

THE UNIVERSITY OF DETROIT

THE WECHSLER-BELLEVUE INTELLIGENCE SCALE
AS A PREDICTOR OF SUCCESS IN A
COLLEGE OF ENGINEERING

A THESIS

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BY

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CHAPTER I
INTRODUCTION

One of the important aspects of research apparently neglected in the Wechsler-Bellevue literature is the reliability of the scale as a predictor of academic success. There have been many studies on its reliability and validity as an intelligence test and as a clinical tool in diagnosing mental disorder. Other studies have concentrated on its reliability in a shorter form and on its relationship to similar tests. However, studies relative to its reliability as a predictive device in educational and vocational counseling are extremely limited.

Purpose of this Study

This study was undertaken in an effort to determine the reliability of the Wechsler-Bellevue as a predictor of success with freshmen engineering students. More specifically this investigation is directed toward accomplishing four goals; namely the determination of the relationship between:

1. The Wechsler-Bellevue subtest weighted scores, the Wechsler-Bellevue Verbal, Performance and Full Scale IQs, Form II, and five freshman engineering courses.
2. The Wechsler-Bellevue Verbal, Performance and Full Scale IQs, Form II, and the Pre-Engineering Inventory Composite Scores.

3. The Wechsler Verbal, Performance and Full Scale IQs, Form II, and the grade point average.

4. The Pre-Engineering Inventory Composite Scores and the grade point average.

Rationale

Intelligence tests have been used for many years as predictors of academic success. In discussing intelligence as one of the factors affecting college grades, Daniel Harris states that

Although more and more attention has been paid to factors other than intelligence, the importance of this factor is ever with us. Various investigators report correlation with grades ranging from .33 to .64. At a number of places intelligence test scores were found to be the best single predictive device for grades.¹

The possibility of utilizing the Wechsler-Bellevue as an aid to educational and vocational counseling was first inferred from Wechsler's own statements. In regard to the general significance of dividing the scale into a Verbal and Performance part, he asserted that

In practice this division is substantiated by differences between posited abilities and various occupational aptitudes. Clerical workers and teachers, in general, do much better on verbal tests, whereas manual workers and mechanics do better on performance. The correlations are sufficiently high to be of value in vocational guidance, particularly with adolescents of high school age.²

1. Daniel Harris, "Factors Affecting College Grades: A Review of the Literature, 1930-1937," Psychological Bulletin, XXXVII (March, 1940), 125.

2. David Wechsler, The Measurement of Adult Intelligence, 3rd edition, p. 146.

Edward E. Anderson and collaborators in a comparative study of the Wechsler-Bellevue, Revised Stanford-Binet and the American Council on Education Tests and grade point averages state that at the college level, "...intelligence tests are expected to show some correlations with scholastic success..."³ However, they recognized the need for further research with the Wechsler-Bellevue in this area and suggested that

...its usefulness with college students would be limited unless its relation to grade average compared favorably with that of other tests.⁴

It is the hope of this investigator that this study will contribute to the research on the Wechsler-Bellevue in predicting academic success.

The Instruments

No attempt will be made in this study to describe the Wechsler-Bellevue since it is felt that its extensive clinical use and the many studies that have been published on it are familiar to psychologists and educators alike.

However, the use of Form II in this study necessitates a brief consideration of its relationship to Form I. The standardization group used by Wechsler for Form II was based on successive samples of over 1,000 cases of male adults,

3. Edward E. Anderson, et al., "Wilson College Studies in Psychology: I A Comparison of the Wechsler-Bellevue, Revised Stanford-Binet, and the American Council on Education Tests at the College Level," Journal of Psychology, XIV (October, 1942), 317.

4. Ibid.

ages 18-40. He supplemented this sample with studies on special groups. Wechsler indicated a high correlation between the two forms with a mean difference of less than two points between the Full Scale scores.⁵

The writer used Form II of the Wechsler-Bellevue for two reasons; namely, less work has been done with this form and 46 subjects of the total sample used in this study had already been given Form II.

The Pre-Engineering Inventory is a series of tests constructed for the purpose of measuring those abilities fundamental to successful study of engineering. It is designed primarily to assist in the selection of those students who will be the most likely to succeed in an engineering school. It serves a special purpose of comparing the freshman engineering student with the other members of his class and with freshmen engineering students in general. The tests are divided into two booklets. Booklet I consists of tests measuring general verbal ability, technical verbal ability, and ability to comprehend mathematical materials. Booklet II consists of tests measuring abilities in general mathematics, mechanical principles, spatial visualization and in understanding society. The inventory is designed to be administered in two three-hour periods which may be scheduled on the same day. It can either be hand or machined scored.

