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A comparison of Raven's Progressive Matrices with the Wechsler Adult Intelligence Scale.

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A COMPARISON OF RAVEN'S PROGRESSIVE MATRICES

WITH

THE WECHSLER ADULT INTELLIGENCE SCALE

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ABSTRACT

The purpose of this present research was to find the relationship between the Raven Progressive Matrices and the Wechsler Adult Intelligence Scale (WAIS). This study extended the investigation in this area by employing the complete, rather than partial, forms of both tests. The experimental sample consisted of 40 male university students ranging in age from 18.6 years to 24.2 years, with a median age of 21.6 years.

The correlations between the Matrices and the WAIS ranged from low to moderate. In general, these results were lower than comparable studies in this area. A restriction in the range of intelligence, the lack of discriminative power of the Matrices, the lack of a constant time limit, and the lengthy administration period of the WAIS were some of the reasons advanced to explain this fact.

The lack of a constant time limit for the Matrices provided the basis for a subsidiary analysis in this study. The number of correct items on the Matrices was recorded for each subject at 30-second intervals. Various time limits were then selected and the total scores thus obtained were correlated with the WAIS. The resulting correlations were higher than those obtained in the main study although the difference was not significant with the small number of cases used.

In a second subsidiary analysis, the Progressive Matrices and WAIS scores were correlated with the subjects' School and College Ability Test scores (SCAT). For the most part, SCAT scores tended to correlate higher than the Matrices scores with the WAIS.

PREFACE

This study began as a result of the author's personal interest in the Progressive Matrices, while he was serving as a psychology intern at Thistletown Hospital, Thistletown, Ontario.

The author wishes to express his grateful appreciation to Rev. R. C. Fehr, CSB, Ph.D., under whose direction this study was undertaken and whose patient and critical guidance was so helpful in its execution. He is also indebted to Brother Roger Philip, FSC, Ph.D., and Rev. L. A. McCann, CSB, S.T.D., for their many valuable suggestions during the task of writing the final manuscript.

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CHAPTER I

INTRODUCTION

Intelligence tests have proven themselves to be one of the most valuable quantitative tools that psychology has developed. Despite the vast amount of work done in this field, the term "intelligence" has never been uniquely or satisfactorily defined, probably due to the fact that it is not a unitary phenomenon. Guilford (1956) lists 40 different factors attributable to intelligence. Because of this complexity of factors one test cannot measure every aspect of intelligence. As a result, different tests have been devised to account for the many contributing factors.

One of the prime concerns for the clinical psychologist is the comparison of different intelligence tests. Correlations between two tests are often cited as evidence that they measure approximately the same area of behavior. Usually an adequately standardized instrument is used as a criterion to judge other tests.

Guertin, Frank and Rabin (1956) point out that the Wechsler Scales are now the well-accepted standard of intelligence evaluation for adults. As many tests of varied composition are correlated with them, it becomes clear that the Wechsler Scales occupy a central position in evaluation of the factor of general intelligence. Thus the correlations between the Wechsler Scales and other tests argue well for the validity of the test.

In 1955, the Wechsler-Bellevue underwent a considerable revision and a new form was developed called the Wechsler Adult Intelligence Scale (WAIS). With the advent of this new form there have been a number of studies comparing the WAIS to other measures of intelligence. One such study was the comparison of the WAIS to Raven's Progressive Matrices. Previous studies by Julia C. Hall (1957), Kasper (1958), Levinson (1959), and Urmer, Ann B. Morris and Wendland (1960) have used only partial forms of these tests. The present research adds to these studies by using the complete forms of both tests.

Background of Related Research

The Progressive Matrices, as devised by Raven (1948), is a non-verbal test of a subject's present capacity to form comparisons, to reason by analogy, and to develop a logical method of thinking, regardless of previously acquired information. The subject has to apprehend the relationship between geometric figures and designs and then complete each system of relations presented.

Many of the studies correlating the Matrices with the Wechsler Scales have been done with children. Raven (1949) has developed a 36-item Scale for the testing of children. This form is primarily composed of the easiest problems in the standard form of the Matrices and is called the Colored Progressive Matrices (CPM).

Comparing the Wechsler Intelligence Scale for Children (WISC) and the CPM as measuring instruments, Martin and Wiechers (1954) obtained a correlation of .91 while Stacey and Carleton (1955) found a correlation of .62. Barratt

(1955) showed the WISC to correlate .75 with the Standard Scale of the Matrices.

Prior to the advent of the WAIS several comparative studies were done with the Wechsler-Bellevue and the Matrices. Laurra Moya-Diaz and Matte-Blanco (1957) found a positive correlation between both tests. Levine and Iscoe (1954) found a correlation of .55 between the Matrices and a short form of the Wechsler-Bellevue. With the Verbal Scale of the Wechsler, Desai (1955) showed the Matrices to correlate .55 with the Wechsler-Bellevue Performance Scale. Using subnormal subjects, Stacey and Gill (1955) obtained correlations of .68, .56, and .51 between the Matrices score and W-B. Full Scale, Verbal, and Performance IQ's. In general, these studies indicate a moderate, positive relationship between the Matrices and the Wechsler-Bellevue.

