

# Early math: Numbers, counting, and number principles

- What kinds of number representations?
- Counting: rote memorization; later rule-like system (shown by errors):
  - ◆ **Early errors: “one, two, four, five, seven”**
  - ◆ **Later: “20-10” for 30, or “tenny” for 100**
- Number principles (preschool):
  - ◆ **1-1 correspondence**
  - ◆ **Stable order principle**
  - ◆ **Cardinal principle**
  - ◆ **Order Irrelevance principle**
  - ◆ **Abstraction principle: can count anything**

# Early calculation skills

- True calculation skills appear at 2.5 to 3 yrs.
  - ◆ **Early home experiences, education, and media facilitate development.**
  - ◆ **Debate: Can infants count (1 vs. 2)?**
- Concrete problems easier than number-fact problems
  - ◆ **this:**
    - ◆ “Two horses and two more horses make how many altogether?”
  - ◆ **is easier than**
    - ◆  $2 + 2 = [ ? ]$

# Challenge: synthesizing formal & informal number knowledge

- Early grades: formal tasks do not tap into informal knowledge. Why?
  - ◆ **Conventional symbols: new language-like code**
    - ✦ ex: interpret  $3 + 4 = X$  as an uncertainty *and* a request to solve it
  - ◆ **Teachers do not always help connect conventional symbols with informal knowledge**
  - ◆ **Math ed (in US) emphasizes facts over concepts**
  - ◆ **Also, traditionally teachers don't emphasize...**
    - ✦ choosing & creating problem-solving strategies,
    - ✦ communicating about problem-solving,
    - ✦ evaluating problem solving approaches

# Advanced math skills

$$\sim\{ [ (\sim A \cdot B) \cdot (\sim X \cdot Z) ] \cdot \sim [ (A \cdot \sim B) \vee \sim ( \sim Y \cdot \sim Z) ] \}$$

- Some early knowledge contributes to later misunderstandings:
  - ◆ **multiple digit addition & multiplication**
- Knowledge must be augmented: new concepts
  - ◆ **rational number difficulties**
  - ◆ **example: attending to place values & decimals**
    - ✦ 237 and 84 versus .237 and .84
    - ✦ adding fractions:  $1/2 + 1/2 = ?$
- Errors:
  - ◆ **of symbols or math language; of concepts**
  - ◆ **distraction by irrelevant information (word problems)**

“Each Y weighs X% more than each Z...”

# Summary/Review

- Early development: Number concepts (e.g., cardinality) can be shown in preschool children
- More challenging: rational number concepts and operations (ex: fractions & decimals)
  - ◆ **Why? Not *really* conceptually hard...**
  - ◆ **Problem of synthesizing formal and informal knowledge**
- Calculations: Read Byrnes on multiple strategies (pp. 222-226)
- Complex math skills: several difficulties (symbolic conventions, coordination)