

Relations between Grades 7-9 students' conception of the equal sign and algebraic reasoning:

Does having a dual interpretation matter?

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INTRODUCTION

- Students' conceptions of the equal sign are often characterized as:

Operational	Relational
"Calculate the total"	"The same as"
"The answer"	"The amounts on both sides are equivalent"

- Students who hold a relational view are more successful with algebraic tasks (e.g., McNeil & Alibali, 2005; Knuth et al., 2006).
 - However, this research only considered students' "best" definition of the equal sign.
- The current study investigates the impact of holding both operational and relational views simultaneously on students' algebraic reasoning.

RESEARCH QUESTION

How do students' conceptions of the equal sign relate to their performance on algebraic tasks?

METHODS

Participants

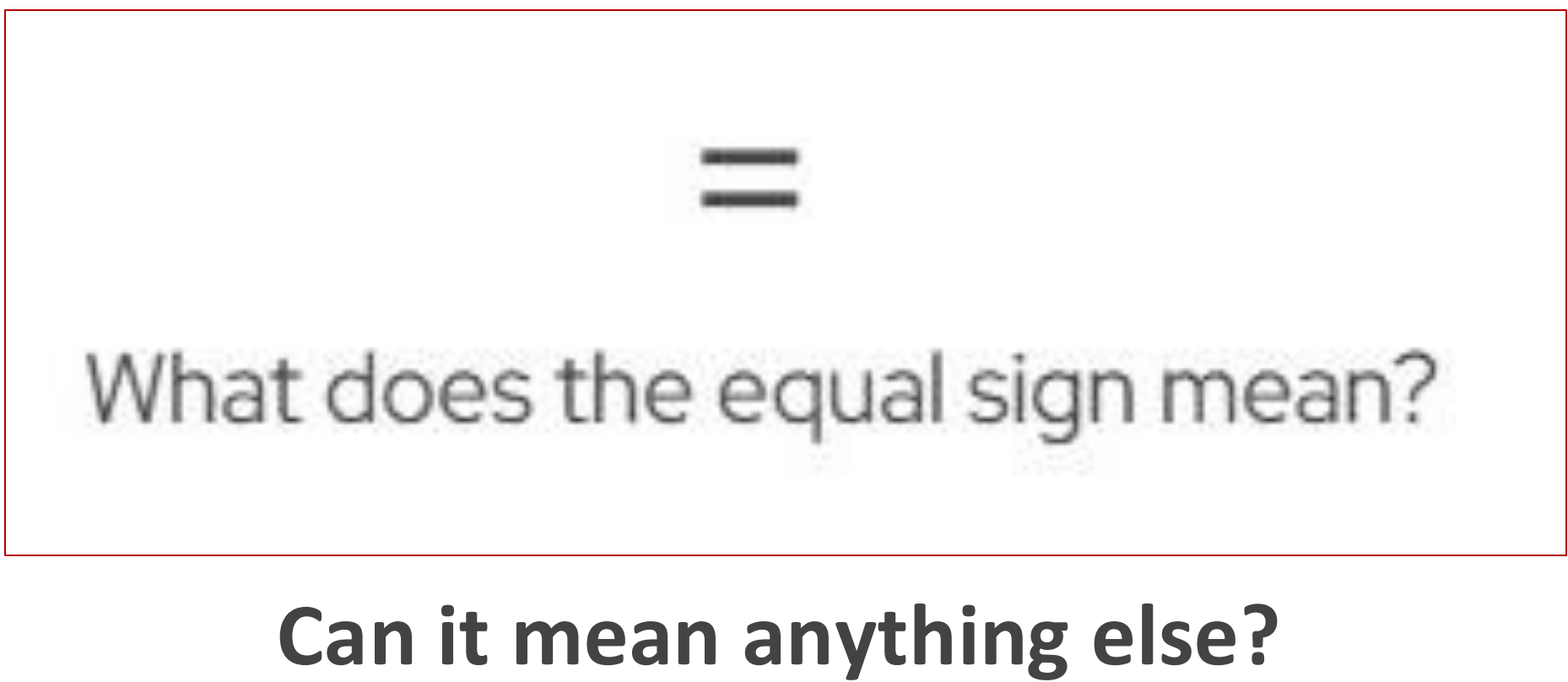
- 163 Grades 7–9 students ($M_{age} = 14.58$) completed four study sessions over Zoom, one of which focused on algebraic reasoning.
- 82 male, 75 female, 6 non-binary
- 12.3% Asian, 4.9% Black, 6.7% Multiracial, 0.6% Native American, 70.6% White, 4.9% Other

Algebra Measure

38 multiple choice and open response items addressing reasoning about expressions, equations, functions, and generalized arithmetic.

