

# Fraction Schemes and Magnitude as Predictors of Algebraic Functional Thinking

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## INTRODUCTION

- Algebra is an important predictor of students' future outcomes, yet many students struggle to understand it.
- Fractions knowledge is uniquely related to algebra, but the exact relationship is unknown (e.g., Hurst & Cordes, 2018).
- Previous research has shown fraction scheme to be a stronger predictor than fraction magnitude knowledge for algebra success (Viegut et al., 2024).
- It is uncertain if this would replicate with algebra's subconstruct, functional thinking.

## RESEARCH QUESTION

Which fraction subconstruct - fraction magnitude or fraction schemes – better predicts success on algebraic functional thinking?

## HYPOTHESIS

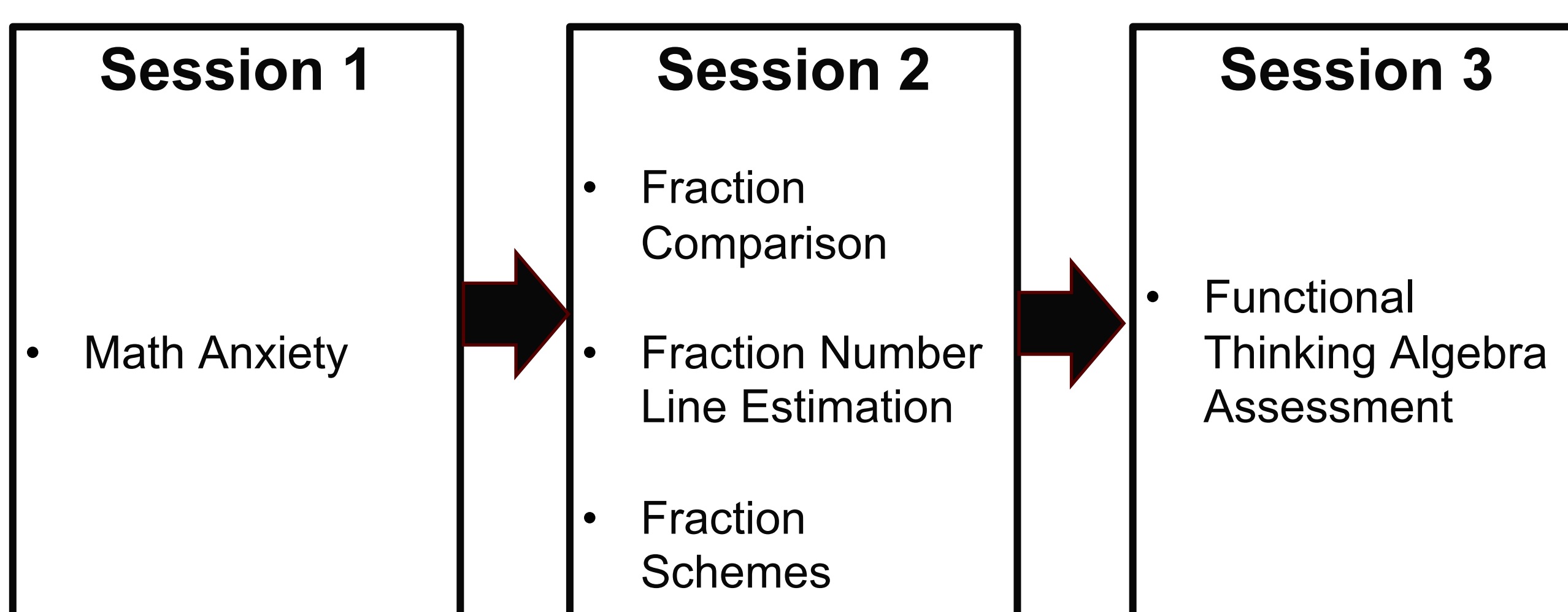
Fraction schemes will be a stronger predictor of algebraic functional thinking than fraction magnitude.

- Fraction schemes require understanding the complex relationships between fraction parts and wholes, similar to the reasoning necessary in functional thinking tasks.

