Welcome to Content Session 2

Making Sense of Number Sense

Find somebody whose card has the **same quantity** of dots as yours

- *What's your favorite number?* Share briefly with your partner.
- Introduce your partner and her/his favorite number to the rest of the group.

Learning about number from Mitsumasa Anno

How many fives do you see?

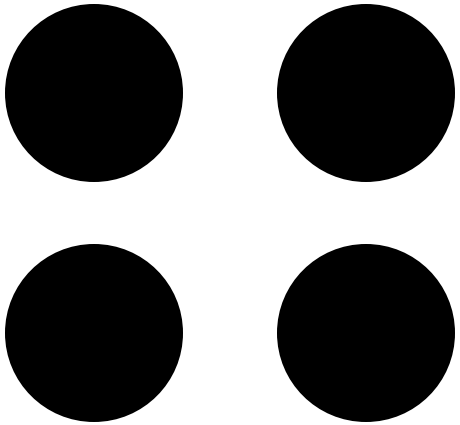
Reprinted from *Anno's Counting Book* by M. Anno (HarperTrophy, 1977).

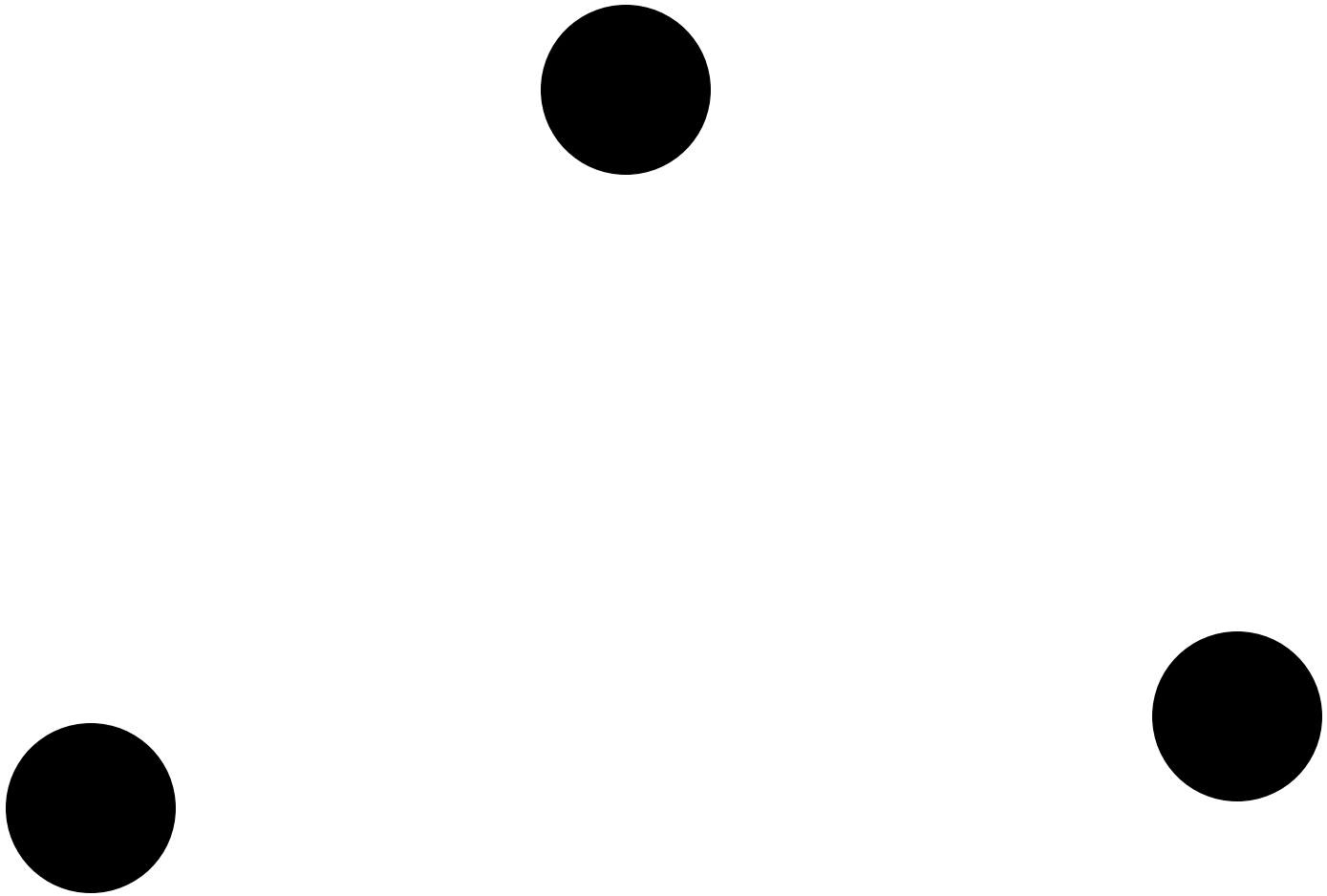
Number is Complex!