Equivalent Equations $25 + 14 = 39$ is true Is $25 + 14 + 7 = 39 + 7$ true or false? How do you know?	Functional Thinking Stephen has a cord for his phone that is some number of feet long. His cord is five times the length of Rebecca's cord. Write an equation to describe the relationship between the lengths of Stephen's and Rebecca's cords.
Operations on Both Sides Solve the equation below for y: $5(y - 2) = -3(y - 2) + 4$	

Equal Sign Definition Measure



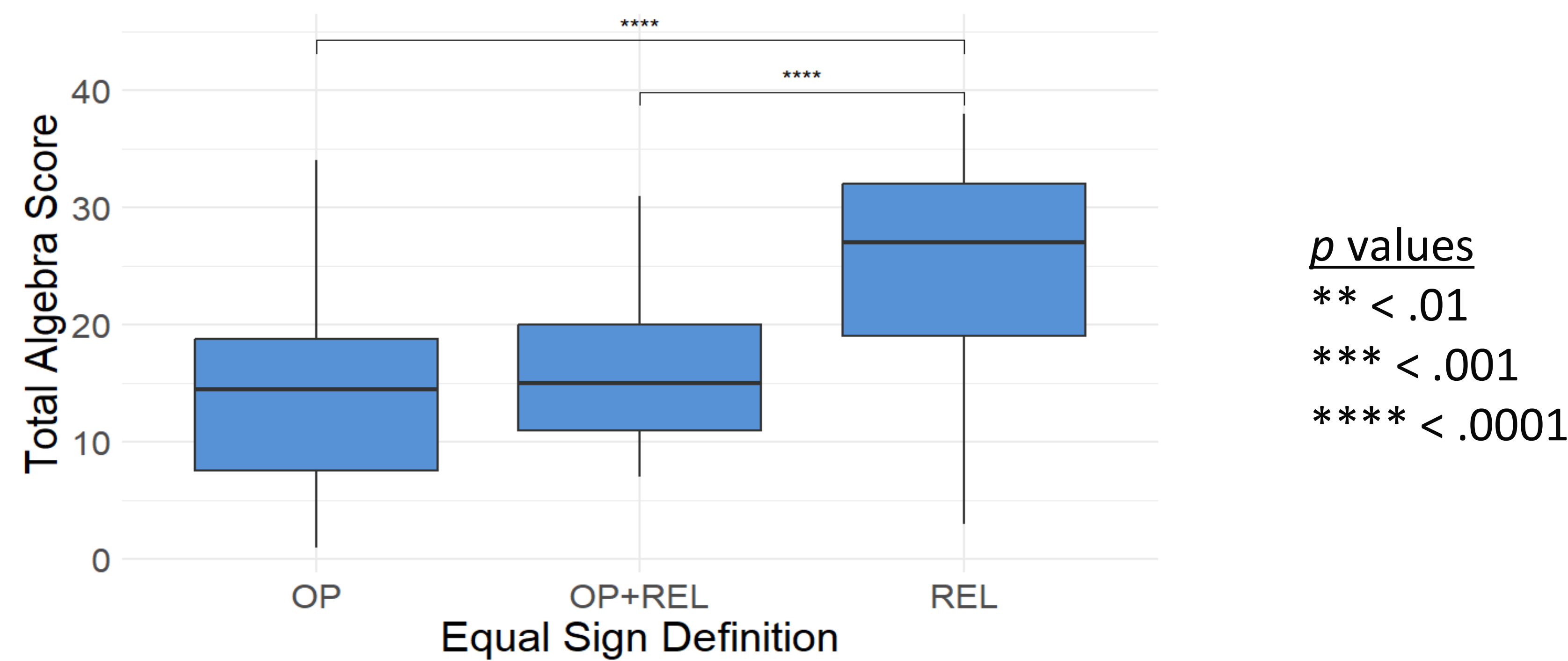
RESULTS

Number of Students Holding Each Equal Sign Conception

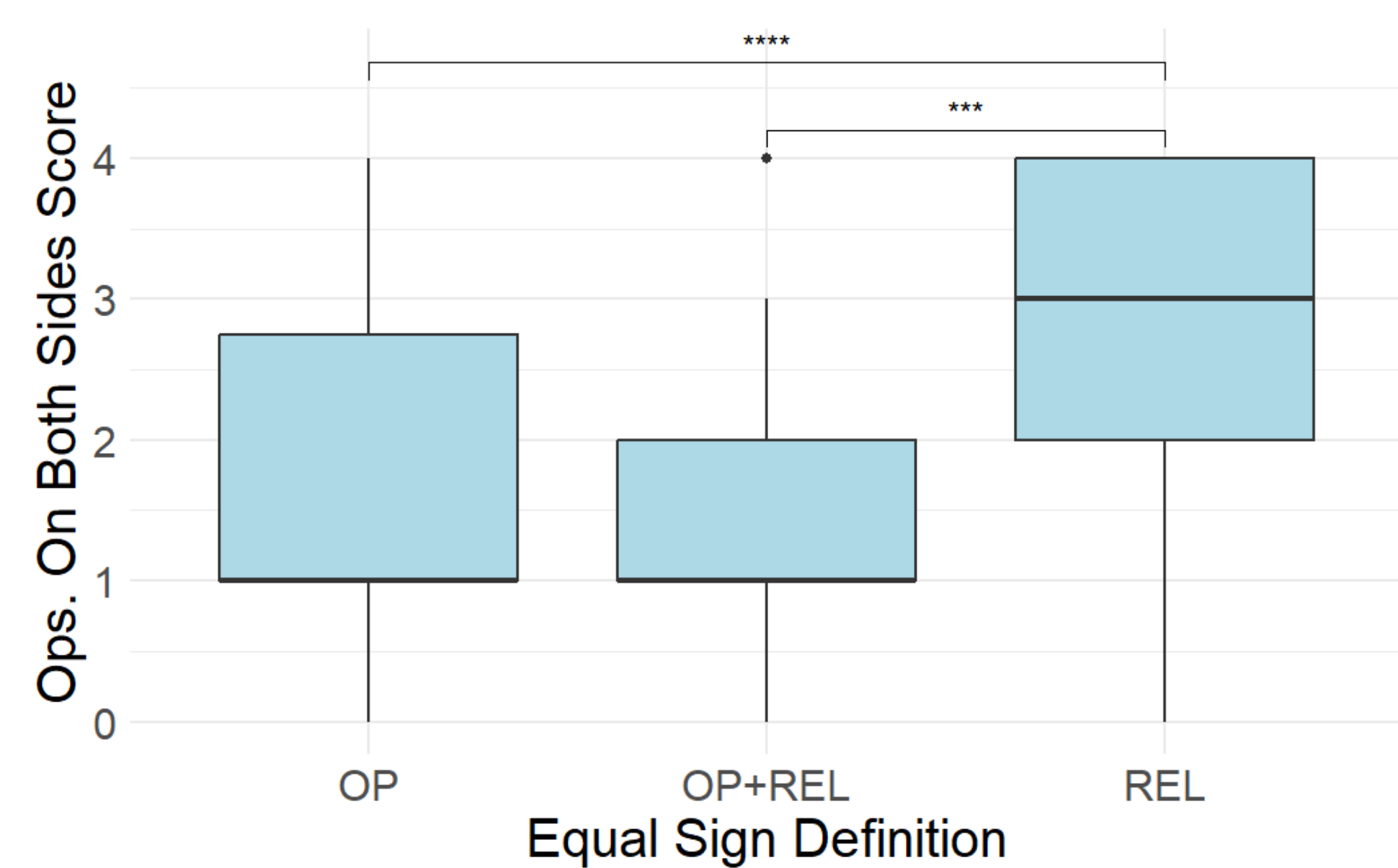
Operational Only	Relational Only	Operational and Relational	Other
26	93	21	23

Only students with OP, REL, or OP + REL conceptions were included in further analyses ($n = 140$).

