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ABSTRACT

The prediction of achievement provides teachers with necessary information to help children attain optimal achievement. If some skill prerequistites to learning which are not fully developed can be identified and strengthened, higher levels of achievement may result. The Metropolitan Readiness Tests (MRT) are routinely given to all University City kindergarten children. The test of Primary Mental Abilities (PMA) was then administered to groups of boys and girls who were reasonably representative of children in University City Schools in the second month of first grade, and the Stanford Achievement Test at the end of first grade. Analyses of the data revealed similarities and differences in the effectiveness of these tests in predicting performance, measured by subtests of the Stanford Achievement Test, seven to thirteen months later. Both tests identified abilities and guided teachers in individualizing programs based on a child's developmental needs. However, the MRT were more applicable to boys, the PMA to girls. The use of the scores on both tests together added very little to their predictive value; the PMA test hs a slight advantage over the MRT if one had to select a single test. (Author/PR)

PRIMARY MENTAL ABILITIES AND METROPOLITAN READINESS TESTS AS PREDICTORS OF ACHIEVEMENT IN THE FIRST PRIMARY YEAR

Office of
Research and Testing

SCHOOL DISTRICT OF UNIVERSITY CITY
University City, Missouri

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PRIMARY MENTAL ABILITIES AND METROPOLITAN READINESS TESTS AS PREDICTORS OF ACHIEVEMENT IN THE FIRST PRIMARY YEAR

Predicting achievement can provide to teachers much information they need to help children attain optimal achievement. If some skill prerequisites to learning which have not developed fully can be identified and strengthened, higher level achievement is likely to result. An earlier study (1) indicated the usefulness of the Metropolitan Readiness Tests as predictors of subtest scores on the Stanford Achievement Test. The present study examined the relative usefulness of both the Metropolitan Readiness Tests and the test of Primary Mental Abilities to predict performance on the Stanford subtests.

METHOD

The Metropolitan Readiness Tests, Form B (2), were given routinely to all kindergarten children in April 1969. The following October, the test of Primary Mental Abilities (3) was administered to 78 boys and 78 girls selected in six schools to provide groups reasonably representative of the University City school population. The October date was the earliest time near the beginning of the current or end of the previous school years when further testing was feasible. The Stanford Achievement Test (4) was given in May 1970. Only children who had taken all three tests were included in the study. The three tests, together with their subtests, are listed in Table 1.

Table 1. Description of the Tests Used

Predictors	
PRIMARY MENTAL ABILITIES: PMA	METROPOLITAN READINESS TESTS: MRT
Verbal Meaning: PMA-VM	Word Meaning: MRT-WM
Perceptual Speed: PMA-PS	Listening: MRT-L
Number Facility: PMA-NF	Matching: MRT-M
Spacial Relations: PMA-SR	Alphabet: MRT-A
Total Score: PMA-T	Numbers: MRT-N
	Copying: MRT-C
	Total Score: MRT-T
Achievement	
STANFORD ACHIEVEMENT TEST: SAT	
Word Reading: SAT-WR	
Paragraph Meaning: SAT-PM	
Vocabulary: SAT-V	
Spelling: SAT-S	
Word Study Skills: SAT-WSS	
Arithmetic: SAT-A	

More detailed descriptions of the subtests are given in Appendix A.

Analyses of Data.

Correlation coefficients were computed for each Stanford subtest with each subtest and the total score of the Primary Mental Abilities and with each subtest and the total score of the Metropolitan Readiness Tests. For these correlations, t-tests were applied for level of significance and possible significant sex differences. Multiple correlations for total PMA with total MRT for each Stanford subtest were computed also. With these correlations and multiple correlations, t-tests were applied to determine if the total score of one predictor was significantly better than the other. Data were treated separately by sex.

RESULTS

The two groups, boys and girls, provided a reasonably normal distribution of grade equivalent scores on two subtests of the Stanford Achievement Test as indicated in Table 2.

