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COMPARING ACHIEVEMENT, ABILITY, WITH VISUAL MEMORY AND VISUAL ASSOCIATION

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Abstract

The purpose of this study was to examine the relationship of achievement in reading, spelling and arithmetic with a variety of other measures, particularly tests of visual memory and visual-motor association. Eighty-seven boys and girls who were learning disabled and who were enrolled in grades two through six in a large urban school system participated in the study. All subjects were individually administered the following tests: Schonell's Graded Word Reading and Word Spelling Test, Form A; the Monroe-Sherman Arithmetic Computation Test, the Wechsler Intelligence Scale for Children—Revised; the Basic Visual-Motor Association Test; and the visual-memory subtest of Visual Perceptual Skills.

Results revealed that reading achievement is significantly and highly related to visual memory and moderately to all other measures (e.g., WISC-R Verbal, Performance, Full Scale I.Q. and coding). Moderate correlations were observed between reading achievement and visual memory. Spelling achievement was significantly correlated with visual association but only moderate correlations were observed between spelling and the remaining criterion variables. Arithmetic achievement was significantly but moderately related to visual association. No significant correlations were noted between arithmetic computations and the remaining variables. To sum up, the findings reported suggest that visual association is more closely related to achievement in reading, spelling and arithmetic than is visual memory.

Introduction

It is often difficult, if not impossible, to accurately determine the relationship between achievement in school related tasks and variables which ostensibly reflect processes underlying achievement. Nevertheless, studies which attempt to demonstrate such relationships are important in that they provide the basis for elucidating some of the important features underlying the role that memory and perception play in achievement in reading, spelling and arithmetic.

Perception can be seen as the process of extracting information from stimulation emanating from the objects, places and events

in the world around us. Processes involved in perceptual learning include abstraction of relations, ignoring irrelevant information, adaptive use of peripheral sense-organ adjustments, and reinforcement by discovery of structure and reduction of uncertainty (Gibson and Levin, 1975, p. 45).

It has often been asserted that inadequate perceptual-motor coordination is one of the factors that prevents children from learning to read successfully. However, the relationship between lack of achievement in reading and poor perceptual-motor coordination has not been established (Nielsen and Ringe, 1969).

Memory, on the other hand, can be characterized in terms of three components: encoding, storage and retrieval. In the case of visual memory, and individual must: (1) properly attend to and interpret the visual event; (2) store (or hold) effectively what he has encoded; and (3) be able to identify what has been originally encoded when that item or design is presented, or be able to gain access to what has been stored previously.

The purpose of this study was to examine the relationship of achievement in reading, spelling and arithmetic with a variety of other measures, including tests of visual memory and visual-motor association.

Method

Eighty-seven boys and girls enrolled in grades two through six in a large metropolitan school system and who were referred to the school psychologist for assessment participated in the study. Ninety percent of the subjects in the study were experiencing problems in learning, with the remaining ten percent made up of referrals on the basis of emotional and behavioral problems. Sixty-five percent of the subjects were boys. All subjects were individually administered Schonell's Graded Word Reading Test, Form A, and Schonell's Graded Word Spelling Test, Form A (Schonell, 1942-55). In addition, all subjects were given the Monroe-Sherman Arithmetic Computation Test (1966), the Wechsler Intelligence Scale for Children—Revised 1974, the Basic Visual-Motor Association Test (1982), and the visual-memory subtest of the Test of Visual Perceptual Skills.

Schonell's Graded Word Reading Test and Graded Word Spelling Test, along with the Monroe-Sherman Arithmetic Computation Test, are commonly known as tests of achievement used to measure reading, spelling, and arithmetic ability respectively. The Wechsler Intelligence Scale for Children—Revised is the most widely used standardized test of intelligence for children and youth aged six through sixteen years. This individual test of intelligence is used to measure verbal and performance abilities.

The Basic Visual-Motor Association test is a non-verbal visual association test which measures: (1) recall of visual symbols; (2) visual-association skills; (3) visual sequencing ability; (4) visual motor ability; (5) visual integrative ability, and (6) symbol integration. Form A has sixty upper case or capital

letters while Form B has sixty lower case or small letters. Both forms incorporate the same 10 stimulus symbols associated with the first ten letters of the alphabet. The testee is required to associate the appropriate symbol with the correct letter under specific time constraints.

The tests of visual-perceptual skills are non-verbal visual memory tests which measure: (1) visual discrimination; (2) visual memory; (3) visual spatial relationships; (4) visual form constancy (5) visual sequential memory; (6) visual figure-ground relationships; and (7) visual closure. The visual memory subtest of the tests of visual perceptual skills requires the testee to identify a geometric design which was previously presented independently from a group of figures comprised of four unlike designs of varying degrees of similarity.