Julia C. Hall (1957) was the first to attempt a correlation between the Matrices and the WAIS. Using an odd-even method of selection, she devised a 30-item form of the Matrices. The experimental sample was composed of 82 neurotics, of whom 26 took partial forms of the WAIS. The correlations between Matrices scores and WAIS weighted Full Scale, Verbal, and Performance scores were .72, .58, and .71 respectively. Correlations between the subtests ranged from .64 (Block Design) to .28 (Digit Span).

Kasper (1958), using 50 mental patients, found the Matrices to correlate .50 with the Vocabulary test of the WAIS. With an aged population, using the CPM and the WAIS, Levinson (1959) found correlations of .56, .49, and .55 for the Full Scale, Verbal Scale and Performance Scale scores.

Urmer, Ann B. Morris and Wendland (1960) administered the Matrices and WAIS (Performance Scale prorated) to 20 normal subjects and 20 brain-damaged

subjects. For the normal group, the Matrices was found to correlate .47, .43, and .45 with the Full Scale, Verbal Scale, and Performance Scale scores. For the brain-damaged group, correlations of .40, .03, and .73 were found for these same scales.

Purpose of the Present Research

As can be seen, previous comparative studies between the Matrices and the WAIS have used only partial forms of these tests. Levinson (1959) conducted the only research using the complete WAIS. However, he used the CPM in his study. Stacey and Gill (1955) used the complete Wechsler-Bellevue but they also used the Colored Matrices. Hence, no research has used the complete WAIS and the complete Matrices. It is, therefore, the purpose of this present study to find the correlation coefficient between the Progressive Matrices and the WAIS using the complete forms of both tests.

At present, there are two methods of administering the Progressive Matrices. Raven (1948) feels that the best results are achieved without a time limit. The Matrices may also be administered as a speed test with a 20-minute time limit and Vernon (1949) has set up norms for this particular form. Both of these methods have certain disadvantages. Guilford (1954) p. 369), in reviewing investigations for the effects of speed conditions on intelligence test performances, feels that speed conditions bring in many uncontrolled factors not related to intelligence. On the other hand, Slater (1948), Shipley (1949), Westby (1953), and Burke (1958) have noted that when the Matrices is administered without a time limit, the scores tend to cluster at the upper end of the scale.

As a secondary part of this experiment the time for the S's performance on the Matrices will be noted. From these data, time limits will be suggested for each set of the Matrices that will best predict the WAIS scores.

A second sub-topic of this study will be concerned with the School and College Ability Tests (SCAT). These are tests designed to predict a person's subsequent performance in related school subjects. Mayer (1958) and Klugh and Bierly (1959) have done comparative studies between SCAT and school grades. However, there have been no studies correlating SCAT with other measures of intelligence.

In summary, research concerned with the correlations of the Matrices with the WAIS and the SCAT are incomplete. It is the main purpose of this study to extend the research in these areas in order to understand better the relationships between these tests.

CHAPTER II

METHODOLOGY AND PROCEDURE

Experimental Sample

The experimental sample consisted of 40 male University students. Wechsler (1958, p. 144) reports that males tend to score higher on the WAIS than do the females. With the Matrices, Elizabeth Z. Johnson (1952) found significant sex differences in favour of males. On the other hand, no differences were found in studies by Higgins and Cathryne H. Sivers (1958) and Orton and Martin (1948). Because of this lack of concurrence it was decided to use male subjects only. The subjects ranged in age from 18.6 years to 24.2 years with a median age of 21.6. Since the WAIS favours those with verbal ability, subjects with language problems were not used.

Psychometric Instruments

The Progressive Matrices

The Progressive Matrices consists of 60 perceptually presented items. Each item is a design or "matrix" from which a part has been removed. The subject must examine the matrix and decide which of the pieces pictured below is the correct one to complete the design. Twelve items complete a Set and there are five Sets, lettered from A to E. The problems are arranged so that success on the easy items at the beginning helps to train the subject to solve the more difficult ones

which follow. Thus each problem in the scale is really the "mother" or "source" of an organized system of thought, hence the name "Progressive Matrices".

The Matrices was devised by J. C. Raven in England, and published as Raven's Progressive Matrices Test in 1938. Raven (1952 b, p. 166) based his test on the theories of Carl Spearman, who taught that, in order to act intelligently in any situation, a person required, on the one hand, the necessary information, and, on the other hand, the intellectual capacity to apprehend the situation and to draw inferences from what he perceived. To measure the latter, meaningless figures could be arranged in such a way that a person's perception of the relations between them could be used to assess his present capacity for intellectual activity, regardless of any information he had acquired in the past.

During the interim, 1940 to 1947, Raven (1952 a) established norms for group testing. The standardization is based on 2,223 children between the ages four and fourteen; 881 University students between 17 and 21; 3,365 Militiamen between 20 and 25; and 3,112 civilian employees between 16 and 65. Raven gives no further description of the subject's backgroumd other than that they were all English.

