A COMPARISON OF THE PEABODY INDIVIDUAL ACHIEVEMENT TEST AND THE WIDE RANGE ACHIEVEMENT TEST

By

DUFF R. WRIGHT

Bachelor of Arts

University of Oklahoma

Norman, Oklahoma

1973

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
December, 1977

A COMPARISON OF THE PEABODY INDIVIDUAL

ACHIEVEMENT TEST AND THE WIDE

RANGE ACHIEVEMENT TEST

Thesis Approved:

Thesis Adviser

Dean of the Graduate College

ACKNOWLEDGMENTS

I would like to thank Dr. Phillip Murphy, my major adviser, for without his aid and expertise this manuscript would not have been possible. Thanks also go to my other committee members, Dr. Kenneth Sandvold and Dr. Robert Schlottmann, for their interest, time and encouragement.

My special thanks go to Deborah A. Murphy, Director of the Oklahoma Child Service Demonstration Center in Cushing, Oklahoma. Her guidance and assistance was invaluable in providing for the collection of the data for this manuscript.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

In recent years, several studies have attested to the criterion-related validity of the Peabody Individual Achievement test (PIAT) over a variety of sampled populations (e.g. educable mentally retarded, learning disabled, emotionally disturbed, etc.). These studies have correlated two widely used criteria of achievement, namely the Wide Range Achievement Test (WRAT) and several subtests of the California Achievement Test (CAT), with the PIAT (Sitlington, 1970; Soethe, 1972; Wetter & French, 1973; Baum, 1975; Bray & Estes, 1975). Several general trends seem apparent across these studies: 1) the reading or word recognition related achievement tasks show moderate to high correlations (Range = .61 to .96); 2) the spelling related tasks show a moderate to high correlation (Range = .66 to .89); and 3) the mathematics related achievement tasks are usually low to moderate in strength (Range = .37 to .79). The thrust of this study is to examine the last of these trends in greater detail.

Additional significance of this study is based upon recent legislation. Amendments to the Education for All Handicapped Children Act, Public Law 94-142, were proposed (Federal Register, Vol. 41, No. 230--Monday, November 29, 1976), which attempt to establish national definitional criteria relating to specific learning disabilities. Among the guidelines is a formula for determining a Severe Discrepancy Level

(SDL). Each student tested must fall at or below the SDL in terms of the achievement measure utilized in the initial diagnostic evaluation in order to provide clear-cut evidence that the student possesses a specific learning disability. Obviously, if the achievement measure selected is inaccurate, students may be inappropriately diagnosed by the evaluation team. Thus, the necessity of an accurate assessment of a student's achievements in the basic skill areas becomes of paramount importance.

Prior to this study, this author has noted, through testing and working intensively with secondary level learning disabled students, that the PIAT grade level equivalent score for the Mathematics subtest overestimates the student's ability as compared to the WRAT Arithmetic subtest. In addition, as the student's WRAT Arithmetic grade level equivalent score decreased below the fourth or fifth grade, the frequency and amount of the overestimated scores increases. This point is especially important because most secondary level LD students will score at the fifth grade level or below on the WRAT if they are having difficulties in their arithmetic coursework.

Given this framework, the task of this study is two-fold: 1) to discover whether the PIAT Math subtest is a statistically significant overestimate of the WRAT Arithmetic subtest; and 2) to investigate the factoral structure of these two tests as compared to intellectual data in an effort to understand any differences shown to exist.

PIAT Versus WRAT: A Selected Review

In 1974 Wilson and Spangler noted that "Despite the fact that the PIAT was not intended for, nor standardized on, an exceptional population, several of the test's characteristics seemed to lend themselves for use with such a population" (p. 60). Soethe (1972, p. 47) spoke to some of these characteristics when he said, "In addition to Reading Recognition, Spelling and Mathematics, the PIAT includes subtests of Reading Comprehension and General Information." This is probably the most frequently voiced advantage of the PIAT over the WRAT: some type of actual reading measure must be used in addition to the WRAT to obtain a comprehensive picture, whereas no such procedure is needed with the PIAT. The PIAT's "built-in" reading measure would certainly seem to make it "a sophisticated and formidable challenge to the WRAT" (Proger, 1970, p. 467). This desirability assumes that "the PIAT is no more biased or inaccurate than other measures (CAT, WRAT, Teacher Ratings) which have been used for academic assessment in special education" (Bray & Estes, 1975, p. 523). A portion of this study attempts to assess whether this assumption is met when testing exceptional populations.

Actually, there are relatively few studies currently available concerning the concurrent validity of the PIAT with exceptional populations. As mentioned earlier, these include: Sitlington, 1970; Soethe, 1972; Wetter & French, 1973; Baum, 1975; and Bray & Estes, 1975. Only the last three studies included an appreciable sampling of secondary level LD students. Thus, the secondary LD student remains an unknown entity at this point.

Most recently, a study by Ollendick, Murphy and Ollendick (1975) compared the criterion-related validity of the PIAT, the WRAT and the Wechsler Intelligence Scale for Children (WISC). The study's sampled population consisted of male adolescent delinquents. The PIAT was found to correlate significantly with the corresponding portions of the WRAT (PIAT Spelling vs WRAT Spelling, .82; PIAT Reading Recognition vs WRAT Reading, .95; PIAT Reading Comprehension vs WRAT Reading, .83; and PIAT Mathematics vs WRAT Arithmetic, .85). A significant positive correlation was also found between the PIAT Total Test and the WISC Verbal, Performance, and Full Scale IQs (.87, .49 and .73 respectively). However, the PIAT Math versus the WRAT Arithmetic means were significantly different ($p < .001$), with the PIAT being an overestimate as compared to the WRAT (the PIAT Math mean was 2.1 grade levels above the WRAT Arithmetic mean).