## METHODS

### Participants

- 7th – 9th grade students ( $n = 58$ )
- 60% male, 38% female, 2% nonbinary
- 71% White, 20% Asian, 2% Black/African American, 2% American Indian/Alaska Native
- 3 sessions via Zoom



## METHOD (CONT.)

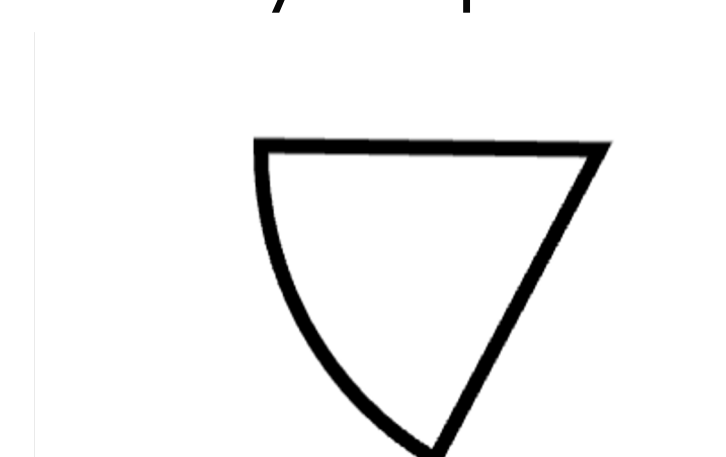
### Fraction Schemes

Ability to reason about multiplicative relations between fraction parts and wholes (Norton & Wilkins, 2012)

2. The bar shown below is  $\frac{5}{4}$  as long as a whole candy bar. Draw the whole candy bar.

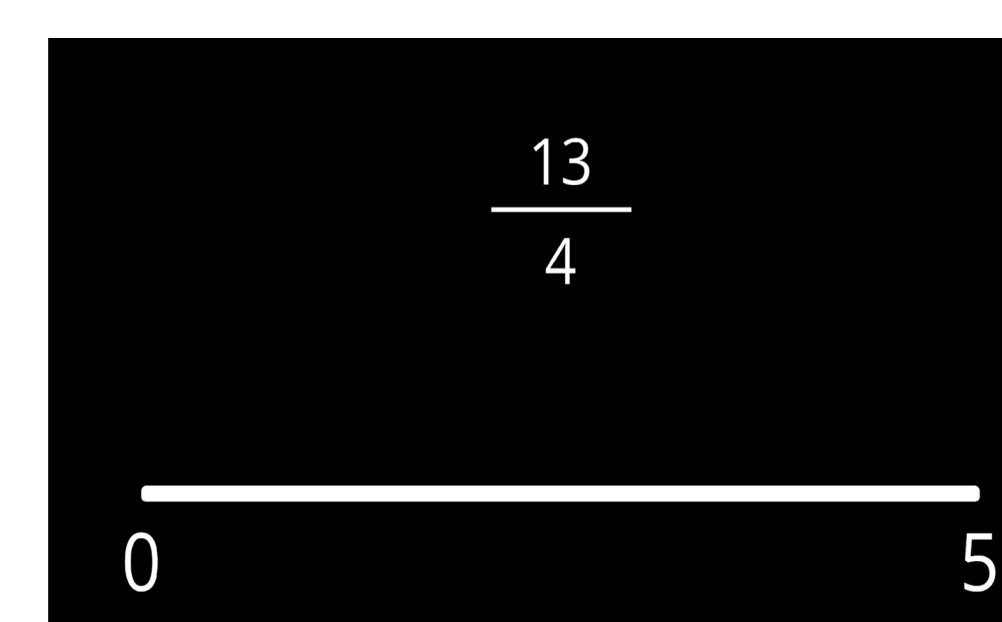
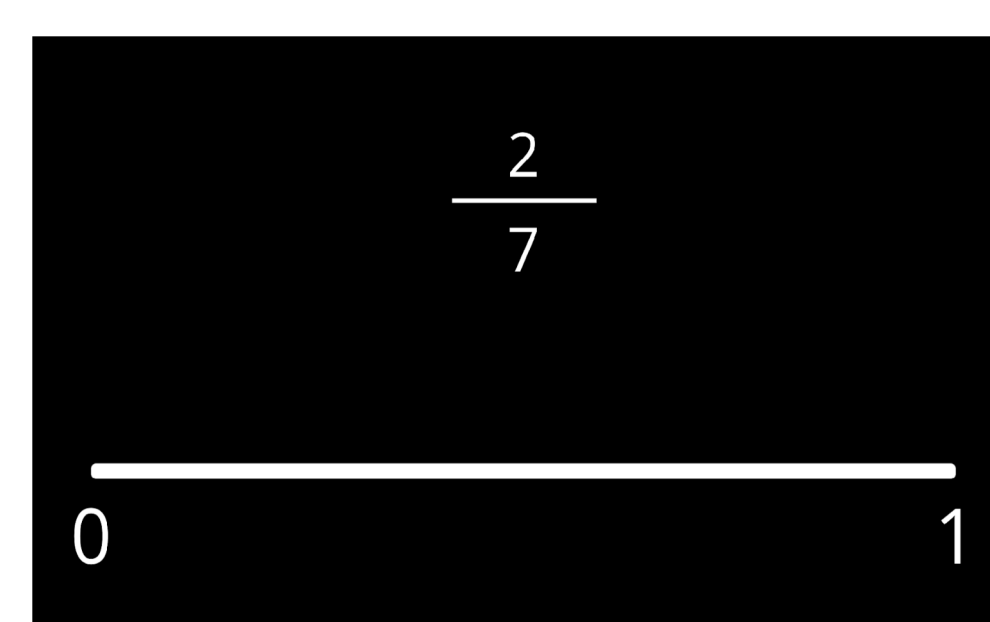


