



ASSESSING THE IMPACT OF A NEW SCIENCE CURRICULUM ON UNDER AND OVER-ACHIEVING STUDENTS

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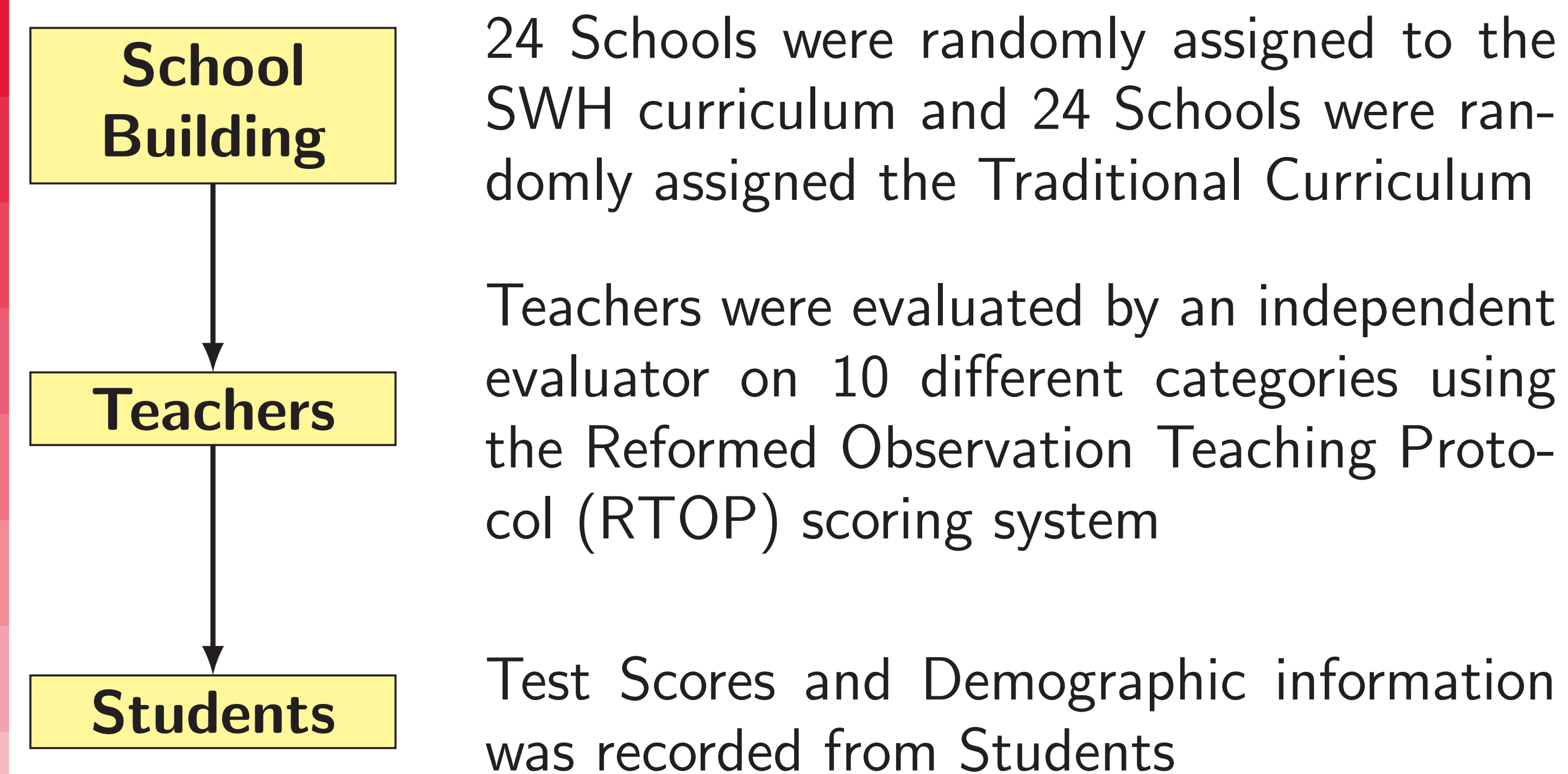
ABSTRACT

The impact of a new science curriculum on students' critical thinking skills was investigated using a randomized controlled study. A structural equation model is used to model students' abilities and evaluate the impact of the quality of the teacher on student performance as measured by their improvement on the Cornell Critical Thinking Test. A two-level quantile regression is used to dissect the effect of the teacher and the Science Writing Heuristic curriculum on students at various quantiles. The quality of the teacher is seen to have the greatest impact on students at lower quantiles. However, the overall impact of the quality of the teacher on the performance of the students is marginal. The impact of the curriculum is seen to have an impact at many quantiles, particularly for students at lower quantiles.

SCIENCE WRITING HEURISTIC (SWH)

SWH targets improving students' understanding of science by embedding science argument within typical inquiry lessons. This promotes critical thinking and science reasoning into the inquiry approaches, using language to negotiate students' understanding of science. Students are required to pose questions, generate claims and evidence, compare their answers with other students and reflect on changes in their understanding. Finally they put this in written form which improves their English and reasoning abilities.

MULTI-LEVEL STUDY DESIGN



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THE DATA

Teachers submitted video recording of themselves teaching which were then rated using the Reformed Observation Teaching Protocol (RTOP) instrument by an independent evaluator at the University of Iowa.

Approximately 88% of the students completed all the exams and approximately 47% of teachers submitted a video to be rated.

