The Relationship of Reading Ability to Performance on the Otis Quick-Scoring Mental Ability Test

Paris P. Choncholas

Loyola University Chicago
THE RELATIONSHIP OF READING ABILITY TO PERFORMANCE ON THE OTIS QUICK-SCORING MENTAL ABILITY TEST

By

Paris G. Choncholas

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CHAPTER 1

GENERAL INTRODUCTION

A. Statement of the Problem

The verbal factor involved in an individual's knowledge of language has usually been considered as an aspect of his intelligence. There have been constructor's of intelligence tests, such as Wechsler and those involved in devising the ACE Psychological Examination, who have endeavored to measure the verbal and non-verbal factors of intelligence separately. The ACE has been constructed with an L and Q score and the Wechsler Intelligence Scale has been divided into verbal and performance sub-tests. Other test constructors have eliminated the verbal factor and have devised tests, such as the Chicago Non-Verbal Examination, to measure the non-verbal factors of mental activity. Still others have constructed group tests of intelligence that are dependent upon the subject's ability to read the test material and have not concerned themselves with the verbal and non-verbal aspects of intelligence. These individuals and, more specifically, those devising group tests seem to have minimally concerned themselves with reading ability as being an aspect of the verbal factor in intelligence.

The influence of reading ability on the performance of individuals on intelligence tests has been of major concern to many specialists in remedial reading who have evaluated measures of general intelligence. This problem involves, first, establishing the relationships, if any, between reading ability and intelligence test performance and, secondly, the reasons underlying such relationships.
B. Observation in Vocational Guidance Center

In one vocational guidance center\(^1\), it had been noted that adult subjects who scored below average on a group intelligence test\(^2\) frequently attained an average to high-average score on the Wechsler-Bellevue Scale. It was evident, therefore, that there was a wide discrepancy between the subject's performance on the Otis and on the Wechsler, both of which are measures of general intelligence. Samples of each subject's score on a test of reading comprehension\(^3\) were likewise checked and found to be correspondingly low. It would seem that these subjects were poor readers whose performance was affected by their inability to read the test material. The Otis then appeared to be dependent, to some extent, upon reading ability so that anyone lacking sufficient reading skills would be penalized on his performance.

C. Major Hypothesis

The purpose of this study was to investigate the relationship between performance on the Otis and reading skills. It was assumed that performance on this test would be dependent, in some measure, upon reading ability. The Otis score would then indirectly reflect the individual's

\(^{1}\) Illinois Institute of Technology, Institute for Psychological Services.

\(^{2}\) Otis Higher Examination - Form AN, Gamma Series, hereafter referred as Otis.

\(^{3}\) ACM Cooperative Reading Comprehension Test - Higher Level, Form C2, hereafter referred as Cooperative Reading Test.
reading skills as well as his mental ability. Specifically the following hypotheses, stated in statistical terms, were to be tested:

(1) There would be a significant relationship between the Coop Reading Test scores and Otis scores of individuals with at least average intelligence as determined by the Wechsler.

(2) Though a good performance on the Otis is dependent upon how well a person can read, the Otis would correlate with the Wechsler, since both measure intelligence.

(3) If, as assumed, the intelligence of poor readers would be underestimated by the Otis, this test would correlate more highly with the Coop Reading Test than with the Wechsler.

(4) On the assumption that reading speed is a more important variable in Otis performance than level of comprehension or vocabulary, there would be a more significant correlation between Otis and Wechsler, when that factor would be partialled out.
CHAPTER II

REVIEW OF THE LITERATURE

A. Instruments

1. Otis Higher Examination - Form AM

The Higher Examination constitutes the more advanced of the Otis Self-Administering Tests of Mental Ability. It is devised for high school students and college freshmen and can be administered with a time limit of twenty or thirty minutes. The twenty minute time limit is used at the vocational guidance center\(^1\), but the thirty minute time limit is sometimes preferred since it gives a more accurate measure. In the examination, provision is made for the student to read the directions on the first page without time limit. There are eighty items in multiple choice form, in order of increasing difficulty, to be answered by the examinee without interruption. The score is the number of correct answers.

In selecting items for this test, previous forms were drawn upon. Items from preliminary editions were administered to two groups of students, a good and a poor group, both of which had reached the same average educational status but at different rates. The number of times each item was passed by each group was found and, only those items were chosen which showed a distinct gain in number of passes by the good group over the number of passes by the poor group.

Norms for the test were established on 120,000 pupils who were divided into age and grade groups with the median scores representing

\(^1\)Op. cit., p. 2
each group. The author of the test also considered the converted scores from the norm table for the Advanced form, the correlations between the Higher and Intermediate with the Binet–Simon and, the correspondence between the Intermediate and Higher Examinations themselves.

Reliability was determined by means of correlations between different forms of the same test. A correlation coefficient of .921 was found between Forms A and B of the Higher Examination for two groups. The probable error of a score in either examination was slightly over 3-1/2 points.

The author of the test felt that the method of standardization was perhaps the best assurance as to the validity of the instruments but other indications were available. The coefficient of correlation between the Higher and Advance forms was .889 for 180 cases of pupils in grades seven to twelve. The average of four coefficients of correlation between the Higher and the Advanced Examinations, averaging about one hundred cases, each in groups covering grades seven to nine was .842. Coefficients of .55 between the Higher Examination and scholarship was found among eleventh graders and .57 among twelfth graders. A further coefficient of .59 was found between scores in the Higher Examination and scholarship as reported by the teachers of 157 high school freshmen in a western state.