Further, the PIAT agreed relatively infrequently with the corresponding subtests of the WRAT: PIAT Spelling vs WRAT Spelling, 56 percent; PIAT Reading Recognition vs WRAT Reading, 50 percent; PIAT Reading Comprehension vs WRAT Reading, 44 percent; and PIAT Mathematics vs WRAT Arithmetic, 22 percent.[1] Also, the frequency-of-agreement tally between the PIAT Total Test and WISC Full Scale IQ resulted in 33 percent agreement in terms of gross intellectual classification with the PIAT underclassifying the WISC in the majority of the cases. A significant mean difference was also obtained ($p < .001$) for these same standard scores, with the PIAT being lower.

A recent report has shown that over 25 percent of the juvenile delinquents evaluated by the General Accounting Office (GAO) were shown to have primary learning problems (GAO Report #GGD-76-97,

---

[1]Refer to Chapter II for a complete procedural explanation of what is meant by the frequency-of-agreement percentages listed here.

March 4, 1977).[2] Further, the GAO reported that over 50 percent of the juveniles tested had secondary learning problems.[3] Given that a large proportion of juvenile delinquents have learning problems (and that the relationship between juvenile delinquency and learning problems will require clarification through further research), the social cost of misclassification by inappropriate instruments is heightened. Thus, the results of the Ollendick, et al. study on a sample of adolescent delinquents will necessarily have a significant impact on a discussion of the PIAT's concurrent validity with secondary level LD students.

WISC/WISC-R Factoral Structure: A Selected Review

Cohen (1959) provided the first major study on the factoral structure of the WISC. He obtained three major factors: Factor A--Verbal Comprehension I (I,C,S,V); Factor B--Perceptual Organization (PC,PA,OA,BD,Ma); and Factor C--Freedom from Distractibility (A,DS, Co). Cohen used the standardization sample reported in the manual (Wechsler, 1949) in the analysis of his study.

The same general findings were obtained from several other studies across a variety of exceptional populations (Witkin, et al., 1962; Belmont, Birch & Delmont, 1967; Silverstein, 1969; Rugel, 1974). The only major differences in the factoral structure of the aforementioned studies occurred after the third factor was extracted.

---

[2]Primary learning problems are defined (by the GAO Report) as a demonstrated inability to perform a specific task normally found within the capability range of individuals of comparable mental capacity.

[3]Secondary learning problems are similarly defined as an underachieving juvenile who did not show the definitive signs of an LD.

However, these later specific factors accounted for only a very small percent or proportion of the total variance (usually less than five percent). Consequently, the conclusions drawn on the factor loadings at this point are fairly restricted in terms of their contribution to the overall picture.

Two recent studies (Kaufman, 1975; Hagen & Kaufman, 1975) on the factoral structure of the WISC-R found the same three group factors. In the first study, Kaufman used several different factor analyses of the WISC-R Norm Sample to show the remarkable consistency with which the factor loadings on these three factors occurred. Thus, the evidence for a three factor interpretation of the WISC/WISC-R is substantial.

Given this interpretation, this study will look at how the PIAT Mathematics and the WRAT Arithmetic load on these group factors in addition to looking at the individual factor loadings for each of the WISC/WISC-R subtest scores. Any differences in the factor loadings for these two measures of arithmetic ability might be attributed to differences between the WRAT Arithmetic and the PIAT Mathematics--namely, their stimulus and response characteristics.

A logical analysis of these two tests shows the following differences:

1) PIAT Mathematics;
   - read by and to the examinee (omitting reading)
   - the problems are one to a page
   - the answer choices (4) are on that same page
   - no paper or pencil is required for most of the test
   - the primary input modes are auditory/visual
   - the primary output modes are basically vocal/gross motor

2) WRAT Arithmetic;
   - the problems must be read by the examinee in order to be answered

-there are no answer choices available for each question
-the test is entirely paper and pencil
-the timed nature of the task is made clear to the examinee
-the primary input mode is visual
-the primary output mode is fine motor.

These differences should serve to cause the two math achievement measures to exhibit differential loadings on at least two of the group factors. Also, based upon similarity of output modes alone, the PIAT Mathematics might load most heavily on the WISC Verbal Comprehension Factor, while the WRAT Arithmetic might load most heavily on the WISC Perceptual Organization Factor. These projections are tentative at best and are therefore not ventured as formal hypotheses.

Problem

The general nature of this study is defined as follows:

1) To test for differences between the PIAT Mathematics subtest scores and the WRAT Arithmetic subtest scores. These significance tests will include individual comparisons between grade level equivalent scores, standard scores, and correlations.

2) To factor analyze a WISC/WISC-R--PIAT Mathematics--WRAT Arithmetic data matrix and to look at the resultant differential factor loadings that occur.

3) To interpret all of the above on the basis of apriori predictions listed in Chapter II.

CHAPTER II

METHOD

Subjects

The subjects were 40 secondary level students identified as learning disabled by the Oklahoma Child Service Demonstration Center Title VI-G Project (26 males and 14 females). These students were randomly chosen from a population of 115 students currently enrolled in a learning disability Title VI-G Project. They represented six area school districts and included an appropriate sampling of the Native American population (10 percent of the sample). The ranges of socio-economic levels and of occupations were not so broad as the ranges represented by Dunn and Markwardt's (1971) norming sample for the PIAT. However, the parents of the sampled LD students included a broad range of professional and non-professional occupations, and socio-economic levels, and were seen as a reasonably representative sample of secondary level LD students in rural Oklahoma. These students were diagnosed as learning disabled by a multi-disciplinary diagnostic team, consisting of a psychometrist, a school psychologist, and a psycho-educational diagnostician. The students qualified for placement in a learning disabilities program in accordance with the definition of learning disabilities as set forth by the Oklahoma State Department of Education (Bulletin S.E. No. 8, 1971):

> Children with learning disabilities are defined as those children with normal or potentially normal intelligence who because of some neuropsychological factor are noted to have learning disabilities of a perceptual, conceptual, or integrative nature. Children with major sensory and motor deficits such as the blind, the deaf, the cerebral palsied, the mentally retarded or children whose learning deficit clearly is of emotional origin without concomitant neuropsychological factors, are excluded from this category as there are already established programs and services to meet their needs.

All pertinent sample characteristics are listed in Tables I and II.

