Reasoning about Fractions: Using Number Lines to Understand Fraction Comparison

Nadine Bezuk
San Diego State University
nbezuk@mail.sdsu.edu

2013 NCTM Regional Conference
Las Vegas, NV

Session Overview

We will discuss:

- Relevant CCSS Standards and other recommendations
- Models, activities, and online resources to help students reason and compare fractions on the number line.

Some of the CCSS "Big Ideas (Clusters) in Grades 3 – 5: Number and Operations—Fractions

1. Develop understanding of fractions as numbers (gr. 3)
2. Extend understanding of fraction equivalence and ordering (gr. 4)
3. Use equivalent fractions as a strategy to add and subtract fractions. (gr. 5)

More about CCSS

- Greater emphasis on using the **number line model** to represent and act on fractions. For example (Gr. 3 CCSS):
  - Represent a fraction 1/b on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into b equal parts. (3.NF.2.a)

Improving Fractions Instruction

Help students recognize that fractions are numbers and that they expand the number system beyond whole numbers. Use number lines as a central representational tool in teaching this and other fraction concepts from the early grades onward.

Developing Effective Fractions Instruction for Kindergarten through Eighth Grade: A Practice Guide (Siegler, Carpenter, Fennell, Geary, Lewis, Okamoto, Thompson, & Wray, 2010).

Considerations

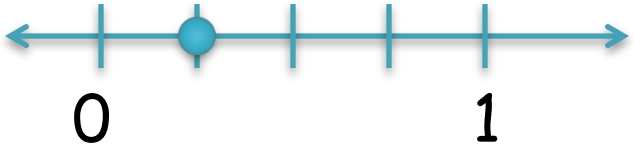
- Most children need to use concrete models over extended periods of time to develop mental images needed to think conceptually about fractions
- Students who don't have mental images for fractions often resort to whole number strategies

(Post, et al. 1985, Cramer, et al. 1997)

Types of Models for Fractions

- Area/region
  - Fraction circles, pattern blocks, paper folding, geoboards, fraction bars, fraction strips/kits
- Set/discrete
  - Chips, counters, painted beans
- **Linear**
  - **Number lines, rulers**

Comparing Fractions with a Model



$\frac{1}{4}$

$\frac{1}{6}$

One Fifth-Grader's Understanding of Comparing Fractions

Circle the larger number or write "=" if they are equal in the pairs below:

1. $\frac{1}{6}$ $\frac{1}{3}$

2. 1 $\frac{4}{3}$

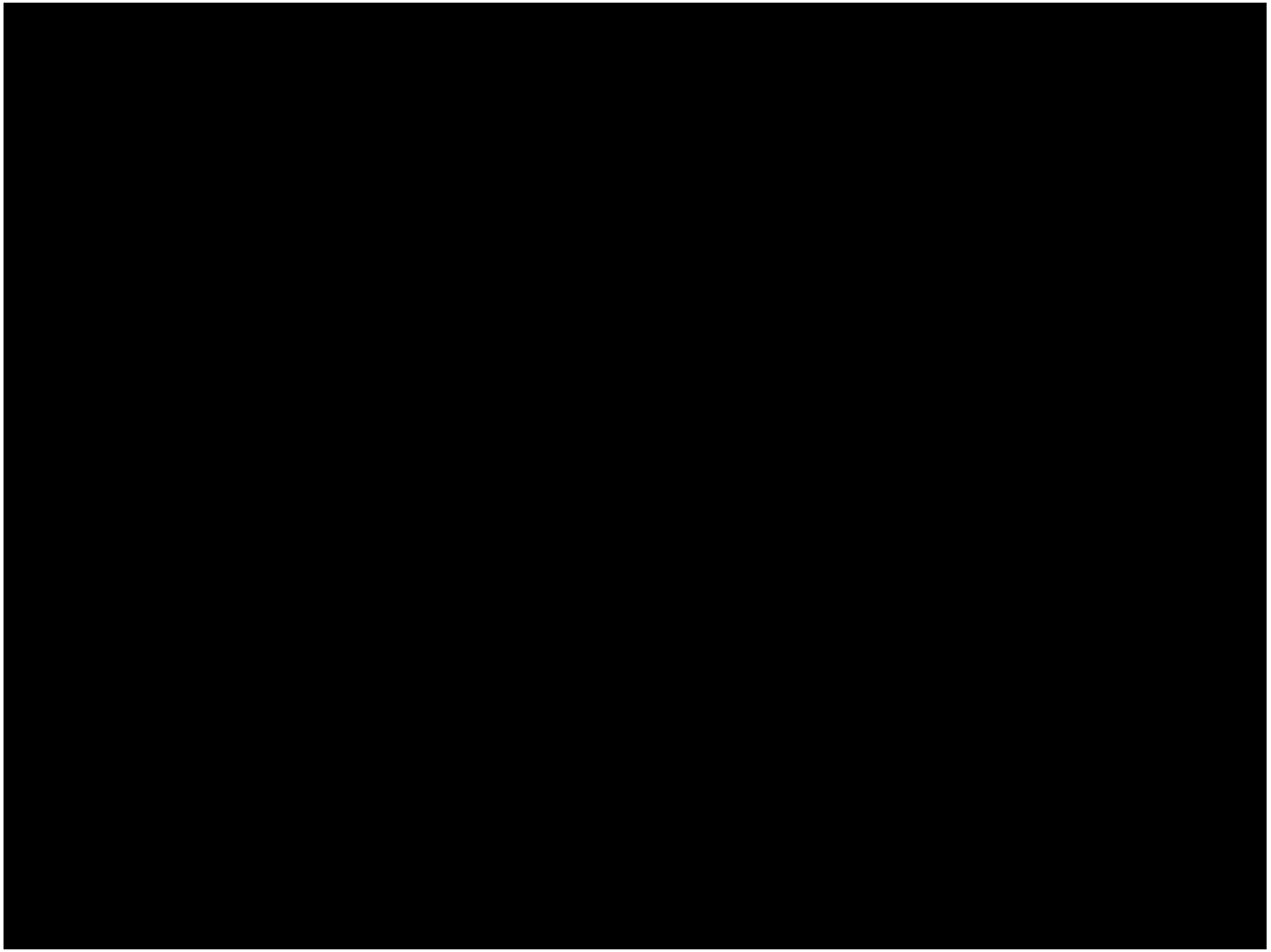
3. $\frac{3}{6}$ $\frac{1}{2}$

4. $\frac{1}{7}$ $\frac{2}{7}$

5. $\frac{3}{10}$ $\frac{1}{2}$

6. $\frac{1}{2}$ $\frac{4}{6}$

One Fifth-Grader's Understanding of Comparing Fractions

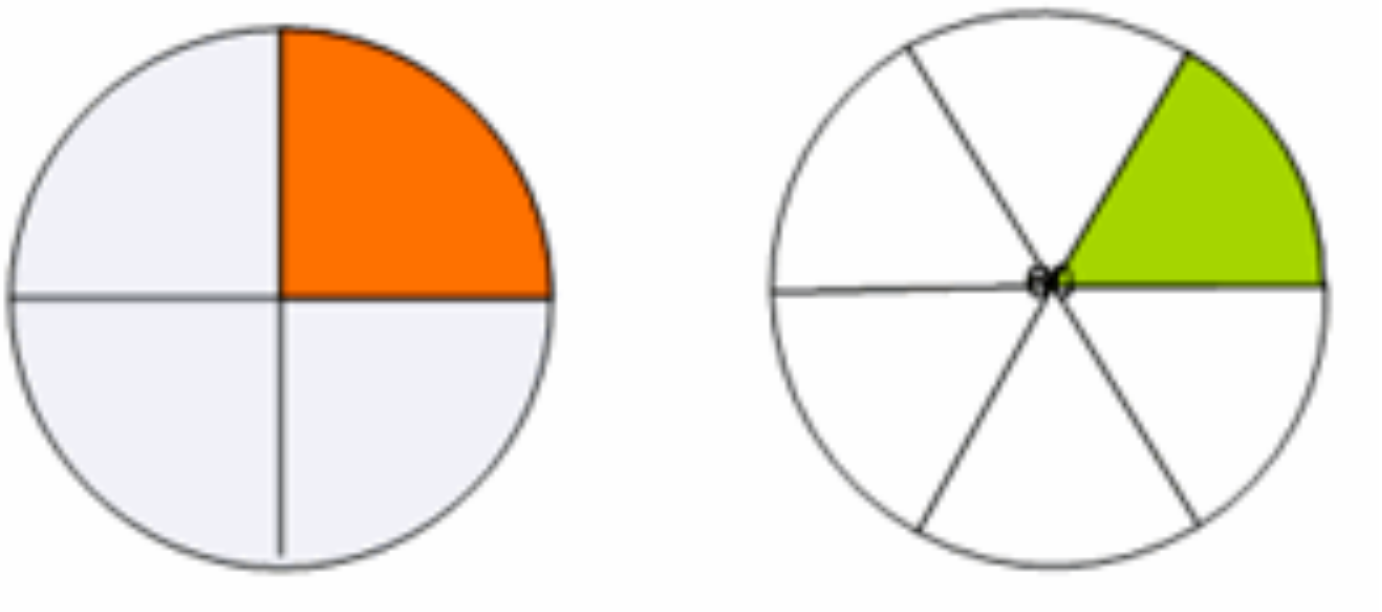


When comparing 1/6 and 1/3:

- According to Ally, "1/3 is bigger, because if you change the digit down from 3, if it was 1/1 it would be equal to 1 and one's a whole number so it's bigger".
- What does she understand and what is she struggling to understand about comparing fractions?

Think about the Language of Comparison

- Should we use "Bigger" or "Greater"? (or "Smaller" or "Less than"?)



Ordering Fractions

$$\frac{5}{8}, \frac{3}{8}, \frac{6}{8}$$

Fractions with the same denominator have the same-sized pieces, so the numerators tell which fraction has more pieces (and is greater).

Ordering Fractions

$$\frac{4}{8}, \frac{4}{5}, \frac{4}{6}$$

Fractions with the same numerator have the same number of pieces, and the denominators tell us which pieces are larger (and which fraction is greater).

Ordering Fractions

$$\frac{3}{4}, \frac{2}{5}, \frac{1}{2}$$

Fractions close to a benchmark (such as ½ or 1) can be compared by finding their distance from the benchmark.

Fractions Equivalent to One-half

$$\frac{2\frac{1}{2}}{5} = \frac{1}{2}$$

The denominator is twice the value of the numerator, so it's equal to 1/2

Ordering Fractions

$$\frac{7}{8}, \frac{3}{4}, \frac{2}{3}$$

Fractions close to one can be compared by finding their distance from one, for example, by focusing on the amount that's missing from the whole.

Ordering Fractions

