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Gender and Toys as Factors in the Relation Between Spatial and Math Skills During Childhood

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Abstract

Previous research has suggested that early sex differences in visuospatial skills may be related to science, technology, engineering, or math (STEM) careers being disproportionately male.[1] Visuospatial skills such as spatial visualization and mental rotation are correlated with childhood math skills.[2] Findings regarding sex differences in math skills have been inconsistent.[3] However, there is a slight female advantage in computation and algorithmic solutions in elementary school and middle school before there is no sex difference, and there is a male advantage in assessments involving problem-solving and the application of math concepts to novel contexts beginning in high school.[4] Male advantages in spatial skills are present in childhood and become increasingly exaggerated over time beginning in middle school.[5] Visuospatial skills are a predictor of computational and algorithmic math skills in middle school aged males but not in middle school aged females.[3] The development of visuospatial and math skills such as mental rotation, numeracy, and shape recognition are correlated in early childhood with playing with spatial toys such as puzzles or blocks—which are less commonly played with by females than males.[6,7] Gender and its influence on types of toys played with may influence visuospatial skills, math skills, and eventual involvement in STEM.

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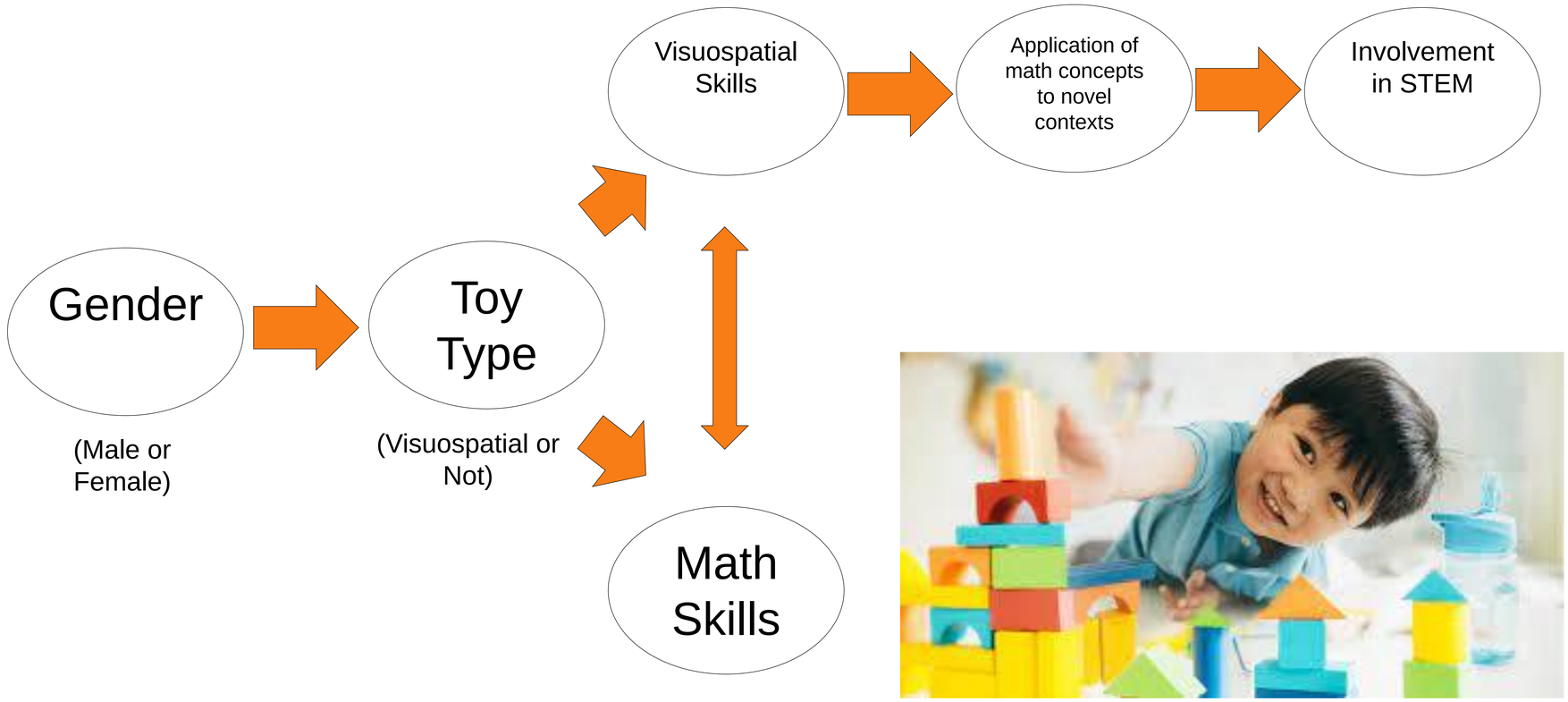
Conceptual Scheme Explanation

The proposed scheme starts with gender as a variable. Gender influences toy types, as males are more likely to play with toys that enhance visuospatial skills such as blocks than females (Schmitt et al., 2018). Playing with visuospatial toys such as blocks or physical puzzles has been shown to enhance the development of both math skills and visuospatial skills in children; visuospatial skills and math skills bidirectionally influence one another (Greer, Quinn, & Ganley, 2019).

The fact that males begin to have significantly better visuospatial skills than females at a similar age as when standardized testing shows that their application of math to novel contexts becomes significantly better than females implies that visuospatial skills may influence the development of the ability to apply math concepts to novel contexts.

Finally, the application of math concepts to novel contexts is a highly necessary skill for many occupations related to science, technology, engineering, and math (STEM). The female disadvantage in this skill may be related to the lesser female involvement in STEM. Indirectly, gender and toys may have influence on the STEM gender discrepancy.

Conceptual Scheme Visualized



Background

Previous research has suggested that early sex differences in visuospatial skills may be related to science, technology, engineering, or math (STEM) careers being disproportionately male (Sanchez & Wiley, 2010). Visuospatial skills such as spatial visualization and mental rotation are positively correlated with and predictive of math skills and achievement in early and middle childhood (Greer, Quinn, & Ganley, 2019). Findings regarding sex differences in math skills or performance overall have been inconsistent, with no clear sex advantage recurring in all methods of assessment (Ganley & Vasilyeva, 2011). However, sex differences were present in math assessments when accounting for differences in question type; there is a slight female advantage in computation and algorithmic solutions in elementary school and middle school before there is no sex difference, and there is a male advantage in assessments involving problem-solving, the application of math concepts to novel contexts, and spatial reasoning beginning in high school (Lindberg et al., 2010). Male advantages in spatial skills, however, are present in childhood and become increasingly exaggerated over time beginning in middle school (Geiser, Lehmann, & Eid, 2008). Visuospatial skills are a predictor of computational and algorithmic math skills in middle school aged males but not in middle school aged females (Ganley & Vasilyeva, 2011). The development of visuospatial and math skills such as mental rotation, numeracy, and shape recognition are correlated in early childhood with playing with spatial toys such as puzzles or blocks—which are less commonly played with by females than males (Schmitt et al., 2018) (Jirout & Newcombe, 2015). The role of the sex difference in spatial toy play may be an early developmental factor in the sex differences of visuospatial skills, math skills, and STEM involvement.

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