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Mathematics Performance of At-Risk First Graders with Limited English Proficiency

Introduction

- A link between oral language abilities and mathematical development is well established, not only in the development of word-problem (WP) solving, but also in calculation (CA) skill
- Many students struggle to make sense of numerals and symbols, as well as building a problem model from text.
- English Learners (ELs) face additional obstacles:
 - Conventions of the English language
 - Unfamiliar math vocabulary
 - Language structure of math WPs
- Important to distinguish between risk for math difficulty (MD) and second language learning challenges for proper early intervention.

Purpose

- To explore the interaction between students' limited English proficiency (LEP) status and mathematical risk status on CA and WP solving ability.
- To provide insight into how the achievement gap between LEP students and native English-speaking students emerges during first grade.

Participants

- Southeastern metropolitan school district
- 1st grade

lunch.

- 260 students, 118 classrooms, 25 schools
- No significant difference between at-risk (AR) and not at-risk (NAR) groups on race, gender, or socio-economic status.

Table 1. Demogra	phics by Subgro	oup		
	At-	At-Risk Not At-Risk		t-Risk
	Limited	Native	Limited	Native
	English	English	English	English
	Proficiency	Speakers	Proficiency	Speakers
	(1-17)	(11-34)	(11-37)	(1-170)
	n (%)	n (%)	n (%)	n (%)
Gender				
Female	12(63%)	18(53%)	17(46%)	80(47%)
Male	7(37%)	16(47%)	20(54%)	90(53%)
Race				
African American	0(0%)	21(62%)	1 <mark>(</mark> 3%)	75(44%)
White	0(0%)	9(26%)	0(0%)	68(40%)
Hispanic	17(90%)	3(9%)	31(84%)	17(10%)
Asian	1 (5%)	0(0%)	3(8%)	4(2.5%)
Other	1 (5%)	1 (3%)	2(5%)	6(3.5%)
Low Income	19(100%)	29(85%)	35(95%)	144(85%)
Note. Low income	e was operation	alized as qualif	ying for free or red	duced-price

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Measures



Screening Measures

First-Grade Test of Computational Fluency: 25 items sampling the typical firstgrade computation curriculum: adding and subtracting singledigit numbers, adding three single-digits, adding numbers without regrouping, and subtracting a 1-digit number from 2-digit number First-Grade Test of Mathematics Concepts and Applications: 25 items sampling the typical first-grade concepts/applications curriculum (i.e., numeration, concepts, geometry, measurement, applied computation, money, charts/graphs, word problems) Wechsler Abbreviated Scale of Intelligence: WASI-Vocabulary & WASI-Matrix Reasoning

Calculation Performance

Test of Arithmetic Fluency: 25 addition problems with answers from 0 to 18, presented vertically on one page and 25 subtraction fact problems with answers from 0 to 18, presented vertically on one page

Word-Problem Performance

Story Problems: 14 story problems involving sums or minuends of 9 or less, with change, combine, compare, and equalize relationships First-Grade Vanderbilt Story Problems: 18 problems sampling combine, compare, and change word-problem types

Method

Fall Grade 1 Measures

CA: Test of Arithmetic Fluency WP: Story Problems

CA: Test of Arithmetic Fluency WP: First-Grade Vanderbilt Story Problems

Risk status was determined using a latent class approach by combining the concepts and computations screening measures into a single latent factor. Excluded students who scored <10th percentile on WASI-Vocab & WASI-

- Matrix Reasoning.
- Two-way between-group analysis of variance (ANOVAs) were conducted to assess interactions between risk (AR vs. NAR) and LEP status (LEP vs. native-English speaking) on CA and WP performance.
- Effect sizes (ESs) were calculated by subtracting means and dividing by the standard deviation (SD) of the NAR or the native-English speaking groups.



Spring Grade 1 Measures

	LEP Status			Risk Status			LEP*Risk	
	F	р	d	F	р	d	F	р
CA Fall	.31	.576	.34	63.39	<.001	1.33	.77	.382
CA Spring	5.48	.02	.58	40.35	<.001	1.13	1.03	.311
WP Fall	5.19	.023	.66	83.65	<.001	1.6	5.94	.016
WP Spring	7.08	.008	.64	37.19	<.001	1.12	2.03	.156

- measures.
- No main effect for LEP status on Fall CA; however, a main effect developed by spring.
- Interaction effect between LEP status and risk status on Fall WP solving
 - Post-hoc analysis found a significant difference between NAR LEP and native-English speaking students, but no significant between AR LEP and native-English speaking students.
- Results show the impact of LEP status on the development of early computation skills as well as an interaction between LEP status and risk status on word-problem solving skills.
- The emerging achievement gap between ELs and native English speakers suggests English language proficiency is a factor in CA skill development.
- In WP, the differing ES patterns could be attributed to academic language, with NAR students having stronger academic vocabulary and understanding than their AR peers.
- Future research should explore relationships between ELs math achievement and
- Performance on language placement assessments Hours of language services per week Generational status– first or second generation

Please contact:

of Health.



Results

Anticipated a main effect for risk status on CA and WP solving because students had been designated as AR for mathematics disability based on performance on screening

Discussion

English Language Learner

For Further Information

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