Table 2. Distribution of Grade Equivalents in Reading and Arithmetic

	STANFORD ACHIEVEMENT SUBTESTS			
	PARAGRAPH MEANING Grade Equivalent		ARITHMETIC Grade Equivalent	
LEVEL	BOYS	GIRLS	BOYS	GIRLS
Highest	4.0	4.0	5.5	5.5
High 25%	2.7	2.9	3.1	2.6
Median	1.9	2.3	2.4	2.2
Low 25%	1.6	1.7	1.9	1.8
Lowest	0.0	1.0	1.1	1.4

Diagnoses and Programming.

An examination of the correlations (r) of subtest grade equivalent scores of the Stanford Achievement Test with PMA and MRT subtests and total raw scores showed a number of similarities and differences in the predictive value of the two tests. Correlations of $r = .50$ and higher are given in Table 3. These correlations were significant at $p < .005$ level. Complete correlation data are provided in Appendixes B and C.

Table 3. Correlations of Subtests and Totals of Primary Mental Abilities and the Metropolitan Readiness Tests with Subtests of the Stanford Achievement Test*

	P M A				M R T			
STANFORD	Boys		Girls		Boys		Girls	
WORD READING SAT-WR	TOTAL	.59	TOTAL	.63	TOTAL	.62	TOTAL	.59
	No.Facil.	.52	Verb.Mean.	.58	Numbers	.60	Numbers	.58
			Space.Rela.	.56	Alphabet	.58	Alphabet	.56
			No.Facil.	.50				
PARAGRAPH MEANING SAT-PM	TOTAL	.57	TOTAL	.69	TOTAL	.63	TOTAL	.58
	Perc.Speed	.50	Verb.Mean.	.60	Alphabet	.57	Alphabet	.55
	No.Facil.	.50	Space.Rela.	.59	Numbers	.57	Numbers	.54
			No.Facil.	.57	Matching	.56		
VOCABULARY SAT-V	TOTAL	.70	Verb.Mean.	.69	Numbers	.63	Listening	.58
	Verb.Mean.	.62	TOTAL	.66	TOTAL	.59	TOTAL	.56
	No.Facil.	.60	No.Facil.	.58			Alphabet	.53
			Space.Rela.	.51				
SPELLING SAT-S	TOTAL	.59	TOTAL	.57	Numbers	.58	Numbers	.57
	No.Facil.	.52			TOTAL	.56	TOTAL	.55
					Alphabet	.50	Alphabet	.53
WORD STUDY SKILLS SAT-WSS	TOTAL	.65	TOTAL	.70	TOTAL	.68	TOTAL	.59
	No.Facil.	.58	Space.Rela.	.63	Numbers	.63	Numbers	.58
			Verb.Mean.	.63	Alphabet	.59	Alphabet	.57
			No.Facil.	.57	Matching	.55	Listening	.50
ARITHMETIC SAT-A	TOTAL	.69	TOTAL	.73	Numbers	.63	TOTAL	.56
	No.Facil.	.60	No.Facil.	.62	TOTAL	.60	Numbers	.52
	Verb.Mean.	.56	Verb.Mean.	.62				
			Space.Rela.	.60				

*Only significant correlations of $r = .50$ and higher at $p < .005$ have been reported. Correlations of $r = .60$ and higher are underlined to indicate the most predictive tests.

Table 3 suggests how subtest scores may be used in determining individual strengths and weaknesses as a basis of personalizing programs.

Primary Mental Abilities. For example, in examining a boy's reading potential (SAT-Paragraph Meaning) from PMA total and subtest scores, high scores on PMA-Total, PMA-Perceptual Speed, or PMA-Number Facility indicate the likelihood of the child's experiencing little difficulty in learning to read. If all three of the test scores are high, the probability of success in reading is even greater.

Low scores on PMA-Total, PMA-Perceptual Speed, and/or PMA-Number Facility signal the need for help and identify two specific areas requiring special attention.