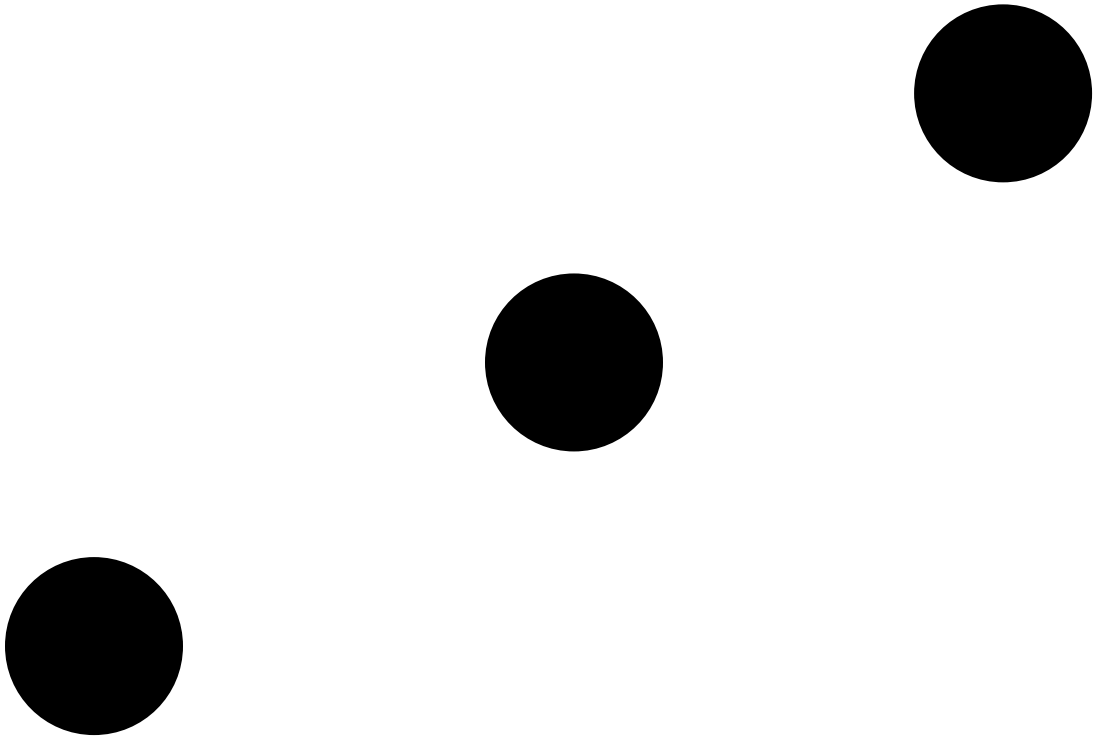
A *Big Idea*

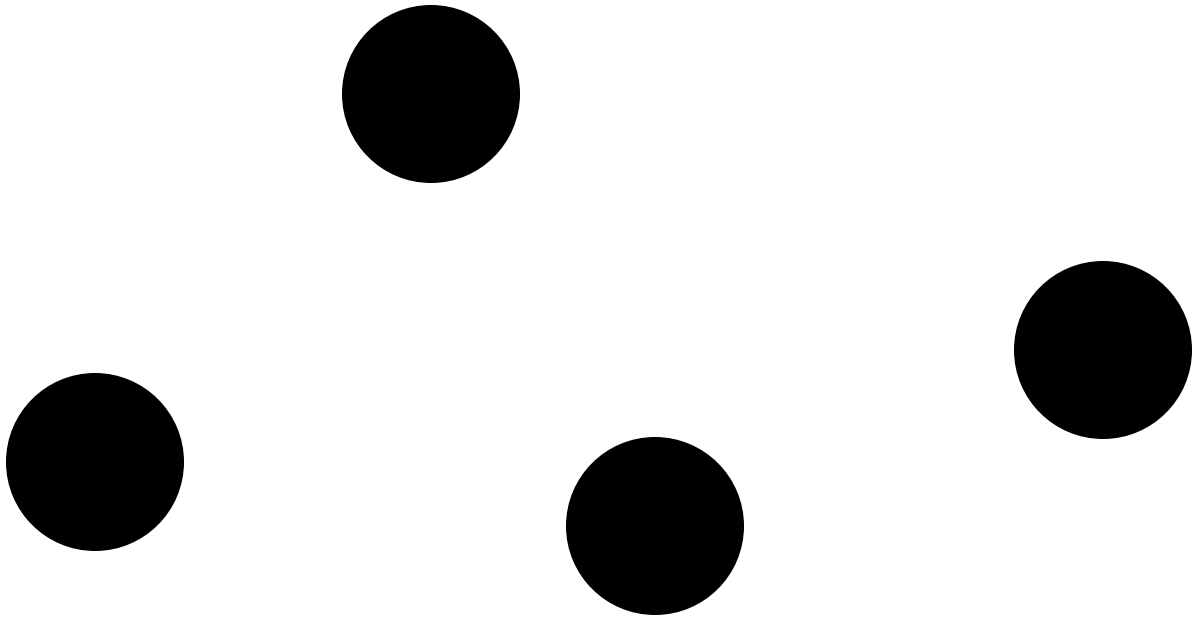
Numbers are used many ways, some more mathematical than others.

What can you see quickly?