$$\frac{99}{100}, \frac{6}{7}, \frac{15}{16}$$

Fractions close to one can be compared by finding their distance from one, for example, by focusing on the amount that's missing from the whole.

Ordering Fractions on a Number Line: The "Clothesline" Activity

- Task:
  - Order fraction tents using a clothesline to represent a number line and
  - mathematically justify the reasons for your ordering.
- Materials: fraction tents and clothesline (string, yarn, etc.)

“Clothesline” Fractions Activity

$$\frac{1}{2}, \frac{3}{4}, 1$$

“Clothesline” Fractions Activity

$$1\frac{2}{3}, \quad \frac{7}{4}$$

“Clothesline” Fractions Activity

$$\frac{1}{3}, \frac{3}{4}, \frac{5}{8}$$

“Clothesline” Fractions Activity

$$\frac{3}{5}, \frac{4}{9}, \frac{3}{4}$$

“Clothesline” Fractions Activity

$$\frac{1}{8}' \qquad \frac{7}{8}' \qquad \frac{11}{12}$$

“Clothesline” Fractions Activity

$$\frac{1}{4}, \quad \frac{3}{13}, \quad \frac{6}{27}$$

Free Online Fraction Resources

ConceptuaMath

www.conceptuamath.com

Resources→ Tool Library →

”Try the Tools”

A Few iPad Activities for Fractions

- Number Line
- Motion Math HD
- Math Tappers: Estimate Fractions

Strengthen students' fraction reasoning by helping them:

- Develop understanding of fractions as numbers.
- Understand fraction concepts, order, and equivalence,
- Use number lines as a central representational tool (but not as the first model students use for fractions) in teaching fraction concepts from the early grades onward.
- Make "Why?", "How do you know?", "Can you explain?" classroom mantras.

Contact me:

nbezuk@mail.sdsu.edu

Slides and Fraction Tents Master are available at:

www.sdsu-pdc.org (click on “PDC Presentations”)

SAN DIEGO STATE UNIVERSITY