Spatial Training Improves Mathematics Performance Independent of Mathematics Anxiety in Early Adolescence

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The training of spatial skills such as mental rotation and perspective taking has been shown to improve mathematics performance, yet the mechanisms underlying this relation remain poorly specified (Resnick & Adams, 2024). Most accounts emphasize shared cognitive resources or representational overlap between spatial and mathematical thinking, but comparatively little attention has been given to the role of learners' affective experiences in mathematics. Mathematics performance depends not only on competence, but also on one's attitudes towards mathematics and other affective responses such as mathematics anxiety, which can constrain working memory, reduce persistence, and impair performance (e.g., Barroso et al., 2021).

Training spatial skills may alter these affective factors by increasing perceived control, fluency, and intelligibility when engaging with mathematically relevant representations. As a result, improvements in mathematics following spatial training may be mediated by changes in mathematics-related beliefs and anxiety. The current study explored this mediation effect, by examining whether the relation between spatial training and mathematics performance is explained by changes in mathematics affect. By evaluating affective pathways alongside performance outcomes, this work aims to clarify how and why spatial training transfers to mathematics, and to integrate cognitive and affective perspectives on learning and transfer.

Drawn from a larger classroom-based digital spatial intervention study, which include pre/post measures on spatial skills and mathematics performance (Harris et al., under review), 320 Year 7 and 8 students also completed pre/post measures on mathematics anxiety and attitudes towards mathematics. Qualitative data, including interviews and metaphor analysis, were used to elaborate on and contextualise quantitative findings. It was found that spatial training produced a significant improvement in mathematics performance irrespective of the level of mathematics anxiety experienced by the student, highlighting the impact of spatial training.

Drivers of mathematics anxiety and attitudes towards mathematics in Years 7 and 8 appear more complex. The study found that there was no significant reduction in mathematics anxiety due to spatial training. In contrast, attitudes towards mathematics declined across the entire cohort, independent of participation in the intervention. Initial analysis of the qualitative data highlights the complexity of factors that are present in these year groups which may be obscuring the potential benefits of spatial training on mathematics affect.

References

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