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The Collective Effects of Teachers' Educational Beliefs and Mathematical Knowledge on Students' Mathematics Achievement

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Introduction

Background

Research Questions

Method

Results

Conclusions



To investigate the predictive value of teacher-related factors such as beliefs, knowledge, and professional background on student mathematics achievement

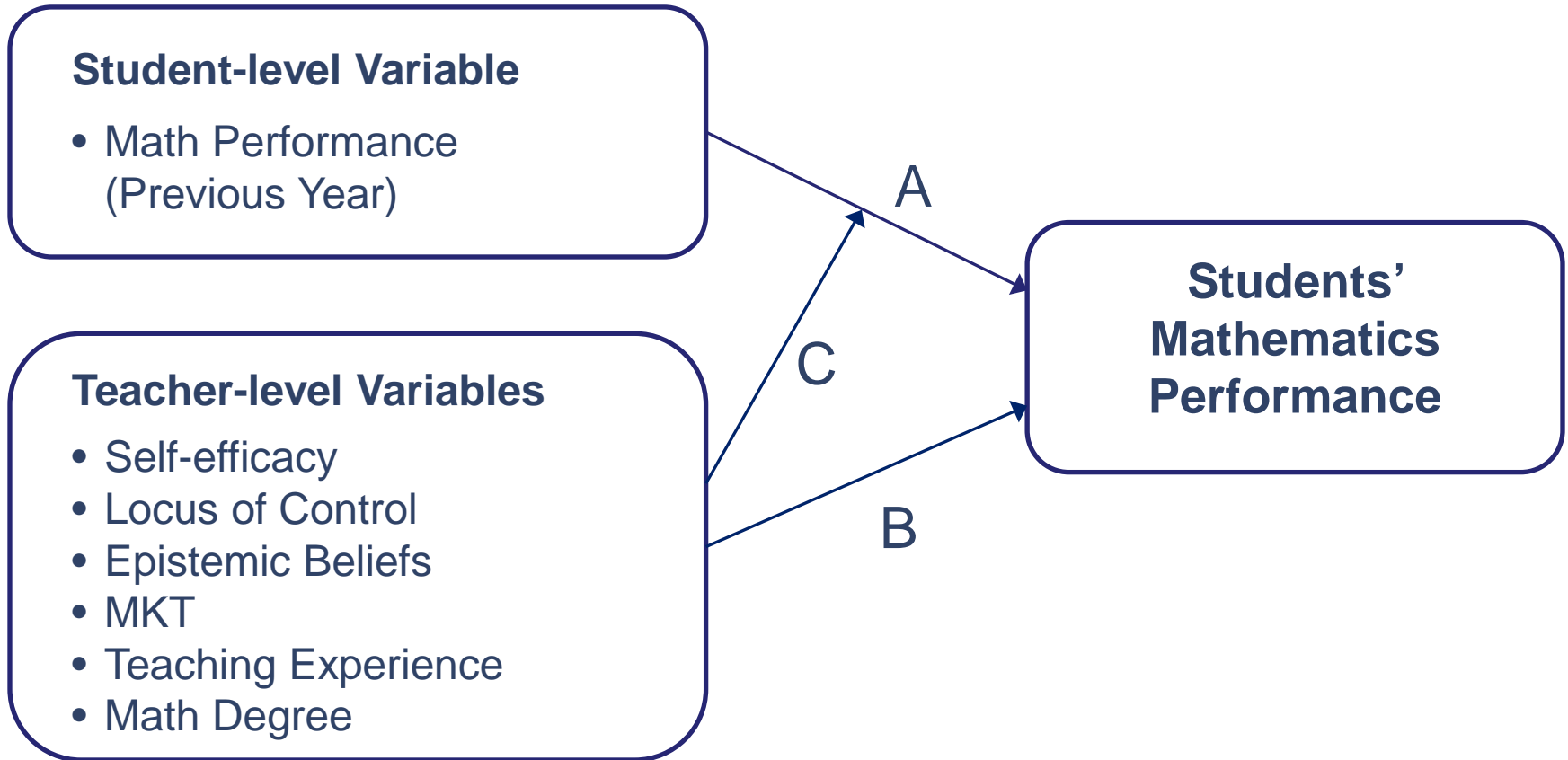


- Teacher educational beliefs:
 - Self-efficacy beliefs: degree to which teachers believe they can successfully perform teaching-related tasks within a particular domain or context (Enochs, Smith, & Huinker, 2000)
 - Internal locus of control: extent to which teachers attribute student outcomes (i.e., achievement) to themselves or other (external) factors (Rose & Medway, 1981)
 - Epistemic beliefs: beliefs about the nature of knowledge—i.e., where it comes from, its essence, and how one comes to know (Hofer & Pintrich, 1997)



- Mathematical Knowledge for Teaching (MKT):
“The mathematical knowledge that teachers use in classrooms to produce instruction and student growth”