2. The Wechsler–Bellevue Adult Intelligence Scale

This Intelligence Scale is divided into the verbal and the performance parts. The division is based upon the view that intelligence involves the ability for abstract reasoning and the ability to perceive logical relations and use symbols, as measured by the verbal sub-tests.
In addition, it involves the ability to handle practical situations that may involve manipulative skills, as measured by the performance sub-tests. The Information, Comprehension, Similarities, Digit Span, Arithmetic, and Vocabulary, constitute the sub-tests of the verbal part. The Picture Completion, Object Assembly, Picture Arrangement, Block Design, and Digit Symbol, make up the sub-tests of the performance part. The examinee is timed on all of the performance sub-tests, but there is no timing on the verbal sub-tests with the exception of the arithmetic problems.

The test author’s selection of sub-tests was made on the basis of several considerations:

1. Analysis of various standardized tests of intelligence with reference to the type of functions measured, character of the population, and the evidence of the test’s reliability.

2. An evaluation of each test’s claim to validity as evidenced by its degree of correlation with other recognized tests, and with subjective ratings of intelligence.

3. Rating the tests on the basis of the author’s clinical experience and that of others.

4. Preliminary experimental work of trying out various likely tests on groups of known intelligence level.

The author’s adult sample consisted of over 1800 males and females from the City and State of New York. In order to standardize the test and establish norms, it was important that the sample be representative of the total population. The source used was the United States Census for 1930 based upon the occupational distribution of the adult
population. The percentage of the total number of individuals engaged in the listed occupations was calculated for each sex and for each age. In this manner, the percentages for the various occupational categories agreed closely in terms of the individual's age and sex with those determined for the country as a whole. By this method, the educational level of the subjects used in the sample corresponded very highly with that of others in the total population. The factor of age was taken into account by the establishment of different norms for all age groups up to sixty.

The reliability of the Scale was based upon intra-correlations between the sub-tests, the correlation between alternate forms of the same scale, correlation between retests, and correlations with other scales.

The validity of the Scale rested on its author's contention that it had worked well in practice. However, a number of separate correlation studies were made between subject's test scores and psychiatrists' ratings, as well as teachers' estimates, in an attempt to statistically verify its validity.

3. ACE Cooperative Reading Comprehension Test - Higher Level, Form 02

The reading sections of this series of tests, one of which is this form, were based on the belief that "reading comprehension is essentially a thinking process which requires mental facility in manipulating verbal concepts, a background of experience, and skill in the specialized techniques of reading comprehension" (9, p. 2). The emphasis in this instrument was the measurement of the thinking processes in reading which,
heretofore, had been neglected by others in the estimation of the test's author.

The test is divided into two parts: The first fifteen-minute part consists of 60 multiple choice items of recognition vocabulary, the second, twenty-five minute part, of 90 multiple choice items of reading comprehension.

The norms were based on three different groups of entering freshmen through college senior students designated as Type I, II, and III norms. The first group consisted of 10,000 students in fifteen colleges enrolled in a pre-professional curriculum. The second group consisted of 50,000 students in ninety colleges enrolled in a typical liberal arts curriculum. The third group comprised 14,000 students from thirty-five junior and teachers colleges.

The reliability and validity of the instrument was established by correlations between the three part scores in themselves and with the total score, correlations between Higher and Lower forms, and intercorrelations between scores on Test A, Test B, and this reading test. The intercorrelations between the scores on these and other tests showed that they measured related abilities. Since their reliability coefficients were quite high, the factors measured by these tests differed sufficiently to warrant separate measurement.

B. Studies

Investigators have conducted a number of studies that have dealt

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1. ACE Cooperative English Test A: Mechanics of Expression
2. ACE Cooperative English Test B: Effectiveness of Expression
with the relationship of reading ability to intelligence test performance. In most of these studies they have employed various tests of mental ability, as well as several of the better known reading tests. A review of the literature has shown only a few investigations in which the Otis was used directly as an example of a group test of intelligence that is affected by reading. The research to be cited below deals with studies in which the Otis was not involved directly but was referred to in conjunction with the investigators' remarks on group tests of intelligence.

Albert Harris (1) discussed the problem of intelligence test performance and reading disability as part of his investigation into the causes of reading difficulties. He felt that an accurate measurement of intelligence in cases of individuals suspected of being disabled readers was difficult because handicaps that interfere with reading may also hinder the person from showing his true ability on intelligence tests. Accordingly, he was of the opinion that group tests of intelligence are limited for use in the study of reading difficulties because the test material must be read. Even if a person had average or superior mental ability, he would have difficulty reading the questions if he had poor reading skills. He cited many cases of individuals whose group test IQ's were below eighty-five and whose Stanford-Binet IQ's were above 100 or more. "Such widely used group tests as the Otis Self-Administering, National, Raven-Nelson, Terman Group, and Army Alpha, are relatively useless in the study of poor readers" (1, p. 130). Concerning the effect of remedial reading on intelligence test performance, the author stated that cases do occur in which a marked change in IQ is found after remedial teaching. However, he felt that the
true reason for the change is the fact that a group test was administered that gave a false impression of mental retardation, or that the person was handicapped and could not show his actual ability when he was first tested. He maintained that there is no scientific evidence to indicate that the efficacy of remedial reading is a remedy for dullness.