Instruments

All participating subjects were individually administered the PIAT Mathematics and WRAT Arithmetic subtests by a qualified psychometrist. Order of presentation was counterbalanced by randomly assigning half of the subjects to each of the two possible test presentation orders (PIAT-WRAT; WRAT-PIAT).

The WISC or WISC-R was also administered by a qualified psychometrist. The records were scored by the psychometrist and then reviewed by a certified school psychologist.

Procedure

Subjects were assigned to one of two groups on the basis of the grade equivalent score for the WRAT Arithmetic subtest. If the student scored at or below the 4.5 grade level, placement was made into Group 1, and if the student scored higher than the 4.5 grade level, placement was made into Group 2. Both the grade level equivalency score and standard score were computed for each student. Pearson correlation coefficients were computed for each group separately and for Group 1+2 (Overall). The coefficients reflect the correlation between

TABLE I

SAMPLE GRADE, AGE AND SEX CHARACTERISTICS

Independent Variable	Grade	Age Range	Mean Age	Median Age	Sex
Group 1	7-11	12-1 to 16-9	14-9	14-4	5F, 15M
Group 2	7-11	12-5 to 16-8	14-7	14-7	8F, 12M
Overall (1+2)	7-11	12-1 to 16-9	14-8	14-9	13F, 27M

TABLE II

SAMPLE IQ CHARACTERISTICS

Independent Variable	IQ Range	Mean IQ	S.D.	No. WISC's	No. WISC-R's
Group 1	76 to 109	87.05	11.40	6	14
Group 2	83 to 116	95.70	8.76	6	14
Overall (1+2)	76 to 116	91.30	9.78	12	28

the PIAT Mathematics and WRAT Arithmetic grade equivalent scores (See Table III).

A Fisher r to Z transformation on the correlation coefficients for Group 1 versus Group 2 was performed and a Z-test of this difference was computed. Significance tests (t-tests) for correlated or matched pairs were computed on the standard score means for the PIAT Math and WRAT Arithmetic for Group 1, and then for Group 2. A t-test was also utilized to test for the significance between the mean difference scores of Group 1 versus Group 2 (again based on the standard scores for the PIAT and the WRAT subtests).

The present study incorporated the same frequency-of-agreement measures as advocated by Ollendick, Finch and Ginn (1974) and by Ollendick, Murphy and Ollendick (1975). The gross intellectual classification advocated by Jastak and Jastak (1965) was used to determine the frequency-of-agreement scores (see Tables V and VI for the specific ranges). The ranges for the Jastak system were listed along two perpendicular axes. The PIAT Math standard scores were tallied along the vertical axis and the WRAT Arithmetic standard scores along the horizontal axis. The frequency count was summed along the main diagonal and converted to a percentage. This percentage, then, reflects the number of times the PIAT agrees with the WRAT. This same frequency-of-agreement method was used to obtain the percentage-of-agreement for each group.[1]

---

[1]This study is thus discretely divided into two phases: the first phase being the analysis of the PIAT-WRAT subtest score differences; the second being the factor analysis of the WISC/WISC-R, PIAT Mathematics and WRAT Arithmetic standard scores.

The data matrix to be employed in the factor analysis included sixteen entries. Eleven subtests of the WISC/WISC-R were recorded for each subject (Mazes subtest omitted), as were the Verbal, Performance and Full Scale IQ Scores; and finally, the PIAT and the WRAT Math subtest standard scores were entered.

The principal-components factor analytic technique was employed to study the 16 X 16 data matrix (correlation values of 1.00 were entered on the main diagonal of the correlation matrix and varimax rotation of all factors having eigenvalues greater than 1 was conducted). Three factors were extracted.

Hypotheses

The following predictions were made concerning the hypothesized relationship between the PIAT Mathematics and WRAT Arithmetic (Phase 1):

1) The correlation between the secondary level LD students' two math achievement scores will be higher for students who are closer to grade level--and therefore more closely approximate the Norm Sample listed in the PIAT Manual by Dunn and Markwardt (1970). In other words, the correlation for Group 2 should be significantly greater than the correlation for Group 1 (as tested by the Fisher r to Z transformation).

2) The percentages which indicate frequency-of-agreement between the PIAT Mathematics and WRAT Arithmetic standard scores will be low.

3) The PIAT versus the WRAT standard score means should be significantly different for Group 1 and for Group 2 (a two-tailed t-test will test for this difference).

4) The PIAT-WRAT mean standard difference score for Group 1 will be significantly greater than the mean difference score for

Group 2 (a one-tailed t-test will test this hypothesis).

In addition to interpreting the individual factor loadings of the data matrix in Phase 2, the following apriori predictions are made about the hypothesized differential factor loading pattern expected:

5) The three general group factors found in earlier research should also be obtained in this study; Verbal Comprehension (I,C,V,S), Perceptual Organization (PC,PA,OA,BD,Ma), and Freedom from Distractibility (A,DS,Co). Sublisted below are two related minor predictions:

a) Verbal IQ should load most heavily on Factor A.

b) Performance IQ should load most heavily on Factor B.

6) The PIAT Mathematics will load differentially on two of the group factors compared to the WRAT Arithmetic.

CHAPTER III

RESULTS

For the purposes of clarity, the results of this study are divided into two sections. The first section (Phase 1) is an exposition of the findings when only the differences between the PIAT Mathematics and WRAT Arithmetic subtests are considered. The second section (Phase 2) exhibits the findings of the factor analytic study of the PIAT Mathematics, the WRAT Arithmetic and the WISC/WISC-R tests.