(Hill, Ball, & Schilling, 2008, p. 374).
- Experience
 - High experience: 6 years or more
 - Low experience: < 6 years (Wolters & Daugherty, 2007)
- Educational background in subject matter (Rice, 2003)







- A. To what extent do students' prior math achievement relate to their subsequent math achievement?

- B. To what extent do teacher-level characteristics (e.g., beliefs, MKT, college math degree, and experience) relate to students' math achievement?

- C. To what extent does the relation between students' prior math achievement and current math achievement vary by teacher-level characteristics?



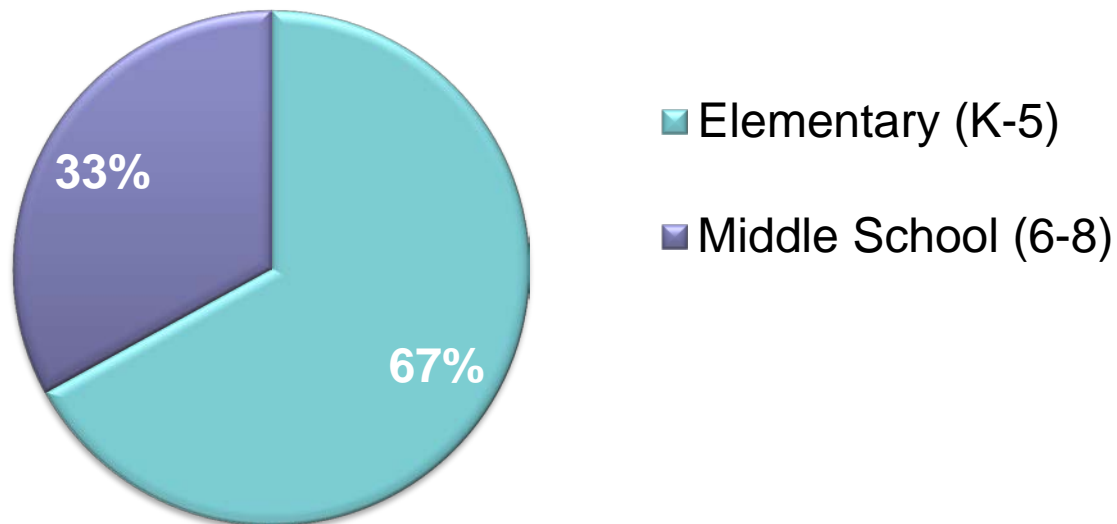
- Teacher data:
 - Survey:
 - Demographics and teachers' educational background
 - Teacher self-efficacy (Enochs, Smith, & Huinker, 2000)
 - Internal locus of control (Enochs, Smith, & Huinker, 2000)
 - Epistemic beliefs (Schoenfeld, 1989)
 - MKT:
 - Learning Mathematics for Teaching (LMT) assessment (Hill, Schilling, & Ball, 2004)
- Student data:
 - Student scores on a standardized mathematics test (Stanford 10) given at the end of the academic year



