Exploring Symbolic Math Processing in Immersion and Non-Immersion Students

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Introduction

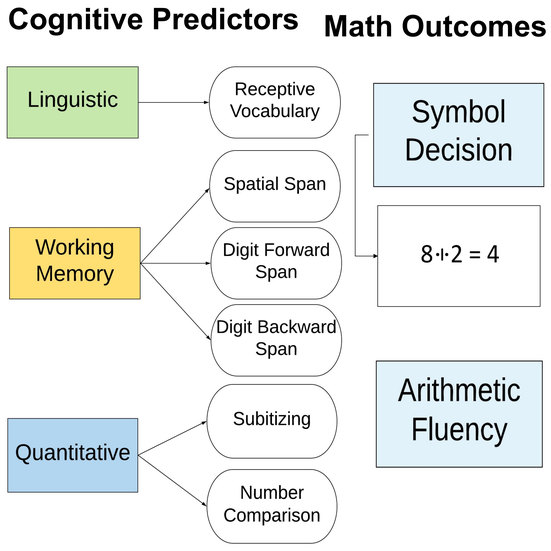
- Children's knowledge of math orthography and symbolic associations (e.g., Arithmetic) among number is foundational for the development of mathematical competence.
- The *Pathways Model* suggests that linguistic ability, in addition to domain-specific quantitative skills and domain–general working memory, contribute to the development of symbolic number skills (LeFevre et al., 2010). Sowinski et al. (2014) found that linguistic pathway predicted grade 2 children's performance on symbolic number system knowledge. **Thus, students may be disadvantaged if the language they speak at home is not the language of math instruction.**
- Are there **differences** in the **pathways to math acquisition** for children who were enrolled in **immersion programs** (i.e., learning math a second language – French) and children who were enrolled in **non-immersion programs** (i.e., learning math in their first language – English)?

Method

Participants:

- **108 French Immersion**
  - Completed tasks in English and French
  - three 25-minute sessions.
- **74 Non-Immersion**
  - Completed all of the tasks in English
  - two 25-minute sessions.
- M_{age} = 7 yrs:10mons (grade 2)

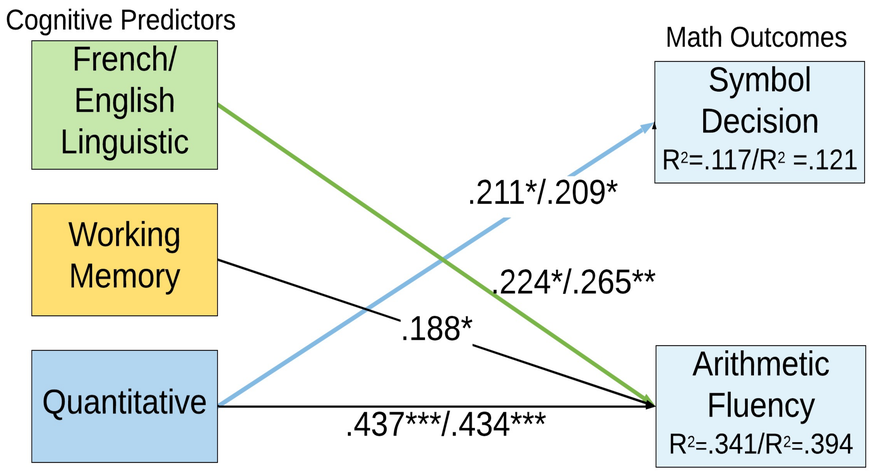
- No performance differences between groups



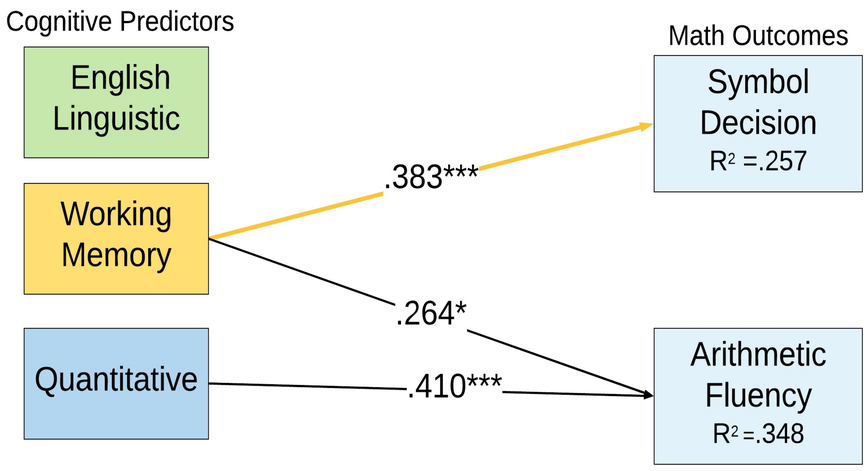
Results

Multiple Regression Analyses

Immersion



Non-Immersion



Note: Gender and mother's education were controlled for in the models

Discussion

Symbolic Math Knowledge

- The symbolic decision task assess students' knowledge of math orthography (i.e., the rules and conventions of written math symbols).
- Since **non-immersion students** are proficient in the instructional language, teachers may be more inclined to rely on oral language to support math learning (e.g., "what's five plus four"). This may explain the unique role of working memory when students are discriminating patterns of math symbols.
- In contrast, **immersion students** are less proficient in the instructional language, thus teachers may use more visual representations of the math symbols to support math learning (e.g., "what's 5 + 4"). As a result, working memory may be less implicated when students are discriminating patterns of the math symbols.
- Furthermore, **for immersion students**, quantitative ability predicted symbol decision knowledge, suggesting that the activation of symbol knowledge may be involved in both of the tasks for the immersion students.

Arithmetic Fluency

- Children rely on a combination of calculation strategies (i.e., counting) and retrieval-based strategies to solve arithmetic fluency (e.g., Geary et al., 2004; Siegler, 2007). Thus, both working memory and the accessibility of quantitative knowledge are relevant for the strategy implementation **for both groups**.
- **For immersion students**, the linguistic pathway to arithmetic fluency reflect an additional language demand when children are articulating the mental processes of problem solving (e.g., to solve 9 + 3, children may use a counting up strategy: 10-11-12).

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