PIAT vs WRAT

Table III presents the grade equivalent means, standard deviations and Pearson product-moment correlations for the PIAT Math and WRAT Arithmetic subtests for Group 1, Group 2, and Group 1+2 (Overall). The Overall correlation coefficient reflects a very low correlation between the PIAT and WRAT math subtests ($r = .23$). However, the PIAT-WRAT correlation coefficient for those students scoring at or above the 4.6 grade level on the WRAT (Group 2) revealed a moderate positive correlation ($r = .61$), while the corresponding coefficient for those students scoring at or below the 4.5 grade level (Group 1) showed a small negative correlation ($r = -.25$). A Fisher r to Z transformation revealed that the correlation coefficient for Group 2 represented a significantly greater true value of ρ than did the coefficient for Group 1 ($\zeta = 2.802$; $F(z) = .997$; $p < .003$ for a

TABLE III

MATHEMATICS GRADE EQUIVALENT SCORES AND THE CORRESPONDING CORRELATIONS

Means ($\overline{X}$)	Group 1 ($\leq$ 4.5) n=20	Group 2 ($\geq$ 4.6) n=20	Overall (1+2) N=40
PIAT	4.79	5.49	5.14
WRAT	4.00	5.47	4.73
Standard Deviation	**Group 1 ($\leq$ 4.5) n=20**	**Group 2 ($\geq$ 4.6) n=20**	**Overall (1+2) N=40**
PIAT	1.64	1.47	1.58
WRAT	.60	.45	.91
Correlations (r_{xy})	-.25	.61	.23

one-tailed test).

Table IV lists the means and standard deviations for the standard scores for Groups 1 and 2. The PIAT and WRAT math standard score means and standard deviations follow basically the same pattern as did the grade equivalent scores listed in Table III. These standard score means were shown to be significantly different for Group 1 ($t = 3.806$, $df = 19$; $p < .002$ for a two-tailed test) and for Group 2 ($t = 2.39$, $df = 19$; $p < .05$ for a two-tailed test). The PIAT-WRAT standard difference score was also shown to be significantly greater for Group 1 when compared to the corresponding mean difference score for Group 2 ($t = 1.718$, $df = 38$; $p < .05$ for a one-tailed test).

Tables V and VI present the results of the frequency-of-agreement tally between the PIAT Mathematics and the WRAT Arithmetic subtests for Groups 1 and 2 respectively. Summing along the main diagonals of each table reveals that the PIAT Mathematics agreed with the WRAT Arithmetic only 40 percent of the time in Group 1 and only 50 percent of the time in Group 2.

WISC/WISC-R Factor Analysis

Appendix B shows the correlation matrix for the sixteen variables selected. When this matrix was subjected to the principal-components technique, three significant group factors emerged--Verbal Comprehension, Perceptual Organization, and Freedom from Distractibility (see Table VII). The Verbal Comprehension factor included substantial loadings (.523-.900) on the following subtests (arranged in descending order of magnitude): Verbal IQ, Vocabulary, Information, Comprehension, Similarities, Full Scale IQ, PIAT Mathematics, and Picture

TABLE IV

MATHEMATICS STANDARD SCORES

Mean ($\overline{X}$)	Group 1 (≤ 4.5) n=20	Group 2 (≥ 4.6) n=20	Overall (1+2) N=40
PIAT	79.9	84.4	82.1
WRAT	71.9	80.8	76.4
Standard Deviation	**Group 1 (≤ 4.5) n=20**	**Group 2 (≥ 4.6) n=20**	**Overall (1+2) N=40**
PIAT	10.18	8.26	9.43
WRAT	4.14	4.50	6.21

TABLE V

FREQUENCY-OF-AGREEMENT BETWEEN THE PIAT MATHEMATICS AND THE WRAT ARITHMETIC FOR GROUP 1

		WRAT				
		50-69	70-79	80-89	90-109	110-119
	50-69	3				
P	70-79	1	5			
I						
A	80-89		8			
T						
	90-109	1	2			
	110-119					

TABLE VI

FREQUENCY-OF-AGREEMENT BETWEEN THE PIAT MATHEMATICS AND THE WRAT ARITHMETIC FOR GROUP 2

		WRAT				
		50-69	70-79	80-89	90-109	110-119
	50-69		1			
P	70-79		4	2		
I						
A	80-89		4	5		
T						
	90-109		2	1	1	
	110-119					

TABLE VII

VARIMAX ROTATED PRINCIPAL FACTOR MATRIX
AND LOADINGS ON THE FIRST
UNROTATED FACTOR*

Test	Unrotated First Factor	Varimax Rotation (Three Factors)		
		Verbal Comprehension	Perceptual Organization	Freedom from Distractibility
PIAT	710	557	314	334
WRAT	579	295	198	610
FSIQ	972	615	686	342
VIQ	856	900	176	314
PIQ	784	185	915	281
I	645	699	044	325
S	520	642	-107	332
A	719	392	309	628
V	656	848	064	082
C	556	647	206	-024
DS	317	217	-011	410
PC	522	523	549	-376
PA	365	-061	674	026
BD	725	214	659	446
OA	615	164	793	087
Co	355	-254	467	599

*Decimals omitted. N = 40.

Completion. The Perceptual Organization factor included substantial loadings (.549-.915) on the following subtests (again in descending order of magnitude): Performance IQ, Object Assembly, Full Scale IQ, Picture Arrangement, Block Design, and Picture Completion. The third factor, Freedom for Distractibility, included substantial loadings (.410-.628) on the following subtests (in descending order of magnitude): Arithmetic, WRAT Arithmetic, Coding, Block Design, and Digit Span. These factors are nearly identical to those obtained by earlier researchers (Cohen, 1950; Kaufman, 1975; Hagen & Kaufman, 1975).

The average proportion of the total variance attributable to successive unrotated factors is listed in Table VIII. Although only three factors were extracted, four factors showed eigenvalues greater than 1.00 (see Table VIII). However, the fourth factor would only have accounted 7.1 percent of the total variance. The conclusions drawn concerning this fourth factor would have necessarily been limited in terms of their actual contribution to the study.

TABLE VIII

AVERAGE VARIANCE ATTRIBUTABLE TO SUCCESSIVE UNROTATED FACTOR EXTRACTIONS*

Factor	Variance Explained	Cumulative Proportion of Total Variance
1	6.611	.413
2	2.303	.557
3	1.298	.638
4	1.124	.709
5	.867	.763
6	.812	.813
7	.677	.856
8	.609	.894
9	.426	.921
10	.393	.945
11	.337	.966
12	.292	.984
13	.185	.996
14	.042	.999
15	.021	1.000
16	.001	1.000

*The variance explained by each factor is the eigenvalue for that factor. Total variance is defined as the sum of the diagonal elements of the correlation matrix.

