

Expanded Notions of Number Sense

Mathematics educators have a much broader view of number sense than do cognitive neuroscientists. We have already noted that cognitive neuroscientists view number sense as a biologically based innate quality that is limited to simple intuitions about quantity, including the rapid and accurate perception of small numerosities (subitizing) and the ability to count, compare numerical magnitudes, and comprehend simple arithmetic operations. Dehaene (2001) is a major proponent of a single number sense—namely, the basic representation of quantity—rather than a patchwork of representations and abilities. He does suggest, however, that this core number sense becomes connected to other cognitive systems as a consequence of both cognitive development and education.

When Berch (2005) reviewed the literature in cognitive development, mathematics cognition, and mathematics education, he found that mathematics educators consider number sense to be much more complex and multifaceted in nature. They expand this concept to include skill sets that develop as a result of involvement with learning activities in mathematics. According to Berch, these abilities include the following:

- Recognizing something has changed in a small collection when, without direct knowledge, an object has been removed or added to the collection
- Elementary abilities or intuitions about numbers and arithmetic
- A mental number line on which analog representations of numerical quantities can be manipulated
- An innate capacity to process approximate numerosities
- Making numerical magnitude comparisons
- Decomposing numbers naturally
- Developing useful strategies for solving complex problems
- Using the relationships among arithmetic operations to understand the base-10 number system
- Using numbers and quantitative methods to communicate, process, and interpret information
- Awareness of levels of accuracy and sensitivity for the reasonableness of calculations
- Desire to make sense of numerical situations by looking for links between new information and previously acquired knowledge
- Knowledge of the effects of operations on numbers
- Fluency and flexibility with numbers and understanding of number meanings
- Recognition of gross numerical errors
- Understanding of numbers as tools to measure things in the real world
- Inventing procedures for conducting numerical operations
- Thinking or talking in a sensible way about the general properties of a numerical problem or expression, without doing any precise computation

Portions of this more expansive view of number sense already appear

- in the Common Core State Standards in Mathematics,
- in contemporary mathematics textbooks, and