Similar norms to those of Raven have been found in studies done in Argentina by Rimoldi (1948) and in Uruguay by Rimoldi and Marta G. Nieto (1959). In the United States, Green and Ewert (1955) found that Raven's norms were too low. However, later studies carried out by Tuddenham, Davis, Davison, and Schindler (1958) and Sperrazzo and Wilkins (1958) have shown Raven's norms to be applicable to American subjects.

Retest reliability measures of the Matrices have shown a distinct lack

of concurrence. Foulds (1949) found the reliability to vary between .93 for ages under 30 to .83 for ages of 50 and over. Desai (1952) found a retest-reliability of .737 with a significant rise in the mean score on retest.

With the Matrices the number of problems correctly solved represents the subject's total score. Scores can then be converted to percentiles at different age levels for comparative purposes. Raven (1948) does not believe that the scores should be converted to "intelligence quotients". Walton (1955) attempted to interchange Terman-Merrill IQ scores and Matrices scores. He found that Matrices scores cannot be converted into IQ's since the function they measure does not develop uniformly through childhood.

In addition to rejecting the IQ concept, Raven (1959) states that for people of all ages the usual distribution of test scores does not conform to a Gaussian curve but is negatively skewed. In contradiction to Raven, Notcutt (1949), in a study done with Zulu subjects, found a pronounced positive skewing. Notcutt states this skewing of scores is due to the nature of the test rather than to the groups tested.

The Wechsler Adult Intelligence Scale (WAIS)

Wechsler (1959, p. 7) defines intelligence as the aggregate or global capacity of the individual to act purposefully, to think rationally, and to deal effectively with his environment. It is "aggregate" or "global" because it is composed of elements or abilities which, though not entirely independent, are qualitatively differentiated. In order to measure this aggregate of abilities, the WAIS employs a Verbal and Performance Scale consisting of 11 subtests. The Verbal

Scale includes the following subtests: (1) Information; (2) Comprehension; (3) Arithmetic; (4) Similarities; (5) Digit Span; (6) Vocabulary; The Performance Scale consists of the subtests, (1) Digit Symbol; (2) Picture Completion; (3) Block Design; (4) Picture Arrangement; (5) Object Assembly.

The raw scores on these subtests are converted into scaled scores, i.e., normalized standard scores with a mean of ten and a standard deviation of three. These standard scores are then summed to yield Full Scale, Verbal, and Performance Scores.

In order to obtain IQ scores, Wechsler (1955) developed the Deviation IQ. The original IQ concept involved the ratio of mental age (MA) to chronological age (CA). It was found that with adult subjects, the MA loses its meaning. The method used in the computation of the Deviation IQ was to set the mean at 100 and the standard deviation at 15 for each age group. Thus, for any age group, the distribution of IQ's has a mean of 100 and a standard deviation of 15. Wechsler (1955, p. 20) classified the IQ's into the groups shown in Table 1:

Table 1

Intelligence Classifications for the Wechsler Adult Intelligence Scale

IQ	Classification	Per Cent Included
130 and above	Very Superior	2.2
120-129	Superior	6.7
110-119	Bright Normal	16.1
90-109	Average	50.0
80-89	Dull Normal	16.1
70-79	Borderline	6.7
69 and below	Mental Defective	2.2

The WAIS is a revision of Form I of the Wechsler-Bellevue Intelligence Scale. Wechsler (1955) based his restandardization on a nationwide sample of 1700 adults, prorated according to the 1950 U. S. Census. The sample was stratified according to the following seven variables: age, sex, geographic region, urban-rural residence, race (white vs. non-white), occupation, and education.

Guertin (1959) feels that the overall change in content in the WAIS is not very large. Only the vocabulary subtest is entirely new. Nancy Bayley (1959) states that the tests themselves have been changed primarily in the direction of adding more ceiling and thus increasing the range in scores of some of the subtests. Also, ambiguities both in test items and in their scoring have been removed. In a review of comparative studies between the WAIS and W-B, Guertin, Rabin, Frank and Ladd (1962) report that it appears that scores are slightly higher on the Wechsler-Bellevue. The general agreement is that the WAIS is an overall improvement of a good instrument.

Cooperative School and College Ability Tests (SCAT)

The Cooperative School and College Ability Tests are intended to measure four of the school-learned skills which research has shown to be closely related to academic success. Each subject is tested for ability in the following tasks: (1) sentence-completion; (2) numerical computation; (3) vocabulary; (4) problem solving. Parts 1 and 3 are converted into a Verbal Score; Parts 2 and 4 yield a Quantitative Score.

The Total Score on the test is obtained by conversion of the total number of questions answered correctly on all four parts (110 questions) to a score scale

similar to the part score scales. Davis (1959) points out that the Total Score has a slight "verbal loading" because there are ten more verbal questions than quantitative questions.