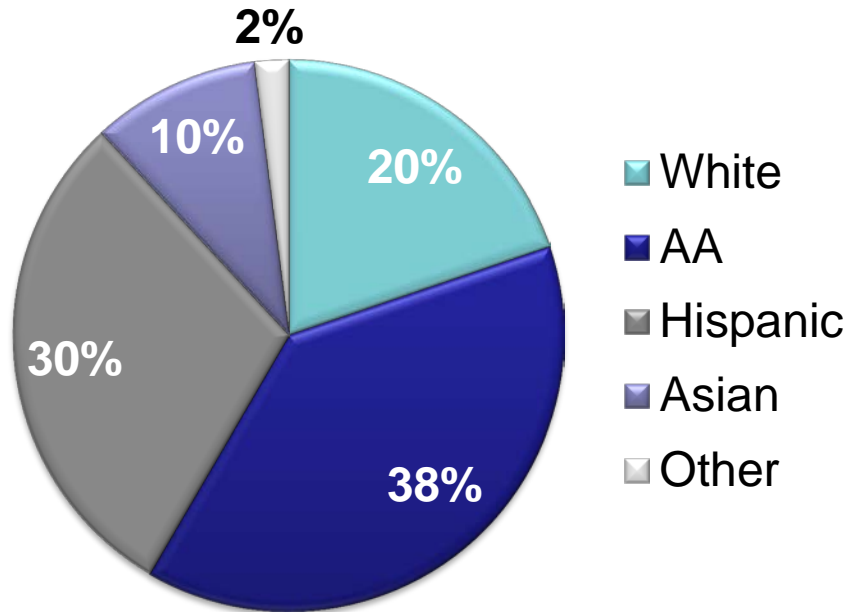


- This study included 39 of 80 K-12 math teachers who participated in a summer professional development (PD) program.

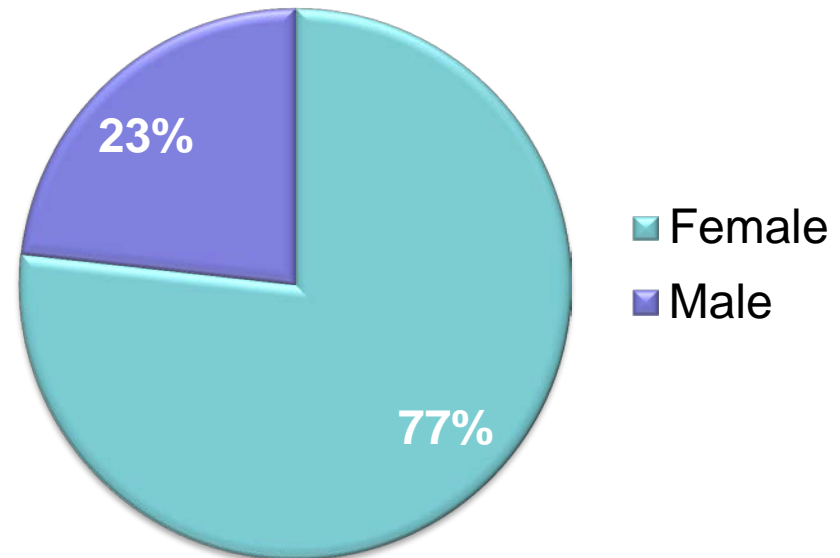
School Level of Teachers Included in the study