For girls, strengths and weaknesses are indicated by Primary Mental Abilities total, PMA-Verbal Meaning, PMA-Spacial Relations, and PMA-Number Facility.

Information on predicting achievement in the other areas measured by the Stanford subtests also are given in Table 3.

Metropolitan Readiness Tests. The total score and subtest scores on the Metropolitan Readiness Tests also are predictive. In anticipating a boy's reading potential, the MRT-Total, MRT-Alphabet, MRT-Numbers, and MRT-Matching should be examined. For girls, the same scores are predictive with one exception, MRT-Matching, which did not appear as useful in identifying skill needs.

Similar information on the prediction of achievement in other areas measured by the Stanford subtests also may be obtained from Table 3.

A simplified interpretation of the preceding table is provided by the rank orders of correlations listed in Table 4. Only correlations of $r = .50$ and higher are reported while correlations of $r = .60$ or above are underlined to indicate the most predictive tests. This table also indicates that the Primary Mental Abilities subtest of Perceptual Speed appears in only one instance--boys in Paragraph Meaning. The Metropolitan Readiness Tests include two subtests, Word Meaning and Copying, which did not appear on any Stanford subtest.

In comparing the predictive value of the two tests with Stanford subtest scores, the correlations of eight Metropolitan and 18 Primary Mental Abilities subtest or total scores were $r = .60$ or higher. However, sex differences were minimal. Only for PMA-Verbal Meaning with Stanford Paragraph Meaning were the correlations of $r = .60$ for girls and $r = .30$ for boys statistically significant at $p < .05$. These figures appear in Appendixes A and B, pages 13 and 14.

Table 4. Rank Order of Correlations of Subtests and Totals of Primary Mental Abilities and Metropolitan Readiness Tests with Subtests of the Stanford Achievement Test

PREDICTION TESTS	STANFORD ACHIEVEMENT TEST, PRIMARY I BATTERY											
	WR Word Reading		PM Paragraph Meaning		V Vocab-ulary		S Spelling		WSS Word Study Skills		A Arith-metic	
	B	G	B	G	B	G	B	G	B	G	B	G
PMA												
Verb. Mean.		2		2	2	1				3	3	3
Percept. Speed			2									
No.Facility	2	4	3	4	3	3	2		2	4	2	2
Spacial Rela.		3		3		4				2		4
Total	1	1	1	1	1	2	1	1	1	1	1	1
MRT												
Word Meaning	-	-	-	-	-	-	-	-	-	-	-	-
Listening						1				4		
Matching			4						4			
Alphabet	3	3	2	2		3	3	3	3	3		
Numbers	2	2	3	3	1		1	1	2	2	1	2
Copying	-	-	-	-	-	-	-	-	-	-	-	-
Total	1	1	1	1	2	2	2	2	1	1	2	1

NOTE: Correlations of r = .60 and higher are underlined.

Relative Predictive Value of PMA and MRT.

The total and subtest scores of Primary Mental Abilities and the Metropolitan Readiness Tests appeared to predict some achievement areas better than others and the stronger predictors for boys and girls frequently were different. For boys, the total test scores on Primary Mental Abilities were more closely related to Stanford Vocabulary, Spelling, and Arithmetic while the total scores on the Metropolitan Readiness Tests were more closely correlated with Word Reading, Paragraph Meaning, and Word Study Skills. For girls, the total test scores on PMA gave higher correlations than MRT on all six Stanford subtests. In an attempt to identify which test as a whole provided the more reliable predictions, t-tests were applied and only one difference reached an acceptable level of significance (for girls, PMA-Total > MRT-Total on Stanford Arithmetic). Comparisons were also made between the simple correlations of PMA and MRT totals with each Stanford subtest and the multiple correlations of the total scores of PMA and MRT together with each Stanford subtest. In each instance, the multiple correlations were equal to or only slightly greater than the higher simple correlations by an amount too small to warrant the administration of both tests. Table 5 gives these data.

