Putting Your Finger on It
How Neuropsychological Tests Predict Children's Math Ability

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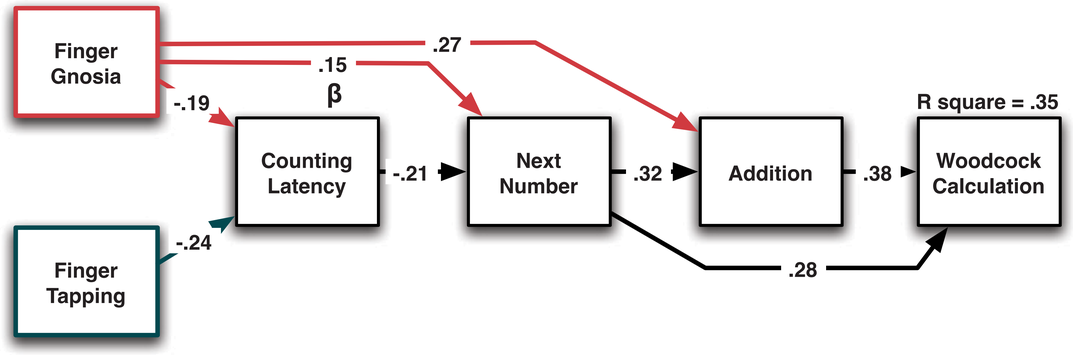
How can neuropsychological tests be used to predict children's math ability?

Fingers play an important role in the development of mathematical ability (Butterworth, 1999; Fayol & Seron, 2005). Children use their fingers to represent quantities, and also to perform counting and arithmetic procedures. Thus, fingers play a role both *representationally* and *procedurally*. Neuropsychological tests of finger gnosia—the ability to mentally represent one's fingers—and finger tapping—a measure of fine-motor speed—have been found to predict children's math ability (Barnes et al., 2005, Fayol, et al., 1998; Noel, 2005).

What remains unclear is how these tests come to predict math outcomes. To address this question, we (1) examined which early math skills are correlated with finger gnosia and finger tapping, and (2) explored the path from these two neuropsychological tests to math ability in Grade 1. Early math skills examined included: counting, knowledge of the number system, and addition performance. We assessed 145 Canadian children in Grade 1 (mean age = 6 years, 10 months).

In the **finger gnosia** task, the experimenter shielded the child's view of their hand, and touched two fingers simultaneously. The shield was removed, and the child was asked to point to the fingers touched.

In the **finger tapping** task, the child pressed a key with their index finger as many times as possible during a 10 s. interval.



Math tasks	
Counting	objects to 6
Next Number	shown numbers ranging from 2 to 407,276 and asked "What comes next?"
Addition	single-digit
Woodcock-Johnson calculation subtest	standardized measure of math achievement

Which early math skills are correlated with finger gnosia and finger tapping?

Consistent with Butterworth's (1999) view that children's representation of number hinges on the ability to mentally represent one's fingers, finger gnosia was correlated with all math measures: counting latency (r = -.21), next number (r = .22), addition (r = .34), and the Woodcock-Johnson calculation subtest (r = .18).

Consistent with Barnes et al.'s (2005) view that children's development of counting and arithmetic is aided by fine-motor ability, finger tapping was correlated with counting latency (r = -.25) and addition (r = .17).

Finger gnosia and finger tapping were not correlated, consistent with our position that they index different skills.

What is the path from finger gnosia and finger tapping to math ability?

Multiple regressions were performed controlling for gender and PPVT. Paths with significant standardized coefficients are shown.

Both finger gnosia and finger tapping scores predicted significant unique variance in counting. Consistent with the procedural/representational distinction, the predictive power of finger tapping was mediated through counting, whereas finger gnosia accounted for significant unique variance in next number and addition over and above the mediated relation.

Our findings support the view that children who are able to use their fingers as representational and procedural tools perform better in mathematics.

Finger gnosia can be used to index children's ability to use their fingers to represent quantities and is predictive of counting, knowledge of the number system, and arithmetic skills.

Finger tapping can be used to index children's ability to use their fingers to perform counting and arithmetic procedures.

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