The authors of SCAT, Melville and Gaver (1955), make no direct reference to intelligence but prefer to consider their tests as measures of "school-learned abilities". They claim that SCAT measures specific developed abilities rather than psychological traits. Fowler (1959) feels that SCAT will probably be used in much the same way as the ACE tests have been used: i.e., for identifying the overachiever and the underachiever, for counseling the individual student and for comparing the abilities of different groups of students.

Experimental Procedure

The main purpose of this research is a correlational study between the Progressive Matrices and the WAIS in their complete forms. To insure rapport for the administration of the tests, the subjects were told the purpose of the study before taking the tests. All subjects were assured that the findings would be kept in strictest confidence.

The Matrices was administered in group sessions, the number of subjects varying from two to five. The same set of standard instructions as stated in the Manual were used for each testing session. No time limit was imposed. The WAIS was individually administered to each subject in its entirety, following the procedure in the WAIS manual. Both tests were administered by the writer.

Secondary Analysis

Part 1. A subsidiary analysis was attempted to estimate the best possible correlation between the Matrices and the WAIS, had a time limit been imposed. The scores of the last 20 subjects from the main analysis were used.

The examiner noted each subject's progress at 30-second intervals. These data were then charted and it was possible to see how many items each subject had solved for any given time interval. Each subject was ranked according to his WAIS and Matrices score. Special attention was given to subjects with high Matrices scores, especially those who took longest to complete the test. Using the subject's WAIS score as a criterion it was possible to find what correlations might have been obtained had certain time limits been imposed.

Part 2. In this part of the study correlations were computed between the subject's SCAT scores and his Matrices and WAIS scores. SCAT data on seven of the subjects were unavailable, reducing the total number of subjects in this analysis to 33.

Statistical Analysis

All correlations were calculated by means of the Pearson Product-Moment method. For comparative purposes the correlations were transformed to z scores using the Tables found in McNemar (1955, p. 384). The standard error of the difference between the two z's was then calculated to find the significance of the difference between the correlation coefficients. The correspondence of the distribution of scores to the normal curve was determined by the chi-square method described by Guilford (1956, p. 240).

CHAPTER III

PRESENTATION AND ANALYSIS OF RESULTS

The primary aim of the present study was to extend the investigation of Raven's Progressive Matrices by comparing the complete form of this test with the complete form of the WAIS. In the present chapter, the main analysis is divided into three sections. The first section will deal with the results of the WAIS; the second with the results of the Matrices. The third section will study the correlations found between these tests.

Two subsidiary analyses make up the remainder of the chapter. The first part of these is concerned with the correlations obtained between the Matrices and the WAIS under the influence of a time limit. The second part will be a comparison of the correlations obtained between the SCAT scores and the Matrices and WAIS scores.

Main Analysis

Wechsler Adult Intelligence Scale Results

The full Scale IQ of the subjects ranged from 105 to 134 with a mean of 117.22 and a standard deviation of 6.90. The shape of the Full Scale IQ distribution approximates that of a normal curve as indicated by the chi-square value of 3.26 with 5 df; (50 p .30). Table 2 indicates the Verbal IQ's of the subjects, ranging from 98 to 136, were slightly higher than the Full Scale IQ's. Performance IQ's were lowest with a range of 94 to 127. Range, means, and standard deviations

Table 2

Range, Mean, and Standard Deviation for Various Measures of Intelligence on the Wechsler Adult Intelligence Scale

MEASURES	RANGE	MEAN	S.D.
Full Scale IQ	105 - 134	117.22	6.90
Verbal IQ	98 - 136	120.55	7.98
Performance IQ	94 - 127	110.35	7.78
Full Scale Score	121 - 167	138.32	11.50
Verbal Scale Score	57 - 96	80.10	8.07
Performance Scale Score	46 - 71	58.28	5.65
Verbal Subtests:			
Information	14 - 27	22.64	2.61
Comprehension	15 - 28	23.07	3.10
Arithmetic	10 - 18	13.40	2.05
Similarities	12 - 24	18.35	2.72
Digit Span	8 - 17	12.35	2.35
Vocabulary	45 - 77	65.20	7.30
Performance Subtests:			
Digit Symbol	41 - 87	59.67	9.82
Picture Completion	12 - 20	16.67	2.18
Block Design	20 - 47	39.70	6.53
Picture Arrangement	18 - 34	27.81	3.82
Object Assembly	21 - 41	32.28	6.60

for the subtests and scaled scores were also calculated and can be found in Table 2. An analysis of this Table indicates a restricted range of intelligence. In terms of Wechsler's intelligence classifications, 80 per cent of the students tested here fall in the "superior" and "bright normal" categories.

Progressive Matrices Results

Progressive Matrices scores ranged from 43 to 58 with a mean of 52.75 and a standard deviation of 3.58. The distribution showed a negative skewing although the mean, 52.75, the median, 53, and the mode, 53, were equal. A chi-square analysis of the shape of the distribution showed it to approximate barely that of a normal curve; the chi-square value being 5.88 with 3 df, $.20>p>.10$.

