Individual differences in fraction concepts are apparent at the start of formal fractions instruction in 4th grade (Resnick et al., 2016), but little is known about the roots of these differences.

We developed and tested a 1st grade measure of early fraction understandings including: non-symbolic, symbolic with fraction words (e.g., half, fourths) and symbolic with written fraction notation (e.g., $\frac{1}{2}$, $\frac{1}{4}$).

We examined various contexts (e.g., area models, number lines) some of which involved equal sharing and others not.

We expected that items without fraction words/symbols would be easiest and that children would perform better on items tapping understanding of halves than thirds or fourths.

Method

Participants were 109 first graders (45% female, 55% male; 57% White, 18% Asian, 7% African-American/Black, 7% two or more identifiers, 1% Hispanic, 10% Not Applicable) from three schools (one independent and two parochial).

Children were assessed individually on their fraction knowledge in school.

The measure contained 43 items and took about 15 min to administer.

Results

Table 1. Item Chart

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Items</th>
<th>Percent Correct</th>
<th>Items At or Below Chance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NON-SYMBOLIC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-symbolic equal sharing</td>
<td>17</td>
<td>68</td>
<td>2 items (12%)</td>
</tr>
<tr>
<td>• Non-symbolic equal sharing set</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>model</td>
<td>2</td>
<td>42</td>
<td>2 items (100%)</td>
</tr>
<tr>
<td>Non-symbolic equivalence</td>
<td>4</td>
<td>61</td>
<td>0 items</td>
</tr>
<tr>
<td>Non-symbolic area rectangular</td>
<td>11</td>
<td>75</td>
<td>0 items</td>
</tr>
<tr>
<td><strong>SYMBOLIC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symbolic fraction word</td>
<td>26</td>
<td>51</td>
<td>6 items (23%)</td>
</tr>
<tr>
<td>Symbolic fraction notation</td>
<td>3</td>
<td>25</td>
<td>3 items (100%)</td>
</tr>
</tbody>
</table>

Fraction Size

- **Symbolic halves**
  
  - Symbolic halves fraction word: 10 (66) 1 item (10%)
  
  - Symbolic halves fraction notation: 9 (70) 0 items

- **Symbolic fourths**
  
  - Symbolic fourths fraction word: 5 (39) 3 items (60%)
  
  - Symbolic 1/4 fraction notation: 4 (44) 2 items (50%)

- **Symbolic quarters**
  
  - Symbolic quarters fraction word: 4 (50) 0 items

- **Symbolic thirds**
  
  - Symbolic thirds fraction word: 7 (40) 2 items (29%)
  
  - Symbolic thirds fraction notation: 6 (42) 1 item (17%)

- **Symbolic number line**
  
  - Symbolic number line: 7 (61) 1 item (14%)

- **Symbolic area model**
  
  - Area model halves: 5 (62) 1 item (20%)
  
  - Area model fourths: 2 (48) 1 item (50%)

- **Symbolic number line**
  
  - Number line quarters: 0 (0) 0 items

- **Symbolic area model**
  
  - Number line thirds: 1 (55) 0 items

- **Symbolic area model**
  
  - Area model halves: 11 (49) 4 items (36%)

- **Area model fourths**
  
  - Area model fourths: 2 (41) 1 item (50%)

- **Area model quarters**
  
  - Area model quarters: 2 (50) 0 items

- **Area model thirds**
  
  - Area model thirds: 2 (25) 2 items (100%)

Figure 2. Categorized examples involving halves

Note. G) Children were asked if two friends would get the same size piece. H) Children were asked whether the ghost was half of the length from 0 to 1. I) Children were asked to recognize one-half (spoken). J) Children were asked how much of the shape was shaded. K) Children were asked to match the notation to the picture. Percentage of correct responses is reported in green.

CONCLUSIONS

Children can solve non-symbolic fractions problems in various contexts, especially equal sharing.

Children show a good understanding of halves verbally, but not in fraction notation.

Set model sharing may be more difficult because children do not map such items onto a number line (Boyer et al., 2008) or because they often use an incorrect strategy (e.g., matching or one-to-one correspondence).

REFERENCES


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