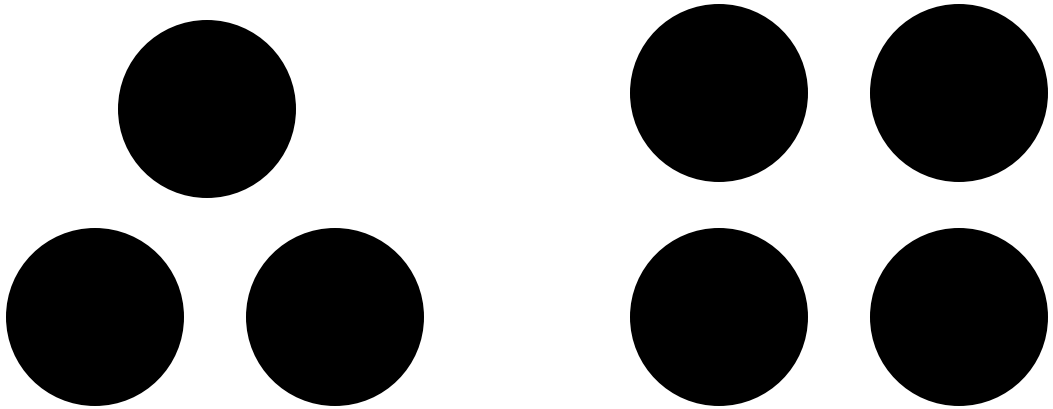


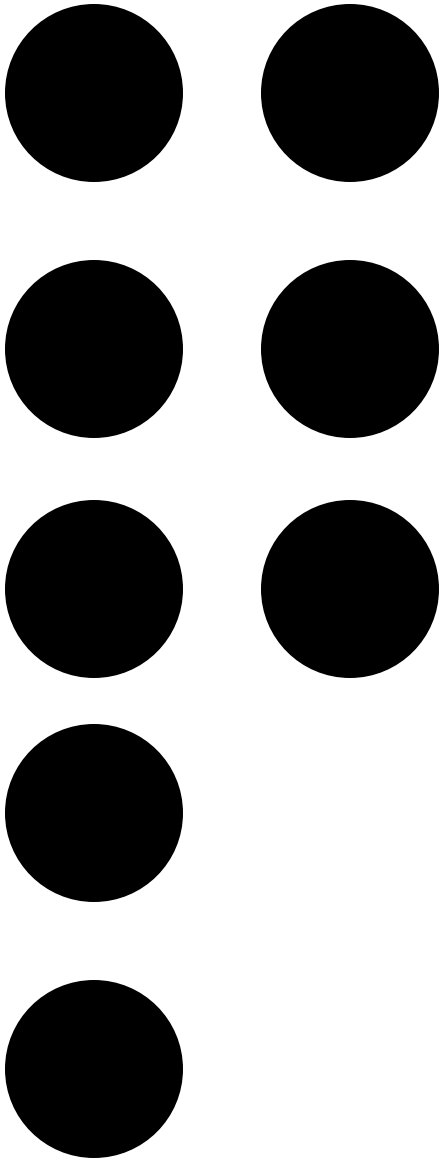
Perceptual Subitizing

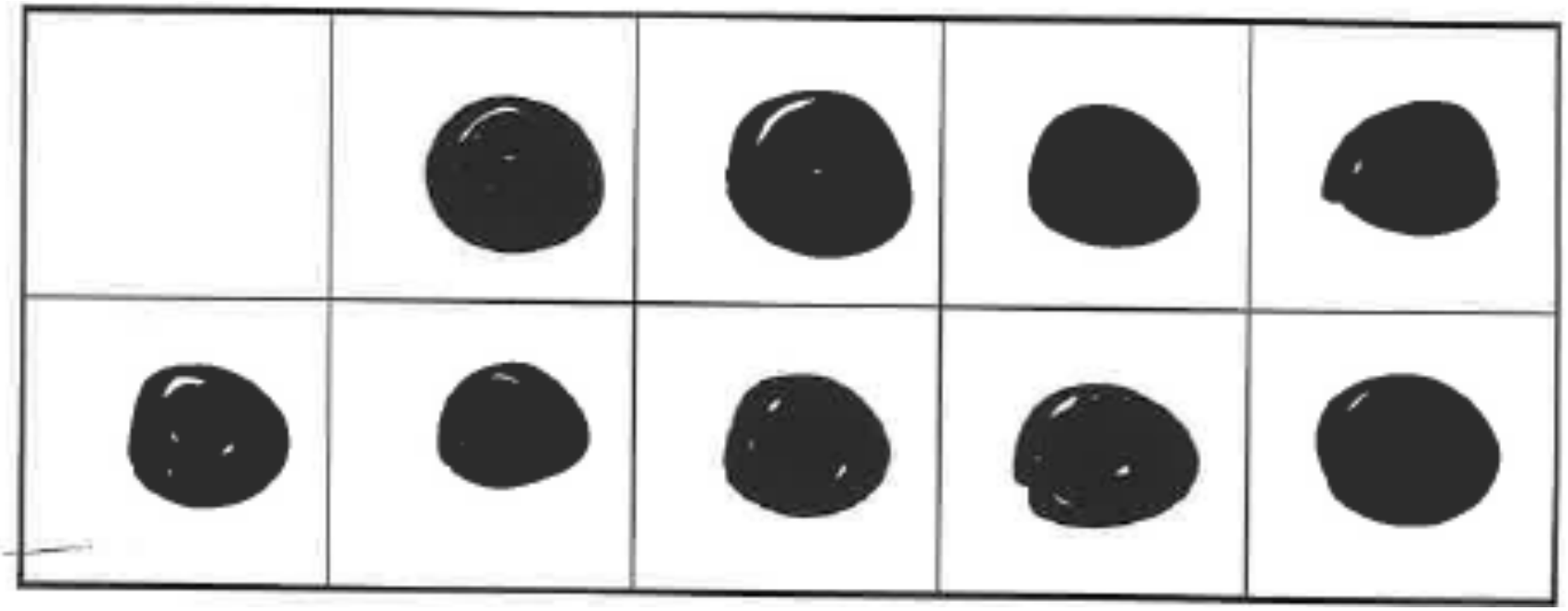
You perceive the three or four dots intuitively & simultaneously.

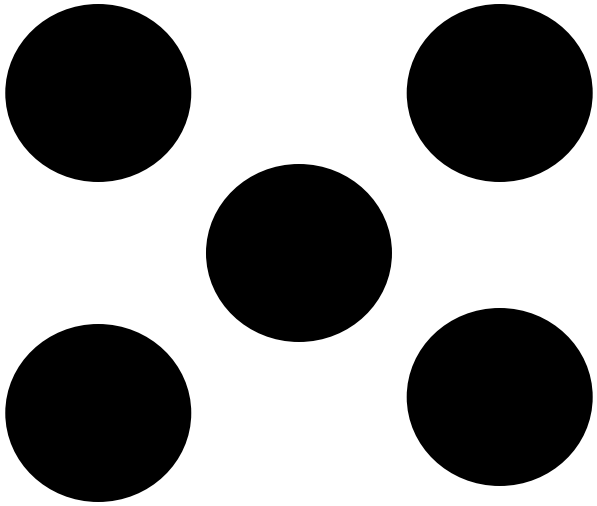
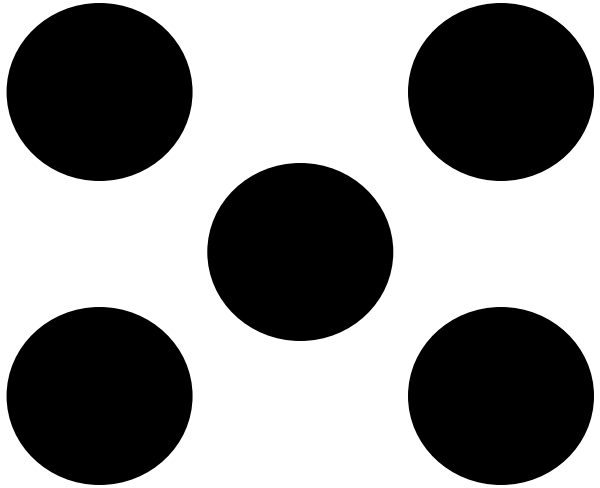
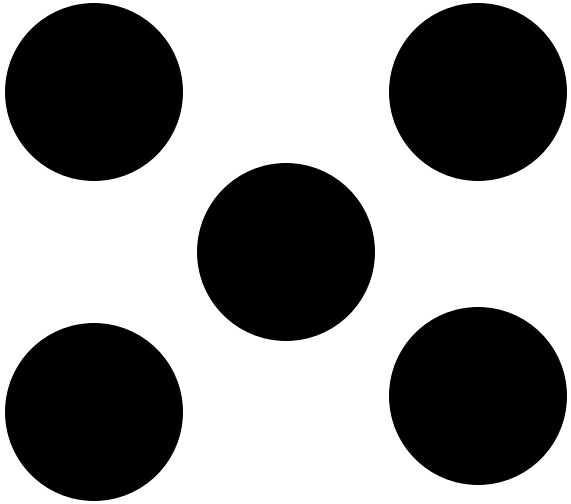
You "just know."