An item analysis of the 60 problems on the Matrices shows that 21 of the items (35 per cent) were solved by all the subjects. Table 3 shows the percentage of subjects passing each item on the Matrices.

From Table 3 it is evident that the three most difficult items on the Matrices were E_{12}, E_{11}, and C_{12}, solved by 18 per cent, 23 per cent, and 45 per cent of the subjects respectively. Anne Anastasi (1954, p.156) states that items passed by 50 per cent of the subjects are considered most discriminative. With this criterion, only items C_{12} (45 per cent), D_{11} (58 per cent), D_{12} (53 per cent), and E_{10} (53 per cent) could be judged as being adequately discriminative.

In the present study, the mean score is somewhat higher than that of previous studies with college students. With 76 junior college students (72 females, four males), Bolin (1955) found a mean of 48.15 and a standard deviation of 7.12. Levine and Iscoe (1954), using 60 undergraduates (30 males, 30 females), found a

mean of 50.8 and a standard deviation of 6.6. While the mean score in the present study is somewhat higher than in the studies cited, these latter contained no information about the time spent on the tests.

Table 3

The Percentage of Subjects Passing Each Item of the Progressive Matrices

Item No.	Percentage Passing				
	Set A	Set B	Set C	Set D	Set E
1	100	100	98	100	93
2	100	100	100	93	95
3	100	100	100	100	100
4	100	98	95	93	85
5	98	98	100	100	87
6	100	90	98	93	78
7	100	85	100	82	82
8	100	87	78	95	85
9	100	95	85	87	80
10	95	100	78	95	53
11	100	85	70	58	23
12	80	90	45	53	18

The discovery of an excess of "easy" items on the Matrices is not unique. Similar findings have been reported by Julia C. Hall (1957), Raven (1948) and Levine and Iscoe (1954). In Seeger's (1956) study, he reported that items E_7 and E_8 were the most difficult. The present study failed to support his results, since E_{11} and E_{12} proved to be the most difficult items here. In an item analysis by Julia C. Hall (1957), which used a 30-item form of the Matrices, E_{12} was found to be the one solved by the least number of subjects. This finding is consistent with

the present findings.

Correlations Between the Progressive Matrices and the Wechsler Adult Intelligence Scale

As Table 4 indicates, correlations between the Matrices and the WAIS ranged from very low to moderate in this study. The Matrices was found to correlate .43 with the Full Scale IQ, .38 with the Verbal IQ, and .32 with the Performance IQ. With the subtests, the correlations ranged from .46 (Digit Span) to .07 (Information).

Digit Span (.46) and Block Design (.44) correlated highest with the Matrices. It has been mentioned previously that the Matrices is a test of "clear reasoning" ability. With this in mind, Wechsler (1958, p.131) has pointed out that Digit Span measures the ability to attend and concentrate on the task at hand.

Block Design appears to be similar to the Matrices,for each test contains a pattern to be completed. According to Wechsler (1958, p.133), this test gives the highest measure of the non-verbal organization factor. This factor is also expressed in the Matrices which requires the subject to understand the principles which make up the complete pattern in order to complete it.

The low correlations between Vocabulary (.11) and Information (.07) are not significant, and understandably so. Both depend on verbal ability and information acquired in the past. The Matrices, on the other hand, is a non-verbal test of reasoning, independent of previously acquired information. Low correlations between Picture Arrangement (.09), Comprehension (.14), and Digit Symbol (.15) seem to be due to a measurement of different mental functions.

Table 4

Pearson r Correlations Between the Progressive Matrices and the Wechsler Adult Intelligence Scale

TESTS	r
WAIS Full Scale IQ	.43 **
WAIS Verbal IQ	.38 *
WAIS Performance IQ	.32*
WAIS Full Scale Score (Raw Scores)	.41 **
WAIS Verbal Scale Score (Raw Scores)	.36 *
WAIS Performance Scale Score (Raw Scores)	.31 *
WAIS Subtests:	
Digit Span	.46 **
Block Design	.44 **
Arithmetic	.32 *
Object Assembly	.24
Similarities	.22
Picture Completion	.22
Digit Symbol	.15
Comprehension	.14
Vocabulary	.11
Picture Arrangement	.09
Information	.07

* significant at .05 level
** significant at .01 level

Supplementary Analyses

Part 1 - Time Limit Study

This part of the study is concerned with the optimum correlation to be obtained between the Matrices and the WAIS when a time limit is considered. As Table 5 indicates, subjects showed considerable variability in the length of time spent on the test.

Table 5

Range, Mean, and Standard Deviation of Time Spent on Each Set of the Progressive Matrices

Set	Range (Minutes)	Mean	S.D.
A	1.58 - 4.67	2.65	.96
B	1.92 - 5.58	3.45	1.25
C	3.67 - 13.50	7.72	3.00
D	4.92 - 22.58	10.45	5.05
E	8.33 - 35.00	21.65	8.10
Total	25.25 - 66.45	45.45	14.10

As mentioned previously, in Chapter II, the subject's progress was noted by the examiner at thirty-second intervals. These data were then plotted and it was possible to see how many items each subject had attempted and solved for any time period. Certain limits were then selected, ranging from a time limit reached by 50 per cent of the subjects to one reached by 85 per cent of the subjects. Items solved after these limits were not counted in the subject's total score. The new Matrices scores were then correlated with the WAIS scores. Table 6 shows the correlations found with the new Matrices scores.

