

# CANONICAL ANALYSIS OF A JANGLE FALLACY<sup>1</sup>

R. S. Dean  
Arizona State University

## ABSTRACT

This study assessed the degree of redundancy between the WISC-R and the PIAT using a canonical correlation analysis. The test scores for 205 children yielded two significant canonical correlations. Taken together, these two  $R$ 's indicated over 65% of functions measured by the PIAT overlapped with the WISC-R, and 37% of the WISC-R subtest variance was shown to be redundant with the PIAT. The primary source of this nonsymmetrical redundancy was attributed to a verbal-educational overlap between measures.

## INTRODUCTION

People constantly infer that standardized tests of intelligence and achievement measure different constructs. Unfortunately, there is little data to support this assumption. To the contrary, numerous researchers have reported redundancy between group measures of intelligence and achievement. In one early study, Kelley (1927) demonstrated that with age held constant the overlap between group intelligence and achievement tests was approximately 90%. He argued that the distinction between group intelligence and achievement batteries were in name only — a “jangle fallacy.” In analyzing the same question, Coleman and Cureton (1954) estimated a 95% overlap between the *Otis Quick-Scoring Test, Beta* and verbal subtests of the *Stanford Achievement Test* when measurement errors were accounted for. More recently, Cronbach (1970) examined the *Lorge-Thorndike Verbal and Non-Verbal Intelligence Tests* in terms of their redundancy with achievement tests. In general, he estimated a 76% overlap of the reliable portions of verbal intelligence and achievement measures and 15% distinctiveness while the non-verbal measure of intelligence had 59% overlap with achievement and 29% distinctiveness.

Many educators and psychologists continue to make hard and fast distinctions between individual achievement and intelligence data despite solid evidence to the contrary. Although past research concentrates on group-administered measures, one would hypothesize a similar relationship for individually administered tests. Obviously, interpretation of children's scores on individually administered intelligence and achievement tests requires knowledge of the overlap between the two instruments.

For example, one is intuitively uncomfortable with measures such as the *Peabody Individual Achievement Test* (PIAT) (Dunn & Markwardt, 1970) which purports to measure postinstruction achievement exclusively. The PIAT is offered as a screening instrument of present school achievement in spite of the fact that many of the subtests are very similar to those comprising the verbal scale of the *Wechsler Intelligence Scale for Children* (WISC, 1949). Likewise, Wechsler (1974), in revising the WISC, claims the new version (WISC-R, 1974) to be a measure of general intellectual ability and not specific achievement in areas apparently analogous to those of the PIAT.

The present study sought to determine the degree of redundancy between subtests of the WISC-R and the PIAT. A canonical analysis was used as a base for comparing linear components of each test which were similar. Basically, a canonical correlation is a linear combination of two sets of variables in such a way that the correlation between the two linear components is maximized (Tatsuoka, 1971). Significant canonical correlations indicate that related components, or canonical variates, are derived to account for the maximum amount of overlap between the two sets of variables. Because a canonical correlation represents the relation between two composites rather than two sets of variables themselves, further analysis is necessary to extract the redundant variance for each set of variables (Stewart & Love, 1968).

## METHOD

### SUBJECTS

The subjects were 205 children (120 male and 85 female) from the Phoenix, Arizona, area who had been referred for psychological evaluation resulting from learning difficulties in the classroom. These children represented an IQ range from 78 to 123 on the WISC-R full scale. The chronological age (CA) of the subjects ranged from 6.1 to 16.3 years, with a mean CA of 10.69 ( $SD = 2.73$ ) years. Children were predominantly from lower middle and middle-class backgrounds as determined by the occupation of the family's major wage earner.

### PROCEDURE

The PIAT and regular subtests of the WISC-R were administered to each subject in a single session. One of five experienced examiners tested subjects on an unsystematic rotating basis and scored all subtests in the usual fashion. To equate all children for age, raw scores were transformed into scaled scores (after Wechsler, 1974, and Dunn & Markwardt, 1970). These scaled scores, on the WISC-R subtests, were related to those of the PIAT using a canonical correlational analysis (Cooley & Lohnes, 1971). When analyzing the resulting canonical variates, only weights of  $\pm .3$  were considered large enough for interpretation. In interpreting the degree of intersection accounted for by the canonical analysis, the data was analyzed according to Stewart and Love's (1968) procedure.