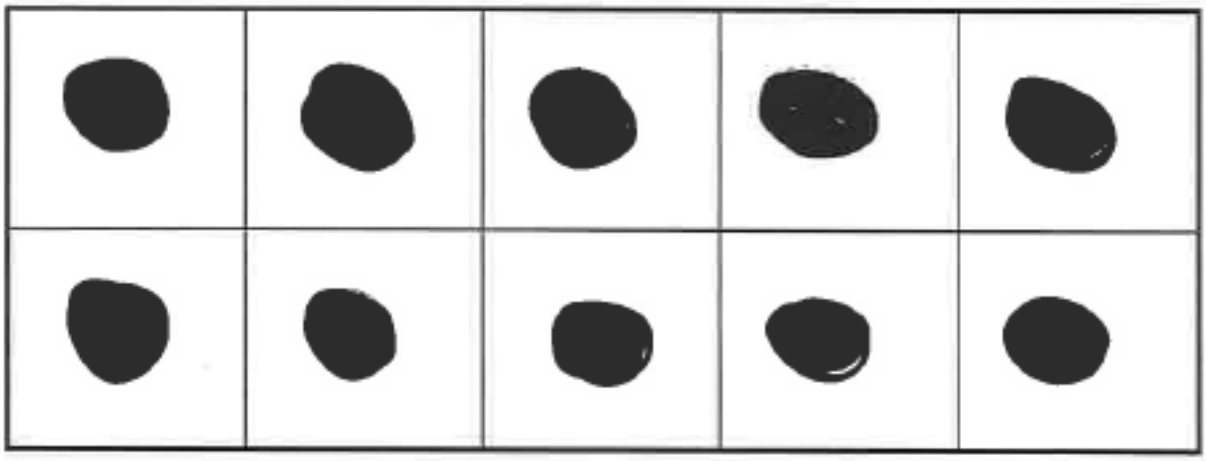
Let's try some more "quick looks" …

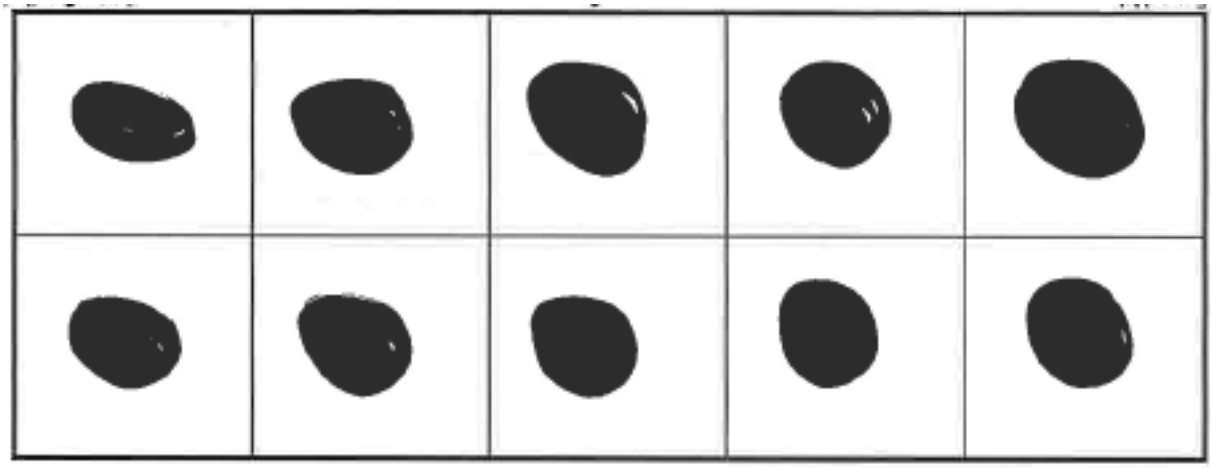


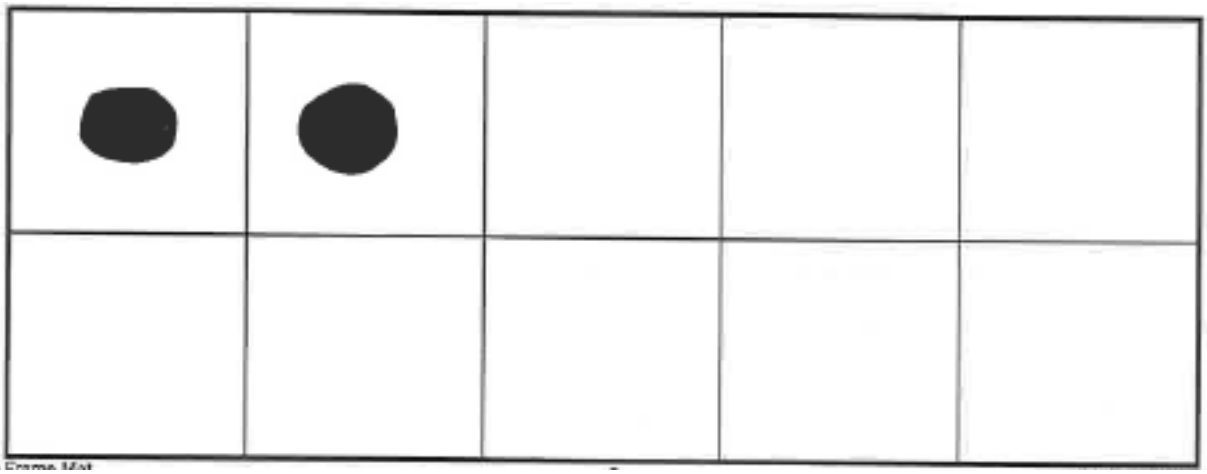


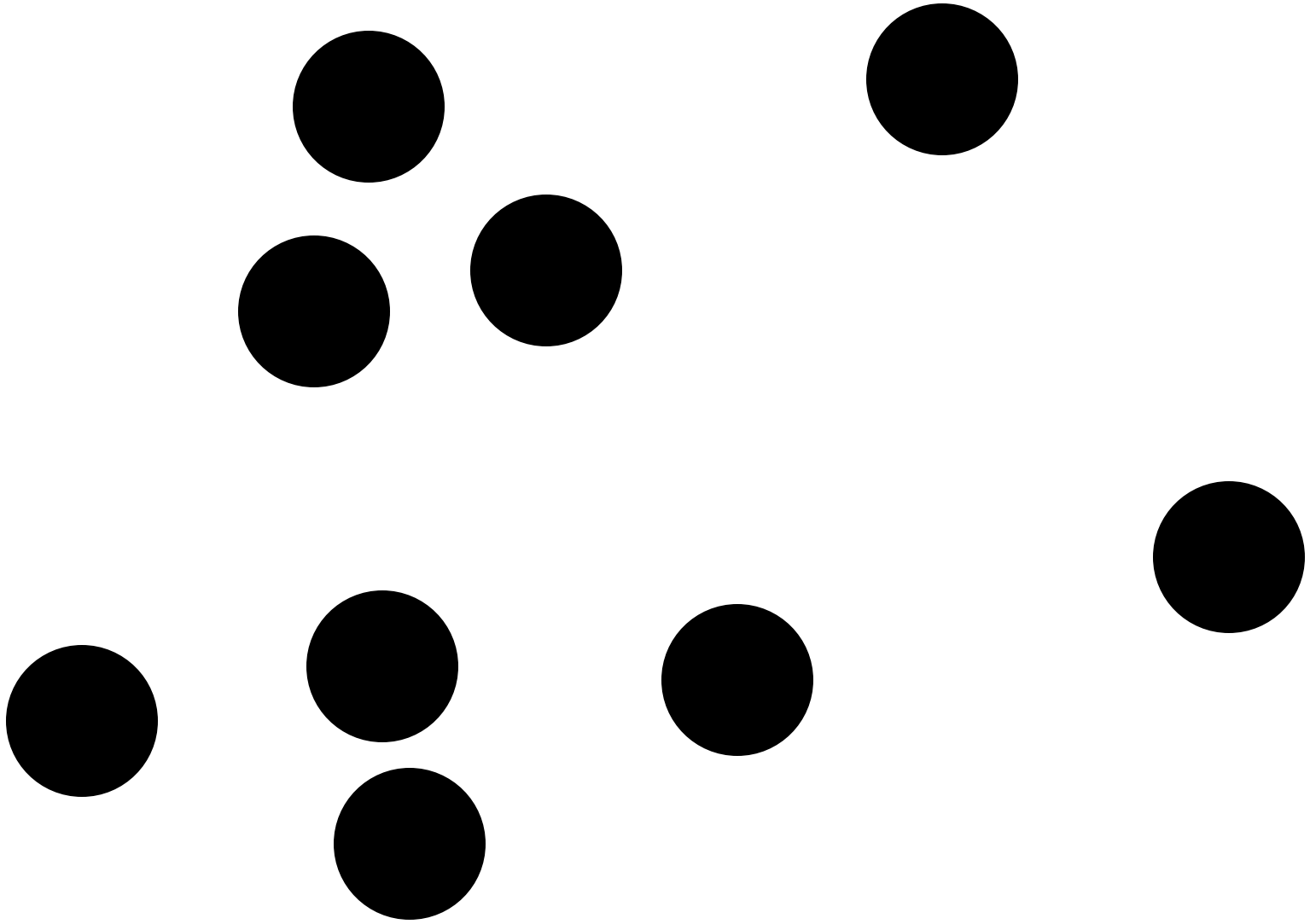










Conceptual Subitizing

You perceive the parts and put together the whole

All of this happens quickly and often is not conscious—it is still subitizing

A *Big Idea*

The quantity of a small set can be intuitively perceived *without counting*.

A *Big Idea*

Quantity is an attribute of a set of objects.

A *Big Idea:*

Quantity is an attribute of a set of objects

3 elephants

might seem obviously bigger when compared to 3 mice …

… if you used the attribute of size, but, for the attribute of number/ numerosity, they are identical.

A *Big Idea:*

Quantity is an attribute of a set of objects.

A Collection Can Have Many Attributes

Roses

- Red color is an attribute
- Round shape is an attribute
- Sweet smell is an attribute
- Quantity is another attribute: there are THREE roses in this collection.

A *Big Idea*

Quantity is an attribute of a set of objects.

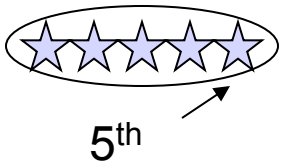
We call this *numerosity* - the "threeness" of 3.

Numerosity exists apart from number words and written symbols. Words and symbols vary from language to language - numerosity does not.

