = .60

Interpretation

This study was designed to evaluate an intelligence and a readiness test as to their dependability at prediction of school success. Specifically, four questions were posed.

1. Is the Otis-Lennon Mental Ability Test a good means of predicting how a child will achieve in reading and math during his first two primary years?
2. Is the Metropolitan Readiness Test given at the end of kindergarten a good means of predicting how a child will achieve in reading and math during his first two primary years?
3. Are the Otis-Lennon and Metropolitan Readiness Test when used together in a multiple correlation a good means of predicting primary achievement?
4. Are the Metropolitan Readiness Test subtests copying, matching, word meaning, and numbers, when used individually or in combination good predictors of primary achievement?

The data from this study provide answers to these questions, at least as they pertain to the sample in question. Since correlation studies have been used for this sample in question, a few comments concerning the meaning of correlation figures are offered. Factors such as intelligence and achievement are expected to be positively correlated as are readiness factors and achievement. Previous studies have found correlations in the range of $r = .50$. Thus, it is expected from the data that correlations would be about $r = .50$. Correlations considerably below $r = .50$ would suggest that a factor was not highly correlated and in turn not a very good predictor. Correlations considerably above $r = .50$ would suggest that two factors were highly correlated and that the predictor variable could well be used for good prediction of the criterion variable.

There is a statistical technique called coefficient of determination which is a measure of the percentage of determinants that two factors have in common. When the correlation (r) is squared and multiplied by 100, it indicates the amount of variance held in common by the two variables or the amount of variance in one variable that is accounted for by variance in the other variable.

This is mentioned here only to make more meaningful the differences between the correlations discussed, as the difference between a correlation of .5 and .7. When r = .5 is converted to a coefficient of determination, it becomes r of .5 = 25% coefficient of determination, whereas an r of .7=49% coefficient of determination. Thus, with only .2 increase in r (from .5 to .7) the amount of variance in common between two variables doubles (from 25% to 49%).

The first question concerns the Otis-lennon Mental Ability Test as a predictor. The I.Q. scores when correlated with reading achievement produced an r = .52, and when they were correlated with math achievement produced an r = .54. This is well within the expected range of about .50. Thus, the Otis-Lennon Mental Ability Test would not appear to be either an exceptionally good or weak predictor and by itself would be better than no predictor at all, although not infallible.

The second question concerns the Metropolitan Readiness Test as a predictor. The composite score when correlated with reading produced a correlation of r = .69. When correlated with math achievement, the composite yielded an r = .67.

Both r's approaching the range of r = .70. This is considerably higher than the correlation produced with the I.Q. scores. This would seem to suggest that the Metropolitan Readiness Test is a good predictor of future achievement in the primary grades both in math and reading.

The third question regards the combination of the I.Q. scores and the Metropolitan Readiness Test Composite scores in a multiple correlation (R) as a predictor of reading and math achievement. The formulaes used produced a multiple correlation (R) of .70 for readiness composite and I.Q. as predictors of reading achievement, and a (R) of .69 for readiness composite and I.Q. as predictors of math achievement.

These multiple correlations are slightly better than the simple correlations produced by the readiness composite and achievement (r=.69 and r=.67), however, it would hardly seem worth the additional calculations for the very slight improvement in correlation, and thus predictability.

The final question posed concerns the Metropolitan Readiness Test subtests of word meaning, matching, numbers, and copying and their correlation to achievement. These subtests were selected for study because it was felt that they represented individual skills important to reading and math achievement.

Word meaning or vocabulary skills are thought to be an important requisite to reading achievement. The word meaning subtest correlated r = .55 with reading achievement. While its correlation was higher than either the matching or copying

subtests were with reading, the r = .55 was not as high as was expected. It would seem that perhaps the word meaning test itself is not a very good discriminator of vocabulary skills or that other factors, such as motivation or perception might in some cases be interfering with or aiding the functioning of the child's potential vocabulary skills.

The matching subtest which purports to tap skills involved in visual discrimination correlated .50 with achievement in reading. It would seem that visual discrimination is important in reading, but that significant other factors are operating as well.

The copying subtest had the lowest correlation with reading achievement of all those studied, r = .46. This could have been anticipated in that reading achievement contains little or no motor skill output which is a major component of the copying tasks on the subtest. However, as a factor in the composite score, copying contributes to its relationship to achievement.

The matching and word meaning subtests were combined as predictors because visual perception and vocabulary skills were thought to be high value components in reading achievement. An(R) for these two was obtained of R = .60 which was good, but not as good as the composite readiness score in simple correlation with reading achievement(.69).

The matching and copying subtests were used together in a multiple correlation and an (R) ~~of .55 was obtained~~. This also was not as high as the simple correlation with reading achievement using the composite score.

The numbers subtest was correlated with math achievement and found to correlate r = .67, the same as the composite readiness with math. Thus, it would seem that if one had no other subtest than the numbers subtest with which to predict math achievement, that a fairly good prediction would be possible.

