The Role of Language in Math Problem Solving for Immersion and Non-Immersion Students

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Introduction

• The Pathways Model suggests that there are three pathways the contribute to Children's symbolic number skills, linguistic ability, quantitative skills and working memory (LeFevre et al., 2010).
• Further, children's math-specific vocabulary mediates the relationship between their mathematical abilities and language abilities (Purpura et al., 2017).
• Educators are concerned that children learning math in immersion programs may be disadvantaged because they are learning math in their second language.

Research question: Do the pathways to math word problem solving differ for children enrolled in immersion programs (i.e., learning math a second language – French) compared to children enrolled in non-immersion programs (i.e., learning math in their first language – English)?

Method

• Participants: Grade 2, no performance differences between groups
• 108 French Immersion
  • Completed tasks in English and French
  • three 25-minute sessions.
  • M_age = 7y:9m
• 74 Non-Immersion
  • Completed all of the tasks in English
  • two 25-minute sessions.
  • M_age = 7y:8m

Cognitive Predictors

- Linguistic
- Spatial Span
- Digit Forward Span
- Digit Backward Span
- Subsizing
- Number Comparison

Math Outcomes

- Math Vocabulary
- Problem Solving

Results

Multiple Regression Analyses

<table>
<thead>
<tr>
<th>Cognitive Predictors</th>
<th>Math Outcomes</th>
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<tbody>
<tr>
<td>French / English Linguistic</td>
<td>French Math Vocabulary R²=.276**</td>
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<tr>
<td>Working Memory</td>
<td>.320**/.284**</td>
</tr>
<tr>
<td>Quantitative</td>
<td>.323**</td>
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<tr>
<td>Math Vocabulary</td>
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<th>Cognitive Predictors</th>
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<tr>
<td>Math Problem Solving</td>
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Discussion

Math Vocabulary

• The math vocabulary task assesses students' knowledge of mathematical and spatial terms (e.g., less than, tens column).
• For both immersion and non-immersion students, working memory and linguistic skill uniquely predicted math vocabulary

Problem Solving

• To problem solve a child must understand the overall content of the question and the mathematical operations they will need to use
• Math vocabulary directly predicts problem solving for both immersion and non-immersion students, which is consistent with Powell et al., 2017. For immersion students, it mediates the vocabulary problem solving relationship.
• For non-immersion students, there is an additional direct pathway from general linguistic to math problem-solving. In contrast, for immersion students, math vocabulary fully mediated the relationship between general linguistic and math problem-solving.
• Thus for non-immersion students, their prior knowledge of English may contribute to equal proficiency in both general linguistic skill and math vocabulary. Immersion students may not have prior knowledge of French, thus regardless of general linguistic skill, their knowledge of math vocabulary in the instructional language is predictive of their success in math problem-solving.

• A limitation to this study is this that French Immersion students knowledge of English Math Vocabulary was not collected. This is being addressed in the second year of testing.

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