In her textbook, Ruth Strong (2) stated that reading proficiency is dependent upon an individual's ability to learn. She had found correlations of .60 and .70 between group tests of intelligence and silent reading. She appeared to share the same opinion with the author cited above about the reliability of group tests. "The problem of the relationship between reading ability and mental ability is complicated by the fact that the mental tests usually given involve reading comprehension" (2, p. 210). For this reason she felt group tests of intelligence were relatively useless in dealing with individuals with reading handicaps.

In an exposition concerning intelligence test performance versus the factor of reading ability, Wheeler (3) made certain definite statements with regard to his appraisal of group tests of intelligence. Drawing upon his acquaintance with other studies he stated that, although individuals need a certain degree of mental ability to develop good reading skills, there are many with average and superior intelligence who have reading difficulties. He maintained that the mental capacity of such persons cannot be accurately determined by intelligence tests that require reading the items. "Any individual who has a reading retardation, i.e., fails to develop a reading proficiency level commensurate with his mental level is handicapped when given an intelligence or aptitude test requiring reading beyond his
reading achievement level" (3, p. 225).

The purpose of Webb's (4) study was to discover the significance of one's reading ability in relation to one's general intelligence, such as is employed when he is tested by a group test of mental ability. The subjects were sophomore, junior, and senior psychology students. Although the number of subjects used was not mentioned, there was an equal proportion of men and women in the group. The Army Alpha Test was given first, and, two weeks later, two group tests devised by Thurstone were administered, Test A the first day, Test B the following day. The reading test employed was Monroe's Silent Reading Test, grades nine through twelve. Webb correlated reading rate and comprehension with the Army Alpha sub-tests as well as with the other two group tests. He found significant coefficients (.34 to .66) in all instances except when he correlated the reading factors of rate and comprehension with the Arithmetic sub-test of the Army test. He stated several conclusions from the statistical findings. First, he maintained that there is a close relationship between rate and comprehension in reading. Second, he felt that "rapidity of comprehension in reading is one of the large factors in determining the grade one makes in a pencil-paper intelligence test, such as those employed in this study" (4, p. 570). Thirdly, the reading test used is a fairly good test of intelligence which is supported by the fact that, out of twenty-four coefficients, twenty-one were rather significant.

A study was conducted to compare the performance of good and poor readers on the individual items of the Stanford-Binet. Bond and Fay (5) administered Forms L and M of this test and the Gates Silent Reading
Test—Types A, B, C, D, to 4th, 5th, and 6th grade pupils of an elementary school. Mental ages from both forms of the Stanford-Binet were averaged and composite reading ages were determined for each child on the basis of the four Gates Tests. After this, comparisons of the MA and RA were made. Good readers were classed as those whose RA was higher than their MA. The responses of each group to the individual items of Forms L and M were tabulated and the percentage of each group passing each item was determined.

The percentage of good readers passing each item was compared with the percentage of poor readers passing the item, and the significant difference was sought. The investigators compared the performances of good and poor readers on the verbal items and found that the MA was distorted by the influence of the subject's reading ability. Those who were good readers received a correspondingly high MA score, while the poor readers were penalized on their performance and received a lower MA score. The investigators subsequently stated that, "This tendency, which is the same observed with group tests of intelligence like Otis which are verbal in nature, indicates the need for a test whose items are not dependent on the knowledge of definitions of words, ability to read, and the manipulations of words in sentences" (5, p. 479).

One of the most pertinent studies done in which the Otis was directly used dealt, again, with the influence of reading ability on intelligence test performance. Durrell (6) administered the Otis Intermediate Examination to 357 children (age and education not reported) who had also been given the Stanford-Binet. The reading measures employed were the Stanford Reading Tests, the Chapman-Cook Speed of Reading, and the Burgess
Silent Reading Tests. Stanford-Binet IQ's were compared with Otis IQ's for groups of children with different reading accomplishments. One hundred of these children were reading one year above their Binet MA, seventy-one were reading one year or more below their Binet MA, and 186 of them were reading normally within the Binet mental age. The mean Stanford-Binet IQ of the superior readers was 96.9 as compared to the mean Otis IQ of 106.9 for the same individuals. The retarded, or poor, readers performed better on the Stanford-Binet as shown by a mean IQ of 105.5 than they did on the Otis as shown by a mean IQ of 99.9. The results indicate that there was a tendency for Otis to follow reading reading achievement, as witnessed by the fact that the superior readers attained a higher performance on this test than did the poor readers. The converse is true with regard to the good and poor readers performance on the Stanford-Binet. According to the investigator, IQ's from group tests appeared to vary to a significant degree with the reading accomplishment of the group examined. Nevertheless, the Otis would not be valid as a measure for the prediction of school success, if the reading accomplishment of the child is relatively constant. Yet, "it is true that the presence of this large factor of reading in intelligence tests will allow many children to be classed as dull who are otherwise really normal or bright, but who have poor reading ability" (6, p. 416).

