Cognitive Deficits and Math Anxiety
Limited evidence for a causality hypothesis

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Background
Previous math anxiety research has focused on correlational studies that may include: gender, spatial skills, basic symbolic number skills, working memory and math performance.

We account for these correlations with a comprehensive model of the inter-relations between predictors. This model addresses claims that deficits in spatial and numeric foundations may lead to math anxiety.

Hypotheses
H1: Relations between math anxiety and spatial skills will be accounted for by shared relations with symbolic number skills and gender.

H2: Math anxiety will directly predict arithmetic performance after accounting for relations with basic symbolic number skills.

H3: Spatial skills and working memory will predict performance indirectly through basic number skills.

Method
Adults (N=90) completed measures of math anxiety (AMAS), basic symbolic number skills, spatial skills, working memory (backwards digit span, spatial span), and arithmetic (addition, subtraction, multiplication, and procedural arithmetic)

Symbolic number skills:
Magnitude comparison
\[
\begin{array}{cccc}
\emptyset & 3 & 8 & 2 \\
9 & 7 & 5 & 6 \\
3 & 9 & \checkmark & \  \\
\end{array}
\]

Number ordering
\[
\begin{array}{cccc}
2 & 3 & 4 & \checkmark \\
9 & 7 & 5 & 6 \\
\end{array}
\]

Number sets test
\[
\begin{array}{cccc}
1 & 7 & 0 & * \\
8 & 4 & 2 & 1 \\
\end{array}
\]

Spatial skills:
Mental rotation

Results

Figure 3: SEM model of relations with cognitive and affective predictors of arithmetic performance.
Solid lines represent significant paths (\(^*\)p<.05, \(^**\)p<.01). Numbers shown are the standardized coefficients.
Model fit was strong (e.g., \(\chi^2(30, N=90) = 35.5, p = .23\)).

Conclusions

• The relation between math anxiety and spatial skills is accounted for by symbolic number skills (H1).

• Deficits in basic cognitive skills DO NOT fully explain the math anxiety/performance relation (H2).

• Domain-general cognitive skills (working memory and spatial skills) are related to calculation fluency through symbolic number skills (H3).

• The relation between basic number skills and math anxiety could be concurrent or causal. Longitudinal research with children is needed to test any causality claims.