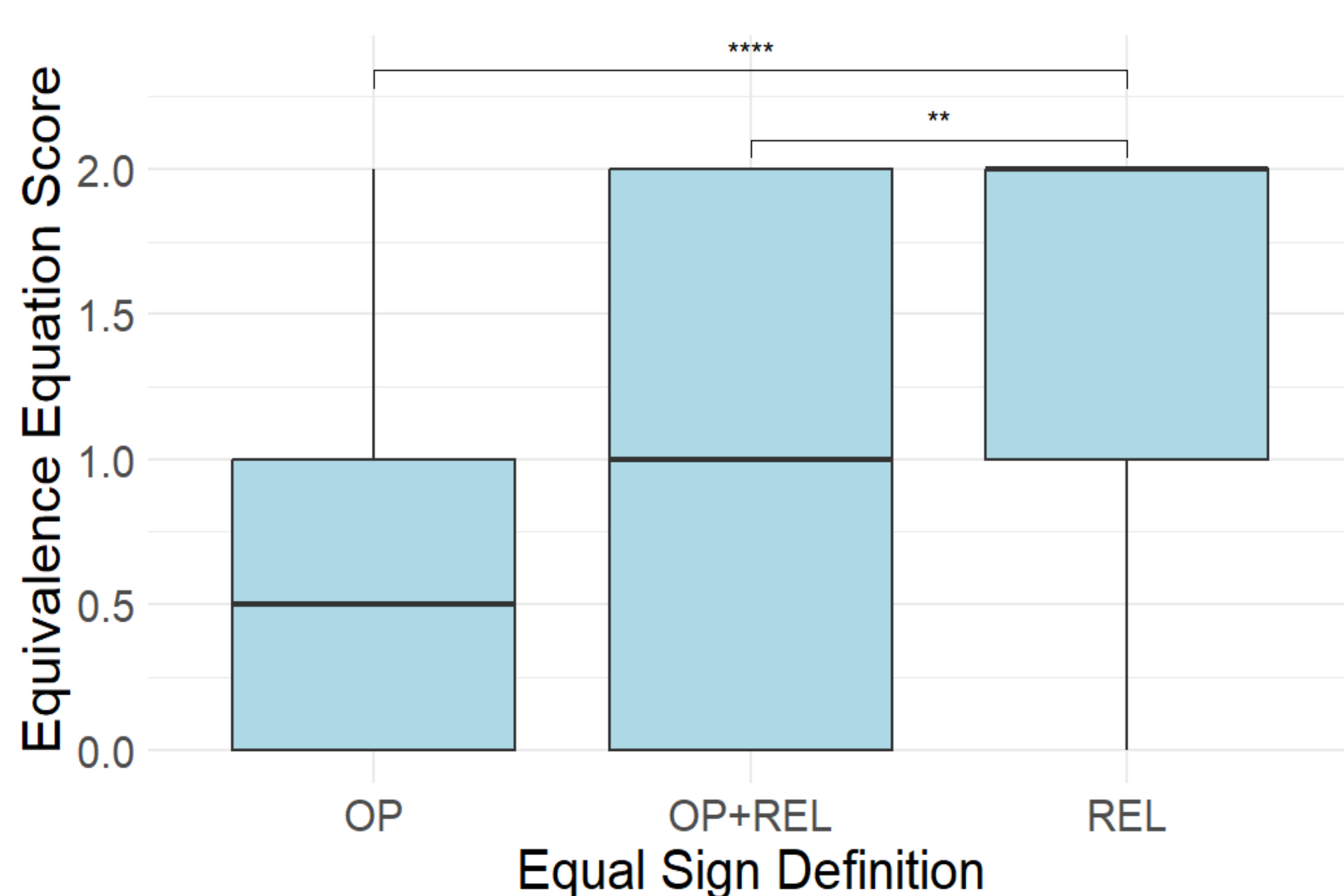
Relation Between Equal Sign and Total Algebraic Performance



Relation Between Equal Sign and Operations on Both Sides



Relation Between Equal Sign and Equivalent Equations



Note. Responses to the equivalent equations items were coded for use of structural strategies (i.e., recognizing truth value or equivalence without computation).

DISCUSSION

- For students holding more than one equivalence conception, an operational conception of the equal sign "hurts" performance on algebraic problem solving more than holding a relational conception "helps."
- Educators' use of precise and consistent relational language in reference to the equal sign may promote a solely relational understanding in students, leading to improvements in their algebraic performance.
- Further exploration of which equal sign interpretation was produced first may provide insights into what conceptions students are relying on while solving algebraic problems.

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