Blair and Kamman (7) wanted to know if intelligence tests requiring reading ability give spuriously low scores to poor readers at the college freshman level. At the University of Illinois, 1018 new freshmen took the Iowa Silent Reading Test—Advanced Form AN in the years 1940 to 1941. One hundred of these students rated above the 75th percent-
ile in rate and comprehension, and 117 of them rated below the 25th percentile in rate and comprehension. From the group of one hundred excellent readers, sixty-three individuals whose ACE scores were below 142 were selected for the good reading group. From the 117 very poor readers, sixty-one persons whose ACE scores were above 60 were selected for the poor reading group. These individuals were asked to report for further testing but only forty-six good readers and forty-five poor readers responded to the call. The scores indicating the average reading ability of the good and poor readers were in the 91st and 13th percentiles, respectively. These two groups were each given the Otis Higher Examination—Form AM and the Revised Beta Examination. The average Beta score was 106.4 for good readers and 98.3 for poor readers, which is equivalent to an Otis score of 56.4 and 48.3, respectively. The actual average Otis score attained by the good readers was 62.0 and 52.8 for poor readers.

The authors found that the intelligence of good as well as poor readers was not underestimated in their performance on the Otis. Both groups' actual average Otis score was higher than the Otis equivalent score corresponding to their Beta IQ score. They concluded that "the amount and difficulty of the reading matter in the Otis is inconsequential and forms no special barrier, even to the poorest readers among college freshmen" (7, p. 283).

It seems that the poor readers also attained a higher actual score on the Otis than what the equivalent score corresponding to their Beta IQ indicated. According to the hypothesis made in this study, the poor readers should have scored higher on the Beta since it does not involve read-
ing directly. It should be noted, however, that the authors base their generalizations on the difference between actual Otis scores as compared to Otis scores which are equivalent to Beta IQ's derived from a table. Such equivalent scores leave room for error, and it should be realized that the difference between the actual and the equivalent Otis scores is not too significantly different to warrant such an over-generalization.

The literature in terms of studies directly involving Otis performance as related to reading ability is quite meager. Specialists in remedial reading, however, have concerned themselves with the performance of poor readers on other group tests of intelligence. They have come to the conclusion that these instruments are rather inaccurate as estimators of an individual's mental capacity. The general opinion is that these tests involve reading of the material so that the poor reader is thereby handicapped by slow rate of reading and poor comprehension. They state that even if a person has average or superior mental ability, he has difficulty reading the questions if he has poor reading skills.

In actual studies concerning the significance an individual's reading ability has in relation to his general intelligence, it has been found in one instance, where the Army Alpha Test was used, that rate of comprehension is one of the large factors determining the score a person makes on group tests of mental ability. In another study, where the Stanford-Binet was used, the authors concluded that the poor readers were penalized in their performance on verbal items and achieved a lower MA score. They also felt that this tendency was the same observed with group tests like the Otis. Another author who used the Otis itself in a study
found that it tended to follow reading achievement, as witnessed by the fact that superior readers attained a higher performance on this test than did the poor readers.

In summary, it seems that the general conviction among investigators concerning paper and pencil tests of intelligence is that the mental capacity of subjects cannot be accurately determined by them because they require reading the items. If, therefore, an individual has not developed a reading level that is commensurate with his mental level, he is handicapped when given an intelligence test requiring reading beyond his reading achievement level. If the levels are commensurate with each other, it is probable that the subject will not be handicapped in his performance on the mental ability test. Such group tests as the Otis, as a result, are not applicable in cases where an estimate of a poor reader's IQ is in order. If it is previously known that an individual's reading age is commensurate with his chronological age, it is probable that he can perform adequately on a test such as the Otis and attain a score that rather validly indicates his current level of mental functioning.
A. Description of the Subjects

The group used in the study consisted of fifty adult men. Their ages ranged from twenty-one to forty-five years, with a mean age of 32.70 years and a standard deviation of 6.91 years. The extent of their education ranged from high school graduates to college graduates, with a mean educational level of 13.26 years of schooling and a standard deviation of 1.64 years. All of these subjects were candidates for promotion to sales or management positions.

It was evident that there was a rather large range in the subjects' ages and extent of education and it was necessary, therefore, to determine whether or not these factors were responsible for differences in their reading test performance. Product-moment coefficients were computed between their ages and reading performance, and between education and reading performance. It was found that a coefficient of .082 between educational level and reading, and a coefficient of .124 between age and reading, were both statistically non-significant. Hence, it may be assumed that factors of age and education did not influence the subjects' performances on the Cooperative Reading Test.

B. Distribution of Test Scores

1. Otis

The raw score of each subject on this test was converted to its IQ equivalent for the purpose of comparison with the Wechsler Full Scale IQ scores. The frequency of Otis IQ scores appears in Table 1 in the
Appendix. The distribution, with its mean of 95.22 and a standard
deviation of 7.16 is close to a normal distribution, but it is not repre-
sentative of the standard population because the majority of cases fall in
the low-average range.

2. Wechsler-Bellevue Scale

The distribution of the Wechsler IQ scores, presented in Table 2
in the Appendix, shows a mean score of 111.04 and a standard deviation of
8.00. It should be noted that the majority of cases falls in the high-
average--above-average range and, therefore, cannot be considered as repre-
sentative of the population. The scores indicate a curve that is skewed in
favor of high IQ scores.

The mean of the Wechsler IQ scores is significantly higher than
the mean of the Otis IQ scores, beyond the .01 percent level of confidence1.

