Subitizing, Finger Gnosis, and Finger Agility as Precursors to the Representation of Number

by

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A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of Doctor of Philosophy

ABSTRACT

The goal for this program of research was to determine whether the ability to represent number is facilitated by (1) the ability to represent small numerosities (indexed by subitizing), (2) the ability to mentally represent one's fingers (indexed by finger gnosis), and (3) finger agility, as proposed by Butterworth (1999).

In a series of three experimental studies, the concurrent relation between the precursors and number system knowledge and calculation skill in Grade 1 children (Studies 1 & 2), and the longitudinal relation between the precursors and performance on tasks designed to specifically assess numerical representations: number comparison and number-line estimation from Grade 1 to Grade 2 (Study 3) were examined. Subitizing was related to number system knowledge and calculation skill (Studies 1 & 2), but not to tasks assessing the representation of number (Study 3). Finger gnosis was related to both number system knowledge and calculation skill (Studies 1 & 2) and, moreover, to measures of the representation of number: the distance effect in number comparison and the linearity and slope of children's estimates. Children who had more distinct mental representations of their fingers, as measured by finger gnosis, also had more distinct representations of number, as measured by a reduced numerical distance effect in number comparison and more accurate number-line estimations. Finger agility was related to calculation skill, but not to number system knowledge (Study 2).

Second, in a pair of synthetic studies, the relation between finger gnosis and number representations was further examined. In Study 4, a novel view of this relation was proposed, the redeployment view, according to which one of the functional circuits originally evolved for finger representation has since been redeployed to support the representation of number and now serves both uses. In Study 5, imaging results from multiple domains were used to investigate and propose a mechanism responsible for the phylogenetic impact of finger representation on the development of number representations (Study 5).

This work constitutes the first complete test of Butterworth's theory and provides support for elements of the model in typically developing children in Grades 1 -2.