THE MODEL

A recursive Structural Equation Model as discussed in Chesher (2003) and Ma and Koenker (2004) is used to evaluate estimate the teacher and student effects. A generic version of the model is given below. Missingness was accounted for through inverse probability weighting.

$$\text{Rating} = \text{Treatment} + \text{Student Teacher Relationship} + \text{Procedural Knowledge} + \text{Communicative Interaction} + \text{Lesson Design and Implementation}$$

$$\text{Improvement} = \text{Rating} + \text{Treatment} + \text{Hispanic} + \text{Black} + \text{Free and Reduced Lunch} + \text{Pretest Score}$$

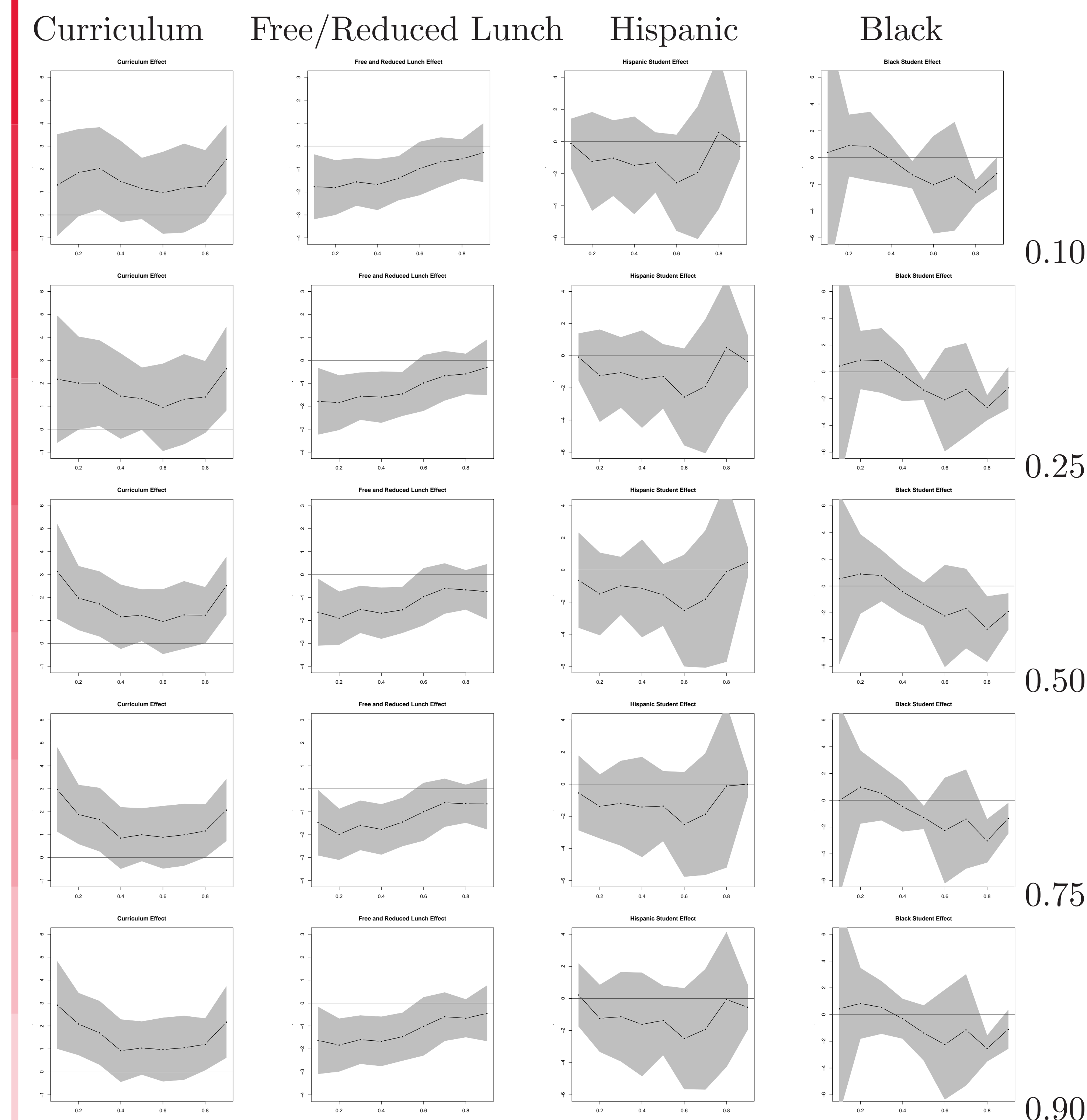
TEACHER QUALITY EFFECTS

Table 1: Quantile Regression Coefficients for Teacher Quality Indices at the Teacher Level.

	0.10	0.25	0.50	0.75	0.90
PK	0.2944	0.3014	0.3425	0.3659	0.3885
CI	0.2974	0.2891	0.2354	0.2597	0.2707
STR	0.1854	0.1923	0.1777	0.1826	0.1981
LDI	0.2203	0.1971	0.2174	0.1927	0.1907

The quantile regression coefficient estimates for teacher level at the five different considered quantiles. The four dimensions, measured using factor scores, from the RTOP instrument evaluated were lesson design and implementation (LDI), procedural knowledge (PK), communicative interactions (CI), and student teacher relationships (STR). All coefficients were highly statistically significant.

QUANTILE REGRESSION RESULTS



The plots, from top to bottom, show the estimated effects conditioned on the 10th, 25th, 50th, 75th, and 90th percentile of teacher ability. The gray shaded area represents 95% confidence bands.

CONCLUSIONS

1. The quality of the teacher has its greatest impact on the students in the bottom quantiles.
2. Teachers are starting off with students of similar overall ability.
3. The largest teacher predictors are the factors for procedural knowledge and communicative interactions.
4. A teacher's understanding of subject matter knowledge and the pedagogical strategies needed to teach that subject matter knowledge have the greatest influence on how well children learn.