3. Cooperative Reading Test

The frequency of the sub-test scores and the mean and standard
deviation of the distribution of the Cooperative Reading Test are shown in
Tables 3 and 4, respectively, in the Appendix. The mean, total scaled
score of 50.92 corresponds with the 20th percentile for adult men of
various ages and educational levels2, which is below average. The other
sub-test mean scaled scores of 56.94 for vocabulary, 46.88 for speed, and

1. Critical ratio 12.6

2. Norms based on 1,602 adult males at Illinois Institute
of Technology, Institute for Psychological Services, unpublished
data.
48.70 for comprehension also fall in the below-average range.

C. Statistical Methods.

In order to ascertain the relationship between the various measures used in the study, product moment coefficients between the two tests of intelligence, and between each of these and the reading sub-tests were calculated. The sample was not divided into poor and good reading sub-groups because the reading scores tended to cluster around one mean. In order to determine if, and to what extent, one test score may affect the relationship between two other test scores, the coefficient of partial correlation was computed. The basic assumption underlying the use of this statistical technique was that each test measured an independent entity. In other words, it was prematurely assumed that the Wechsler was basically an IQ test and the Otis was primarily a test of reading.

In its first application, the partial correlation was employed when the Cooperative Reading sub-test scores were partialled out to establish the relationship between the Otis and the Wechsler, with these reading factors held constant. With reading removed, so to speak, it was felt that the relationship between the two intelligence tests would become statistically significant. It was noted, however, that this technique did not really eliminate the reading in the Otis.

In its second application, the partial correlation was employed when the Wechsler scores were partialled out to establish the relationship between the Otis and the Cooperative Reading Test, with intelligence held constant. By comparing the Otis and the reading sub-tests, it was felt that the significance of their correspondence would aid in determining
what reading variables influenced Otis test performance. It can be seen that the Wechsler, as an IQ test only, was being taken for granted.

In its third application, the partial correlation was employed to establish the relationship between the Wechsler and reading factors, with Otis performance held constant. Here it was noted that reading skill was involved in Wechsler test performance. Yet, in this application, the Otis was assumed to be primarily a test of reading. It was realized at this point, in the statistical method, that much confidence could not be placed in the partialling out of one test score as an influencing variable affecting the relationship between two other test scores.

As this statistical method was carried out, it became increasingly apparent that a reciprocal relationship seemed to exist between reading ability and general intelligence. Perhaps it was not too presumptuous to assume that reading comprehension may very well be a function of intelligence.
CHAPTER IV
RESEARCH RESULTS

A. Report of the Pilot Study

Since it was assumed that the poor reading skills of handicapped readers would be reflected in their Otis performance, a preliminary study was conducted to investigate whether or not the reading skills of good readers would also be reflected in their Otis performance. It was felt that there would be a more significant correspondence between Otis and reading performances of good, rather than poor, readers.

The subjects used in the pilot study consisted of twenty-five adult men who were candidates for promotion to sales or management positions. Their ages ranged from twenty-six to forty-nine years, with a mean age of 36.4 years and a standard deviation of 6.5 years. The extent of their education ranged from high school graduates to college graduates, with a mean educational level of 14.6 years of schooling and a standard deviation of 1.3 years.

Table 5 shows the range, mean, and the standard deviation of the various test scores and the factors of age and education.

The Otis IQ scores, with their mean of 117.1 and a standard deviation of 12.4 are not normally distributed and, therefore, are not representative of the total population. The majority of cases falls in the high-average--above-average range.

The Wechsler IQ scores, with their mean of 131.2 and a standard deviation of 5.6 approximate, but are not exactly, normally distributed and definitely not representative of the standard population. The majority
of cases are in the above-average to superior range.

The mean total scaled score of the Cooperative Reading Test is 68.5 with a standard deviation of 8.0. This mean scaled score corresponds with the 83rd percentile as found in the norms for adult males of the population used in the vocational guidance center. The other sub-test scaled scores of 70.9 for vocabulary, 66.8 for speed, and 64.4 for level of comprehension, also fall in the above-average range.

Table 5

The Range, Mean, and Standard Deviation of Age, Education, and Various Test Scores Emanating from the Pilot Study

<table>
<thead>
<tr>
<th>Factor</th>
<th>Range</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>26-49</td>
<td>36.4</td>
<td>6.5</td>
</tr>
<tr>
<td>Education (years)</td>
<td>12-16</td>
<td>14.6</td>
<td>1.3</td>
</tr>
<tr>
<td>Otis IQ</td>
<td>85-133</td>
<td>117.1</td>
<td>12.4</td>
</tr>
<tr>
<td>Wechsler IQ</td>
<td>117-146</td>
<td>131.2</td>
<td>5.6</td>
</tr>
<tr>
<td>Coop. Rdg. Vocabulary</td>
<td>53-82</td>
<td>70.9</td>
<td>7.7</td>
</tr>
<tr>
<td>Coop. Rdg. Speed</td>
<td>48-97</td>
<td>66.8</td>
<td>11.6</td>
</tr>
<tr>
<td>Coop. Rdg. Level</td>
<td>52-85</td>
<td>64.4</td>
<td>9.8</td>
</tr>
<tr>
<td>Coop. Rdg. Total</td>
<td>57-87</td>
<td>68.5</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Product moment and partial coefficients of correlation were computed for the same purpose as in the main study and are presented in Tables 6 and 7 that follow.