15. The piece of pie below is  $\frac{2}{5}$  as big as your piece of pie. Draw your piece of pie.

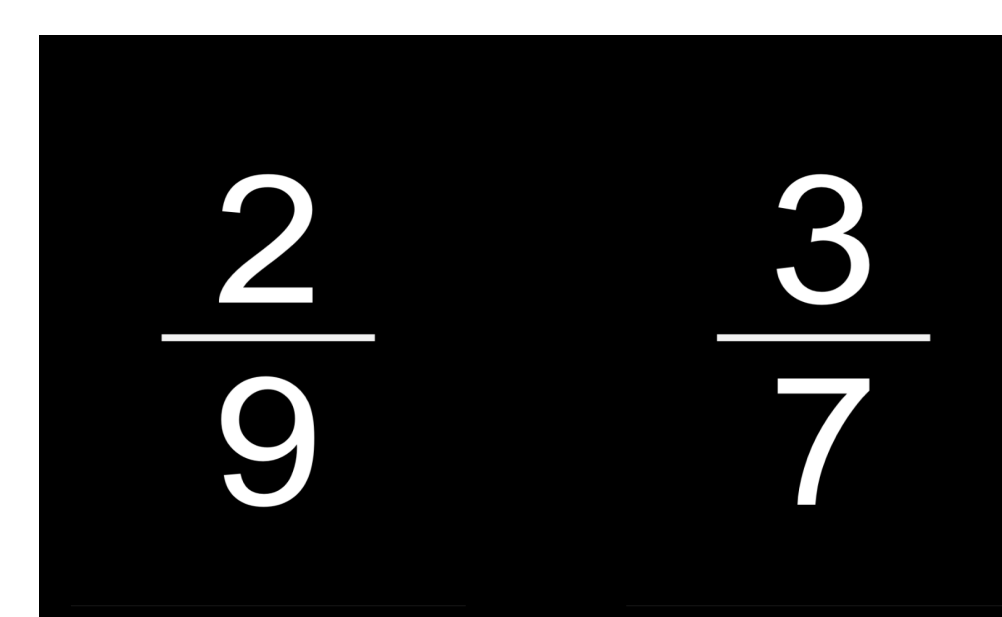
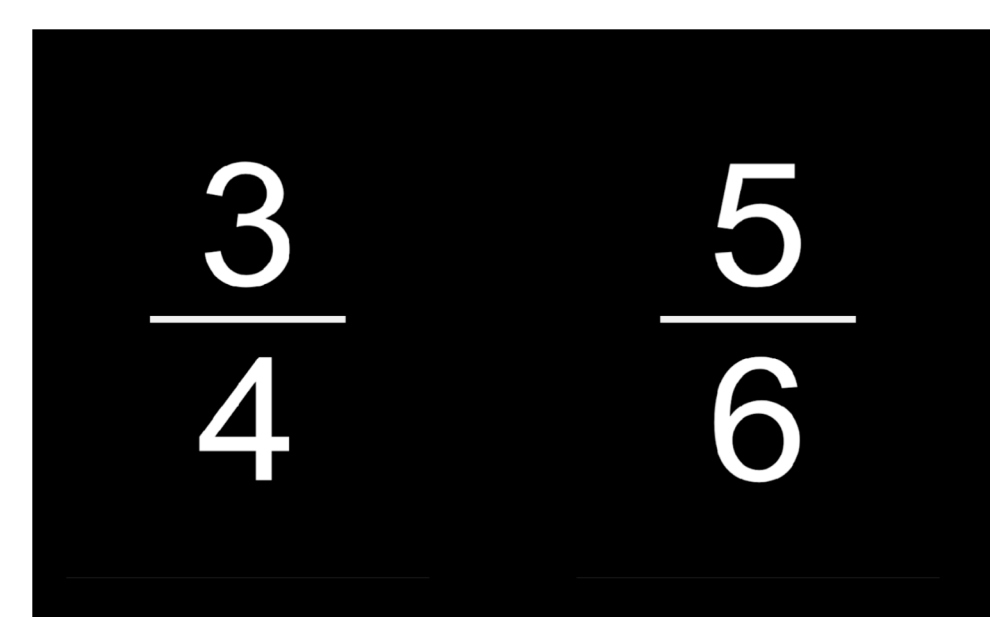