Table 6 indicates that a time limit reached by 75 per cent of the subjects

yields scores that correlate best with the Matrices. Various other time limits, around the 75 per cent level, were then sampled to find if the correlation coefficient could be raised still higher. After trying many combinations of different times for each set it was found that the following limits produced the best correlation between Full Scale IQ scores and the Matrices scores: Set A - three minutes; Set B - four minutes; Set C - 11 minutes; Set D - 14 minutes; Set E - 20 minutes.

With this set of time limits the predicted correlation coefffcient was .65. Thus, the correlation rose 22 points although this increment is not significant. However, Table 6 does show a definite trend in that all correlations rose when a liberal time limit was imposed.

Table 6

Correlations Between the Progressive Matrices With the Wechsler Adult Intelligence Scale for Different Cut-Off Points on the Matrices

% Completing a Set Within Specified Time Limits	Time Limits (in Minutes) A	B	C	D	E	r
50 per cent	2	3	7	9	24	.42
66 per cent	3	4	8	10	26	.57 **
75 per cent	3	4	10	13	28	.62 **
85 per cent	4	5	12	17	31	.51 *
Selected Limits	3	4	11	14	20	.65 **

* - significant at .05 level
** - significant at .01 level

Part 2 - Correlations: SCAT, WAIS, and Matrices

This part of the study was a comparison between the SCAT test scores and the Matrices and WAIS scores. Table 7 contains the results of the SCAT testing.

It should be noted that the Verbal, Quantile, and Total scores on the SCAT are not directly comparable. To compare them, the scores have been placed into percentiles according to the tables found in Melville and Gaver (1955). These percentile ratings on the SCAT corroborate the results of the WAIS concerning the superior ability of the subjects in this study.

Table 7

Range, Mean, Percentile, and Standard Deviation of the School and College Ability Test Scores

Tests	Range	Mean	Percentile	S.D.
SCAT Verbal	279 - 326	305.21	61	11.48
SCAT Quantile	291 - 336	313.67	72	9.97
SCAT Total	291 - 330	309.00	70	9.67

Correlations Between the Matrices and the Scat. Table 8 shows a moderately high correlation between SCAT Quantile and the Matrices but a very low correlation with SCAT Verbal and the Matrices. It is suggested that the low correlation between SCAT Verbal and the Matrices may be due to the fact that verbal ability is dependent upon information gained in the past. Arithmetic problems, on the other hand, require reasoning ability similar to that needed to solve the Matrices items and is reflected in the higher correlation.

Correlations Between the SCAT and the WAIS. In Table 9, the correlation is .66 between SCAT and the Full Scale IQ and .72 between SCAT and the Verbal IQ., both of which are high and significant. The correlation between SCAT and the Performance

IQ is .32 which is low and statistically insignificant. As Table 9 indicates, correlations between the SCAT and the WAIS subtests ranged from .73 (Vocabulary) to -.06 (Digit Symbol).

Table 8

Pearson r Correlation Coefficients Between the Progressive Matrices and the School and College Ability Test

Tests	r
SCAT Verbal	.12
SCAT Quantile	.51 **
SCAT Total	.31

* Significant at .05 level
** Significant at .01 level

Table 9

Pearson r Correlations Between the School and College Ability Test Total Score and the Wechsler Adult Intelligence Scale

Tests		r
WAIS Full Scale IQ		.66 **
WAIS Verbal IQ		.72 **
WAIS Performance IQ		.32
WAIS Subtests	- Vocabulary	.73 **
	- Arithmetic	.64 **
	- Information	.45 **
	- Comprehension	.40 *
	- Picture Arrangement	.38 *
	- Similarities	.37 *
	- Object Assembly	.34 *
	- Digit Span	.25
	- Picture Completion	.12
	- Block Design	.12
	- Digit Symbol	-.06

* Significant at .05 level
** Significant at .01 level

CHAPTER IV

DISCUSSION OF RESULTS

The present research was concerned primarily with the relationship between the Progressive Matrices and the Wechsler Adult Intelligence Scale when the complete forms of both tests were used. Two subsidiary analyses were also undertaken. For the first, the Matrices was given without a time limit, although the amount of time for each set of the Matrices was recorded. An attempt was then made to estimate the highest correlation between the Matrices and the WAIS when a time limit was imposed. The second subsidiary analysis was concerned with finding the correlations between the School and College Ability Tests and the Matrices and the WAIS.

Compared with previous studies, the correlations found between the Matrices and the WAIS were low. On the other hand, moderately high correlations were found between the SCAT and certain subtests of the WAIS and Matrices.

It is the aim of the present chapter to discuss these findings in the light of previous studies. The correlations between the Matrices and the WAIS compose the main analysis and will be considered first.

