

THE ROLE OF METAPHORS IN THE DEVELOPMENT OF MULTIPLICATIVE REASONING OF A YOUNG CHILD

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This paper presents a case study of the growth of multiplicative reasoning in a child before the age of five. Observations of the child's activities are viewed next to two models of numerical reasoning development.

Models of number construction can be analyzed using the notion of metaphor. For example, in Confrey's (1994) model, splitting is the basis of number construction. Splitting as a primitive cognitive scheme can be considered related to the metaphor that connects such sources as sharing and folding, and the target of multiplicative one-to-many actions. Steffe (1994) considers the counting scheme to be fundamental in number construction and in the development of multiplicative reasoning. Counting is related to the metaphor that connects the source of "co-occurrence of uttering a number word and producing a countable item" (p.14), and the target of the number sequence. Multiplicative reasoning depends on the emergence of iterable units, which in turn develop on the basis of interiorized, reversible counting (Steffe, 1994).

The splitting and the counting models can be viewed as complementary examples in a framework focused on metaphors. If we consider multiplicative reasoning, as well as all thinking, to be metaphor-based, and if we consider metaphors children use to be co-defined by contexts, then differences in reasoning within the two models may stem from differences in contextual factors.

In Steffe's model, multiplicative reasoning is based on linking metaphors (Lakoff, 2000). That is, unitizing is based on another mathematical operation of counting. In Confrey's model, multiplicative reasoning is based on grounding metaphors (Lakoff, 2000) that ground composite unit construction in experiences such as sharing. My subject developed a repertoire of individual grounding metaphors, using sources, such as symmetry, sharing, and "fractals." In "fractals" the target of composite units is connected to sources such as tracing a hand on the tip of each finger of a traced hand for "five fives." Such multiplicative work with small numbers preceded additive strategies, including counting by ones, in the subject's actions and utterances.

References

- Confrey, J. (1994). Splitting, similarity, and rate of change: A new approach to multiplication and exponential functions. In J. Confrey, & G. Harel (Eds.), *The development of multiplicative reasoning in the learning of mathematics* (pp. 293-330). Albany, NY: State University of New York Press.
- Lakoff, G., & Nunez, R. E. (2000). *Where mathematics comes from: How the embodied mind brings mathematics into being* (1st ed.). New York, NY: Basic Books.
- Steffe, L. P. (1994). Children's multiplying schemes. In J. Confrey, & G. Harel (Eds.), *The development of multiplicative reasoning in the learning of mathematics* (pp. 3-40). Albany, NY: State University of New York Press.