### Fraction Magnitude

#### Number Line Estimation (e.g., Booth et al., 2014)



#### Speeded Fraction Comparison (e.g., Matthews et al., 2016)



### Functional Thinking

Ability to understand and reason about the relationships between variables (e.g., Stephens et al., 2021)

Consider the sequence of toothpick squares below.



- How many toothpicks will pattern 5 have? Explain.
- How many toothpicks will pattern 15 have? Explain.
- Find a direct formula for the total number of toothpicks  $T$  in any pattern number  $n$ . Explain how you got your answer.
- If the pattern above is extended, a certain pattern will use 76 toothpicks in all. Which number is this? Explain how you got your answer.

**Covariates** Grade, Math Anxiety

## RESULTS

### Descriptives

Grade ( $n$ )	Functional Thinking (%)	Fraction Schemes (%)	Fraction Comparison (%)	Fraction NLE (PAE)
7 <sup>th</sup> (20)	41.45	66.54	87.02	10.73
8 <sup>th</sup> (22)	59.20	73.96	88.49	8.90
9 <sup>th</sup> (16)	63.08	71.39	88.08	7.58

### Multiple Regression

The overall regression predicting functional thinking was statistically significant,  $F(5, 35) = 9.28, p < .001, adj. R^2 = .51$ .

	$\beta$	$SE$	$t$	$p$
Grade	2.50	0.54	4.64	< .001***
Math Anxiety	-2.68	0.64	-4.22	< .001***
Fraction Comparison	0.13	0.05	2.49	.02*
Number Line Estimation	0.02	0.15	0.10	.92
Fraction Schemes	-0.05	0.16	-0.29	.78

Notes. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

## DISCUSSION

- Fraction comparison predicts functional thinking when controlling for grade and math anxiety.
- Similarities between fraction comparison and functional thinking could explain our results.
- Math anxiety predicts functional thinking.
- Did not replicate previous findings with fraction schemes and algebra.
- Future research should increase the sample size and examine other algebra subconstructs.

## ACKNOWLEDGEMENTS

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