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ABSTRACT

This study reports correlations among scores from two commonly used individual measures of intelligence, the Revised Stanford Binet and the Peabody Picture Vocabulary Test, and reading subtests of a standardized achievement test with a group of elementary-aged disadvantaged children. The present study employs longitudinal design to assess correlations among beginning-first grade IQ scores and measures of reading performance obtained toward the end of the first, second, third, and fourth grades. The content of both reading and IQ tests thus remained essentially constant, thereby avoiding the confounding of reading ability with the assessment of intelligence. A complementary objective of the study was to determine the test-retest reliabilities of the two IQ measures for disadvantaged children during the same time interval. Determining reliability and validity of these measures is of particular interest since both tests were standardized on white children of essentially middle socioeconomic backgrounds. The sample included 36 subjects, 18 boys and 18 girls, from the public schools of metropolitan Nashville, Tennessee. The sample comprised children who had participated in an experimental reading project in which they were taught to read by the initial teaching alphabet method during the first and second grades. The findings suggest that verbal ability, particularly verbal proficiency, becomes more highly associated with reading performance as the child proceeds through school. (Author/JM)

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CHANGE AND STABILITY IN CORRELATIONS BETWEEN INTELLIGENCE AND READING TEST SCORES AMONG DISADVANTAGED CHILDREN

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The relationship of intelligence test scores to reading test scores has been the subject of much research during the past 50 years. An examination of past research in this area reveals that reading achievement and intelligence test scores are moderately related (r's from 0.40 to 0.60), that scores on verbal IQ tests correlate higher with measures of reading than do nonverbal intelligence test scores, and that some evidence suggests that the magnitude of correlations between these two attributes increases with advances in chronological age (cf. Neville and Bruininks, in press). Analysis of the literature in the area of intelligence and reading further reveals that most studies have employed cross sectional rather than longitudinal research designs. In many investigations, moreover, the assessment of intelligence has been confounded with reading performance by employing group IQ tests which require reading for response. Increments with age in correlations could be merely an artifact of changes in the test instruments employed to assess reading and intellectual skills, since the content of group measures of intelligence and reading become more similar at higher age levels.

Aside from ignoring the general attributes of test instruments, past investigations have given little attention to the influence of sampling factors (e.g., experiential background) in evaluating relationships between intelligence and reading test scores. Samples in most studies have been heterogeneous in age and socio-economic status and have rarely included disadvantaged children. Little is presently known, therefore, about the magnitude and pattern of relationships between scores on intelligence and reading tests among disadvantaged children. It is essential that characteristics, particularly reliability and validity, of available measures of aptitude and achievement be thoroughly explored if they are to be employed in educational settings with such children.

This study reports correlations among scores from two commonly used individual measures of intelligence, the Revised Stanford Binet and the Peabody Picture Vocabulary Test, and reading subtests of a standardized achievement test with a group of elementary-aged disadvantaged children. The present study employs longitudinal design to assess correlations among beginning-first grade IQ scores and measures of reading performance obtained toward the end of the first, second, third and fourth grades. The content of both reading and IQ tests thus remained essentially constant, thereby avoiding the confounding of reading ability with the assessment of intelligence. A complementary objective of the study was to determine the test-retest reliabilities of the two IQ measures for disadvantaged children during the same time interval. Determining reliability and validity of these measures is of particular interest since both tests were standardized on white children of essentially middle socio-economic backgrounds.

Method

Subjects

The sample included 36 subjects, 18 boys and 18 girls, from the public schools of metropolitan Nashville, Tennessee. The sample comprised children who had participated in an experimental reading project in which they were taught to read by the initial teaching alphabet (ITA) Early-to-Read series (Mazurkiewicz and Tanyzer, 1963) during the first and second grades. About one-third of the children made the transition to the Lippincott reading series in traditional orthography (TO) before the end of the first grade. The remaining children made the transition from ITA to TO by Christmas of the second grade.

The subjects were considered economically disadvantaged according to socio-economic status data collected in home interviews. Children were not included in the sample if their families lived in a good house or apartment and the total family income was over $6,000, or if the main wageearner in the family was employed as a professional, technical or managerial worker, or if the better educated parent had four or more years of college training. Approximately 80 percent of the sample comprised black children.

Tests

Each subject was given the following measures beginning with entrance into the first grade and terminating at the end of the fourth grade:

Stanford-Binet Intelligence Scale (SB). This test (Terman & Merrill,1960) is an individually administered measure of general verbal ability. The SB was administered to all subjects at the

beginning of the first grade and at the end of the first, second, third, and fourth grades.

Peabody Picture Vocabulary Test (PPVT). The PPVT is an individual measure of listening vocabulary (Dunn, 1965). The PPVT, Form A, was administered upon entrance into the first and at the end of the first, third and fourth grades. Unlike the SB the PPVT was not administered to the subjects as part of the evaluation project at the completion of the second grade.