5. David Wechsler, The Wechsler-Bellevue Intelligence Scale, Form II. (Manual), p. v.

Eight raw scores are finally derived, one for each of the tests plus a Composite Score. These are then converted to scaled scores and to percentile ranks. The norms for the inventory are based on a selected sample of 9,994 freshmen engineering students in colleges of engineering throughout the United States.⁶

Subjects

The group selected for this study consisted of 100 freshmen in the College of Engineering at the University of Detroit. Of this group, 47 were obtained from a similar study conducted by Trygg Engen, who used 50 freshmen engineering students to compare the Wechsler-Bellevue, Form II, with academic success in the College of Engineering at the University of Detroit.⁷ Three subjects in his sample were excluded from the total group since they did not complete the courses required for this investigation. The entire group selected for this study was obtained by a strictly volunteer system. A freshman engineering student, for the purpose of this study, was one who had no previous college training and was enrolled in the College of Engineering at the University of Detroit from the Fall Semester of 1951 to the Spring Semester of 1953. None of the group had taken

6. K. W. Vaughn, "The Pre-Engineering Inventory," The Journal of Engineering Education, XXXIV (May, 1944), 615-26.

7. Trygg Engen, "A Comparison of Performance on the Wechsler-Bellevue Intelligence Scale and Success in the Engineering College," Unpublished Master's thesis, University of Detroit Library, 1952.

the Wechsler-Bellevue previously. The age distribution for the group is presented in Table I.

TABLE I
AGE DISTRIBUTION

Age Group	Subjects
17	12
18	69
19	13
20	2
21	0
22	1
23	1
24	1
25	1

Procedure

The Wechsler-Bellevue, Form II, was administered to 53 freshmen engineering students during the Fall Semester of 1952. The 47 students from Trygg Engen's group were tested during the Fall Semester of 1951.

Testing conditions, such as place of testing, rapport, praise and encouragement were held as constant as possible. The time of testing, however, was difficult to control and possible influences due to fatigue should be noted.

The students' final grades for the first semester and their Pre-Engineering Inventory Composite Score percentiles were obtained from the office files of the Dean. The inventory is administered by the College of Engineering at the beginning of the Fall Semester as part of its regular orientation procedure. All pertinent data for each subject, i.e.,

name, age, date of examination, birthdate, test scores, and the final grades were transcribed to a master chart to facilitate further statistical operations.

It is assumed that the use of Trygg Engen's group of 47 students has little or no effect on the final data since they were investigated under similar circumstances and each examiner used the standardized procedure outlined by Wechsler for the administration and scoring of the test.

CHAPTER II

RELATED STUDIES

A survey of the literature reveals several studies that have contributed substantially to our present knowledge in regard to the use of the Wechsler-Bellevue as a predictor of academic success.

Studies with Various College Curricula

Edward E. Anderson and others at Wilson College, using a group of 112 freshmen women in various curricula, studied the relationship of their scores on the Wechsler-Bellevue to their scores on the Revised Stanford-Binet, the American Council on Education Tests at the College Level and to their college grades. The results showed the mean Full Scale IQ for the group to be 118.5 with a median of 119(SD: 7.2) and a range from 99 to 135. The Verbal Scale IQ mean was 116.0 with a median of 115(SD: 7.0) and a range from 100 to 131. The Performance Scale IQ mean was 115.8 with a median of 116 (SD: 8.8) and a range from 95 to 133. The correlations of the grade point averages for the first semester with the Wechsler Full, Verbal and Performance Scales were .41, .50 and .19 respectively. With regard to the finding of a low correlation between the Performance Scale and grade point

averages, Anderson states

The correlation of the Wechsler-Bellevue Performance Scale with other measures are all approximately .20--.30 pts. lower than the corresponding correlation of any other test. It is apparent that, at the college level, the Wechsler-Bellevue Performance Scale is not measuring an ability markedly involved in scholastic success or other intelligence tests. There is considerable doubt that the performance scale is measuring the same function as the verbal scale at the college level.⁸

The Verbal Scale correlated .34 with the Performance Scale, substantially lower than the correlation of .71 reported by Wechsler.⁹

He concluded his explanation of the lower Performance Scale relationship with grade point average by remarking that

When differences in intelligence are great, as in the heterogeneous standardization group, it appears that individual differences on the performance scale are in part due to the same function as are individual differences on the verbal scale. But when differences in intelligence are restricted and the level of intelligence high it seems that individual differences on the performance test are to a large extent influenced by some factors other than those involved in the verbal scale, other intelligence tests, and scholastic success.¹⁰

This finding of Anderson's is important to consider in evaluating data obtained from relatively homogenous groups.

