MindPrint Linking Study with PSSA

The Correlation Between the MindPrint Cognitive Assessment and the Pennsylvania System of School Assessment (PSSA)

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Results from this study were generated using the Web-Based Computerized Neurocognitive Battery licensed from the University of Pennsylvania.

MindPrint learning

Research Overview

The MindPrint assessment battery significantly predicted student outcomes on the Pennsylvania System of School Assessment (PSSA), accounting for performance on Mathematics (44%), English Language Arts (40%), and Science (41%).

Methodology (or "About the Students in the Study")

MindPrint Learning conducted a large-scale study examining performance on the assessment battery in several Pennsylvania schools using the Pennsylvania System of School Assessment (PSSA) in 2022. Sixth to ninth grade students (*n*= 1472; 50% male) participated in the study **(Table 1)**. We examined both sets of data to uncover the predictive link between student performance on the cognitive assessments and their performance on Mathematics, English Language Arts (ELA), and Science outcomes on the PSSA.

Table 1. Student Demographics (grade and gender frequencies)

Grade	gender	Counts	% of Total	Cumulative %
6	female	160	10.9%	10.9%
	male	172	11.7%	22.6%
7	female	194	13.2%	35.7%
	male	173	11.8%	47.5%
8	female	187	12.7%	60.2%
	male	202	13.7%	73.9%
9	female	193	13.1%	87.0%
	male	191	13.0%	100.0%

Results

Correlation Results

We estimated Pearson's *r* correlation coefficients to quantify the associations among all the cognitive factors of interest by accuracy and reaction time and student outcomes on the PSSA. Findings on performance for Mathematics, ELA, and Science are presented below in standardized z-score format.

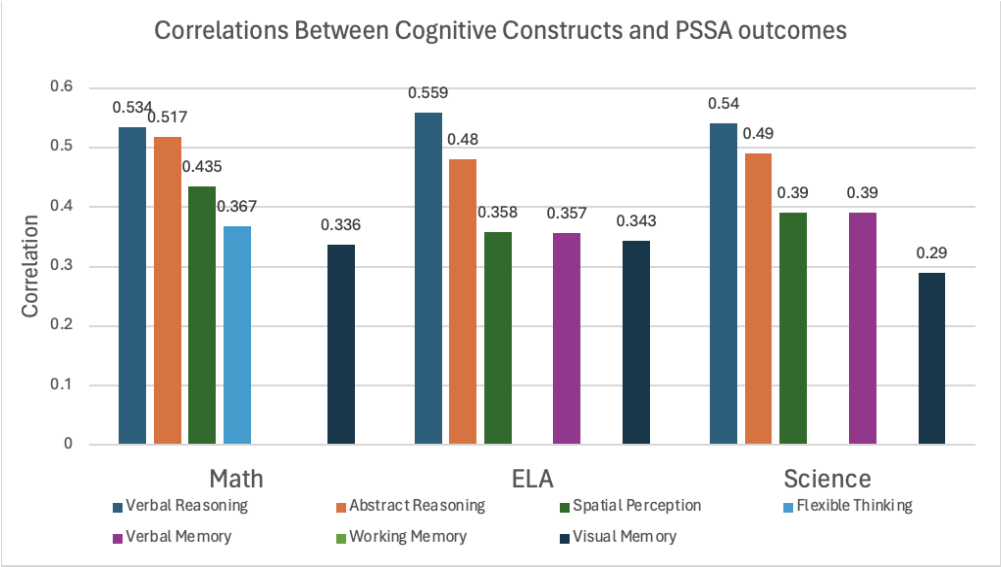
Performance in the following areas had significant ($p<.05$) correlations with **Math** outcomes: Verbal Reasoning accuracy ($r=0.53$), Abstract Reasoning accuracy ($r=0.52$), Spatial Perception accuracy ($r=0.43$), Flexible Thinking accuracy ($r=0.36$), Verbal Memory accuracy ($r=0.29$), Attention accuracy ($r=0.25$), Working Memory accuracy ($r=0.29$), and Visual Memory accuracy ($r=0.34$).