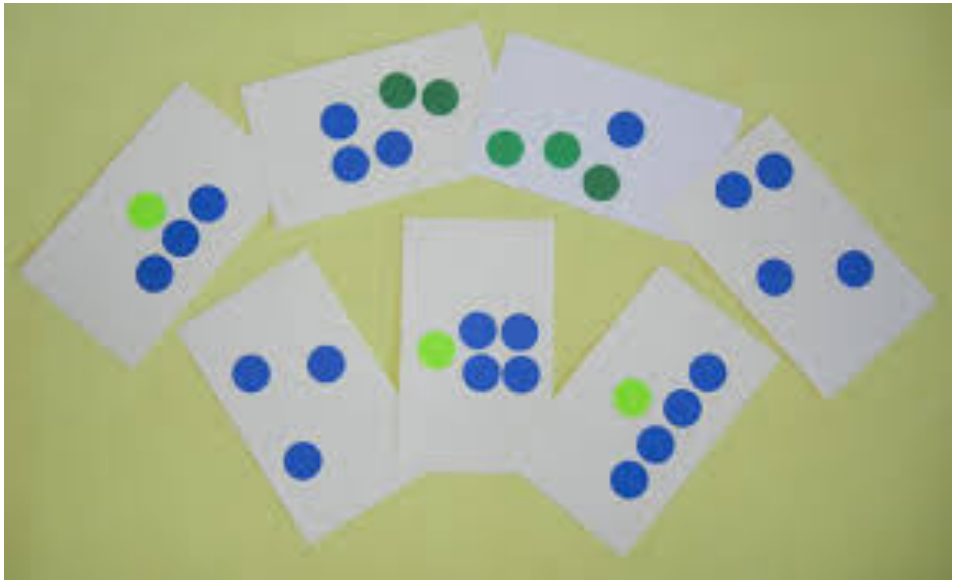
Humans seem to be biologically programmed to automatically perceive the numerosity of small sets.

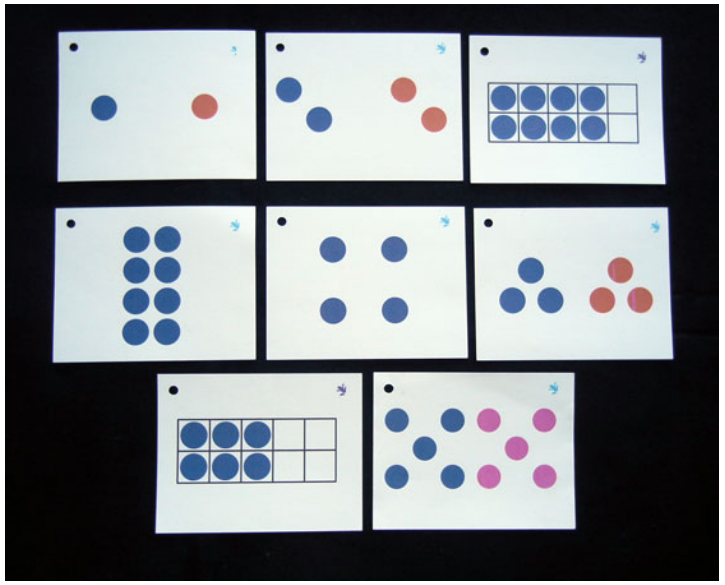
Counting,
determining & naming quantity,
telling “how many” …
all of these use number
as an adjective, not a noun.
Are there 3 dots? 3 fingers?
3 inches? 3 tenths?

Big Ideas of Number Sense

Topic	Big Ideas	Examples
Uses of Number  	● Numbers are used many ways, some more mathematical than others.	• *Tommy has 5 books.* (cardinal) • *Ava is fifth in line today.* (ordinal) • Numbers on basketball jerseys, home addresses, telephone numbers (nominal) • *Let's meet at 5 pm on December 5.* (referential)
Numerosity  = 5	● Quantity is an attribute of a set of objects and we use numbers to name specific quantities. ● The quantity of a small collection can be intuitively perceived without counting.	• 5 mice and 5 elephants are alike in quantity, though different in other ways. • Children just "see" three objects and know it's 3.

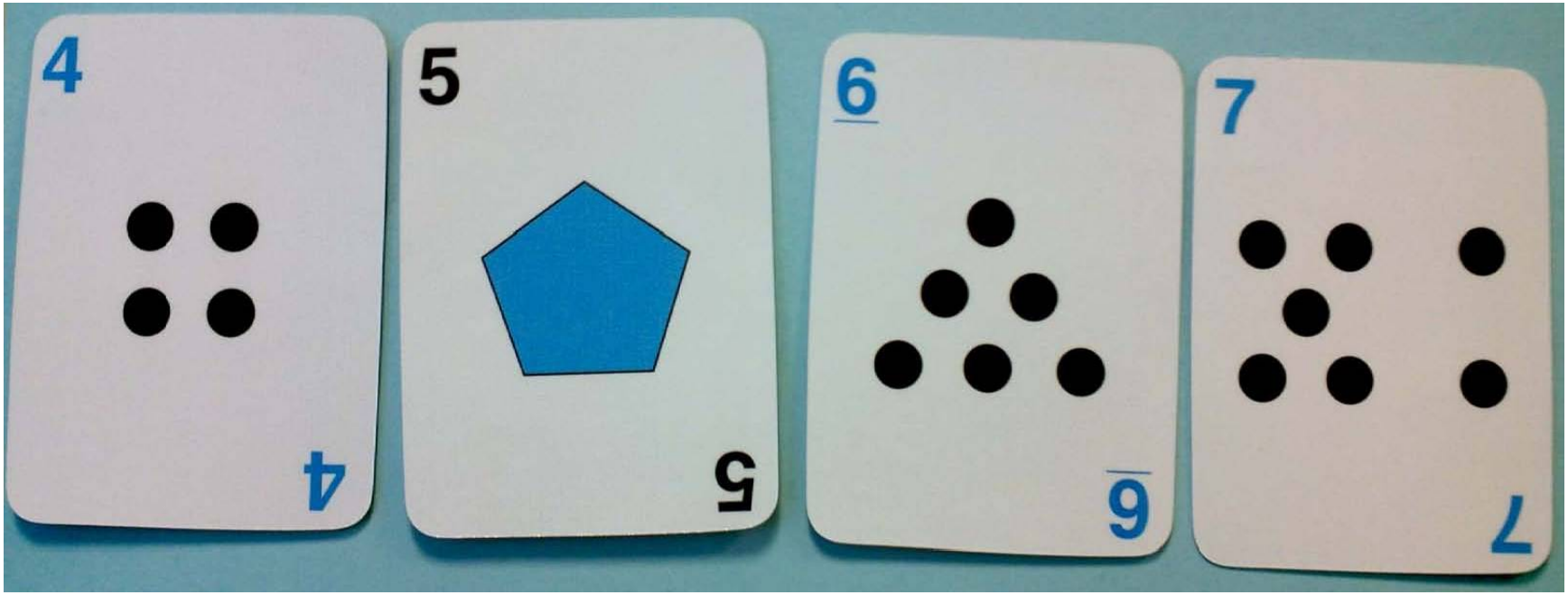
Developing Visual Number Sense Through Models





