Assessing Early Informal Fraction Knowledge

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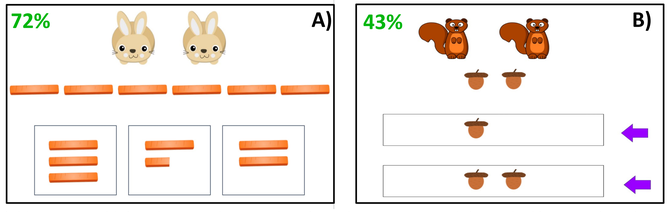
Background & Aims

- 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., ½, ¼).
- 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.

Figure 1. Two non-symbolic equal sharing items



Note. Children were told that the animals wanted to share the resources and then asked how much each animal should get so that they received the same amount. Although the wording was almost identical across the two problems, children were much more successful on **A)** *72% correctness* compared with **B)** *43% correctness.*

Results

- Internal reliability: r_{KR20} =.82
- Children performed better on non-symbolic items (*M* = 68%) than symbolic items (*M* = 51%).
- Children understand some fraction words (*M* = 55%), especially halves, but usually *not* fraction notation (*M* = 25%).
- Children scored better than chance on equal sharing items (*M* = 71%) except for set model items (*M* = 42%).

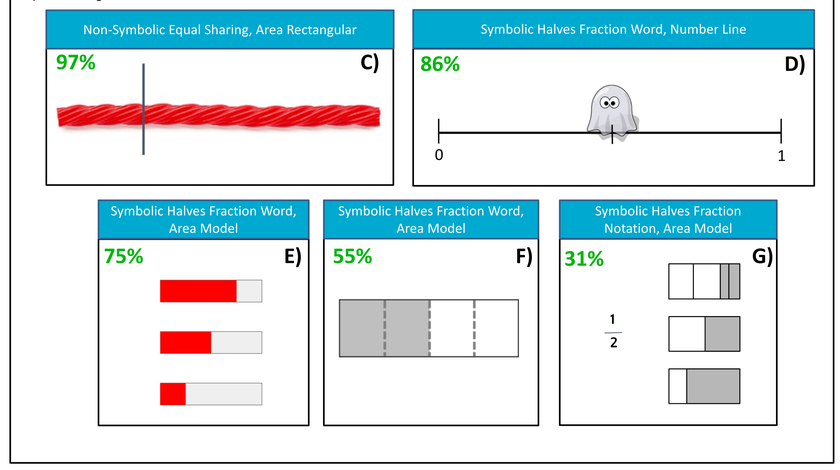
Results

Table 1. Item Chart

Category	Number of Items	Percent Correct	Items At or Below Chance
NON-SYMBOLIC	**17**	**68**	**2 items (12%)**
Non-symbolic equal sharing	11	71	2 items (18%)
• Non-symbolic equal sharing set model	2	42	2 items (100%)
Non-symbolic equivalence	4	61	0 items
Non-symbolic area rectangular	11	75	0 items
SYMBOLIC	**26**	**51**	**6 items (23%)**
Symbolic fraction word	23	55	3 items (13%)
Symbolic fraction notation	3	25	3 items (100%)
Fraction Size			
• Symbolic halves	10	66	1 item (10%)
○ Symbolic halves fraction word	9	70	0 items
○ Symbolic halves fraction notation	1	31	1 item (100%)
• Symbolic fourths	5	39	3 items (60%)
○ Symbolic fourths fraction word	4	44	2 items (50%)
○ Symbolic 1/4 fraction notation	1	18	1 item (100%)
• Symbolic quarters	4	50	0 items
○ Symbolic quarters fraction word	4	50	0 items
• Symbolic thirds	7	40	2 items (29%)
○ Symbolic thirds fraction word	6	42	1 item (17%)
○ Symbolic thirds fraction notation	1	26	1 item (100%)
Symbolic number line	7	61	1 item (14%)
• Number line halves	4	69	0 items
• Number line fourths	2	48	1 item (50%)
• Number line quarters	0	0	0 items
• Number line thirds	1	55	0 items
Symbolic area model	11	49	4 items (36%)
• Area model halves	5	62	1 item (20%)
• Area model fourths	2	41	1 item (50%)
• Area model quarters	2	50	0 items
• Area model thirds	2	25	2 items (100%)

Figure 2. Categorized examples involving halves

Note. **C)** Children were asked if two friends would get the same size piece. **D)** Children were asked whether the ghost was half of the length from 0 to 1. **E)** Children were asked to recognize one-half (spoken). **F)** Children were asked how much of the shape was shaded. **G)** 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

- Boyer, T. W., Levine, S. C., & Huttenlocher, J. (2008). Development of proportional reasoning: where young children go wrong. *Developmental Psychology, 44*(5), 1478–1490.
- Resnick, I., Jordan, N. C., Hansen, N., Rajan, V., Rodrigues, J., Siegler, R. S., & Fuchs, L. S. (2016). Developmental growth trajectories in understanding of fraction magnitude from fourth through sixth grade. *Developmental Psychology*, 52(5), 746.

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