Growth Curve Modeling of Preschoolers’ Spatial Skills during Spatial Training

Lien Vu1, Corinne Bower1, Natalie Evans1, Laura Zimmermann2, Brian Verdine2, Tamara Spiewak Toub1, Lindsey Foster2, Siffat Islam1, Roberta Michnick Golinkoff2, & Kathy Hirsh-Pasek1

1 Temple University, 2 University of Delaware

Introduction

• Early spatial skills → later spatial and math skills (Mix & Cheng, 2012) and likely achievement in STEM disciplines (Wai, Lubinski, Benbow, & Steiger, 2010)
• Many longitudinal studies regarding achievement gaps have led to inconsistent conclusions (T.Shin et al., 2013)
• Low-income preschoolers have worse spatial skills than middle-income peers (Verdine et al., 2014); however, spatial skills are malleable (Uttal et al., 2013)
• Little is known about which interventions optimize spatial skills for younger, especially low-socioeconomic (SES), learners, AND
• Almost nothing is known about the trajectory of spatial skills during training.
• The particular training used here required puzzle assembly with colored geometric forms (see Method).

Research Questions/Hypothesis

1. How does each child’s spatial ability change over time (within-person change) with spatial training?
2. Do children’s spatial skill trajectories during spatial training vary by SES (between-person change)?

Participants

• 187 Three-year-olds tested at Head Start and private preschools
• 96 girls, M_age = 42.65 mo, SD_age = 3.37 mo, 50% Low SES

Method

Week 1        Weeks 2-6        Week 7
Pre-Test      5-week training (1x/week)      Post-test

2D TOSA Training Conditions Embedded in Birthday Party Game

<table>
<thead>
<tr>
<th>Shape Familiarization</th>
<th>Demo Trial</th>
<th>Training Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modeling &amp; Feedback</td>
<td>E shows the correct locations to place shape. Then E asks child to place shapes.</td>
<td>E traces correct shape location before placing. Then E asks child to trace and place shapes.</td>
</tr>
<tr>
<td>Gesture</td>
<td>E models tracing correct location before placing. Then E asks child to trace and place shapes.</td>
<td>E traces correct shape location before moving incorrect pieces.</td>
</tr>
<tr>
<td>Spatial Language</td>
<td>Told the name of each shape and shape properties and child repeats the name</td>
<td>E talks about shape locations and names them as they are placed. Then E asks child to say where shapes go and place shapes.</td>
</tr>
<tr>
<td>Control</td>
<td>No training during weeks 2-6</td>
<td>No training during weeks 2-6</td>
</tr>
</tbody>
</table>

Results

Growth curves (lines) for Low SES

Growth curves (lines) for High SES

• Spatial training using puzzle assembly is effective with 3-year-old children. All children completed the training.
• Growth rate did not vary by SES.
• Plots indicate a linear, continuous growth pattern with individuals having different starting points, and different slopes (rate of change).
• But over time, there is more spread in scores, which may indicate possible subgroups (e.g., age in months, bilingualism, gender)

Future Directions

• Additionally, other factors such as age and home environment (whether they have spatial toys) could also have an effect on the starting point and rate of growth.
• Identify and group by high and low growth rates and examine if that predicts later spatial and math performance.

Discussion

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References

Mix & Cheng (2012). The relation between space and math: Developmental and educational implications. In J. B. Benson (Ed.), Advances in child development and behavior
Wai, Lubinski, Benbow, & Steiger (2010). Accomplishment in science, technology, engineering, and mathematics (STEM) and its relation to STEM educational doses: A 25-year longitudinal study. Journal of Educational Psychology

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