

Does Strategy Use Explain the Relations Between Students' Performance on Different Fractions Tasks?

Introduction

- Fraction knowledge strongly predicts later mathematical achievement (Booth et al., 2014); however many students struggle with basic fractional concepts
- Fractions are understood through various subconstructs (e.g., Behr et al., 1983; Kieren, 1980)

Subconstruct	Example: %
Part-Whole	3 slices out of a whole pizza with 4 slices
Measure	Distance that is $\frac{3}{4}$ of the way from 0 to 1
Quotient	3 divided by 4
Operator	Scaling factor that one can multiply by 4 to get 3
Ratio	3 apples: 4 oranges

- Performance on part-whole and fraction measure tasks may be highly related
 - Similarity in representations (number lines and bars)
 - May elicit same type of strategy across tasks
- OR regardless of representation, the tasks themselves may independently elicit specific strategies
 - More estimation strategies (e.g., benchmarking) on number lines
 - More exact strategies (e.g., partitioning) on part-whole problems

Research Questions

- Q1. Is performance on part-whole reasoning and NLE related when controlling for other relevant fraction knowledge and characteristics?**
- H1:** Part-whole reasoning will predict fraction NLE, over and above other subconstructs of fractions knowledge and covariates
- Q2. Are strategies for working with fractions task-specific or do students use the same types of strategies across different tasks?**
- H2a:** Students will use the same types of strategies across different tasks
- OR
- H2b:** Part-whole tasks will elicit more exact strategies (partitioning) and number line problems will elicit more estimation strategies (e.g., benchmarking)

Methods

Participants

- 289 Students in grades 7th, 8th, and 9th ($N_s = 109, 101, 79$)
 - 55% Male, 48% Female, 2% Non-Binary
 - 74% White, 18% Asian, 5% Black and/or African American, 3% Other
 - 65% of families earned over \$100,000 annually, 10% between \$75,000-\$99,000, 8% between \$50,000-\$74,999, and 4% less than \$49,999.

Procedure

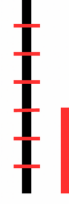
- Students participated in 3 Zoom sessions that assessed their fractions and algebra knowledge
- A subsample of 40 students also completed a 4th session in which they were interviewed on their strategy use

Key Measures

Part-Whole Reasoning

The bar shown below is $\frac{7}{3}$ as long as the whole candy bar.
Draw the whole candy bar.

Exact Strategy



Estimation Strategy



Fraction Number Line Estimation



Exact Strategy

"I mentally split the line into 9."

Estimation Strategy

"It's very close to the end."

Results

- Part-whole reasoning significantly predicted fraction NLE ($\beta = -0.20, p = .002$)

Figure 1

Strategy usage for those who used the same types of strategies across both tasks ($N = 21$)

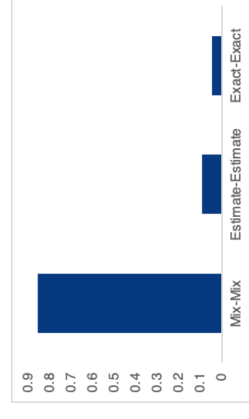
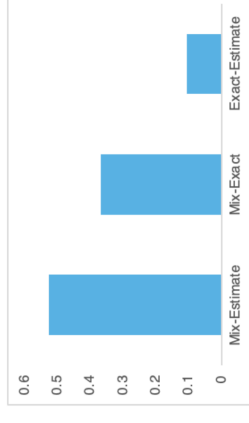


Figure 2

Strategy usage for those who used different types of strategies across both tasks ($N = 19$)



Discussion

- Part-whole reasoning uniquely predicted fraction NLE
- Students' strategies vary both across tasks and within-task
 - Students often switched between estimation and exact strategies
- Future work will examine effects of task wording on strategy use
 - e.g., "Draw a line as long as..." vs. "Draw the whole bar."

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