Results

Table 1 (following page) presents the means and standard deviations of six criterion measures. Pearsonian correlations and significance associated with the means for the total group of subjects, males and females, on the six criterion measures are presented in Tables 2, 3, and 4 respectively.

The results show that reading achievement is significantly and highly related to visual association as measured by the Basic Visual-Association Test (Form A; $r = .70$; Form B; $r = .73$), moderately to the WISC-R Verbal I.Q. ($r = .46$); Performance I.Q. ($r = .39$); Full Scale I.Q. ($r = .49$), and coding ($r = .31$).

Moderate correlations were noted between reading achievement and visual memory as measured by the test of visual perceptual skills ($r = .45$). Spelling achievement was significantly and highly correlated to visual association (Form A; $r = .72$; Form B; $r = .74$), moderately to WISC-R Verbal I.Q. ($r = .46$), Performance I.Q. ($r = .46$), Full Scale I.Q. ($r = .51$), and coding ($r = .35$). Moderate correlation was noted with visual memory ($r = .41$).

Arithmetic achievement was significantly but moderately related to visual association (Form A; $r = .37$; Form B; $r = .42$), and weakly related to WISC-R Verbal I.Q. ($r = .32$), Full Scale I.Q. ($r = .25$), and coding ($r = .35$). No relationship was noted between arithmetic achievement and visual memory ($r = .06$).

Discussion

Results revealing that visual association correlated more highly with reading, spelling and arithmetic achievement suggest that visual association plays at least as important a role as I.Q. and visual memory in the achievement process. There is, however, another way of looking at the differences which exist between the test for visual association and the test for visual memory.

The test for visual memory is a test involving visual recognition of symbols whereas the test for visual association entails processes involving both recognition and recall. According to one hypothesis (Crowder, 1976), recognition is basically the same

TABLE 1
Means and Standard Deviations for All Groups of Subjects (N = 87)

Group	N	Schonell Reading	Spelling	Monroe-Sherman Arithmetic	Verbal	WISC-R Performance	Full Scale	Code	Visual Association		Visual Memory TVFS
									A	B	
Total											
M	87	35.72	33.41	34.54	98.49	106.40	102.19	9.56	44.31	41.41	9.15
S.D.		20.29	20.52	27.26	16.71	15.32	15.21	3.22	14.63	15.12	2.69
Males											
M	57	37.44	36.00	32.23	100.16	108.69	104.35	9.30	43.08	40.73	9.71
S.D.		19.69	20.10	25.21	12.31	14.67	13.36	3.06	14.70	15.16	2.65
Females											
M	30	31.81	28.78	38.87	95.32	102.07	98.10	9.70	46.63	42.70	8.06
S.D.		21.64	21.01	31.13	19.99	15.85	17.75	3.58	14.45	15.21	2.47

Relationships Among Variables

TABLE 2
Correlations and Significance for All Subjects (N = 87)

Variable	1	2	3	4	5	6	7	8	9	10
Achievement										
1. Reading		.93 ^x	.26 ^t	.46 ^x	.39 ^x	.49 ^x	.31 ^x	.70 ^x	.73 ^x	.45 ^x
2. Spelling	.93 ^x		.25 ^t	.46 ^x	.45 ^x	.51 ^x	.35 ^x	.72 ^x	.74 ^x	.41 ^x
3. Arithmetic	.26 ^x	.25 ^t		.32 ^x	.12	.25 ^t	.35 ^x	.37 ^x	.42 ^x	.06
WISC-R IQ										
4. Verbal	.46 ^x	.46 ^x	.32 ^x		.60 ^x	.90 ^x	.48 ^x	.21 ^t	.28 ^x	.26 ^x
5. Performance	.39 ^x	.46 ^x	.12	.60 ^x	.87 ^x	.87 ^x	.58 ^x	.31 ^x	.35 ^x	.56 ^x
6. Full Scale	.49 ^x	.51 ^x	.25 ^t	.90 ^x	.87 ^x	.87 ^x	.58 ^x	.28 ^x	.34 ^x	.44 ^x
7. Coding	.31 ^x	.35 ^x	.35 ^x	.48 ^x	.58 ^x	.58 ^x		.29 ^x	.32 ^x	.38 ^x
Visual-Association										
8. A	.70 ^x	.72 ^x	.37 ^x	.21 ^t	.31 ^x	.28 ^x	.29 ^x		.95 ^x	.38 ^x
9. B	.73 ^x	.74 ^x	.42 ^x	.28 ^x	.35 ^x	.34 ^x	.32 ^x	.95 ^x		.41 ^x
Visual Memory										
10. tvps	.45 ^x	.41 ^x	.06	.26 ^x	.56 ^x	.44 ^x	.38 ^x	.38 ^x	.41 ^x	

xp = .10 Tp = .15

TABLE 3
Correlations and Significance for Males (n = 57)

