Children's Evaluations of Fraction Magnitudes in Strip Diagrams: Strip Lengths and Visible Segments Matter

Vijay Marupudi, Martha W. Alibali, Andreas Obersteiner

BACKGROUND & PURPOSE

Fractions
- Difficult for middle school students (Lortie-Forgues, Tian, & Siegler, 2015)
- Magnitude knowledge strongly associated with math achievement, even controlling for fraction arithmetic (Siegler et al., 2012)

Strip Diagrams
- Commonly used to teach fractions (Murata, 2008)
- Kindergarten to grade 4 students perform less well on magnitude comparison with discrete vs. continuous diagrams (Boyer et al., 2008)

Research Questions
Do children perform better at magnitude comparison with:
- continuous strips than with discrete ones?
- same length strips than with different length strips?

Can eye tracking data provide insights into the performance differences?

STIMULI & PROCEDURE

SAME

Different

Discrete

Continuous

Which battery has more power left?

Hypothesized saccade patterns

RESULTS

- Significant interaction of discreteness * length, \( p = .03 \)
- Main effect of discreteness, \( p = .004 \), interaction with magnitude difference, \( p = .02 \)
- Main effect of length, \( p < .001 \)

- Significant interaction of discreteness * length, \( p = .04 \)
- Main effect of discreteness not signif., \( p = .051 \)
- Main effect of length, \( p = .002 \)

DISCUSSION

- Same-length trials allow comparison of shaded portions; different-length trials require mental stretching/squishing or computation with segments
- Discrete trials may have fostered counting strategies

METHOD

Participants: \( N = 22 \); grades 4-6; 12M, 10F

Procedure: Children performed fraction magnitude comparisons; eye movements were recorded

Stimuli: 48 trials, half with segments marked (discrete), half with same length strips

Measures: Accuracy, reaction time, eye tracking data

Analysis: Linear Mixed Effects Model

Fixed Effects:
- Discreteness (continuous, discrete)
- Length (same, different)
- Length congruency (is longer bar larger fraction? yes, no)
- Magnitude difference
- Grade level
- Interactions of discreteness * length and discreteness * magnitude difference

Random Effects: Participant, Item