A time limit on the Matrices would have affected the results of the test and the resulting correlations. The results of the time analysis will be considered in the first part of the subsidiary analysis; the second part discusses the correlations found between the SCAT and the Matrices and the WAIS.

Main Analysis

The Matrices was found to correlate .43 with the Full Scale IQ, .38 with the Verbal IQ, and .32 with the Performance IQ. These correlations are lower than those previously reported in other studies. Julia C. Hall (1957), using a 30-item form of the Matrices found the Matrices to correlate .72 with Full Scale, 158 with the Verbal Scale, and .71 with the Performance Scale. Urmer, Ann B. Morris and Wendland (1960), using a partial form of the WAIS, found correlations of .47, .43, and .45 for the Full Scale, Verbal Scale, and Performance Scale scores.

It appears that one of the principal reasons for the lower correlations in the present study is a marked restriction in the range of the subject's intelligence. The standard deviation of the Matrices in the present study was 3.58. Eysenck (1947, p.115) reports that the standard deviation of Raven's standardization population was 9.77. With the WAIS, the standard deviation of the Full Scale IQ was 6.90 compared with the standard deviation of 15.00 that Wechsler (1955) has established. Thus, in this study, the computation of the correlation coefficient involved a curtailment of both variables tending to depress the resulting coefficient. Formulas exist for correcting double curtailment, but since McNemar (1955, p.150) reports them as unsatisfactory, no corrections were made.

Another factor that may contribute to the low correlations is the lack of a time limit on the Matrices. Eysenck (1953, p.37) indicates that speed of mental functioning is one of the prime determinants of intellectual ability. Yet in this study speed was working as an uncontrolled variable. A subject's performance in this research was often a measure of his willingness to search for an answer. His

score, then, depended to a great extent on his persistence as well as his intellectual ability. When no time limit is imposed on a test, a relatively, dull person might succeed on one of the more difficult items simply because he was more persistent. By the same token, a more intelligent person might fail that particular item, should he be unwilling to expend the intellectual effort needed to solve the problem.

In this connection, it should be pointed out that Julia C. Hall (1957) found the highest correlation between the Matrices and the WAIS. Using a 30-item form with a 20-minute time limit, she found a correlation of .72. It appears that the principal reason a high correlation emerged was this constant time factor.

The present research found that the mean Verbal IQ, 120.55, is ten points higher than the mean Performance IQ, 110.35. The mean difference between Verbal and Performance IQ's on the standardizing population was approximately zero. This indicates that the positive and negative differences were, on the whole, equal and symmetrically distributed. According to Wechsler (1958) p. 160) a difference of ten points will be encountered in less than 32 cases in 100. However, he also points out that the intelligence level of the subjects was an important factor in determining both the direction and degree of difference found. Thus, subjects of superior intelligence generally did better on Verbal subtests.

From Wechsler's standardization sample, then, it would be expected that the Verbal IQ's be higher than the Performance IQ's. This was the finding in the present study. However, it was not expected that such a high proportion of the subjects, i.e. 85 per cent of the population tested, would have higher Verbal scores than Performance scores. It should also be noted that the

WAIS takes a relatively long time to administer. In its standard presentation the Performance subtests are placed at the end of the test when the subject is most likely to be tired. These are possible reasons for the discrepancy between the scores of the present study and that of Wechsler.

As mentioned previously, Stacey and Gill (1955) conducted the only comparative study with the Matrices using the complete Wechsler-Bellevue. In their investigation, the Matrices was also found to correlate higher with the Verbal Scale, .56, than with the Performance Scale, .51. In summary, when the entire WAIS or W-B is administered in one session, subjects may be too tired to function at maximum efficiency with the Performance Scale because of its position on the test and, therefore, their true score is not revealed. This is a possible reason for the depression in the correlation coefficient between that scale and the Matrices.

A further reason for the low correlations between the Matrices and the WAIS is found in the difference between the tests themselves. The WAIS is composed of 11 different subtests. The Matrices, on the other hand, attempts to estimate intelligence through a single measurement of performance. Wechsler (1938) has pointed out that, for all tests, certain individuals may fail to perform well simply because they are not proficient in doing the test or type of task used. The Progressive Matrices is no exception. Mention was made earlier of the lack of discriminative power of the Matrices. The WAIS, on the other hand, does discriminate among a superior group. Because the Matrices does not adequately discriminate among a college population, correlations between this test and the WAIS would naturally be affected.

Supplementary Analyses

Part 1: Time Limit Study

It was found that the following time limits produced the best correlation between Full Scale IQ scores and the Matrices score: Set A - three minutes; Set B - four minutes; Set C - 11 minutes; Set D - 14 minutes; Set E - 20 minutes. With this set of time limits the predicted correlation coefficient rose 22 points to .65,although this gain is not significant. For a correlation coefficient to be significantly different from .43 at the .05 level, with the number of cases used here, the correlation would have to increase approximately 34 points. In other words, a correlation of .77 would have been needed to be significantly different at the .05 level. However, there is a definite trend in that all correlations rose when a liberal time limit was imposed.