Variable	1	2	3	4	5	6	7	8	9	10
Achievement										
1. Reading		.91	.13	.45 ^x	.43 ^x	.51 ^x	.32 ^x	.68 ^x	.71 ^x	.43 ^x
2. Spelling	.91 ^x		.15	.42 ^x	.50 ^x	.51 ^x	.38 ^x	.71 ^x	.74 ^x	.42 ^x
3. Arithmetic	.13	.15		.29 ^t	.17	.27	.39 ^x	.21	.26	.16
WTISC-R I.Q.										
4. Verbal	.45 ^x	.42	.29 ^t		.53 ^x	.88 ^x	.35 ^x	.25 ^t	.24 ^t	.24 ^t
5. Performance	.46 ^x	.50	.17	.53 ^x		.87 ^x	.49 ^x	.47 ^x	.44 ^x	.60 ^x
6. Full Scale	.51 ^x	.51	.27	.88 ^x	.87 ^x		.48 ^x	.40 ^x	.38 ^x	.47 ^x
7. Code	.32 ^t	.38 ^x	.39 ^x	.35 ^x	.49 ^x	.48 ^x		.31 ^x	.26 ^t	.40 ^x
Visual-Association										
8. A	.68 ^x	.71 ^x	.21	.25 ^t	.47 ^x	.40 ^x	.31 ^x		.95 ^x	.43 ^x
9. B	.71 ^x	.74 ^x	.26	.24 ^t	.44 ^x	.38 ^x	.26 ^t	.95 ^x		.45 ^x
Visual-Memory										
10. TVPS	.43 ^x	.42 ^x	.16	.24 ^t	.60 ^x	.47 ^x	.40 ^x	.43 ^x	.45 ^x	

xp = .10 tp = .05

TABLE 4
Correlations and Significance for Females (n = 30)

Variable	1	2	3	4	5	6	7	8	9	10
Achievement										
1. Reading		.95 ^x	.50 ^x	.49	.22	.44 ^x	.33	.77 ^x	.80 ^x	.45 ^x
2. Spelling	.95 ^x		.46 ^t	.53 ^x	.29	.48 ^t	.35	.77 ^x	.77 ^x	.31
3. Arithmetic	.50 ^t	.46 ^t		.40	.10	.29	.26	.58 ^x	.63 ^x	.06
WISC-R I.Q.										
4. Verbal	.49 ^t	.52 ^x	.40		.67 ^x	.93 ^x	.67 ^x	.26	.42 ^x	.24
5. Performance	.22	.29	.10	.67 ^x		.88 ^x	.77 ^x	.15	.30 ^t	.42 ^x
6. Full Scale	.44 ^t	.48 ^t	.29	.93 ^x	.88 ^x		.77 ^x	.23	.40 ^x	.35 ^t
7. Code	.33	.35	.25	.67 ^x	.77 ^x	.77 ^x		.26	.44 ^x	.38 ^t
Visual Association										
8. A	.77 ^x	.77 ^x	.58 ^x	.26	.15	.23	.26		.94 ^x	.44 ^x
9. B	.80 ^x	.77 ^x	.63 ^x	.42 ^x	.30 ^x	.40 ^x	.44 ^x	.94 ^x		.45 ^x
Visual-Memory										
10. TVPS	.45 ^t	.31	.07	.24	.42 ^x	.35 ^t	.38 ^t	.44 ^x	.45 ^x	

xp = .01^x tp = .05

as recall in that recognition involves a lower threshold than recall.

A second hypothesis (Slamecka, 1967) is that recall and recognition are the same except that recall entails an extra step. In recall the subject must first implicitly generate items that may have been on the list and then these generated items are subjected to a recognition test. In recognition, however, it is the test which provides the items to be recognized, saving the subject the generation process.

The visual association test, it would seem, is both a recognition and recall test. However, in addition to requiring these two steps, there are the additional requirements involving association, sequencing, visual-motor and symbol integration. Tasks of these dimensions should correlate more highly with reading and spelling achievement on the grounds that they are processes fundamental to reading and spelling. A recognition task, on the other hand, is not unlike the task demands associated with responding to items in a reading workbook where children are required to "look and locate" words through a process of visual recognition.

In sum, the findings reported in this study suggest that teachers be aware not only of the limited role that recognition plays in all aspects of achievement, but that achievement in reading, spelling and arithmetic does entail higher cognitive processing.

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