Generally, with regard to the subtests, they each appear to perform an important function. However, they are more effective in combination as in the composite score than they are individually as predictors of achievement.

The multiple correlations used in the study improve the correlation and predictability slightly. However, the improvement over the single correlations of the Metropolitan Readiness Test and achievement is very slight.

For the students represented by this study, the Metropolitan Readiness Test composite score would seem to be the better predictor of their achievement in reading and math during the first two years of their primary grades.

Using the prediction equations discussed on page 17 tables were developed for future use with children taking the Metropolitan Readiness Test and the Otis-Lennon Mental Ability Test. Predicted achievement test scores for reading and math are given for children scoring within certain ranges on the readiness and intelligence tests. The expectancy tables containing these predictions are Table 15 and Table 16.

Table 15

Table for Prediction of Achievement Level from Otis-Lennon Mental Ability Test

I.Q. Score Interval	Predicted Reading Achievement	Predicted Math Achievement
50-54	-----	-----
55-59	-----	1.1
60-64	1.2	1.3
65-69	1.4	1.5
70-74	1.7	1.6
75-79	1.9	1.8
80-84	2.2	2.0
85-89	2.4	2.2
90-94	2.7	2.3
95-99	2.9	2.5
100-104	3.2	2.7
105-109	3.5	2.9
110-114	3.7	3.0
115-119	4.0	3.2
120-124	4.2	3.4
125-129	4.5	3.6
130-134	4.7	3.7
135-139	5.0	3.9
140-144	5.2	4.1
145-149	5.4	4.3

Note.-The achievement levels are an estimate of where a child will be achieving after being in third grade for one month-beginning October, using the Otis-Lennon Mental Ability Test I.Q. scores and achievement on the Metropolitan Achievement Test-PrimaryII.

Table 16

Table for Prediction of Achievement Level from the Metropolitan Readiness Test

Readiness Test Composite Score Interval	Predicted Reading Achievement	Predicted Math Achievement
12-16	-----	1.2
17-21	1.1	1.4
22-26	1.4	1.6
27-31	1.7	1.7
32-36	2.0	1.9
37-41	2.3	2.1
42-46	2.6	2.3
47-51	2.9	2.5
52-56	3.2	2.7
57-61	3.5	2.9
62-66	3.7	3.1
67-71	4.0	3.2
72-76	4.3	3.4
77-81	4.6	3.6
82-86	4.9	3.8
87-91	5.2	4.0
92-96	5.5	4.2
97-101	5.8	4.4

Note.- The achievement levels are an estimate of where a child will be achieving after being in third grade for one month-beginning October, using ~~the~~ Metropolitan Readiness Test composite score, given end of kindergarten and achievement on the Metropolitan Achievement Test-Primary II.

Summary

In summary, from the data studied it would appear that the Otis Lennon Mental Ability Test is about as good a predictor of school achievement as are most intelligence tests, being correlated at r = .52 and r = .54. The Metropolitan Readiness Test appears to be a very good predictor of school achievement at the primary level in both reading (r=.69) and math (r=.67). The Metropolitan Readiness Test numbers subtest is a good predictor of math achievement. The other subtests studied; word meaning, matching, and copying while contributing to the whole composite, singly are not as good at predicting achievement. The multiple correlations studied, while improving the correlation slightly,are very little higher in correlation with achievement than is the Metropolitan Readiness Test composite score.

Discussion

Limitations of the Conclusions

As with any study, there are certain limiting factors. In this study the following are to be considered as limiting to the value of the results.

1. Group tests do not always reflect the best ability of the children taking them. The childs physical well being at the time of testing, his attitude toward the test and test taking in general affect his performance on the tests.

2. Errors in administering or scoring the tests, and in copying data can affect the outcome of the study.

3. The measuring instruments themselves-data are only as good as the validity of the instruments used.

4. Due to the high degree of mobility among low income families, as well as, a higher rate of absenteeism on testing days, some of the lower scoring subjects on the Otis-Lennon Mental Ability Test had no scores available on the Metropolitan Readiness Test, and thus were excluded from the study.

5. Subjects who would have scored at the lower extremes (below 80) on the intelligence test are in special education and thus did not take the tests.

6. Due to differences in readiness related to sex differences, a comparison of the correlations for boys and for girls might have been meaningful to the results of the study.

Except for the absence of the lower extremes, this sample should be representative of Mattoon students as a whole. As such, the results can be generalized to this selected population and used to predict performance of future students in the Mattoon elementary schools. Due to the greater number of average to above average students in the sample, future predictions for students in this range should be very good.

Recommendations

Implementation

It is hoped that the charts worked out for the use in predicting future achievement from the Metropolitan Readiness Test and Otis-Lennon Mental Ability Test scores will result in a practical side to this study. It must be kept in mind that the predictions made will only be as good as the correlations between variables. In this case it would seem that predictions can best be made if the readiness test composite score of the child is available. However, prediction can also be made from the Otis-Lennon score of the child in question.