A study similar to that of Anderson and co-workers is that of Aaron Sartain, who compared various intelligence tests with each other and with average freshmen grades. He used the Revised Alpha Examination, Form 5; the Otis Self Adminis-

8. Anderson, et al., op. cit., p. 323.

9. Wechsler, op. cit., p. 126.

10. Anderson, et al., op. cit., p. 323.

tering Test of Mental Ability, Form A; the American Council on Education Psychological Examination, 1942; the New Revised Stanford-Binet, Form L and the Wechsler-Bellevue, Form I. The subjects for the study consisted of 50 college students who were given the tests during their freshman year. His conclusions were that there was no appreciable difference in the intercorrelations of the tests themselves. Secondly, the results indicated no significant differences in the correlations of these tests with the average freshmen grades. Thirdly, the best weighting of the test scores raised the correlation from .581 to .636 for predicting grades. Lastly, it was found that the IQs of the Stanford-Binet were significantly higher than those of the other two intelligence tests. Sartain points to the relatively low correlation of the Wechsler Performance Scale with grade average. The correlations between grade average and the Wechsler Full, Verbal and Performance were .53, .58 and .35 respectively. The mean Full Scale IQ was 117.5.¹¹

Trygg Engen investigated the relationship of the Wechsler-Bellevue, Form II, and success in the College of Engineering at the University of Detroit. His purpose was to determine the mean scores of 50 freshmen engineering students on the Wechsler-Bellevue, Form II, and to correlate these scores with the mean school grades at the end of the first semester. A sec-

11. Aaron Sartain, "A Comparison of the New Revised Stanford-Binet, the Wechsler-Bellevue Scale and Certain Group Tests of Intelligence," Journal of Social Psychology, XXIII (May, 1946), 237-39.

ondary objective of this investigation was to compare the relative efficacy of the Wechsler-Bellevue, Form II, and the Pre-Engineering Inventory for predicting success in engineering schools. His sample was a homogenous group of 50 freshmen who had no previous college training and who ranged, with only four exceptions, from 17 to 19 years of age. The means of the Wechsler Full, Verbal and Performance Scale were 124.10 (SD: 6.98), 120.14 (SD: 7.73) and 120.98 (SD: 8.00), respectively. The mean Pre-Engineering Inventory Composite Score was 47.32. The coefficients of correlation for the Wechsler Full, Verbal and Performance Scale were .556 (SE: .144), .594 (SE: .144) and .417 (SE: .144), respectively. The Pre-Engineering Inventory Composite Score correlation with the mean school grades was .719 (SE: .149), suggesting a substantially higher reliability for the inventory as an indicator of success in the school. All the correlations obtained were significant at the 1% level. He concluded that there was a dependable relationship between the Wechsler-Bellevue, Form II, and grades earned in the college. It should be noted that Engen's finding of a lower Performance Scale reliability is consistent with the findings of Anderson and Sartain.¹²

A Study with High School Seniors

Arden N. Frandsen, using 83 high school seniors, determined the relationship of the Wechsler-Bellevue to high school achievement. The correlations with third year grade

12. Engen, op. cit., pp. 28-32.

point average were, .685, .69, and .48 for the Wechsler Full, Verbal and Performance Scales respectively. The means for the Full, Verbal and Performance Scales were 119.8 (SD: 11.86), 115.7 (SD: 12.96) and 119.6 (SD: 10.08) respectively.¹³

The subtests found to be separately least valid for predictive purposes were the Picture Arrangement, Picture Completion and Object Assembly. Omitting these three least valid subtests, the author found that the combination of the remaining seven, excluding the Vocabulary subtest, correlated .765 with the grade point average. Although the data are limited to high school seniors, Frandsen believes the conclusions would apply to college freshmen as well. It is interesting to note the suggestion made that certain subtests be omitted in order to obtain a higher prediction of academic success.

A Study of the Two Forms of the Wechsler-Bellevue

Renate Gerboth investigated the relationship between the Wechsler-Bellevue, Form I and Form II. Her comparative study was conducted to determine the differences between the mean scores of the two forms and to determine the practice effect due to retesting. Finally, she determined their intercorrelations and their relationship to the American Council on Education Psychological Examination

13. Arden N. Frandsen, "The Wechsler-Bellevue Intelligence Scale and High School Achievement," Journal of Applied Psychology, XXXIV (December, 1950), 406-12.

and to their college grades.¹⁴

The group consisted of 100 students at Washington University, 50 of whom were males and 50 females. The group was somewhat heterogeneous since the students ranged in classification from freshmen to graduate students. Nevertheless, the results are significant in showing how the two forms compare. The correlation between the Verbal Scale of Form I and II was .86. The correlation of the Performance Scale of Form I with Form II was .71. These correlations were obtained when Form II was administered first and Form I was given last. When Form I was administered first, the same correlations were somewhat lower.

The Full Scale of Form I and Form II was correlated with the grade point average. The correlation of Form I with the grade point average was .29, which was significant at the 0.05 level. The correlation of Form II with the grade point average was .26, which was almost significant at the 0.05 level. Form I apparently has a slightly higher predictive value than Form II, although the difference is only .03 points. It would be well to point out here that comparative studies on the two forms are scant and until further research is done in this area, little can be deduced from isolated studies. However, the two forms have yet to be shown to be significantly different.

14. Renate Gerboth, "A Study of the Two Forms of the Wechsler-Bellevue Intelligence Scale," Journal of Consulting Psychology, XIV (October, 1950), 365-70.