Metropolitan Achievement Tests (MAT). The Word Knowledge (WK), Word Discrimination (WD) and Reading (R) subtests from appropriate levels of the MAT (Durost, Bixler, Hildreth, Lund & Wrightstone, 1959a, 1959b, 1959c) were given to all subjects near the completion of the first, second, third, and fourth grades. An alternate form of the MAT was also administered to the sample at the end of the first grade, using initial teaching alphabet symbols.

Results

Table 1 presents means and standard deviations on intelligence and reading test scores. Product-moment correlations between beginning first grade SB and PPVT IQs and end-of-first grade reading scores are presented in Table 2. Table 3 presents correlations between IQs and end-of-fourth grade reading scores.[2]

Correlations between beginning first grade IQs and reading scores at the end of the first grade were positive, but low. The coefficients between SB IQs and reading scores were considerably higher than those obtained by correlating the PPVT scores with reading achievement. Correlations between IQ scores and reading scores on the TO version of the MAT were higher than those obtained

Table 1

Means and Standard Deviations on Scores from the SB, PPVT, and MAT

Measure	$\bar{X}$	s
SB	86.94	13.59
PPVT	75.08	22.98
MAT - First Grade[a]		
WK	2.07	.44
WD	2.68	.79
R	2.09	.50
MAT - First Grade[b]		
WK	1.79	.40
WD	1.88	.42
R	1.82	.42
MAT - Fourth Grade		
WK	3.40	.88
WD	3.54	.88
R	3.20	.86

[a]ITA version.

[b]TO version.

Table 2

Correlations Between Beginning First Grade SB and PPVT IQs with End-of-First Grade Reading Scores

Measure	SB	PPVT	MAT[a]			MAT[b]		
			WK	WD	R	WK	WD	R
SB	1.00	.71	.19	.33	.20	.32	.39	.32
PPVT		1.00	.14	.20	.01	.15	.25	.18
MAT - WK[a]			1.00	.72	.63	.62	.69	.56
MAT - WD[a]				1.00	.55	.67	.74	.42
MAT - R[a]					1.00	.62	.64	.72
MAT - WK[b]						1.00	.84	.57
MAT - WD[b]							1.00	.56
MAT - R[b]								1.00

[a] ITA version.

[b] TO version.

with an alternate form of the MAT using ITA symbols. A substantial correlation was obtained between the two IQ tests (r = .71).

The data reported in Table 3 reveal a substantial increase in the magnitude of correlations between IQ and reading test scores from the end of the first grade to the end of the fourth grade. Most of this increase in correlations between IQ and reading scores was present by the end of the second and third grades. While the SB correlations with reading performance are higher than those obtained between PPVT and reading scores, the difference between the size of the SB and PPVT correlations with reading is smaller at the upper grades in comparison to the magnitude of those obtained after the first grade.

Table 4 contains test-retest reliability coefficients for SB and PPVT IQ scores from the beginning of the first grade to the end of the first, second, third and fourth grades. The stability coefficients on SB IQs ranged from a low of 0.68 after the second grade (interval of 21 months) to a high of 0.85 in the third grade (interval of 33 months), with an average correlation of 0.77. The PPVT IQ test-retest coefficients displayed an increase from 0.58 after the first grade (interval of 9 months) to 0.74 after the fourth grade (interval of 45 months), with an average correlation of .64.

Discussion

The findings of this study suggest that verbal ability, particularly vocabulary proficiency, becomes more highly associated with reading performance as the child proceeds through school. Most of this increase was present by the end of the first and

Table 3

Correlations Between Beginning First Grade SB and PPVT IQs with End-of-Fourth Grade Reading Scores

Measure	SB	PPVT	MAT[a]		
			WK	WD	RD
SB	1.00	.71	.60	.51	.60
PPVT		1.00	.50	.38	.45
MAT - WK[a]			1.00	.82	.79
MAT - WD[a]				1.00	.80
MAT - RD[a]					1.00

[a]TO version.

Table 4

Test-Retest Reliability Coefficients for

SB and PPVT IQ Scores

Measure	End-of-First Grade	End-of-Second Grade	End-of-Third Grade	End-of-Fourth Grade
SB (Beginning-first grade)	.78	.68	.85	.77
PPVT (Beginning-first grade)[a]	.58		.61	.74

[a]The PPVT was not administered at the end of the second grade.

second grades. The correlations obtained in this study with disadvantaged children were similar in magnitude to those reported in previous cross-sectional studies using more heterogeneous groups of subjects. Even though verbal IQ scores were found to correlate with reading achievement to approximately the same degree among disadvantaged children, at best only 10 to 15% of the differences in first grade reading performance could be predicted by beginning first grade SB IQ scores. The variance in first grade reading performance explained by PPVT IQ scores was considerably lower than that predicted by SB IQs. By completion of the fourth grade, 35 to 40% of the variance in reading performance could be explained by differences in IQ scores. It thus appears that IQ scores, even on individually administered tests, are rather poor predictors of early reading performance among disadvantaged children, but reasonably good predictors of later reading performance. Test-retest reliability coefficients on both the SB and PPVT were high enough to indicate that IQ scores on these instruments are relatively stable with disadvantaged children.