1Op. cit. p. 2
Table 6 shows the correlations between the Otis and the Wechsler when reading factors are partialled out. It can be seen that the relationship between the two measures of intelligence, with and without the influence of reading, is no better than chance. A lack of significance in the relationship between the Otis and the Wechsler, when reading factors are partialled out, may be due to the fact that reading skill is involved in both test performances. If such be the case, partialling out these reading factors means holding them constant in the performance of the subject on both instruments. As a result, the relationship between the two tests of intelligence becomes mere speculation since reading seems to be an influencing variable in both Otis and Wechsler test performance. A more statistical explanation for the low correlation between the two measures of intelligence, with and without reading factors partialled out, may stem from the size of the sample and the spread of scores. It should be noted that the Otis and Wechsler scores are not highly diversified so that the spread of these scores is rather small. These factors may account for a depression in the coefficients. The validity of such a statistical inference regarding the causes for the depressed coefficients could be tested only by repeating the study on a sample with greater variance.
TABLE 6
Correlations Between the Otis and the Wechsler With and Without Various Sub-tests of The Cooperative Reading Test Partialled Out

<table>
<thead>
<tr>
<th>Sub-tests Partialled Out</th>
<th>&quot;r&quot; Between Otis and Wechsler</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>.068</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>.055</td>
</tr>
<tr>
<td>Speed</td>
<td>-.047</td>
</tr>
<tr>
<td>Level of Comprehension</td>
<td>-.083</td>
</tr>
<tr>
<td>Total Reading Scores</td>
<td>-.138</td>
</tr>
</tbody>
</table>

Table 7 shows the correlation between Otis scores and reading factors, with and without Wechsler performance partialled out. There is a positive, statistically reliable, relationship between Otis performance and each of the reading factors. The correspondence between Otis performance and the reading factors of comprehension and rate remains at the same level of confidence, when the influence of Wechsler scores is held constant. However, the correspondence between Otis performance and vocabulary does not remain at the same level of confidence when Wechsler scores are held constant. It appears that the significance of this relationship becomes reduced, possibly because vocabulary is a more important influencing variable in Wechsler, rather than Otis test performance.
TABLE 7
Correlations Between Otis Scores and Various Sub-test Scores of the Cooperative Reading Test With and Without Wechsler Scores Partialled Out

<table>
<thead>
<tr>
<th>Coop. Rdg. Sub-test Score Correlated with Otis Score</th>
<th>Product-Moment r</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Partialling</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>.421*</td>
</tr>
<tr>
<td>Speed</td>
<td>.685*</td>
</tr>
<tr>
<td>Level of Comprehension</td>
<td>.611*</td>
</tr>
<tr>
<td>Total Reading Scores</td>
<td>.618*</td>
</tr>
</tbody>
</table>

*Statistically significant beyond .05 percent level of confidence
* Statistically significant beyond .01 percent level of confidence

The statistical findings (Table 7) show that the reading skills of good readers used in this pilot study are reflected on their Otis performance. It seems that good readers have relatively minor difficulty comprehending the items on the Otis. Consequently, there is a significant correspondence between their reading and Otis test scores. The fact that the Otis and the Wechsler do not correlate significantly, when reading factors are held constant, may be due to the fact that reading is involved in both test performances. Another cause may be that the size of the sample and the spread of test scores is such that it depresses the coefficients of correlations. In addition, the Otis tables, from which the raw scores are converted to IQ's, do not offer the subject an IQ above 133, which is found in the 18 year level. Therefore, the range of Otis scores does not extend
as far as that of the Wechsler IQ scores.

B. Main Findings

The statistical findings are incorporated into three tables. Each table is discussed separately and an attempt is made to integrate any findings in one table that bear on the findings of another one.

Table 8 shows the correlations between the Otis and the Wechsler when reading factors are partialled out. A positive coefficient of correlation between these instruments indicates some relationship but it is not statistically significant. It appears that the relationship between the Otis and the Wechsler is reduced the most when Cooperative Reading total scores are partialled out. This relationship is also reduced, although to a lesser extent, when vocabulary and level of comprehension are held constant. A lack of significance in the relationship between the two tests of intelligence, when these reading factors are partialled out indicates, as in the pilot study findings (Table 6), that reading skill is probably involved in both test performances. In contrast, however, the relationship becomes statistically reliable when the factor of reading speed is partialled out. It seems that speed of reading is a factor which may cause the product moment coefficient between the Otis and the Wechsler to be spuriously low, thus being an important influencing variable.
TABLE 8

Correlations Between the Otis and the Wechsler With and Without Various Sub-tests of The Cooperative Reading Test Partialled Out

<table>
<thead>
<tr>
<th>Sub-tests Partialled Out</th>
<th>&quot;r&quot; Between Otis and Wechsler</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>.259</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>.197</td>
</tr>
<tr>
<td>Speed</td>
<td>.357*</td>
</tr>
<tr>
<td>Level of Comprehension</td>
<td>.095</td>
</tr>
<tr>
<td>Total Reading Scores</td>
<td>.043</td>
</tr>
</tbody>
</table>

"Statistically significant at .05 percent level of confidence

Table 9 shows the correlations between the Otis and reading factors with and without Wechsler scores partialled out. Positive, statistically reliable, relationships were found between the Otis and reading factors of speed and comprehension, as well as total reading score, but not vocabulary. These findings seem to indicate further that reading skills, particularly reading speed, influence Otis performance. In addition, on the basis of the previous table as well as on the present one, it would seem that reading speed influences Otis performance to a greater extent than it does Wechsler performance. Although the coefficients of partial correlation are lower than the product moment coefficients, the relationship between the Otis and reading factors remains statistically significant at the same level of confidence. Nevertheless, this difference between the product moment "r's" and the partial "r's" can be attributed to chance. As
a result, much confidence cannot be placed in partialling out the Wechsler performance as an influencing variable in the relationship between Otis and the reading factors. The partialling out process seems to indicate that some intelligence may very well be used by subjects in both operations, that is, on Otis as well as reading test performance.