A Study of the Wechsler-Bellevue with
Certain Vocational Aptitude Tests

Solomon Diamond investigated the Wechsler-Bellevue in its relationship to certain vocational aptitude tests. He grouped the subtests of the Wechsler-Bellevue into three categories; namely, the Linguistic, which consisted of the Information, Comprehension, and Similarities; the Clerical, which included the Digit Span, Arithmetic, and Digit Symbol; and the Spatial, which contained the Picture Completion, Object Assembly, and Block Design. The results showed that such a grouping indicated a fairly high degree of correspondence to the scores on vocational aptitude tests falling in the same general areas. His sample consisted of 100 male clients of a vocational guidance agency.¹⁵

The use of the Wechsler-Bellevue in vocational guidance has received scant attention. As Diamond states

The Wechsler-Bellevue Scales, which have been so thoroughly studied as instruments of clinical diagnosis, have received little attention, as far as the literature indicates, from the standpoint of their possible helpfulness in determining vocational aptitudes.¹⁶

15. Solomon Diamond, "The Wechsler-Bellevue Intelligence Scales and Certain Vocational Aptitude Tests," Journal of Psychology, XXIV (October, 1947), 279-82.

16. Ibid., p. 279.

Studies with the Pre-Engineering Inventory

Since it was made available in 1944, the Pre-Engineering Inventory, Revised Form A, has received a great deal of attention in research projects in order to determine its efficacy as a predictive device in engineering colleges.

Joseph Moore in reviewing the literature of a decade's attempts to predict scholastic success in engineering colleges shows that from data obtained from ten engineering colleges, the Pre-Engineering Inventory correlated with the grade point average in a range from .16 to .71 for the various tests, and that the Composite Score correlations ranged from .44 to .68.¹⁷ Moore's opinion was that predictive instruments for engineering schools remained as effective as they were in the 1930's. He felt that the Pre-Engineering Inventory failed to correlate significantly higher than many shorter tests.

Frederic Lord and co-workers, using the data obtained on freshmen in twelve schools of engineering find that correlations between the Composite Score and first term grades ranged from .38 to .68. The median coefficient of correlation for the group was .60. They concluded that the findings further substantiate the reliability of the Pre-Engineering Inventory as a predictor of success in engineering schools.¹⁸

17. Joseph Moore, "A Decade of Attempts to Predict Scholastic Success in Engineering Schools," Occupations, XXVIII (November, 1949), 92-7.

18. Frederic Lord, Cowles, J. T. and Manuel Cynamon, "The Pre-Engineering Inventory as a Predictor of Success in Engineering Colleges," Journal of Applied Psychology, XXXIV (February, 1950), 30-39.

H. W. Case, analysing various engineering entrance examinations, including the Pre-Engineering Inventory, found tetrachoric correlations of the Composite Score with first semester grade averages of .32; with second semester grade averages of .54; and with third and fourth semester grade averages of .54. All these correlations were significant at the 1% level. He concluded that the Pre-Engineering Inventory was a consistent instrument for prediction and constitutes a useful selection device.¹⁹

Summary

The studies which have been reviewed give us a concrete picture of the research at the present time, showing the areas yet to be investigated and those which should be followed up further. Summarizing this short review of the literature, we can note several indications.

1. The studies of Anderson, et al, Sartain, and Frandsen give evidence that the Performance Scale correlates significantly lower than either the Verbal or Full Scale with grade point average.

2. These sources indicate that although there is a substantial correlation between the Wechsler Verbal and Full Scale with grade point average, which indicates at least the possibility of using the Wechsler-Bellevue as a good supplementary predictor, the lower Performance Scale correlations

19. H. W. Case, "An Analysis of Engineering Entrance Examinations," Journal of Applied Psychology, XXXVII (February, 1953), 42-6.

suggest weakness in utilizing the test as it is now constructed.

3. The Wechsler-Bellevue, Form II, as far as is indicated in the literature, is not significantly different than Form I.

4. There is a need for further extensive study of the Wechsler-Bellevue as a predictor of educational and vocational success.

5. The Pre-Engineering Inventory is an adequate instrument for predicting engineering school success. However, it is not significantly better than many shorter engineering aptitude tests.

CHAPTER III

PRESENTATION AND DISCUSSION OF DATA

In the statistical manipulations of the data of this study, the problem under investigation is whether or not the Wechsler-Bellevue, Form II, is a reliable predictor of success with freshmen engineering students. The data are subsequently analyzed in terms of the three specific goals outlined in Chapter I. Briefly, these goals were to determine the relationship between: a) the Wechsler-Bellevue subtest weighted scores, the Wechsler-Bellevue Verbal, Performance and Full Scale IQs, Form II, and five freshman engineering courses; b) the Wechsler-Bellevue Verbal, Performance and Full Scale IQs, Form II, and the Pre-Engineering Inventory Composite Scores; c) the Wechsler-Bellevue Verbal, Performance and Full Scale IQs, Form II, and the grade point average, and finally, d) the Pre-Engineering Inventory Composite Scores and the grade point average.