Demographic Breakdown of Participating Teachers



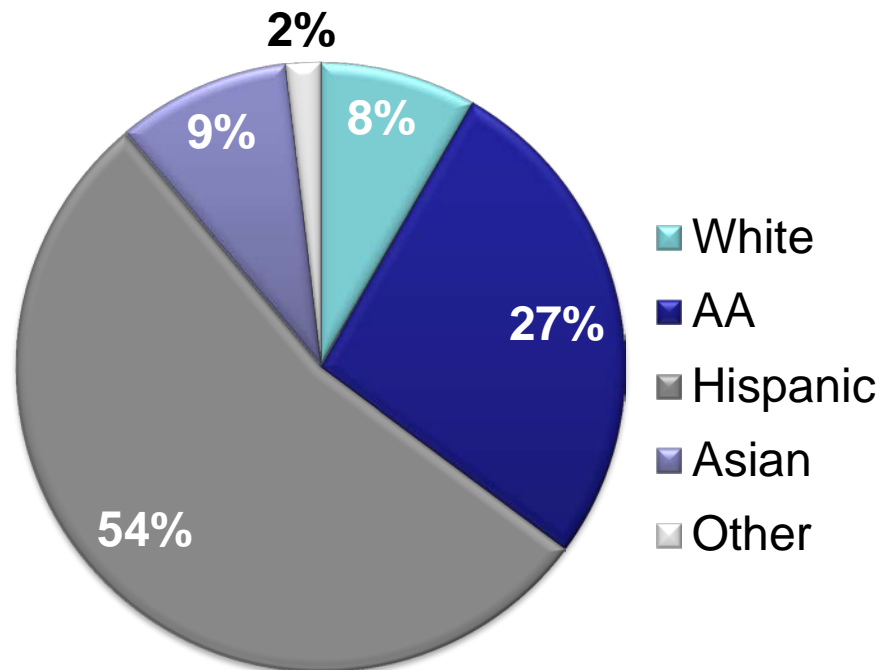
Gender of Participating Teachers





- This study included 2038 K-8 students (List-wise deletion resulted in a sample size of 1129).

Ethnic Background of Students





Independent Variable	Model 1 (unconditional)		Model 2 (within teacher)		Model 3 (between teacher)	
	β	SE	β	SE	β	SE
<i>Fixed Effects</i>						
Intercept	0.03	0.10	0.02	0.11	0.21	0.16
Prior Math Achievement			0.79***	0.02	0.85***	0.05
Self-Efficacy					-0.19	0.16
Locus of Control					0.02	0.12
Epistemic Beliefs					0.28	0.16
LMT					0.06	0.15
Math Degree					0.42*	0.19
Years of Teaching					0.09	0.11
Prior Math Achievement X						
<i>Self-Efficacy</i>					-0.02	0.03
<i>Locus of Control</i>					0.02	0.03
<i>Epistemic Beliefs</i>					0.00	0.04
<i>LMT</i>					0.04*	0.03
<i>Math Degree</i>					0.08	0.06
<i>Years of Teaching</i>					0.06*	0.03
<i>Random Effects (Variance Components)</i>						
Student-level effect r_{ij} (σ^2)	0.77***	0.03	0.30***	0.01	0.29***	0.01
Intercept Teacher mean, u_{0j}	0.26**	0.08	0.26**	0.09	0.24*	0.10
Slope, u_{1j} (τ_{11})					0.00	0.01
Wald Z (Variance explained)	3.260** (25%)		2.864** (64%)		2.660** (9%)	
AIC / BIC	3775 / 3785		1938 / 1948		1932 / 1942	