**Table 9**

Correlations Between Otis Scores and Various Sub-tests of the Cooperative Reading Test With and Without Wechsler Scores Partialled Out

<table>
<thead>
<tr>
<th>Coop. Rdg. Sub-test Score Correlated with Otis Score</th>
<th>Product-Moment r Before Partialling</th>
<th>W-B Scores Partialled Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocabulary</td>
<td>.266</td>
<td>.206</td>
</tr>
<tr>
<td>Speed</td>
<td>.586*</td>
<td>.552*</td>
</tr>
<tr>
<td>Level of Comprehension</td>
<td>.517*</td>
<td>.471*</td>
</tr>
<tr>
<td>Total Reading Scores</td>
<td>.534*</td>
<td>.485*</td>
</tr>
</tbody>
</table>

*Statistically significant at .01 level of confidence

Table 10 shows the correlations between the Wechsler and reading factors when Otis performance is partialled out. Positive, statistically significant relationships exist between the Wechsler and the Cooperative Reading Test scores. The administration of Wechsler does not measure reading ability directly, since the subject is not required to read the test items. Such a relationship between these two tests may be due to the common factor that underlies performance on both of them since, in its very nature,
reading requires intellectual capacity to some degree. The statistically reliable relationships between the Wechsler and the reading factors of vocabulary and comprehension may be expected in view of the fact that this instrument has sub-tests which are designed to measure such factors. Speed of reading and the Wechsler are significantly correlated, possibly because of the fact that speed of response is considered in scoring many of the items.

TABLE 10

Correlations Between Wechsler Test Scores and Various Sub-test Scores of The Cooperative Reading Test With and Without Otis Scores Partialled Out

<table>
<thead>
<tr>
<th>Coop. Rdg. Sub-test Score Correlated With Wechsler Score</th>
<th>Product-Moment r Before Partialling</th>
<th>Otis Scores Partialled Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocabulary</td>
<td>.239*</td>
<td>.236*</td>
</tr>
<tr>
<td>Speed</td>
<td>.293*</td>
<td>.180</td>
</tr>
<tr>
<td>Level of Comprehension</td>
<td>.354*</td>
<td>.266</td>
</tr>
<tr>
<td>Total Reading Scores</td>
<td>.424*</td>
<td>.350</td>
</tr>
</tbody>
</table>

*Statistically significant at the .05 percent level of confidence
-Statistically significant at the .01 percent level of confidence

When Otis performance is a factor in the comparison of the Wechsler and Cooperative Reading Test, it reduces the reliability with which these tests are related. The reading factors (vocabulary, speed, comprehension) are no longer associated to a statistically significant degree when they are separately correlated with intelligence. Reading skills as a
whole (The Cooperative Reading total score) are also less related to the Wechsler but still remain at a statistically reliable level, possibly due to the cumulative influence of the several reading factors. It appears, therefore, that the Otis shares factors with both the Wechsler and the Cooperative Reading Test, so that it limits their relationship when its influence is held constant.

A comparison between the pilot study and the main findings (Tables 7 and 9) indicates that there is a more significant correspondence between Otis and reading performances of good, rather than poor, readers. Consequently, it would seem that good readers attain a higher performance on the Otis. Such a conclusion would be based on the apparent fact that good readers can comprehend the test items much better and perform more quickly than the poor readers.
CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to show that Otis performance is dependent upon reading ability so that anyone lacking sufficient reading skills would be penalized in his performance. Consequently, a poor reader would not attain a level of performance that would be an accurate estimate of his intellectual capacity.

The Otis, Wechsler, and Cooperative Reading Test were administered to fifty adult men of middle management positions in industry. The Wechsler was used as the criterion of intelligence against which the Otis was compared. The subjects' ages ranged from twenty-one to forty-five years, and their extent of education ranged from high school graduates to college graduates. Coefficients of correlation were computed between each of these factors and the subject's reading test performance. Age and education, however, were not influencing factors in their test performance.

Frequency distributions of the various test scores were constructed. The Otis scores were close to a normal distribution but not representative of the standard population because the majority of cases fell in the low-average range. The Wechsler scores were similarly not representative of the standard population because the majority of the cases fell in high-average—above average range. The means of the reading test scores were below average when compared with the adult male population used at the vocational guidance center.

1Op. cit. p. 2
In order to establish the relationship of these tests to each other, product moment coefficients of correlation were computed. Once these relationships were found, it was necessary to determine how, and to what extent, one test score might influence the relationship of two other test scores. To accomplish this, partial coefficients of correlation were computed between the two tests of intelligence and each of these with the various factors of reading.