CHAPTER IV

DISCUSSION

All four hypotheses advanced with regard to Phase 1 of this study were confirmed. Further, these findings indicate that the PIAT's use as a diagnostic tool for adolescents with significant learning problems appears questionable.

The low overall correlation coefficient ($r = .23$) was increased substantially by partitioning out the "more exceptional" of the learning disabled population under study (e.g. removing the scores for Group 1). Group 2, which was composed of students who were only moderately below grade level, reflected a moderate correlation ($r = .61$). The correlation for Group 1 was nearly zero ($r = -.25$). The test on the Fisher r to Z transformation, which was predicted to show Group 2 to be significantly greater than Group 1 (Hypothesis 1), was statistically significant. Therefore, the more handicapped the student as a function of the obtained score on the WRAT Arithmetic subtest, the more the PIAT overestimated that student's mathematical ability.

The frequency-of-agreement percentages, which were computed on the standard scores for both tests, were only moderate at best (confirming Hypothesis 2). The percentages reflected that there was optimally only a 50-50 chance that the PIAT Mathematics would agree with the WRAT Arithmetic and only a 40-60 chance for Group 1.

Hypothesis 3, which stated that the PIAT versus the WRAT math standard score means would be significantly different, was also confirmed for Group 1 and for Group 2. The mean standard difference score for Group 1 was shown to be significantly greater than Group 2 (Hypothesis 4). The confirmation of these last two hypotheses reinforces the notion that the mean standard scores for the PIAT are different than those for the WRAT, with the PIAT being the higher mean.

In summary, the PIAT (as currently normed) has been shown to provide an inflated mathematics achievement level as compared to the WRAT. Also, the PIAT's overestimated math score increases as the severity of the specific learning disability increases (as measured in terms of achievement discrepancy). Finally, as might be expected, the two tests do not agree frequently in terms of gross intellectual classification.

Hypothesis 5, which stated in part that the three group factors identified by previous research would also be obtained in this study, was confirmed. Factor A--Verbal Comprehension (I,C,V,S) was, with the exception of the factor loading of Picture Completion, identical to the factors obtained in the work of Kaufman (1975) and Hagen & Kaufman (1975). Factor B--Perceptual Organization (PC,PA,OA,BD) was identically replicated. Factor C--Freedom from Distractibility (A,BS,Co) was approximately replicated except for a factor loading of Block Design.

Kaufman (1975) found Picture Completion to load significantly on Factor A for four of the six age levels from 11½-16½. He explained that Picture Completion would seem to require the most verbal response of any of the other performance subtests. Its loading on Factor A is, therefore, not entirely unexpected and the findings of this study substantiate Kaufman's rationale.

In the work of Kaufman (1975), Block Design, while not always significant, did exhibit the strongest tendency of all the performance subtests to load on Factor C. Kaufman (1975) and Hagen & Kaufman (1975) pointed out that the instability of Factor C and the subsequent differing interpretations that have been offered in explanation of the factor combine to make this factor somewhat confusing. Some researchers believe the factor to be a measure of numerical ability (Osborne & Lindsey, 1967) rather than a measure of short-term memory and attention span. However, Block Design is a visual-motor, integrative task influenced by psychomotor speed; it has no numerical components. The attention span/memory interpretation seems best supported by this study in that the same attention deficits which are known to affect a subject's performance of Arithmetic, Digit Span and Coding subtests are also known to adversely affect the performance of the Block Design subtest.

Factor C may also be influenced by anxiety. Anxiety is known to have a detrimental effect on these same subtests--A,DS,Co,BD (Robb, 1972, p. 224). Thus, a recognition of the role played by anxiety may also need to be included to investigate the precise nature of the construct underlying Factor C.

As in previous research, the rationale for a Verbal/Performance dichotomy was supported (Wechsler, 1949; Cohen, 1959; Kaufman, 1975; Hagen & Kaufman, 1975). Sub-hypotheses 5a and 5b, which predict this dichotomy, were confirmed. Verbal IQ loaded very highly on Factor A (.900) and Performance IQ loaded very highly on Factor B (.915). The

Full Scale IQ loaded substantially on Factor A and Factor B (.615 and .686 respectively) lending support to Wechsler's notion that the Full Scale IQ is a reasonably accurate reflection of a person's overall intellectual profile.

Hypothesis 6, which predicted a differential loading of the PIAT Mathematics and the WRAT Arithmetic subtests, was also confirmed. The PIAT Math loaded substantially only on Factor A (.557), while the WRAT Arithmetic loaded only on Factor C (.610). The PIAT Mathematics, like the other subtests that loaded on Factor A, is presented orally to the examinee (hence, the reading act is not required), does not require a paper or pencil, and the respondent input modes are auditory/visual. The WRAT Arithmetic must be read and visually interpreted by the examinee, is a paper and pencil task, and is obviously timed, as are the other subtests which load on Factor C. Thus, an analysis of the task structure similarities of the PIAT Mathematics and the other variables in Factor A and a similar analysis of the WRAT Arithmetic and Factor C has provided a logical basis for the differential loading of the two achievement measures.

Given the factor loading configurations shown above, it is not immediately apparent why the PIAT Mathematics provides an overestimate of a student's math ability as compared to the WRAT Arithmetic. However, some help is offered in a study by Davenport (1976), which showed the PIAT Mathematics subtest was reflecting the ability to handle math concepts rather than sampling math computation or math problem solving abilities (as called for by such tests as the WRAT Arithmetic). Also, Bray & Estes (1975) point out that the WRAT Arithmetic subtest is presented in a format similar to that used in most teacher-made tests or classroom exercises. Seldom is a student given a test in the regular classroom (such as the PIAT Math) that is entirely verbally presented and has a multiple-choice format. Therefore, even though the PIAT Mathematics subtest may accurately be reflecting a student's knowledge of math concepts, its practical validity and subsequent scores are of dubious utility given the current academic environment.