Means of the Wechsler Scales, the Pre-Engineering Inventory and Five Freshman Engineering Courses

The means and standard deviations were obtained from the correlation chart for the computation of the Pearson Product-Moment Coefficient of Correlation by E. F. Lindquist in which

$$M = i \sqrt{\frac{\sum X}{N}} + A.R. \quad \text{and} \quad \sigma_x = i \sqrt{\frac{\sum x'^2}{N} - \left(\frac{\sum x'}{N}\right)^2}.$$

The means and standard deviations of the Wechsler-Bellevue, Form II, and the Pre-Engineering Inventory Composite Score Percentiles are presented in Table II.

TABLE II

MEANS AND STANDARD DEVIATIONS OF THE WECHSLER SCALES AND THE PRE-ENGINEERING INVENTORY FOR 100 FRESHMEN ENGINEERING STUDENTS AT THE UNIVERSITY OF DETROIT

Instruments	M	SD
Wechsler Subtests		
Information	12.50	1.71
Comprehension	12.49	2.27
Digit Span	10.64	3.09
Arithmetic	11.70	2.26
Similarities	12.52	1.42
Vocabulary	12.42	1.27
Picture Arrangement	12.35	2.42
Picture Completion	11.18	1.71
Block Design	13.69	1.97
Object Assembly	13.53	1.77
Digit Symbol	11.46	2.48
Wechsler IQ Scales		
Verbal	118.31	8.13
Performance	115.22	9.71
Full	120.02	8.00
Pre-Engineering Inventory		
Composite Score	50.33	17.31

A closer examination of the Wechsler Verbal, Performance and Full Scales show that they ranged from 94 to 137, 95 to 137, and 100 to 139, respectively. On the basis of Wechsler's classification of intelligence, the average freshman engineer-

ing student at the University of Detroit ranks in the upper portion of the bright normal group and ranks higher on this capacity than about 74 per cent of the population.²⁰ In his study, Trygg Engen found that with a comparable sample of 50 students the Verbal, Performance and Full Scale mean IQs were 120.14, 120.98 and 124.10 respectively.²¹

The range for the Pre-Engineering Inventory Composite Score Percentiles for the group was 17 to 89 with a mean of 50.33. The mean score for all the freshmen who entered the College of Engineering in the Fall Semester of 1952 was 31, somewhat lower than that of our sample. However, the mean percentile score obtained for the group approaches the mean for the standardization group, namely 50. It would appear then, that the sample used in this study is fairly representative.

The means and standard deviations for the five courses taken in the first semester of the freshman year are listed in Table III. The mean of the grade point average was 2.18 with a SD of .819. The grade point average was computed by allowing 4 points for each hour of credit for Grade A, 3 points for each hour of credit for Grade B, 2 points for each hour of credit for Grade C, 1 point for each hour of credit for Grade D, and no credit for Grade F. The points earned were then summed and divided by the total number of credit hours for the five courses.

20. David Wechsler, The Measurement of Adult Intelligence, 3rd edition, p. 40.

21. Engen, op. cit., p. 18.

TABLE III

MEANS AND STANDARD DEVIATIONS OF FIVE FIRST SEMESTER COURSES FOR 100 STUDENTS IN THE COLLEGE OF ENGINEERING

Course	M	SD
Chemistry	2.14	1.23
English	2.35	.73
Mathematics	1.85	1.29
Drawing	2.11	.89
Religion	2.58	.91

Correlations between the Wechsler Scale Scores and Each of Five Freshman Courses

The means and standard deviations presented in the previous section are not sufficient to determine relationships between the Wechsler Scale and the five freshman engineering courses. In order to find the relationship between the two variables, the coefficient of correlation was computed. In this way, we can better see whether or not the Wechsler Scales can predict success in any one of these courses. The basis for this statement is that, if the sample studied is representative of the freshman engineering student in the College of Engineering and is adequate in number, the correlations should be significant in predicting success in the college. We can compare the correlations of the Wechsler Scales with the individual course, with the grade point average of the courses combined and with the Pre-Engineering Inventory, which is known to have a high degree of practical validity in determining success in the engineering college.

The correlations between the Wechsler Scales and each of the five freshman courses are indicated in Table IV. The correlations were computed by the formula for Pearson's r . The standard error was estimated by the formula $\sigma_r = \frac{1}{\sqrt{N-1}}$.

TABLE IV

CORRELATIONS BETWEEN THE WECHSLER SCALE, FORM II AND GRADES FOR EACH OF FIVE ENGINEERING COURSES*

Instrument	M	R	C	D	E
Subtests					
Information	.24	.20	.23	.20	.18
Comprehension	.23	.03	.10	.01	.11
Digit Span	.29	.17	.22	.15	.31
Arithmetic	.30	.33	.34	.00	.20
Similarities	.04	-.10	.28	.03	.02
Vocabulary	.07	-.17	.36	.05	.19
P. Arrangement	.15	.10	.25	.15	.17
P. Completion	-.15	-.11	-.07	.05	-.02
Block Design	.14	.03	.12	.08	.10
Object Assembly	.09	-.13	.04	.24	.03
Digit Symbol	.16	-.10	-.02	-.17	.12
IQ Scales					
Verbal	.20	.31	.48	.13	.36
Performance	.09	-.11	.05	.11	.12
Full	.20	.10	.30	.11	.26

* The five engineering freshman courses are M: Mathematics; R: Religion; C: Chemistry; D: Engineering Drawing; and E: English.