Performance in the following areas had small to moderate significant correlations with **ELA** outcomes: Verbal Reasoning accuracy ($r=0.49$), Abstract Reasoning accuracy ($r=0.46$), Spatial Perception accuracy ($r=0.50$), Working Memory accuracy ($r=0.30$), Visual Memory accuracy ($r=0.28$), Flexible Thinking accuracy ($r=0.36$), Attention accuracy ($r=0.28$), and Verbal Memory accuracy ($r=0.25$).

Performance in the following areas had small to moderate significant correlations with **Science** outcomes: Verbal Reasoning accuracy ($r=0.54$), Abstract Reasoning accuracy ($r=0.49$), Spatial Perception accuracy ($r=0.39$), Verbal Memory accuracy ($r=0.39$), Visual Memory accuracy ($r=0.29$), Flexible Thinking accuracy ($r=0.26$), Attention accuracy ($r=0.25$), and Working memory accuracy ($r=0.25$).

The correlations presented above highlight the link between the performance on the cognitive construct and the PSSA outcomes. Although performance is presented as accuracy, speed is often significant for the cognitive construct.

Figure 1. Correlation Results



Multivariate Regression Results

We then expand on these bivariate correlations using multivariate regression modeling to examine the unique explanatory power of each factor in predicting student performance outcomes on the PSSA assessments. Student performance on Mathematics, ELA, and Science were used as the dependent measures for the three models. The primary interest of these regression models is to identify which student factors hold the greatest predictive power for the outcomes by examining statistical significance and beta-coefficient output. The relations between all the cognitive measures on Mathematics, ELA, and Science outcomes while controlling for grade level are presented in **Table 2**.

Table 2
Regression model of the relationship between PSSA outcomes and MindPrint cognitive assessments

	Mathematics Model	ELA Model	Science Model
Variable	*B*(SE)	*B*(SE)	*B*(SE)
Verbal Reasoning$_{acc}$	26.26(3.72)***	26.85(3.44)***	53.53(9.96)***
Verbal Reasoning$_{sp}$	12.32(2.91)***	17.69(2.70)***	25.34(9.25)**
Abstract Reasoning$_{acc}$	20.98(4.78)***	14.18(4.41)***	
Spatial Perception$_{acc}$	14.47(3.45)***	7.78(3.19)*	
Spatial Perception$_{sp}$	-11.46(4.28)**	-9.10(3.94)*	
Flexible Thinking$_{acc}$	11.51(2.55)***		
Attention$_{acc}$	5.34(2.65)*	6.42(2.44)**	
Attention$_{sp}$		-6.8(2.14)**	
Verbal Memory$_{acc}$		5.67(2)**	17.22(6.94)*
R^2	0.44	0.40	0.41
N	1433	1441	373

$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

Discussion

This research indicates that the MindPrint Assessment accounted for 44% of Math outcomes, 40% of the ELA outcomes, and 41% of the Science outcomes on the PSSA. These findings reaffirm the importance of examining a broad range of cognitive functions in predicting student outcomes on summative assessments. In particular, student performance on the Verbal Reasoning, Abstract Reasoning, and Spatial Perception tasks were most highly predictive of PSSA achievement outcomes.

Results of this linking study highlight the cognitive skills most highly predictive of PSSA achievement outcomes, clarifying the underlying factors driving student achievement. These results can serve as a guide for instructional next steps to empower educators to create individualized learning experiences and personalize instructional strategies which contribute to longer-term achievement. Overall, these results suggest adapting instruction to support students based on their relative cognitive strengths and weaknesses could translate to gains across Math, ELA, and Science.

About the Author

Dr. Nancy Tsai is an expert in applied Cognitive Neuroscience where she examines the link between executive functions and human well-being. She completed her scholarly training at U.C. Berkeley, Harvard University, U.C. Irvine, and is currently a research fellow at MIT and instructional faculty member at Harvard College. Nancy has won numerous awards for her scientific work, including funding from the National Science Foundation. Her original research is published in *Journal of Neuroscience, Brain & Cognition*, *Journal of Applied Research in Memory and Cognition*, among other top peer-reviewed journals.