Ackerman, Peters & Dykman (1971) found that LD students tend to score below normals in the following areas: Arithmetic and Digit Span (in the Verbal Scale); Coding (in the Performance Scale); and Verbal and Full Scale IQs. The authors noted that the primary deficiency of most children with learning disabilities may be an inability to hold several bits of information until these bits can be synthesized into a meaningful whole which then guides a course of action. They go on to say that this factor seems to be tapped best by the Arithmetic and Digit Span subtests in the WISC. Teachers have characterized this inability to hold and synthesize bits of information as "short attention span for mental work"--especially mental work requiring sustained effort on the part of the individual. Because easy distractibility and mental fatigability are such commonly reported traits of LD children, it is not surprising that they exhibit a lower score on tests which demand concentration. The task structure of the WRAT Arithmetic seems to demand much the same concentration as do the regular classroom assignments. Specifically, the scores on the WRAT Arithmetic are reflecting these same attention deficits that adversely affect the student's regular classroom performance.

As mentioned earlier, the PIAT Mathematics subtest is structured such that the examinee does not have to read the questions to be able to answer them (they are simultaneously verbally administered). The WRAT Arithmetic demands that the problems be read to be answered. The most frequent deficit areas for the learning disabled have long been known to be centered on the reading act. Thus, the PIAT, unlike the WRAT, may be reflecting an overestimated math score because it doesn't tap--but rather bypasses entirely--an area which is usually most severely affected by a student's learning disability.

Two other explanations to account for the consistently overestimated PIAT Math score seem equally as probable as those ventured thus far. First, the degree of difficulty of the response modes of the two math achievement measures may be reflected in the PIAT overestimate. The PIAT requires only a minimal gross motor response (e.g. pointing to a preferred answer choice); the WRAT requires the fine motor response of writing the appropriate numerals or letters to answer the problem. Ackerman, Peters & Dykman (1971) point out that children with learning disabilities are likely to do poorly on many academic-related skills in addition to reading. Handwriting is a complex fine motor task that often times requires the same type of attentional mechanisms as reading of classroom material. Thus, the task of handwriting is often times as difficult as the act of reading, and certainly more difficult than the task of pointing.

Second, the PIAT Mathematics allows for compensation for deficit input and output (response) modes and the WRAT allows no such compensation. As mentioned in Chapter I, the PIAT Mathematics input modes are auditory/visual and its output modes are vocal/gross motor.

However, the WRAT has only one input mode (visual) and one output mode (fine motor). A student may, therefore, choose between either of the two PIAT input or output modes. The direction of this choice is likely to be reflective only of the student's strengths and seldom of his deficits. Nor is it likely that the choice will be conscious, but rather the student will naturally receive information or respond in whichever one of the two input modes or output modes that he is able to best perform the tasks required of him. The WRAT Arithmetic allows for no such compensatory choicemaking and, should a deficit exist for the visual input or fine motor output modes, the student's score will necessarily be reflective of this deficit. The latter situation is more frequently encountered in the regular classroom than is the former. Thus, the WRAT Arithmetic is again reflecting a greater practical validity than is the PIAT Mathematics.

Further research might best attempt to focus on which of the alternative explanations posed in this chapter is best supported. A factor analytic study would serve not only to clarify which of these alternatives is most attractive, but also to clarify the nature of Factor C, and to understand its underlying structure.

CHAPTER V

CONCLUSIONS

The major conclusions of this study are listed as follows:

1. The PIAT Mathematics is an overestimate of a student's ability as compared to the WRAT Arithmetic.
2. As the severity of a student's learning disability increases, the amount of the overestimated PIAT Math score increases.
3. The PIAT Mathematics is most appropriately compared to the WISC/WISC-R in terms of its vocal/gross motor response mode in that it loads on Factor A--Verbal Comprehension.
4. The WRAT Arithmetic is most appropriately compared to the WISC/WISC-R in terms of its attentional demands on a subject in that it loads most heavily on Factor C--Freedom from Distractibility.
5. The following alternative explanations are ventured to account for the conclusions listed above:
    a. The pratical validity of the PIAT Mathematics seems to be less than that of the WRAT Arithmetic in that the WRAT Arithmetic seems to best duplicate the regular classroom situation.
    b. Children with learning disabilities may suffer from substantial attentional deficits which may be affecting the two achievement measures differentially.

c. The PIAT is overlooking a crucial aspect of most learning-disabilities--the inability to read--in that it does not require a student to read many of the problems on the test. The overestimated PIAT Math score may be directly related to its inability to tap this area.

d. The degree of difficulty required to respond appropriately to the PIAT versus the WRAT may be such that the student is able to score higher on the PIAT Mathematics.

e. The PIAT Mathematics subtest may be allowing the student to compensate for deficit areas because it allows a student to choose between one of its two input and output modes. The WRAT has only one input and one output mode and will not allow such compensation for deficit areas.

A SELECTED BIBLIOGRAPHY

Ackerman, P. T., Peters, J. E., & Dykman, R. A. Children with specific learning disabilities: WISC profiles. Journal of Learning Disabilities, 1971, 4, 33-49.

Baum, D. D. A comparison of the WRAT and the PIAT with learning disability children. Educational and Psychological Measurement, 1975, 35, 487-493.

Baumeister, A. A., & Bartlett, C. J. A comparison of the factor structure of normals and retardates on the WISC. American Journal of Mental Deficiency, 1962, 66, 641-646.

Baumeister, A. A., & Bartlett, C. J. Further factorial investigations of WISC performance of mental defectives. American Journal of Mental Deficiency, 1962, 67, 257-261.

Belmont, I., Birch, H. G., & Belmont, L. The organization of intelligence test performance in educable mentally subnormal children. American Journal of Mental Deficiency, 1967, 71, 969-976.

Bray, N. M., Estes, R. E. A comparison of the PIAT, CAT, and WRAT scores and teacher ratings for learning disabled children. Journal of Learning Disabilities, 1975, 8, 519-523.

Cochran, M. L., & Pedrini, D. T. The concurrent validity of the 1965 WRAT with adult retardates. American Journal of Mental Deficiency, 1969, 73, 654-656.