By using the above table we can determine roughly the efficacy of using the Wechsler Scale, Form II and its relationship to each course. The standard error in each case was .101. The levels of confidence vary from 1% to more than 5%. For a sample of 100, the coefficient of correlation must

be at least .196 to be significant at the 5% level, .233 to be significant at the 2% level, and .258 to be significant at the 1% level.²² Generally, the relationship of the Wechsler scales to the individual course is poor. The best coefficients of validity are with Chemistry and the poorest with Drawing. The Arithmetic subtest is the best predictor among the subtests; it falls down only in Drawing. The Information and Digit Span subtests are next in value after the Arithmetic and are about equal. For the course in Mathematics, it appears that the Information, Comprehension, Digit Span and Arithmetic could probably be combined to make a fair prediction. For Religion, the Information, Arithmetic and Verbal Scale IQ are the best combination. For Chemistry, it appears that the Verbal Scale IQ is of value for prediction. For Drawing, the Wechsler scales seem to be of no value for predictive purposes. Finally, for English, the Verbal IQ is the best predictor of success. Generally, the IQ scales are the best predictors. However, it is to be noted that several subtests correlate better with a course than the major scales. The differences between the Performance and Verbal Scales are surprisingly high with one of the Performance Scale correlations being negative (Religion).

The Verbal Scale has the best correlations with each course, and is consistent with all the studies reported at

22. E. F. Lindquist, A First Course in Statistics, p. 195.

the present time. Consistent also are the poor Performance Scale correlations. It would appear then, that the Verbal Scale has the better practical validity since its correlation is consistently more dependable.

Correlations between Wechsler IQ Scales,
the Pre-Engineering Inventory,
and Grade Point Averages

The correlations in Table V should clarify the relationship between the Wechsler IQ Scales, the Pre-Engineering Inventory, and grade point averages.

TABLE V

CORRELATIONS BETWEEN WECHSLER IQ SCALES,
THE PRE-ENGINEERING INVENTORY,
AND GRADE POINT AVERAGES

Instrument	\bar{r}	SE	Sign.
Wechsler IQ Scales			
Verbal	.411	.101	1%
Performance	.079	.101	> 5%
Full	.230	.101	5%
Pre-Engineering Inventory			
Composite Score (Percentile)	.617	.101	1%

The correlation of the Verbal Scale, .411 (SE: .101), suggests a significant relationship with the grade point average. It represents the better of the correlations and therefore suggests practical validity. It is the opinion of this writer that the Verbal Scale could very well constitute

a supplementary test of prediction. The Full Scale is substantially lower than the Verbal Scale; however, the reason seems apparent for the Performance Scale practically correlates zero with grade point average. This low Performance Scale coefficient of validity brings back the suggestion made by Anderson and his co-workers who said;

...when differences in intelligence are restricted and the level of intelligence high it seems that individual differences on the performance test are to a large extent influenced by some factors other than those involved in the verbal scale, other intelligence tests, and scholastic success.²³

If the Performance Scale does not measure the same function as does the Verbal Scale with homogenous groups, its value with this type of group is limited. However, a further reason is suggested; namely that beyond a certain point all further increase of score on most of the Performance Scale tests depends on speed. A homogenous group like our sample will make few failures; hence will differ mainly in speed.

The Pre-Engineering Inventory presents a totally different picture. It has a rather high coefficient of validity with grade point average, .617 (SE: .101), and suggests a dependable relationship between the inventory and success in the engineering college. We can assume then, that in the light of the evidence presented thus far, the inventory has distinctly more value in predicting success in the engineering college. This is to be expected since the test was specifically constructed for the purpose of ascertaining spe-

23. Anderson, op. cit., p. 323.

cial aptitudes conducive to success in engineering schools. However, the Verbal and Full Scale scores of the Wechsler-Bellevue indicate that there appears to be a reliable relationship between the functions measured by this scale and success in engineering schools. This relationship would then suggest that more extensive research be undertaken with the Wechsler in this area.

It should be kept in mind however, that these findings are restricted to the circumstances in the College of Engineering at the University of Detroit. One of the limitations of this study is that there are few similar studies in other universities to corroborate these findings. Further limitations for this type of study are that grades in school courses are themselves poor metric material and such important and variable factors as initiative, persistence, social and economic status, health, moral and volitional factors, and industriousness are left unmeasured. In any final analysis they must be considered.