Further research

There are several possibilities for futher research in the area of prediction of achievement. Several of these the author of this paper plans to pursue in the future.

There are other important factors in achievement which merit consideration. Among them are; socio-economic level or background; motivation, temperment of children, and orientation to classroom activities. These have been studied in the past and futher study seems warranted.

A follow-up to this project using achievement scores of the same children when they are in fifth or sixth grade could provide information as to the longer range predictive value of these instruments.

A separate study of the lower subtest scores for each test could yield information regarding the effect of severity of deficits in skill areas on achievement. This kind of

information could provide help in developing a general screening program for learning disabilities based upon the Metropolitan Readiness Test.

A study of first graders who score low on the Metropolitan Readiness Test and the difficulties they encountered in first grade could help in selecting children for further readiness training in selected areas.

These are only a few of the possibilities for further investigation in predicting success or difficulty in school achievement.

Summary

This study was designed to evaluate certain tests, the Metropolitan Readiness Test, and the Otis-Lennon Mental Ability Test regarding their ability to predict a child's primary achievement in reading and math.

A correlation study was undertaken to evaluate the relationship between predictor variables, readiness and intelligence, both singly and in combination, and the criterion variables of math and reading achievement.

The test of readiness skills proved to be the better predictor both of math and reading. It was correlated at about the same level with both math and reading achievement.

The I.Q. test was found to correlate at around the $r = .50$ range for both math and reading which was in the range where most intelligence tests and achievement tests correlate.

As a result of this study, it would seem that school personnel would be advised to use the test of readiness skills where it is available for prediction in preference to the I.Q. score. However, where a readiness test score is not available, an Otis-Lennon I.Q. score can provide information to predict successful achievement or anticipate difficulty in achieving success in doing school work.

References

Abbott,F. The Prediction of First Grade Reading and Numbers Achievement by Means of Psychological Tests. Dissertation Abstracts XXV,1963,1020.

Ames,L.B. and Walker, R. Prediction of Later Reading Ability from Kindergarten Rorschach and I.Q. Scores. Journal of Educational Psychology,1964,55(6),309-313.

Bloomers,P. and Lindquist,P. Elementary Statistical Methods in Psychology and Education. Boston:Houghton Mifflin,1960.

Duffy, O.B. and Clair, T.N. Follow-up to Egeland's 1966 Study. Journal of Educational Psychology,1972,63(4),358-62.

Durost, W.,et.al. Metropolitan Achievement Test. New York: Harcourt,1971.

Edmiston, R.W. Measures Predictive of First Grade Achievement. Educational Digest,1946,12,52-54.

Egeland, Bryon. Relationship of Intelligence, Visual-Motor, Psycholinguistic, and Reading Readiness Skills with Achievement. Educational and Psychological Measurement, 1970,30,451-458.

Fergeson, G.A. Statistical Analysis in Psychology and Education.(3rd ed.) New York:McGraw-Hill,1971.

Henderson, N.B.,et.al. Will the I.Q. Ban Decrease the Effectiveness of Reading Prediction? Journal of Educational Psychology, 1973,65(3),345-355.

Hildreth,N.G.,et.al. Metropolitan Readiness Test. New York: Harcourt,1969.

Keogh, B.K. and Smith, C.E. Early Identification of Educationally High Risk and High Potential Children. Journal of School Psychology, 1970,8(4),285-290.

Koppitz, E.M. Prediction of First Grade Achievement with Bender Gestalt and Human Figure Drawings. Journal of Clinical Psychology,1959,57,518-521.

Lowell, R.E. Reading Readiness Factors as Predictors of Success in First Grade Reading. Journal Learning Disabilities,1971,4,563-567.

McKnab, P.A. and Fine, M.J. Vane Kindergarten Test as a Predictor of First Grade Achievement. Journal of Learning Disabilities, 1972, 5, 503-505.

Mullis, J.C. The Prediction of Fifth Grade Achievement as Measured by Teacher Grades and Achievement Test Scores Using First Grade Indices of Prediction. Dissertation Abstracts XXVI, 1969, 6515.

Otis, T. and Lennon, R.T. Otis-Lennon Mental Ability Test. New York: Harcourt, 1967.

Rudolph, Charles A. A Comparison of the Cooperative Pre-School Inventory with Selected Measures of Intelligence and Readiness. Dissertation Abstracts, 1973.

Scott, C.M. The Predictive Value of a Beginning First Grade Intelligence Exam. Educational and Psychological Measurements, 1965, 25(2).

Shipp, D.E. and Loudon, M.L. Study of the Goodengough Draw-A-Man as it Predicts General Achievement. Journal of Educational Research, 1964, 57, 518-521.

Strahl, R. The Use of Human Figure Drawings Collected in Kindergarten for Prediction of Learning Performance in First Grade. Dissertation Abstracts, 1972.

Vilscek, E.C. An Analysis of the Effects of Mental Age Levels and Socio-Economic Levels on Reading Achievement in First Grade. Dissertation Abstracts XXVI, 1964, 913.