Components of Early Mathematical Competence:
Fine Motor Ability and Working Memory

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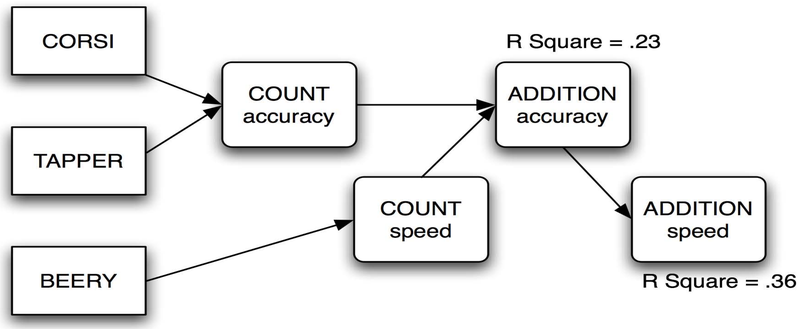
Are children's fine motor and working memory abilities related to early math skill?

Children's acquisition of mathematics, specifically counting and arithmetic skills, is posited to be related to their fine motor (Butterworth, 2003; Noel, 2006) and working memory abilities (Geary, 1993; McLean & Hitch, 1999). Fine motor ability is posited to be important because young children use their fingers to represent quantities and to perform counting and arithmetic procedures. Working memory is posited to influence children's ability to keep track of objects during counting and to maintain intermediate results in arithmetic. Barnes et al. (2005) tested these hypotheses among three-year old children and found support for the view that both fine motor abilities and visual-spatial working memory were related to children's nascent quantitative abilities. In the current analyses, we examined the relations between early math skills and fine motor and visual-spatial working memory in children beginning formal schooling in mathematics.

Children in Grade 1 (n = 61) participated as a part of the Count Me In project. Children completed tasks of fine motor ability (measured with the **Beery** Motor Coordination subtest and Finger **Tapping** test), visual-spatial working memory (measured with a computerized version of the **Corsi** Block task), counting (4 – 6 objects), addition (sums to 10), and the Peabody Picture Vocabulary Test (PPVT).



Fine motor and working memory abilities are related to counting and arithmetic skills.

Linear regressions were performed, and paths with significant unique variance, controlling for receptive vocabulary (PPVT) and gender, are shown.

As predicted, performance on the Corsi task was related to children's counting accuracy. This finding was predicted given that working memory is required to keep track of objects during counting. Performance on the Tapper task was also related to children's counting accuracy. This relation was predicted given that children use their fingers to represent quantities and to perform counting procedures (Butterworth, 2003). Performance on the Beery Motor Coordination task was related to children's counting speed. This relation follows given that the task is a timed measure of fine motor skill.

Relation between component abilities and addition is mediated through counting.

Counting accuracy was related to addition accuracy. This relation was predicted based on children's use of counting to solve addition problems. Counting speed was also related to addition accuracy, consistent with the position that children who could quickly solve a problem (fast counters) were in a better position to form an association between the operands and answer (Geary, 1993). Addition accuracy and speed were also related.

Thus, the relation between the component abilities, fine motor and working memory, and addition accuracy was mediated through counting performance. Specifically, Corsi and Tapper performance were mediated through counting accuracy, and Beery performance was mediated through counting speed.

Our results provide support for the view that working memory and fine motor abilities both contribute to early math skills, extending the findings of Barnes et al. to children just beginning formal schooling in mathematics.

We found that the relation between the component abilities (fine motor and working memory) and addition performance was mediated through counting performance.

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