Correlations of the Wechsler IQ Scales and the Pre-Engineering Inventory

The relationship of the Wechsler Verbal, Performance, and Full Scale to the Pre-Engineering Inventory Composite Score is shown in Table VI. Again, the Performance Scale falls much lower than the other two scales and is therefore less useful. The Verbal Scale, however, seems to have a dependable relationship with the Pre-Engineering Inventory

Composite Score that is of practical usefulness.

TABLE VI

CORRELATIONS BETWEEN WECHSLER'S IQ SCALES
AND THE PRE-ENGINEERING INVENTORY*

Instrument	<u>r</u>	SD	Sign.
Verbal	.516	.101	1%
Performance	.097	.101	>5%
Full	.346	.101	1%

* Composite Score

CHAPTER IV
SUMMARY AND CONCLUSIONS

The purpose of this investigation was to determine the reliability of the Wechsler-Bellevue, Form II, as a predictor of success with freshmen engineering students. We found through the use of the Composite Score of the Pre-Engineering Inventory that our sample was representative of the entire freshman class, assuming that this instrument measures abilities conducive to success in engineering schools to a more or less high degree of accuracy. The criterion for success in the engineering college for this study was the grade point average earned by the students of the sample.

In the related studies, several points were consistently reported. The studies of Anderson and co-workers, Sartain, and Frandsen gave evidence that the Performance Scale correlates significantly lower than either the Verbal or Full Scale with grade point average. These studies also pointed to a weakness in using the Wechsler test as it is now constructed for predictive purposes. The Pre-Engineering Inventory was generally found to be a highly valid instrument for predicting success in engineering schools. However, the inventory is not significantly higher than many of the shorter engineering aptitude tests. Finally, the survey of

the literature showed a further need for more extensive studies with the Wechsler-Bellevue Scale as a predictor of academic success.

The Wechsler-Bellevue, Form II, was administered to 53 freshmen engineering students during the Fall Semester of 1952. An additional 47 subjects were obtained from a similar study conducted by Trygg Engen in the Fall Semester of 1951. The entire sample used was 100 freshmen engineering students, who ranged in age from 17 to 25, and who were enrolled in the College of Engineering from the Fall Semester of 1951 to the Spring Semester of 1953. The individual grades and the Composite Score on the Pre-Engineering Inventory were obtained from the Dean's office. The Pre-Engineering Inventory was administered by the college at the beginning of the Fall Semester.

The data derived from the Wechsler-Bellevue, Form II, the Pre-Engineering Inventory Composite Score, and the grade point average were statistically manipulated in order to determine their various relationships as applied to this particular sample. A summary of the findings are listed below:

1. The means of the Wechsler subtests varied from 10.64 (SD: 3.09), for the Digit Span to 13.69 (SD: 1.97), for the Block Design. The means on the Wechsler Verbal, Performance, and Full Scales were 118.31 (SD: 8.13), 115.22 (SD: 9.71), and 120.02 (SD: 8.00), respectively. The mean percentile Composite Score on the Pre-Engineering Inventory was 50.33

(SD: 17.31), which is about the same as that of the standardization group, 50. This indicates that our sample is fairly representative of freshmen engineering students. The mean grade for the individual courses varied from 1.85 (Mathematics), to 2.58 (Religion). The mean of the grade point average for the combination of courses was 2.18 (SD: .819), a little better than a C grade average.

2. Correlations of the individual courses of Mathematics, Religion, Chemistry, Engineering Drawing, English with the Wechsler subtests varied considerably. The highest correlations were with the subtests and Chemistry. The Arithmetic subtest is the best predictor among the subtests, falling down only in Drawing. The Information and Digit Span are next in value after the Arithmetic and are about equal. For the course in Mathematics, it appears that the Information, Comprehension, Digit Span and Arithmetic could probably be combined to make a fair prediction. It is to be noted that several subtests correlate better with a course than do the major scales, but this is not the general trend.

3. On the whole, the Wechsler Verbal Scale correlated more highly than the subtests with the individual courses. The differences between the Verbal and Performance Scales were great. Correlations with the Performance Scale ranged from -.11 to .12, and with the Verbal Scale, from .13 to .48. The Verbal Scale had the better correlation with each course and is probably of practical value for predictive purposes.

4. The Wechsler Verbal Scale (.411) has the highest correlation with grade point average and is of value for predicting success in the College of Engineering. The Performance Scale (.079) is practically of no value for predictive purposes. The Full Scale (.230) is of little value, and the explanation seems to lie in the fact that the low correlation on the Performance Scale lessened the validity of the Full Scale. It was suggested that perhaps the Performance Scale measures a somewhat different function than the Verbal Scale with relatively homogenous groups who are at a higher intellectual level. A further reason for the poor Performance Scale correlation may be that beyond a certain point all further increase of score on most of the Performance Scale tests depends on speed and that, with a fairly homogenous group, few failures will be made and the subjects will differ mainly in speed. The Pre-Engineering Inventory Composite Score correlated .617 with the grade point average, and hence appears to be a highly valid instrument for predicting success in the engineering college.