Arrow A

Arrow B

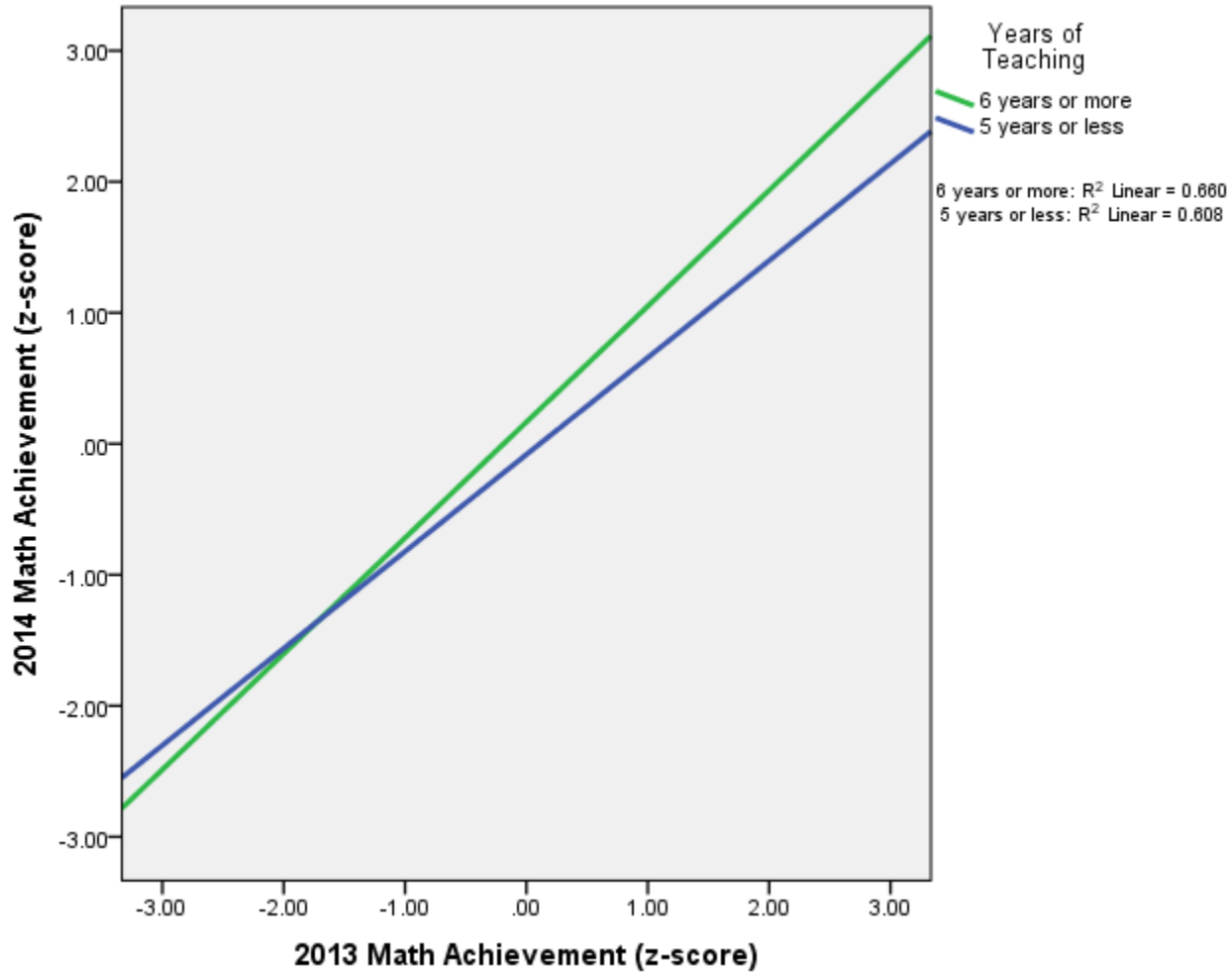
Arrow C

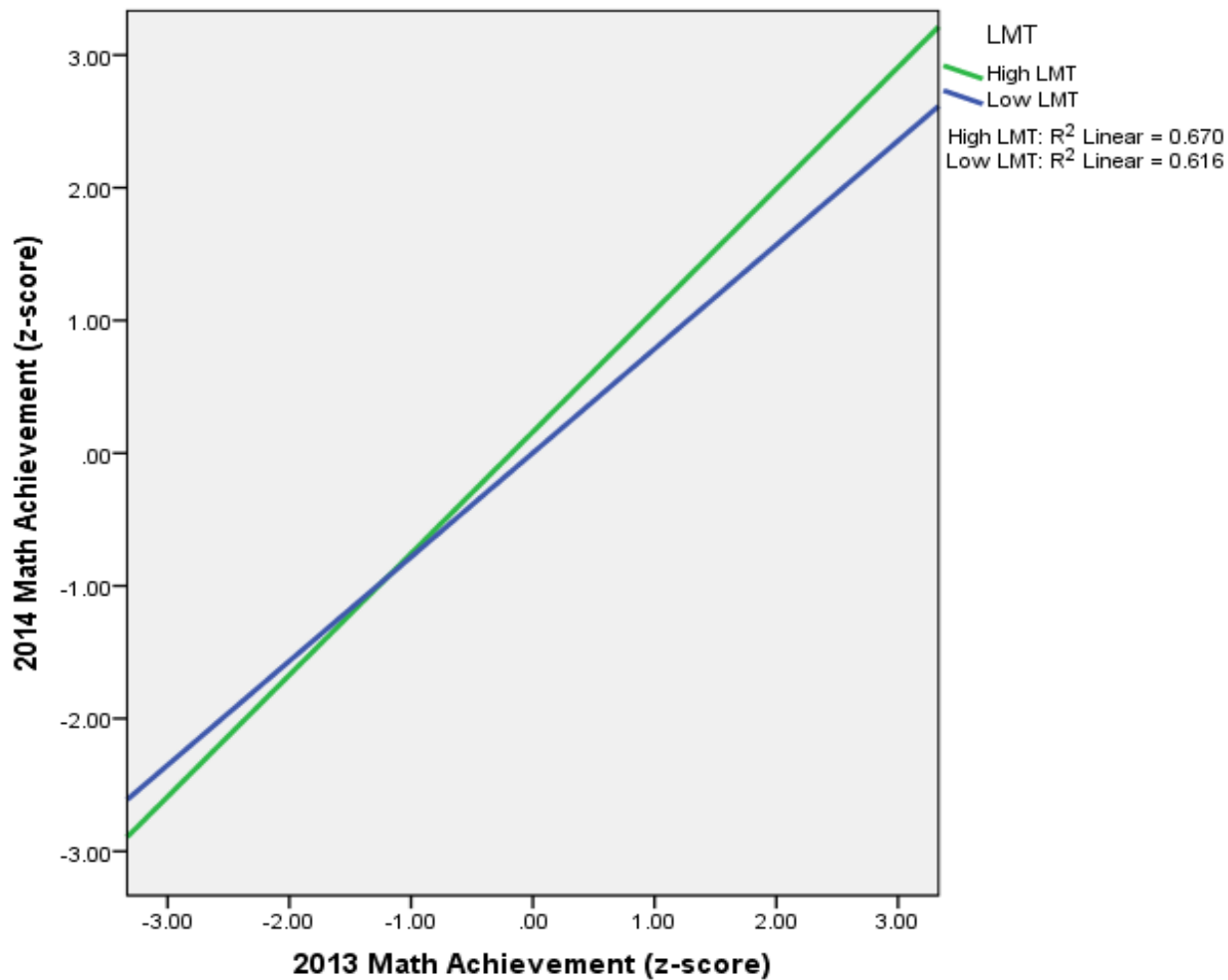
* $p < .05$. ** $p < .01$. *** $p < .001$.



- Significant stand-alone predictors of mathematics achievement were
 - Prior mathematics achievement (*student level*), and
 - Teachers' mathematics degrees (*teacher level*).
- Teachers' years of experience and MKT had a significant effect on the relation between prior and current mathematics achievement.







- Students' prior achievement is the most significant predictor of math achievement (Duncan et al., 2007).
- Teachers having math degrees is positively associated with students' math achievement (Rice, 2003).
- Teaching experience and MKT moderates the relation between prior and current math achievement (Hill, Rowan, & Ball, 2005).
- Teachers' beliefs did not emerge as statistically significant predictors of students' math achievement (see Corkin, Ekmekci, & Papakonstantinou, 2015).



- Teacher educators should pay close attention to developing MKT.
- Teacher preparation courses should place an emphasis on improving MKT.
- Administrators should retain experienced teachers and provide support for less experienced teachers (e.g., induction, mentoring, collaboration, PD programs).
- Teachers who do not have a strong math background should be given opportunities to learn more math content.





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THANK YOU !

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The slides will be available at RUSMP website

