

Research Précis

EARLY NUMERACY:

Initial Cardinality

Cardinality, a fundamental underpinning to number concept, refers to the concept of total quantity. Though usually described in relation to counting—the number of the last object counted in a set is the total number of objects in the set—cardinality is more general in the sense that it applies to a variety of understandings related to quantity, from implicit visual recognition at very early ages to numerical understandings. Over the past two decades, research evidence of very early beginnings, *initial cardinality*, have impacted the extent to which we now believe preschool children can learn about number and operations.

Visual recognition of quantity

In studies where four-month-old infants were habituated (accustomed to seeing) a certain number of objects, findings have indicated that they are able to discern differences between that number and pictures containing a different number of objects (Antell & Keating, 1983; Starkey et al., 1990; van Loosbroek & Smitsman, 1990). In each trial, researchers controlled for all properties (e.g., distance between objects, size of objects, etc.) other than number of objects.

Tests...

- utilized habituation;
- controlled for variables such as distance between objects and size of objects;
- measured infants' ability to distinguish sets containing one, two and three objects; and
- measured infants' abilities to detect when an object is added to an existing set.

Recognizing changes in quantity

Similar studies utilizing habituation have led researchers to claim that these earliest understandings of cardinality help infants to realize the consequences of adding and subtracting small numbers of objects (Simon et al., 1995; Wynn, 1992). For instance, when shown one or two objects, then a screen in front, then a hand placing another object behind the screen, and then the objects with no screen, five-month-old infants showed an expectation that the number of objects would differ. Sometimes they saw what they expected—a new object had been added to the one or two originally behind the screen—and sometimes they did not—researchers did not actually leave the new object with the others.

A lifelong capability

The extent to which infants looked at the pictures or displays behind screens was the measured factor. Given that children are usually three or four years old before they demonstrate the ability to distinguish between sets with four or more objects (Starkey & Cooper, 1980; Strauss & Curtis, 1984), researchers have attributed the findings with infants to quick visual recognition, in this context a process called subitizing. This is substantiated by findings that indicate similar abilities among five-year-olds as well as adults to subitize when presented with sets containing four or fewer objects, but not more (Chi & Klahr, 1975). For certain circumstances we continue to draw on the ability throughout our lives. For others (e.g., larger numbers of objects), we begin to develop and draw upon another special strategy—counting (see the PreKorner article [Count With Me!](#)).

The ability to *subitize*, or quickly recognize quantity through visual means, is observed in people from infancy through adulthood.

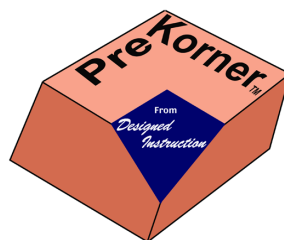
-
- Antell, S., & Keating, D. (1983). Perception of numerical invariance in neonates. *Child Development, 54*, 695-701.
- Chi, M., & Klahr, D. (1975). Span and rate of apprehension in children and adults. *Journal of Experimental Child Psychology, 19*, 434-439.
- Simon, T., Hespos, S., & Rochat, P. (1995). Do infants understand simple arithmetic: A replication of Wynn (1992). *Cognitive Development, 10*, 253-269.
- Starkey, P., & Cooper, R. (1980). Perception of numbers by human infants. *Science, 210*, 1033-1035.
- Starkey, P., Spelke, E. S., & Gelman, R. (1990). Numerical abstraction by human infants. *Cognition, 36*, 97-128.
- Strauss, M., & Curtis, L. (1984). Development of numerical concepts in infancy. In C. Sophian (Ed.), *The origins of cognitive skills*. Hillsdale, NJ: Erlbaum.
- Van Loosbroek, E. & Smitsman, A. (1990). Visual perception of numerosity in infancy. *Developmental Psychology, 26*, 916-922.
- Wynn, K. (1992). Addition and subtraction by human infants. *Nature, 358*, 749-750.
-

Be sure to read the following related articles:

[Early Childhood Numeracy](#)
[Count With Me!](#)
[Add With Me!](#)

Read the following related Research Précis:

[Edition 04 - 1 Early Numeracy: Counting and Conservation](#)
[Edition 04 - 2 Early Numeracy: Number and Language](#)



Read about other resources for teachers and parents of preschool children.

Go to the [PreKorner™ homepage!](#)