5. The Wechsler Verbal Scale (.516) was found to be the most valid of the Wechsler scales with the Pre-Engineering Inventory. This gives further evidence that the Verbal Scale is significantly related with success in the engineering college. The Full Scale (.346) was next with some significant relationship and the Performance Scale (.097) followed with practically no relationship whatsoever.

Conclusions

The concluding statements which follow are based on the analysis of our results:

1. There is apparently little relationship between the subtests of the Wechsler-Bellevue, Form II, and the individual courses in the first semester of the freshman year. The subtests are seemingly not as valid as the total scale for indicating probable success in any one course. This was to be expected.

2. The Wechsler IQ Scales are somewhat more dependable for estimating success in the individual courses.

3. The Wechsler Verbal Scale had the better coefficient of correlation with the grade point average and is therefore of value for predicting success in the engineering college. The Performance Scale seems to be of doubtful value for predictive purposes and its inclusion reduces the value of the Full Scale.

4. The Composite Score of the Pre-Engineering Inventory correlates sufficiently well to be of very practical value in predicting success in the engineering college. This is to be expected since the inventory measures more specific abilities necessary in the engineering field.

5. The relatively high correlation of the Verbal Scale with the Pre-Engineering Inventory suggests that this scale may be used as a supplementary test for counseling purposes.

Suggestions for Further Research

Research along the following lines is suggested on the basis of our findings.

1. The most urgent need appears to be an investigation of the Performance Scale IQ with relatively homogenous groups of higher intelligence.

2. More extensive studies are needed to clarify the differences between the Verbal, Performance and Full Scale IQs with the grade point averages of relatively homogenous groups.

3. Shorter forms of the Wechsler-Bellevue should be investigated for their reliability as predictive devices.

4. A similar study could be undertaken utilizing Form I of the Wechsler-Bellevue in order to determine the comparative value of the two forms for predictive purposes.

5. Such variable factors as initiative, persistence, moral and volitional factors, and industriousness may perhaps be investigated by holding intelligence constant.

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The authors used 112 college women freshmen as their sample. The results show inter-correlations with these instruments of approximately equal value, (.50--.55). The Stanford-Binet yielded higher IQs at the college level than the Wechsler-Bellevue. With what was considered a homogenous group, the Wechsler Full, Verbal and Performance Scale correlated .41, .50 and .19 respectively with grade point average. The low Performance Scale correlation indicated considerable doubt as to the exact function it was measuring and to its validity with groups of high intelligence and relative homogeneity.

Case, H. W. "An Analysis of Engineering Entrance Examinations," Journal of Applied Psychology, XXXVII (February, 1953), 42-6.

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The author's results showed a high degree of correspondence between the Wechsler-Bellevue when divided into the Linguistic, Clerical and Spatial subtests and similar vocational aptitude tests. He concluded that there was value in using the Wechsler as an aid in vocational aptitude testing.

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Using 83 high school seniors, the author found that both the Verbal and Full Scale could predict high school achievement fairly efficiently. The r for both scales was .69. The Performance Scale correlated .48 with academic success. He found that by using the subtests exclusive of the Picture Arrangement, Picture Completion, and Object Assembly, an even higher correlation was obtained with grade point average, .765.

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Correlations obtained from data on freshmen engineering students from twelve engineering colleges ranged from .38 to .68 between the Composite Score and first semester grades. The authors concluded that their findings further substantiate the evidence that the inventory in general and the Composite Score in particular are valid and reliable predictors of engineering school success.

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Sartain, Aaron. "A Comparison of the New Revised Stanford-Binet, the Wechsler-Bellevue Scale and Certain Group Tests of Intelligence," Journal of Social Psychology, XXIII (May, 1946), 237-39.

The author compared various mental tests in order to find how well they predicted scholastic success. His conclusions were that there was no great difference in the correlations between the tests themselves. The Wechsler Full, Verbal and Performance Scales correlated .53, .58 and .35 respectively with grade point averages.

Vaughn, K. W. "The Pre-Engineering Inventory," Journal of Engineering Education, XXXIV (May, 1944), 615-26.

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This text is the primary source of material on the standardization procedures employed on the Wechsler-Bellevue, Form I. The author has a comprehensive outline of intelligence testing and of the concept of intelligence as a global capacity. The basic rationale and principles of scoring and interpreting the test are included. Also included are the instructions for administration.

Wechsler, David. The Wechsler-Bellevue Intelligence Scale, Form II. (Manual) New York: The Psychological Corporation, 1946.

The administration and scoring instructions for Form II are outlined in this manual. Very little, however, is available on the standardization of this form.

Unpublished Material

Engen, Trygg. "A Comparison of Performance on the Wechsler-Bellevue Intelligence Scale and Success in the Engineering College," Unpublished Master's thesis, University of Detroit Library, 1952.

This study found correlations between the Wechsler Full, Verbal, Performance Scales, Form II, the Pre-Engineering Inventory and mean school grades of .556, .594, .417 and .719 respectively. The author concluded that the Wechsler-Bellevue, Form II, had a dependable relationship with success in the engineering college.