BACKGROUND & AIM

- Many students struggle to understand fractions, which can lead to mathematics difficulties in later grades (Hansen et al., 2017).
- There are substantial individual differences in children’s fraction knowledge when formal fraction instruction begins (Resnick et al., 2016).
- Recently, as part of a larger project, we found considerable variation in informal fraction understanding even earlier, as children begin first-grade (Miller-Cotto et al., 2022).
- Here, we examine how these early individual differences in informal-related fraction knowledge relate to whole number competencies, spatial skills, and other cognitive skills associated with math learning.

METHOD

- Participants were 106 first graders (46% female, 54% male; 58% White, 18% Asian, 7% two or more identifiers, 1% Hispanic, 10% unknown) from three schools (one independent and two parochial).
- Measures:
  - Researcher-Developed Fractions Assessment (α = .82)
  - Whole Number Knowledge (Screener for Early Number Sense, SENS, α = .85)
  - Whole Number Line Estimation (α = .88)
  - Inhibitory Control (Hearts & Flowers, α = .82)
  - Spatial Scaling (α = .88)
  - Working Memory (Forward Span & Backward Span, α = .87)
  - Proportional Reasoning (α = .94)
  - Vocabulary (NI Picture Vocabulary, α = .94)
- The fractions assessment and whole number knowledge tasks were administered using paper booklets. All other measures were administered using an iPad.
- All tasks were administered in the same order (as listed above), one-on-one with a trained member of the research team at school.
- Measures were administered at two time points during the school year (start and middle) to reduce student fatigue.

RESULTS

- All correlations with the fractions assessment were significant, r = -0.19 to r = 0.63, except for inhibitory control.
- Red shading represents the strength of the correlation.

<table>
<thead>
<tr>
<th>Measure</th>
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<td>Fractions Assessment</td>
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Note. Significant correlations are bolded and *p < .05.

- A linear regression analysis revealed that whole number knowledge was the only significant predictor of early fraction skill when all the tasks were included in the model.

<table>
<thead>
<tr>
<th>Model Coefficients – Fractions Assessment</th>
<th>β</th>
<th>SE</th>
<th>p</th>
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<tbody>
<tr>
<td>Whole Number Knowledge</td>
<td>0.42</td>
<td>0.17</td>
<td>&lt; .001</td>
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<td>Whole Number Line Estimation PAE</td>
<td>0.07</td>
<td>0.05</td>
<td>0.370</td>
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<td>Spatial Scaling</td>
<td>0.15</td>
<td>0.12</td>
<td>0.095</td>
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<td>Working Memory</td>
<td>-0.08</td>
<td>0.09</td>
<td>0.332</td>
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<tr>
<td>Proportional Reasoning PAE</td>
<td>0.12</td>
<td>0.02</td>
<td>0.143</td>
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R² = 0.450

SIGNIFICANCE

- We found that when accounting for all other variables, only whole number knowledge explained a significant amount of the variance in first graders’ fraction knowledge. That is, whole number knowledge held more weight in accounting for differences in fraction knowledge.
- This is the first study to look at all these variables in combination.
- Whole number knowledge and early informal fraction knowledge may reflect an integrated early understanding of the full mathematical system.
- However, at later ages, knowledge about integers can interfere with using formal fractions, perhaps due to notational confusion (Ni & Zhou, 2005).

REFERENCES


ACKNOWLEDGMENTS

- Many thanks to our research team for creating the fractions assessment and administering the measures.
- Thank you to the schools who we partnered with as well as the first graders who participated.
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