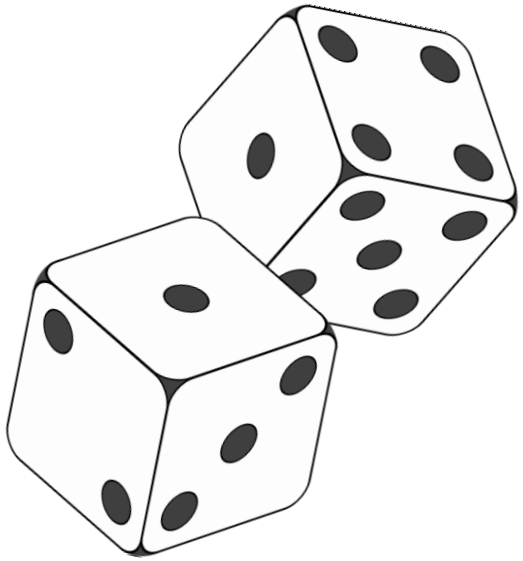
Dot Cards

Developing Visual Number Sense Through Models



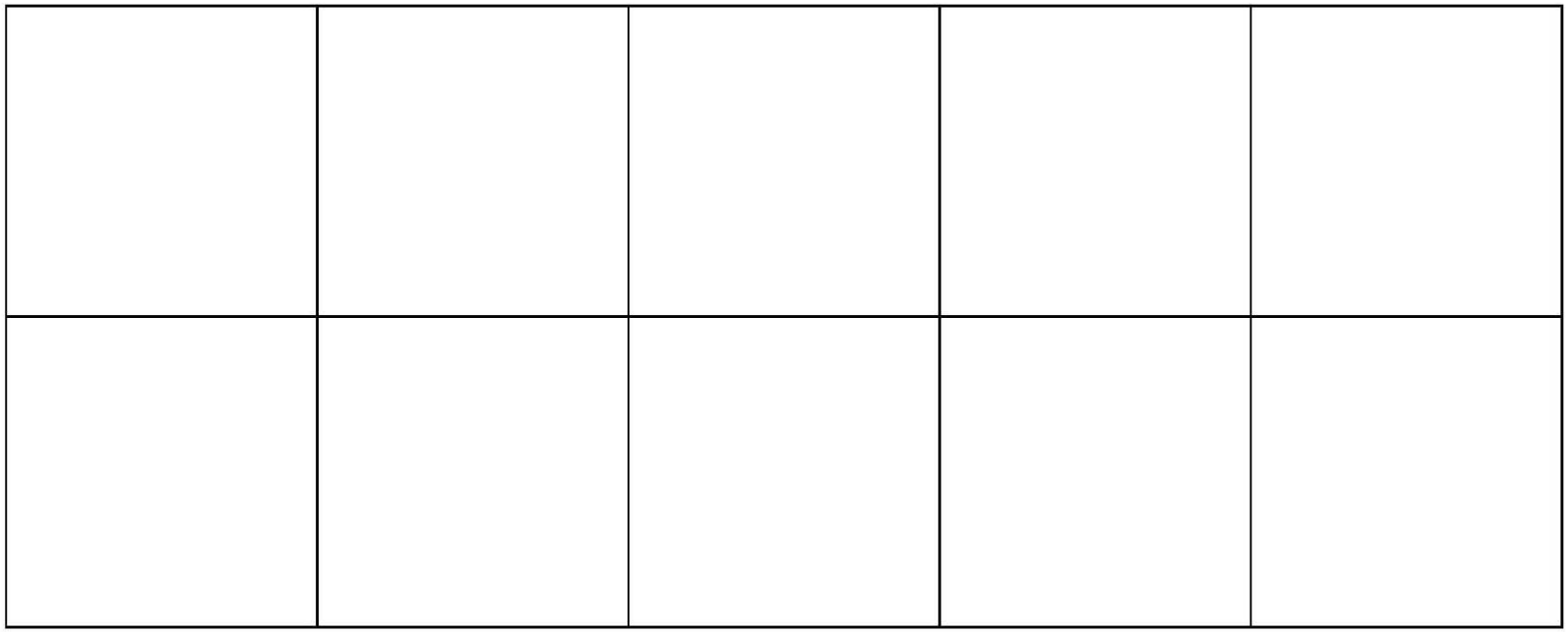
Number Cards

Developing Visual Number Sense Through Models



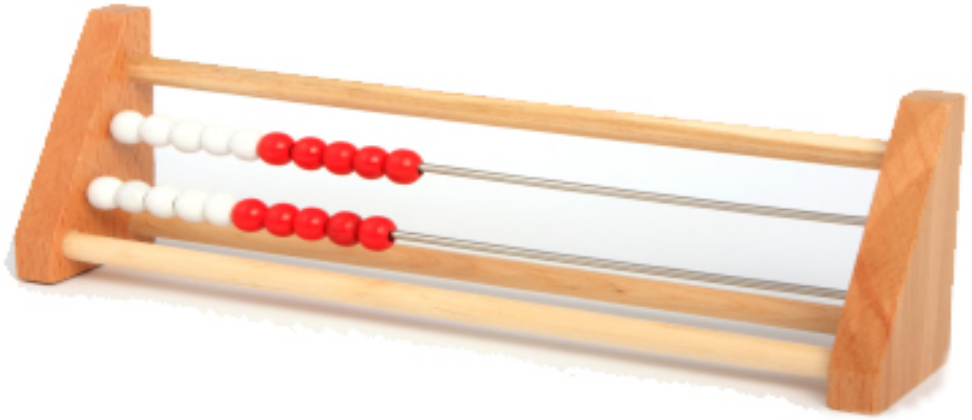
Dice

Building Visual Number Sense



Ten-Frames

Developing Visual Number Sense Through Models



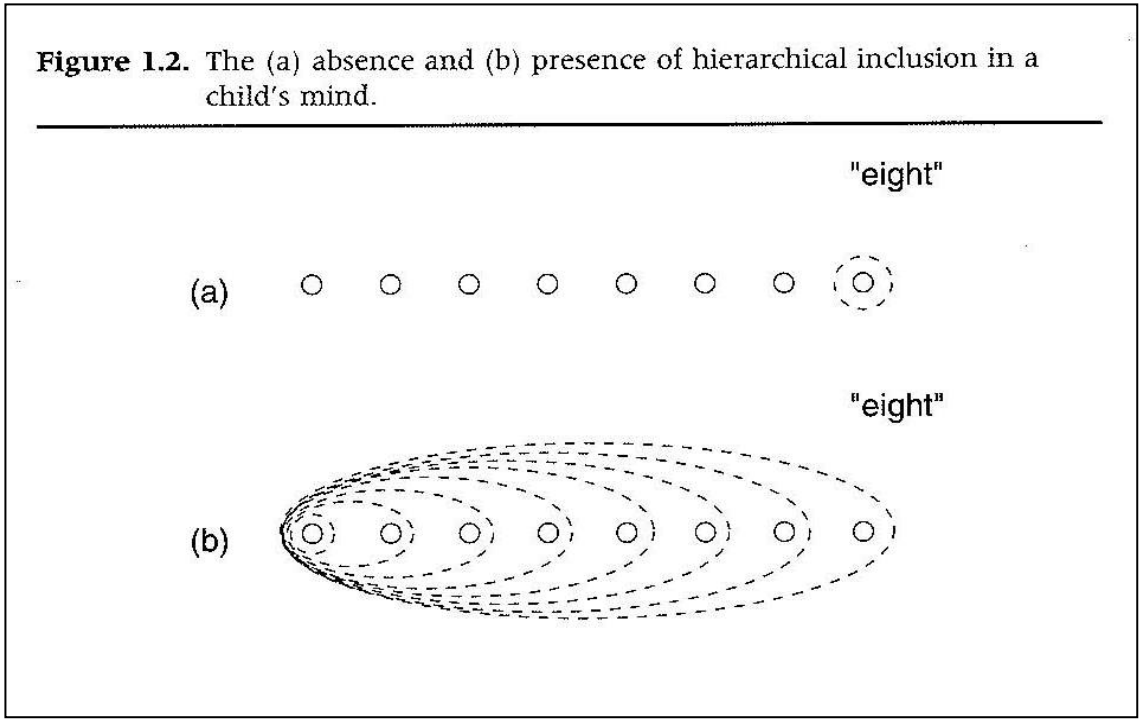
Counting Frames or Rekenreks

Why focus on developing number sense?

We want children to connect counting to cardinality
and to use numbers meaningfully to solve problems

Hierarchical Inclusion

Because each number names a quantity one greater than the number before it, each number includes all the quantities named by those earlier numbers.



From Kamii,C. *Young Children continue to Reinvent Arithmetic, 2nd Grade.* Teachers College Press, 2004.

Solid number sense is key to
mathematically healthy
development & practice.

Number sense is not static.
It continues to deepen & build as
new relationships
amongst more numbers
are established.

Stop & Reflect

Video Analysis: Focus on the Child

1st clip: preschooler is comparing quantities of blocks.

2nd clip: preschoolers naming quantity of dots they see on a card.

3rd clip: preschooler using chips to match quantity of dots on a card.

When watching these clips, consider:

- *What does this child seem to understand about quantity and number?*
- *What does this child say or do that is evidence of thinking?*

Video Analysis: Focus on the Child

Clip shows preschoolers telling "how many" without counting.

When watching this clip, consider:

- *What does this child seem to understand about quantity and number?*
- *What does this child say or do that is evidence of thinking?*

How do children develop the idea of quantity as an attribute?