It should be noted that if these time limits were imposed in a study the same correlations would probably not be found. Imposing a time limit on the actual performance would introduce other factors not included in this statistical analysis. The results, however, suggest that these time limits provide a better estimation of the subjects' WAIS IQ. It should be noted also that a time limit would tend to diminish the effect of the persistence factor discussed in the first part of this chapter.

Part 2 : Correlations - SCAT, WAIS and Matrices

The Progressive Matrices was found to correlate .12 with SCAT Verbal; .51 with SCAT Quantile and .31 with the SCAT Total Scores. The low correlation between the Matrices and the SCAT Verbal Score may be due to the

differences in the tests themselves. The SCAT Verbal Score is a measure of the vocabulary the subject has acquired in the past. The Matrices, on the other hand, measures reasoning ability regardless of what the subject has previously learned.

The SCAT Quantile Score correlated much higher with the Matrices than the Verbal Score. The solution of arithmetic problems involves a high degree of reasoning ability. While dependent upon information gained in the past, the subject must apply the principles he has learned to the present problem. This application of principle is a function similar to that employed in the Matrices and may account for the higher correlation.

With the WAIS, the SCAT Total Score correlated as follows: .66 with the Full Scale IQ, .72 with the Verbal IQ, and .32 with the Performance IQ. The SCAT Total Score is composed of items measuring verbal ability and arithmetic ability. Five of the subtests on the WAIS Verbal Scale measure verbal ability and the sixth measures arithmetic ability. Thus, the high correlations between WAIS Verbal and the SCAT are not surprising since both tests are measuring similar functions.

In summary, the main analysis of the present study found the Matrices to correlate .43 with the Full Scale IQ; .38 with the Verbal IQ, and .32 with the Performance IQ. These correlations were lower than comparable studies in this area. These lower correlations seemed to be due to a restriction in the range of intelligence the lack of discriminative power of the Matrices, the lack of a constant time limit and the lengthy administration period of the WAIS.

In a subsidiary analysis it was found that the following time limits produced the best correlation between Full Scale IQ and the Matrices: Set A - three

minutes; Set B - four minutes; Set C - 11 minutes; Set D - 14 minutes; Set E - 20 minutes. With this set of time limits the correlation rose from .43 to .65. This showed a definite trend although the difference was not significant with the small number of cases used.

In a second subsidiary analysis the Progressive Matrices was found to correlate .12 with SCAT Verbal; .51 with SCAT Quantile and .31 with SCAT Total. With the WAIS, SCAT Total Score correlated .66 with the Full Scale IQ; .72 with the Verbal IQ, and .32 with the Performance IQ. High correlations in both tests seemed to be due to a measurement of similar mental functions.

CHAPTER V

SUMMARY AND CONCLUSIONS

Previous investigators have made comparative studies between the Progressive Matrices and the Wechsler Adult Intelligence Scale. In general, the correlations obtained from these studies ranged from fairly high to moderate. However, only partial forms of the tests were used in these investigations. The present research followed that of the past but differed from the previous investigations in that both tests were administered in their complete forms.

Two subsidiary analyses were included in the present research. First, the time for each set of the Matrices was recorded for the purpose of estimating the maximum possible correlations that might result when a time limit is imposed on the test. The second subsidiary analysis investigated the correlations found between the School and College Ability Tests and the Matrices and the WAIS.

The WAIS scores, in the present research, indicated a restricted range of intelligence. In terms of Wechsler's intelligence classifications, 80 per cent of the students tested were in the "superior" and "bright normal" categories. The Verbal scores of the subjects exceeded the Performance scores in 85 per cent of the cases tested.

An item analysis of the Matrices scores showed an excess of easy items. The mean score, in the present study, is slightly higher than that of previous studies with college students. However, these previous studies contained no

information about the time spent on the test.

As opposed to previous findings, correlations between the Matrices and the WAIS were low. One of the principal reasons for the low correlations was the restricted range of intelligence due to a very homogeneous grouping of the experimental sample. In addition, the lack of discriminative power of the Matrices undoubtedly affected the extent of the correlations found. Since the Matrices was administered without a time limit, the subsequent Matrices scores and correlations were affected by a persistence factor. The administration of the WAIS in one session seemed to depress the Performance score, a fact which helps to explain the low correlation coefficients between the Matrices and the Performance scores on the WAIS.

Subjects showed considerable variability in length of time spent on the Matrices. The time study indicates that if the suggested time limits were adopted a greater variability in results would occur. This would tend to raise the ceiling in the Matrices, thus solving the low-ceiling problem encountered in the past. Since the time limits are liberal, most of the subjects would be able to finish and each subject would have an equal amount of time to complete the test.

The Total Score of the SCAT was found to correlate moderately highly with the Verbal Scale of the WAIS showing marked similarities between the two tests. By the same token, a moderate correlation was found between the SCAT Quantile score and the Matrices, which seems to indicate that these tests are measuring similar functions.

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