Table 5. Correlations and Multiple Correlations of Primary Mental Abilities Total Scores and Metropolitan Readiness Tests Total Scores with Subtest Scores of the Stanford Achievement Test*

	STANFORD ACHIEVEMENT TEST, PRIMARY I BATTERY					
	Word Reading	Paragraph Meaning	Vocabulary	Spelling	Word Study Skills	Arithmetic
B O Y S						
Primary Mental Abilities	.59	.57	<u>.70</u>	<u>.59</u>	.65	<u>.69</u>
Metropolitan Readiness Tests	<u>.62</u>	<u>.63</u>	.59	.56	<u>.68</u>	.60
Primary Mental Abilities and Metropolitan Readiness Tests Combined	.68	.67	.73	.64	.75	.72
G I R L S						
Primary Mental Abilities	<u>.63</u>	<u>.69</u>	<u>.66</u>	<u>.57</u>	<u>.70</u>	<u>.73</u>**
Metropolitan Readiness Tests	.59	.58	.56	.55	.59	.56
Primary Mental Abilities and Metropolitan Readiness Tests Combined	.66	.70	.67	.60	.71	.73

*The higher correlation of PMA-Total or MRT-Total with Stanford subtests is underlined. Multiple correlations derived by combining PMA-Total and MRT-Total are equal to or higher than the corresponding correlations derived from single tests.

**In predicting arithmetic achievement, PMA-Total Score is significantly more reliable than MRT-Total Score for girls in arithmetic at $p < .01$ level of confidence. This figure could have resulted by chance.

DISCUSSION

Primary Mental Abilities and the Metropolitan Readiness Tests were administered to groups of boys and girls who were reasonably representative of children in University City schools. Analyses of the data pointed up a number of similarities and differences in the effectiveness of these tests in predicting performance measured by subtests of the Stanford Achievement Test, seven to thirteen months later. Either test appeared to be helpful in identifying individual strengths and weaknesses as guides to classroom teachers in personalizing programs based on each child's major developmental needs. Conceivably, the Metropolitan Readiness Tests could be used with boys, Primary Mental Abilities with girls. The use of the scores on both tests together added very little to their predictive value. If a choice of a single test based on this study were made, the Primary Mental Abilities test for both sexes would have a slight advantage.

Basically, the decision well could be made jointly by the teachers who administer the tests and use the test results. It is they who need to judge whether the subtests of Primary Mental Abilities or the Metropolitan Readiness Tests provide the information they require for optimum personalized programming.

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APPENDIX A

DESCRIPTION OF TESTS*

PRIMARY MENTAL ABILITIES, K-1 LEVEL

Verbal Meaning (PMA-VM). Ability to understand ideas expressed in words--a vocabulary test in picture form.

Perceptual Speed (PMA-PS). Ability to recognize likenesses and differences of objects or symbols quickly and accurately--important in acquiring reading skill but tends to reach a plateau at a relatively early age.

Number Facility (PMA-N). Ability to work with numbers, to handle simple quantitative problems and to understand and recognize quantitative differences presented in picture form.

Spacial Relations (PMA-SR). Ability to visualize objects and figures rotated in space and the relations between them.

Total Score. Mental Age and Quotient (I.Q.) Scores.

METROPOLITAN READINESS TESTS, FORM B

Word Meaning (MRT-WM). Ability to understand ideas expressed verbally indicated by marking one of three pictures.

Listening (MRT-L). Ability to comprehend phrases and sentences instead of individual words.

Matching (MRT-M). Ability to select one of three words or pictures identical with the stimulus symbol--visual perception.

Alphabet (MRT-A). Ability to recognize lower-case letters of the alphabet.

Numbers (MRT-N). Knowledge of size, amount, value, proportion; ability to count and to solve simple arithmetic problems.