Older infants often learn signs/words for "more" and "all gone" before other ideas.

One-year-old can tell that a pile of 5 is more than a pile of 2, but does not know any number names.

In 2nd half of 2nd year (18-24 mos), toddlers can "take one" or "give two," but do not have words for 3 and bigger.

Preschoolers are building a firm sense of the numerosity of 3, 4 & 5.

Implications for Teaching & Learning

Subitizing is foundational.

- Subitizing relies on visual patterns.
  - Not all arrangements of a number are equally easy to "see."
- How is subitizing different than counting?
  - Label small sets with number, without enumerating.
- How does subitizing support counting?
  - Authentic reasons to count small sets.
  - When counting, restate the last count word to emphasize cardinality: "1, 2, 3, … 3 cups."
- Subitizing & counting build understanding of cardinality.
- Expect children to subitize small sets; avoid "counting to be sure."

More Implications for Teaching & Learning

Children learn about quantity even without exact numbers.

- "Which pile has more?"
- "Put one napkin on each plate."

Smaller numbers are easier than larger.

- With infants and toddlers, talk about "1" and "2" and "1 more" and "2 more"
- With preschoolers, spend a lot of time exploring "3" and "4" and "5"

Fingers are great tools for understanding small numbers, then building to 5 & 10.

Children need repeated exposure to amounts in order to associate number name and quantity.

Video Analysis: Research Lesson
Number Arrangements

- *What evidence do you see of the children's thinking & understanding?*
- *What evidence do you see of the teacher's thinking & planning?*

How might this experience connect to other math?

Stop & Reflect