Cohen, J. The factorial structure of the WISC at ages 7-6, 10-6, and 13-6. Journal of Consulting Psychology, 1959, 23, 285-299.

Davenport, B. M. A comparison of the Peabody Individual Achievement Test, the Metropolitan Achievement Test, and the Otis-Lennon Mental Ability Test. Psychology in the Schools, 1976, 13, 291-297.

Dunn, L. M. Peabody Picture Vocabulary Test: manual. Circle Pines, Minnesota: American Guidance Service, 1959.

Dunn L. M., & Markwardt, F. C., Jr. Peabody Individual Achievement Test: manual. Circle Pines, Minnesota: American Guidance Service, 1970.

General Accounting Office. Learning disabilities: the link to delinquency should be determined, but schools should do more now. GAO Report #GGD-76-97, March 4, 1977.

Glasser, A. J., & Zimmerman, I. L. Clinical interpretation of the WISC. New York: Grune & Stratton, 1967.

Gorsuch, R. L. Factor analysis. Philadelphia: W. B. Saunders Company, 1974.

Hayes, W. L. Statistics for the social sciences. Second edition, New York: Holt, Rinehart and Winston, Inc., 1973.

Jastak, J. F., & Jastak, S. R. Wide Range Achievement Test: manual. Wilmington, Delaware: Guidance Associates, 1965.

Kaufman, A. S. Factor analysis of the WISC-R at 11 age levels between 6½ and 16½ years. Journal of Consulting and Clinical Psychology, 1975, 43, 135-147.

Oklahoma State Department of Education. A program of education for exceptional children in Oklahoma. Bulletin S.E. No. 8, 1971.

Ollendick, D. G., Murphy, M. J., & Ollendick, T. H. Peabody Individual Achievement Test: concurrent validity with juvenile delinquents. Psychological Reports, 1975, 37, 935-938.

Ollendick, T. H., Finch, A. J., & Ginn, F. W. Comparison of the Peabody, Leiter, WISC, and academic achievement scores among emotionally disturbed children. Journal of Abnormal Child Psychology, 1974, 2, 47-51.

Osborne, R. T., & Lindsey, J. M. A longitudinal investigation of changes in the factorial composition of intelligence with age in young school children. Journal of Genetic Psychology, 1967, 110, 49-58.

Proger, B. B. Test review number 4: Peabody Individual Achievement Test. Journal of Special Education, 1970, 4, 461-467.

Robb, G. P., Bernardoni, L. C., & Johnson, R. W. Assessment of Individual Mental Ability. Scranton: Intest Educational Publishers, 1972.

Rugel, R. The factor structure of the WISC in two populations of disabled readers. Journal of Learning Disabilities, 1974, 7, 581-585.

Silverstein, A. B. An alternative factor analytic solution for Wechsler's intelligence scales. Educational and Psychological Measurement, 1969, 29, 763-767.

Sitlington, P. L. Validity of the Peabody Individual Achievement Test with educably mentally retarded adolescents. Unpublished Masters Thesis. University of Hawaii, 1970. Cited in L. M. Dunn & F. C. Markwardt, Jr.: Peabody Individual Achievement Test: manual. Circle Pines, Minnesota: American Guidance Service.

Soethe, J. W. Concurrent validity of the Peabody Individual Achievement Test. Journal of Learning Disabilities, 1972, 5, 560-562.

Van Hagen, J., & Kaufman, A. S. Factor analysis of the WISC-R for a group of mentally retarded children and adolescents. Journal of Consulting and Clinical Psychology, 1975, 43, 661-667.

Wechsler, D. Manual for the Wechsler Intelligence Scale for Children-Revised. New York: Psychological Corporation, 1974.

Wetter, J., & French, R. W. Comparison of the Peabody Individual Achievement Test and the Wide Achievement Test in a learning disability clinic. Psychology in the Schools, 1973, 10, 285-286.

Wilson, J. D., & Spangler, M. A. The Peabody Individual Achievement Test as a clinical tool. Journal of Learning Disabilities, 1974, 7, 384-387.

Woodward, C. A., Santa-Barbara, J., & Roberts, R. Test-retest reliability of the Wide Range Achievement Test. Journal of Clinical Psychology, 1975, 31, 81-84.

Zimmerman, I. L., & Woo-Sam, J. Research with the Wechsler Intelligence Scale for Children: 1960-1970. Journal of Clinical Psychology, 1972, Monograph Supplement No. 33.

APPENDIXES

LITERATURE REVIEW

PIAT-WRAT:

Only the Ollendick, Murphy & Ollendick (1975) study exclusively sampled from an adolescent population. The fact that the population was of juvenile delinquents even further approximates the sampled LD population included in this study. The findings of the GAO Report #GGD-76-97, March 4, 1977 show a large proportion of the juvenile offenders studied to have significant learning difficulties. Therefore, it seems likely that the Ollendick, et al. sample contained a substantial number of secondary LD students.

Specifically, Ollendick, Murphy & Ollendick looked at the concurrent validity of the PIAT as compared to the WRAT and the WISC. The PIAT was found to correlate significantly with the corresponding portions of the WRAT and the WISC. However, the PIAT Math versus the WRAT Arithmetic means were significantly different ($p < .001$) with the PIAT being an overestimate as compared to the WRAT (by 2.1 grade levels and 12.5 standard score points). The authors concluded that the tests should not be interchangeably employed to assess the achievement levels of juvenile delinquents.

Studies previous to the above have focussed on the elementary or middle school LD student. Bray & Estes (1975) looked at the concurrent validity of the PIAT as compared to the California Achievement Test (CAT), the WRAT, and Teacher Ratings of academic performance as criterion measures. Forty-five LD children (ages 7 years 1 month to 12 years 9 months) were included in their sample. Pearson product-moment correlations ranged from moderate to high (.61-.98). The authors concluded that there was substantial validity in favor of the PIAT. Mean grade placement scores on the subtests with similar content for all four measures were found to be generally equivalent; the only exceptions were the PIAT Reading Recognition and WRAT Reading subtests which produced lower scores than the other two measures (by about .5 years).