## RESULTS

The analysis yielded two significant canonical correlations between the WISC-R subtest composites and those of the PIAT. The correlation between the first canonical variates yielded a highly reliable .90,  $X^2 = 414.76$ ,  $df = 50$ ,  $p < .001$ . Analysis of the redundancies for the first pair of canonical composites accounted for 62% of the PIAT subtest variance and 37% of the WISC-R subtest variance. This initial canonical correlation yielded five interpretable weights on the WISC-R consisting of the Information (.446), Arithmetic (.524), and Block Design (.367) subtests. The PIAT M .thematics (.438) and General Information (.666) subtests produced the corresponding interpretable weights for this correlation.

A second significant canonical correlation of .57 ( $X^2 = 110.67$ ,  $df = 36$ ,  $< .001$ ) indicated a further set of linear components between the WISC-R and the PIAT, which were responsible for approximately 1% of the WISC-R subtest variance and

2% of the PIAT subtest variance. The interpretable weights involved in the second correlation were Similarities (.626), Vocabulary (.502), Arithmetic (1.469), and Comprehension (-1.030) subtests on the WISC-R, and General Information (-1.669), Spelling (1.288), Mathematics (1.006), and Reading Comprehension (-.355) subtests on the PIAT.

In general, using the two significant canonical correlations, a total of 65% of PIAT subtest variance and 41% of the WISC-R subtest variance was redundant. This finding was buttressed by the zero order correlations found between the PIAT Total test score and WISC-R Verbal ( $r = .71$ ), Performance ( $r = .46$ ), and Full scale ( $r = .64$ ) IQ scores.

### DISCUSSION

The results suggest that under realistic individual testing conditions, much of the information yielded by the PIAT is redundant with subtests of the WISC-R. The amount of overlap between the PIAT with WISC-R is especially impressive when one examines the sample used. Indeed, compared to normals, children referred for learning problems show a significantly greater amount of variability within achievement and intelligence measures (cf. Dean, 1976). Therefore, despite the fact all children in the present sample were referred for learning problems, over 65% of the variance of the PIAT was accounted for by a measure of general intelligence. Moreover, a relatively small proportion of WISC-R subtest variance was redundant with that of the PIAT. Such a finding would be expected because of the WISC-R's multifactor loading in comparison to the PIAT's apparent unidimensionality.

As would be expected, the primary source of commonality between the WISC-R and PIAT was attributable to verbal loading. That is to say, a component of the PIAT, defined as Mathematics and General Information, was highly redundant with a linear component subsumed in the Information, Arithmetic, and Block Design subtests of the WISC-R. With the exception of the Block Design subtest, item content on these tests are so nearly the same one could hardly expect to find differences between scores except, perhaps, due to errors of measurement. The Block Design subtest, like the WISC-R General Information and Arithmetic, requires mental manipulation of symbols or reasoning which seems to account for the majority of the loading in both measures. Thus, with respect to this verbal-educational overlap (Vernon, 1965), an individual achievement test appears to yield much the same information about probable success as that would be expected by a measure of so-called native verbal intelligence.

The present results seem to be subsumable under current theoretical thinking advanced in favor of a spectrum rather than a discreet approach to test classification (Cronbach, 1970; Vernon, 1965). What may be identified as a verbal-educational complex appears responsible for a large portion of the observed overlap between ability and achievement. In essence, the redundancy between measures appears related to the child's performance on verbal tasks much like those required within the classroom. Canonical weights seem to indicate these skills to be primarily toward the "crystallized" end of Cattell's (1963) continuum. So too, the present findings are not inconsistent with Cronbach's (1970) data showing some 76% overlap between group measures of verbal IQ and achievement. For when one considers the large dependence of such group measures upon

reading ability, a considerable amount of overlap would be expected due to loading on this reading factor alone. Obviously, the finding of over 65% redundancy found in the present study would seem in general agreement with Cronbach's proposed achievement-ability overlap. On the other hand, the present analysis indicates a substantial portion of both measures yield orthogonal information and an unknown amount of inconsistent variance.

It seems clear from the present data that many of the constructs measured by the PIAT are redundant with the verbal scale of the WISC-R. Thus, although the PIAT is purported to be a postinstructional achievement measure, it seems to yield similar information as that of a verbal IQ test. This overlap of information appears due to a general factor of verbal-educational development. Hence, the assumption that achievement tests, like the PIAT, measure native capacity plus instructional effectiveness and motivation to achieve, seems questionable by the present findings.

#### NOTES

1. The comments and assistance of Raymond W. Kulhavy and Burke H. Bretzing on an earlier version of this article are greatly appreciated. Correspondence concerning the article should be sent to Raymond S. Dean, 322 Payne Hall, Arizona State University, Tempe, Arizona 85281.

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