The substantial increments in correlations from the first to fourth grade could be, in part, an artifact of the natural increase in variability of reading test scores (standard deviations increased from approximately 0.40 to 0.80), since correlations tend to be underestimated when the range of one or both variable(s) is curtailed (McNemar, 1962). While it is difficult to estimate the degree to which the range of first grade reading scores is restricted, the effects of heterogeneity of reading scores upon the magnitude of the

correlation can be estimated by adjusting the original coefficient for restriction in range (cf. McNemar, 1962; pp. 144-145). An estimate of the influence of restricted range on first grade correlations was made by using fourth grade standard deviations in a correction formula. This procedure ' 's estimated correlations for first grade scores which might occur . ading scores at this level were as heterogeneous as those obtained in the fourth grade. Assuming the variance in first grade scores is equal to that of fourth grade reading scores, comparisons between adjusted and unadjusted coefficients can be then used to estimate the degree to which greater homogeneity of first grade scores might account for increases in correlations between intelligence and reading test scores with age. These analyses are summarized in Table 5 for the SB and the WK subtest of the MAT. (The results with the WD and R subtests are not reported due to the similarity in results).

Inspection of Table 5 reveals that adjusted correlations are considerably higher than the original coefficients. In the case of the TO version of the MAT, the adjusted correlation at the first grade level equals that obtained between SB and fourth grade reading scores. The adjusted first grade correlation for the ITA version, however, was considerably lower than the fourth grade coefficient. Since the ITA version is perhaps a more valid measure of first grade achievement for children who have been taught to read using the initial teaching alphabet, greater spread of reading scores at the fourth grade level alone cannot account for the increase in correlations between intelligence and reading test scores with age.

Table 5

Adjusted and Unadjusted First Grade

Correlation Coefficients Between SB and WK Scores

Measure	WK - First Grade[a]		WK - First Grade[b]		WK - Fourth Grade
	Unadjusted	Adjusted	Unadjusted	Adjusted	
SB	.19	.36	.32	.60	.60

[a] ITA version.

[b] TO version.

Another possible explanation for the rise in correlations between IQ and reading scores with age emerges in analyzing the changing character of the reading process from initial to latter stages of development. In the initial stages, factors such as perceptual abilities (e.g., discrimination of likenesses and differences, etc.) may be more important to the development of early work recognition skills than general verbal ability (Bruininks, 1969; Neville & Bruininks, in press). By the second and third grades, however, the task of reading appears less dependent upon rudimentary decoding skills. Reading tasks for older children typically require more complex cognitive skills (e.g., logical analysis, making generalizations, etc.) as the reading process changes in emphasis from simple word identification to reading comprehension. The instructional program toward the end of the primary grades also reflects this shift away from the mechanics of "learning to read" toward "reading to learn" (Smith and Dechant, 1961).

Another important factor in evaluating the change in relationships between IQ and reading test scores with age is the nature of items included in standardized intelligence tests. The SB represents a factorially complex measure of intelligence. Heavily weighted in verbal skills, the SB in the age range from four to six years nonetheless includes items which purport to test intelligence through tasks which require vocabulary knowledge (pictorial and aural), solution of analogies, verbal comprehension of cause-effect relationships, analysis of likenesses and differences, memory for instructions and digits, discrimination of forms, and design copying, etc. Apparently, the tasks included in conventional IQ measures at this age level are related more to skills involved in

reading comprehension than to those required in early word identification. As Dechant (1964) has noted: "The ability to cognize symbolic units, to identify or recognize words, is not predictable by the IQ. The IQ predicts the pupil's ability to take meaning to the symbolic unit, to cognize semantic units, or to excel in verbal comprehension (p. 171)." As the act of reading becomes more of an information--processing (Huey, 1968) than a decoding activity, it appears that skills measured by the SB become more related to reading performance.

A final comment on strategies of research in the area of reading and intelligence appears to be in order. Studies similar in design to the present one, in which factorially complex aptitude measures are correlated with facets of reading performance, yield information of limited value either on the nature of the reading process or on the problems of planning reading instruction. While data are reported on the validity of two measures of intellectual ability in predicting reading behavior over age, their factorial complexity virtually precludes analysis of how specific cognitive skills relate to various stages of reading development. Further investigation across a wide range of developmental levels is needed to illuminate the nature of relationships between specific, clearly defined, cognitive skills and aspects of the reading process.

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Footnotes

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[2]Tables summarizing the predictive coefficients with second and third grade reading scores can be obtained from the authors.