



ABSTRACT

Spatial skills picturing, turning, and moving objects in the mind predict later success in STEM. Because these skills can still grow in early childhood, play may help build them. This narrative review examined 28 peer-reviewed studies (2008–2024) on puzzle-like play (jigsaws, tangrams, block building) in children aged 0–12. Structured spatial play was consistently linked to stronger spatial skills and early math, especially when adults guided the play. As most evidence is correlational or short-term, puzzle play is a promising support not a guaranteed route into STEM.

KEY TERMS

- **Mental rotation:** turning an object in your mind.
- **Spatial visualization:** picturing how parts form a whole.
- **Puzzle play:** goal-based play with set rules, e.g., jigsaws, tangrams, block models.
- **STEM:** science, technology, engineering, and math.

AT A GLANCE

28

studies reviewed

2008-24

publication years

5

databases searched

0-12

children's ages (yrs)

Introduction

Spatial skills help children read diagrams, find their way, and see objects from new angles [1]. Strong early spatial skills predict later STEM success [2], and they can still be shaped in early childhood [1,3]. Puzzle play exercises these skills by asking children to fit parts into a whole [4,5].

**Research question:** How does early puzzle play relate to children's spatial skills, and how strong is the evidence?

Why could play help?

**Piaget**
Children build spatial ideas by handling objects [6].

**Vygotsky**
Adult guidance and spatial talk extend children's thinking [7].

Methods

**1. Search**
PsycINFO, ERIC, Web of Science, Scopus, JSTOR + Google Scholar (2008–2024)

**2. Keywords**
Play × spatial-skill × child / STEM search terms

**3. Screen**
Removed duplicates, adult-only, non-spatial, and non-empirical studies

**4. Select & rate**
Children aged 0–12 with a measured spatial or academic outcome; quality rated low, unclear, or high risk

28

Studies included
Grouped by design and play type; PRISMA-guided reporting

Results

**Consistent pattern:** structured spatial play went with stronger spatial skills, and these skills could be trained at many ages.

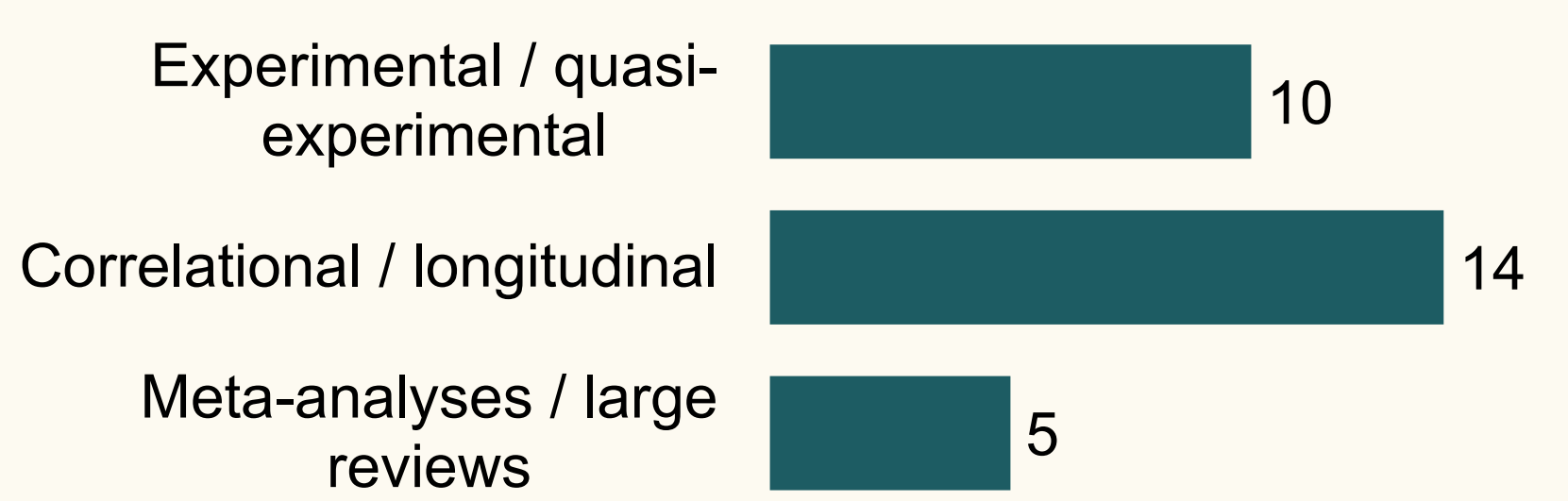


Figure 1. Study designs. Experiments reported medium-to-large gains [8–10].

Findings by Type of Play

**Jigsaw puzzles**
More puzzle play at home (26–54 months) predicted stronger later mental transformation [4].

**Block building**
Guided block programs improved spatial visualization, early math, & executive function [8,9].

**Tangrams & 2D puzzles**
Part-to-whole 2D tasks gave strong gains in preschoolers [3]; complex designs helped more [11].

**Hands-on vs. digital**
Both helped; real materials plus adult spatial talk went deeper [12].

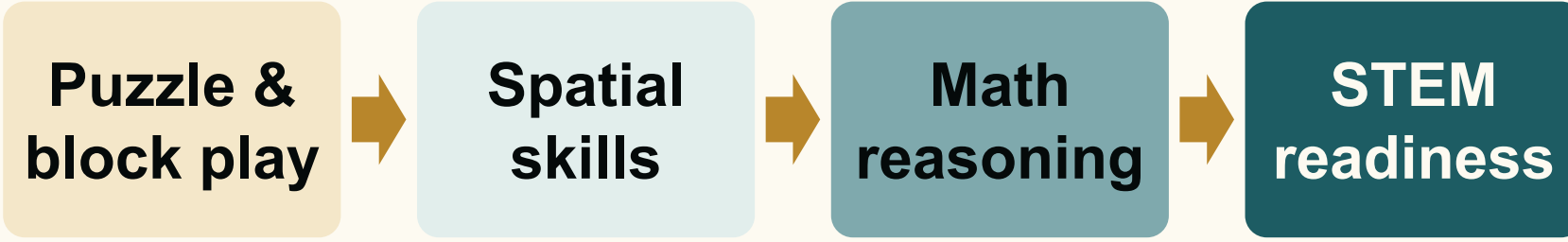
Large-Scale & Brain Evidence

~17,000

children in a randomized trial: spatial training improved math learning [13].

**Brain scans**
Block building activates spatial (parietal) brain areas [14] that also support number and mental-rotation tasks [15].

Discussion



Evidence shows links and short-term gains not a guaranteed path [2].

- **Guidance matters:** how adults guide and talk during play may matter more than which puzzle is used [1,3,12].
- **Early skills last:** Grade 1 girls' spatial skills predicted their Grade 5 math reasoning [16].
- **Fair across groups:** the spatial–math link held across age, SES, and gender [17].

Limitations

- **Mostly correlational**
- **Small samples**
- **Higher-SES families**
- **Mostly Western**
- **Publication bias risk**
- **Few long-term STEM data**

Conclusion

Early puzzle play is consistently linked to stronger mental rotation and spatial visualization. It is a low-cost way to give young children spatial challenges - a promising support, not a guaranteed route into STEM.

**Educators**
Add puzzles & blocks to daily routines

**Caregivers**
Guide play with spatial language

**Clinicians**
Use puzzle play for early spatial weaknesses

Future directions: larger long-term randomized trials; more diverse children; comparing 2D vs. 3D, physical vs. digital, and free vs. guided play.

References

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