Copying (MRT-C). Ability to reproduce letters or symbols--visual perception and motor control.

Total Score. Percentile and Letter Rating Scores.

*Adapted from manuals for test administrators (2, 3, 4).

STANFORD ACHIEVEMENT TEST, PRIMARY I BATTERY

Word Reading (SAT-WR). Ability to analyze a word without the aid of context.

Paragraph Meaning (SAT-PM). Comprehension of a paragraph demonstrated by selecting the correct word for the word omitted.

Vocabulary (SAT-V). Ability to select from among three alternatives the correct answer to a question or statement.

Spelling (SAT-S). Ability to spell correctly a list of words dictated.

Word Study Skills (SAT-WSS). Skill in auditory perception of beginning and ending sounds, identifying the written symbol for a spoken word and a word which rhymes with a spoken word.

Arithmetic (SAT-A). Knowledge of measurement; ability to do simple problems and understand the language of problems; and knowledge of concepts including the meaning of a unit fraction, number sequence, simple problem solving, etc.

Total Score. None.

APPENDIX B

CORRELATION DATA FOR BOYS*

TESTS USED IN PREDICTION	STANFORD ACHIEVEMENT TEST					
	WR	PM	V	S	WSS	A
PRIMARY MENTAL ABILITIES						
PMA-VM	.40	.30**	.62	.40	.49	.56
PMA-PS	.44	.50	.40	.44	.40	.36
PMA-NF	.52	.50	.60	.52	.58	.60
PMA-SR	.39	.40	.40	.39	.45	.49
PMA-TOTAL	.59	.57	.70	.59	.65	.69
METROPOLITAN READINESS TESTS						
MRT-WM	.30	.24[b]	.48	.30	.42	.40
MRT-L	.44	.27[a]	.37	.28[a]	.42	.34
MRT-M	.47	.56	.47	.38	.55	.48
MRT-A	.58	.57	.47	.50	.59	.49
MRT-N	.60	.57	.63	.58	.63	.63
MRT-C	.34	.42	.18[ns]	.36	.36	.22[c]
MRT-TOTAL	.62	.63	.59	.56	.68	.60

*All correlations were statistically significant at $p = <.005$ except as noted:
a. $p = <.01$
b. $p = <.025$
c. $p = <.05$
ns - not significant

**Only one sex difference of a specific predictive test with a specific Stanford test for girls with the corresponding tests for boys was statistically significant. The correlation of PMA-VM with SAT-PM showed $p = <.05$ favoring girls.

APPENDIX C

CORRELATION DATA FOR GIRLS*

TESTS USED IN PREDICTION	STANFORD ACHIEVEMENT TEST					
	WR	PM	V	S	WSS	A
PRIMARY MENTAL ABILITIES						
PMA-VM	.58	.60**	.69	.49	.63	.62
PMA-PS	.35	.43	.27[a]	.38	.38	.48
PMA-NF	.50	.57	.58	.44	.57	.62
PMA-SR	.56	.59	.51	.49	.63	.60
PMA-TOTAL	.63	.69	.66	.57	.70	.73
METROPOLITAN READINESS TESTS						
MRT-WM	.34	.35	.48	.26[b]	.39	.35
MRT-L	.47	.46	.58	.41	.50	.46
MRT-M	.43	.48	.39	.39	.47	.41
MRT-A	.56	.55	.53	.53	.57	.49
MRT-N	.58	.54	.44	.57	.58	.52
MRT-C	.35	.33	.27[b]	.34	.31	.39
MRT-TOTAL	.59	.58	.56	.55	.59	.56

*All correlations were statistically significant at $p = <.005$ except as noted:
a. $p = <.01$
b. $p = <.025$

**Only one sex difference of a specific predictive test with a specific Stanford test for girls with the corresponding tests for boys was statistically significant. The correlation of PMA-VM with SAT-PM showed $p = <.05$ favoring girls.

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