It was found that the two measures of intelligence did not correlate significantly (.259) while Otis performance seemed reliably associated with the reading factors of speed (.586), comprehension (.517), and the total reading score (.534). The extent of this association with these reading factors did not alter, even when intelligence was held constant, the r's being .552, .471, and .485, respectively. However, the differences between the product-moment r's and the partial r's were not statistically significant but appeared due to chance. Consequently, much confidence could not be placed in partialling out intelligence as measured here by the Wechsler. The partialling out process seemed to indicate that some intelligence might very well have been used in both operations, that is, on Otis as well as reading test performances. The primary reading variable which influenced Otis test performance was the factor of reading speed which, if controlled, rendered the Otis score more similar when compared to the Wechsler (.357). Eliminating speed, therefore, made the Otis a much better test of general intelligence. Partial r's of .197, .095, and .043 between the measures of intelligence when vocabulary, comprehension, and the total reading score's influence, respectively, were held constant, indicated that
reading skill was probably involved in both Otis and Wechsler performances. Confirming evidence of this had been found in the statistically reliable relationship between Wechsler performance and vocabulary (.289), speed (.293), and comprehension (.354).

The fact that Otis performance reflects reading ability does not suggest that it is not a test of intelligence. The findings have shown that poor readers are limited in their performance on this instrument because they have to read the items and are penalized if they cannot read them quickly and with good comprehension. Consequently, the Otis becomes limited as an estimate of an individual’s mental capacity if he has meager reading skills. The research findings do not indicate what level of reading ability is necessary to read the test material accurately. Given sufficient efficiency in the mechanics of reading to read the test material correctly, the subject is likely to give an adequate performance on the Otis. In such a case, the Otis would be a satisfactory index of intelligence although it would not become independent of the influence of reading factors. This can be borne out by the fact, as shown in the pilot study, that intelligent subjects, whose efficiency in the mechanics of reading is good, usually make a correspondingly high score on the Otis.

In summary, the findings have shown that intelligence is very probably used on both the Cooperative Reading Test and Otis. In addition, reading skill and comprehension are probably a function of intelligence and Otis performance reflects both of these variables. Verbalized in another way, it seems that Otis performance reflects a factor which underlies an individual’s performance on an intelligence test as well as performance
on a test of reading ability. This common factor appears to underlie intelligence as well as reading skills.
TABLE I

Frequency Distribution of Otis IQ Scores

<table>
<thead>
<tr>
<th>Scores</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>75-79</td>
<td>1</td>
</tr>
<tr>
<td>80-84</td>
<td>1</td>
</tr>
<tr>
<td>85-89</td>
<td>1</td>
</tr>
<tr>
<td>90-94</td>
<td>1</td>
</tr>
<tr>
<td>95-99</td>
<td>1</td>
</tr>
<tr>
<td>100-104</td>
<td>1</td>
</tr>
<tr>
<td>105-109</td>
<td>1</td>
</tr>
<tr>
<td>110-114</td>
<td>0</td>
</tr>
<tr>
<td>115-119</td>
<td>3</td>
</tr>
</tbody>
</table>

N 50
Mean 95.22
S.D. 7.16
### Table 2

**Frequency Distribution of Wechsler Scores**

<table>
<thead>
<tr>
<th>Scores</th>
<th>Frequency</th>
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</thead>
<tbody>
<tr>
<td>85-89</td>
<td>1</td>
</tr>
<tr>
<td>90-94</td>
<td>1</td>
</tr>
<tr>
<td>95-99</td>
<td>2</td>
</tr>
<tr>
<td>100-104</td>
<td>6</td>
</tr>
<tr>
<td>105-109</td>
<td>8</td>
</tr>
<tr>
<td>110-114</td>
<td>13</td>
</tr>
<tr>
<td>115-119</td>
<td>11</td>
</tr>
<tr>
<td>120-124</td>
<td>8</td>
</tr>
</tbody>
</table>

- **N**: 50
- **Mean**: 111.04
- **S.D.**: 8.00
<table>
<thead>
<tr>
<th>Scaled Score</th>
<th>Vocabulary</th>
<th>Speed</th>
<th>Level</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>31-35</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>0</td>
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<tr>
<td>36-40</td>
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<td>4</td>
<td>3</td>
</tr>
<tr>
<td>41-45</td>
<td>4</td>
<td>14</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>46-50</td>
<td>7</td>
<td>16</td>
<td>18</td>
<td>15</td>
</tr>
<tr>
<td>51-55</td>
<td>15</td>
<td>9</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>56-60</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>61-65</td>
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<td>66-70</td>
<td>6</td>
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<td>1</td>
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<td>71-75</td>
<td>1</td>
<td>1</td>
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<td>0</td>
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<td>76-80</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>81-85</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>
TABLE 4

Means and Standard Deviation of Distributions of Sub-test Scores of the Cooperative Reading Test

<table>
<thead>
<tr>
<th>Sub-test</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocabulary</td>
<td>56.94</td>
<td>9.41</td>
</tr>
<tr>
<td>Speed</td>
<td>46.88</td>
<td>7.58</td>
</tr>
<tr>
<td>Level</td>
<td>48.70</td>
<td>7.19</td>
</tr>
<tr>
<td>Total</td>
<td>50.92</td>
<td>7.07</td>
</tr>
</tbody>
</table>
BIBLIOGRAPHY


*Bibliographical reference for studies concerning the relationship of reading to intelligence.
APPROVAL SHEET

The thesis submitted by Paris G. Choncholas has been read and approved by three members of the Department of Psychology.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Arts.

April 12, 1965
Date

Frank J. Koeller
Signature of Adviser