Baum (1975) compared the performance of learning disabled children on the PIAT and the WRAT. The sample LD population included 82 males and 18 females enrolled in self-contained classrooms. Correlations between corresponding subtests of the two instruments were relatively high for Reading (.85-.87) and moderately high for Spelling (.61-.71) and Arithmetic (.49-.79) across four age levels (7-8, 9, 10, and 11 years of age). Baum concluded that the utility of the PIAT is as promising as that of the WRAT, although diagnosticians using the PIAT might wish to exclude the Reading Comprehension subtest, as this subtest tended to be measuring the same skills as Reading Recognition at the lower levels because of the overlapping content of the two subtests.

Soethe (1972) correlated the PIAT and the WRAT and the WISC in much the same manner as did Ollendick et al. (1975). Soethe's findings very closely resemble the findings listed in the Bray & Estes (1975) and Baum (1975) studies; Soethe also sampled from younger aged LD students (mean age 11 years 3 months). Similar findings were obtained by Wetter & French (1973) and Sitlington (1970).

WISC/WISC-R Factoral Structure:

Given the fact that factor analysis is largely a descriptive statistic, it is not surprising that several different factors have been identified across various studies. There is, however, a surprising degree of similarity across the studies in terms of the first three or four factors extracted. The only exception to this statement has to do with the factor analytic studies of some retardate populations (e.g. Baumeister & Bartlett, 1962a, 1962b). The WISC performances of retardates seems to be more complex than that of normals due to the presence of a strong general factor in addition to the verbal and performance factors of the other commonly studied populations. A weaker "Stimulus Trace" factor is also present.

Hagen & Kaufman (1975) and Kaufman (1975) factor analyzed a retardate sample and the WISC-R standardization sample respectively and found the same three group factors across most age levels. The factors were labeled Verbal Comprehension (I,C,S,V), Perceptual Organization (PA,OA,BD,PC) and Freedom from Distractibility (A,DS,Co). These factors were concluded to be quite analgous to the factors found in earlier studies of the 1949 WISC.

Rugel (1974) looked at the performance of two different populations of disabled readers on the 1949 WISC. Both populations of disabled readers showed approximately the same factor structure as that listed above. In no case did any of the three factors differ more than one subtest from being identical (content-wise) to the factors posited by Kaufman.

Cohen (1959) performed the first factor analytic study on the 1949 WISC. He used the standardization sample of the WISC in his analysis. Cohen found a total of five factors, the first three of which he entitled: Verbal Comprehension I, Perceptual Organization and Freedom from Distractibility. Again, these factors were quite stable across the three age levels studied. Silverstein (1969) reanalyzed the same data used by Cohen, utilizing different techniques, and concluded that only two meaningful factors (akin to the Verbal and Performance Scales) were present for each age group.

APPENDIX B

TABLE IX

CORRELATION MATRIX*

Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PIAT																
WRAT	470															
FSIQ	610	449														
VIQ	605	407	811													
PIQ	418	367	866	414												
I	466	379	575	721	288											
S	312	162	495	711	168	480										
A	556	546	648	640	458	353	343									
V	484	378	595	766	271	624	468	316								
C	317	334	526	665	259	317	247	365	445							
DS	171	118	254	273	170	187	323	305	161	094						
PC	346	095	545	382	513	259	116	150	477	309	110					
PA	133	191	421	091	585	088	-045	176	-002	182	-030	143				
BD	470	458	732	426	778	362	194	470	301	248	131	230	387			
OA	411	155	670	334	744	090	152	465	074	201	202	473	354	526		
Co	118	289	413	068	608	094	003	298	-034	-082	129	010	212	415	274	

*Decimals have been omitted. Correlation values of 1.000 are located on the principal diagonal.

TABLE X

RESIDUAL CORRELATION MATRIX*

Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PIAT	479															
WRAT	040	502														
FSIQ	-062	-076	035													
VIQ	-056	-085	030	061												
PIQ	-067	-040	029	-001	050											
I	-046	-034	004	-018	027	404										
S	-123	-209	060	048	054	-072	466									
A	031	-013	-020	036	-074	-139	-084	356								
V	-036	065	002	-034	033	002	-096	-088	270							
C	-101	117	-006	054	-042	-136	-138	062	-115	538						
DS	-083	-194	-011	-049	025	-097	046	-034	-056	-034	785					
PC	008	061	-025	-067	020	-007	-035	011	029	-152	158	283				
PA	-054	060	-013	019	-027	093	057	-026	004	083	-021	-185	542			
BD	-005	-007	-004	-023	010	039	-021	-097	040	-016	-091	-067	-055	321		
OA	042	-103	-004	020	-036	-087	103	101	-123	-067	140	-015	-172	-071	336	
Co	-087	-094	045	026	060	057	018	-123	103	000	-056	112	-133	-105	-106	359

*Decimals have been omitted.

APPENDIX C

VITA

Duff R. Wright

Candidate for the Degree of

Master of Science

Thesis: A COMPARISON OF THE PEABODY INDIVIDUAL ACHIEVEMENT TEST AND THE WIDE RANGE ACHIEVEMENT TEST

Major Field: Psychology

Biographical:

Personal Data: Born in Dallas, Texas, October 13, 1949, the son of Dr. and Mrs. W. C. Wright, D.D.S.

Education: Graduated from Nathan Hale High School, Tulsa, Oklahoma in June of 1967; received the Bachelor of Arts degree from the University of Oklahoma in 1973, with a major in Psychology; enrolled in the psychology program in clinical, Oklahoma State University, 1973-1977.

Professional Experience: Psychological Associate at Psychological Services Center, Oklahoma State University, 1973-1975; teaching assistant for Introductory Psychology and Psychodiagnostics I and II, Oklahoma State University, 1974-1975; psychometrist at the Child Service Demonstration Center, Cushing, Oklahoma, 1975-1977.

Professional Organizations: Member of the Oklahoma School Psychologists' Association; Council for Exceptional Children; and Division for Children with Learning Disabilities.