Introduction

- Early spatial skills → later spatial and math skills (Mix & Cheng, 2012) and possible achievement in STEM disciplines (Wai, Lubinski, Benbow, & Steiger, 2010)
- Low-income preschoolers have worse spatial skills than middle-income peers (Verdine et al., 2014), however, spatial skills are malleable (Uttal, et al., 2013)
- Benefits of spatial training on spatial skills persists up to 1 mo (Uttal et al., 2013). However, little is known about long-term impact (i.e., >1 mo) of these trainings on spatial and math skills, especially among low-socioeconomic (SES) learners

Research Questions

1. Can spatial training have a long-term impact on preschoolers’ spatial and math skills?
2. Will SES moderate the long-term impact of the spatial training on spatial and mathematics achievement?

Participants

- 84 3-year-olds tested at Head Start and private preschools
- 43 girls, $M_{\text{age}} = 42.65$ mo, $SD_{\text{age}} = 3.37$ mo, 52% Low SES

Method

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Weeks 2-6</th>
<th>Week 7</th>
<th>9-months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test</td>
<td>5-week training</td>
<td>Post-test</td>
<td>Follow-Up</td>
</tr>
<tr>
<td>Type</td>
<td>Assessments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial</td>
<td>2D TOSA Trials</td>
<td></td>
<td></td>
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<tr>
<td>Math</td>
<td>Woodcock-Johnson IV: Applied Problems</td>
<td>TEMA Subset</td>
<td></td>
</tr>
<tr>
<td>Vocabulary</td>
<td>Woodcock-Johnson IV: Picture Vocabulary</td>
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<td></td>
</tr>
</tbody>
</table>

Intervention

2D TOSA Training Conditions Embedded in Birthday Party

<table>
<thead>
<tr>
<th>Spatial Training</th>
<th>Shape Familiarization</th>
<th>Demo Trial</th>
<th>Training Trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child looks/attracts/hears spatial properties and names of the shapes</td>
<td>E shows/asks child to place/trace and describe the correct locations to place shapes. Then E asks child to place/trace and place/describe location and place shapes</td>
<td>E fixes incorrect pieces by placing shapes in correct location/tracing correct shape location/tracing incorrect shapes and describing correct locations</td>
<td></td>
</tr>
</tbody>
</table>

| Control | No training during weeks 2-6 |

Results

Longitudinal training effects? No
Moderation of SES on long-term impact? No

Spatial – 2D TOSA

Math – Applied Problems

Math – TEMA

Discussion

- No long-term impacts of training on children’s spatial and math skills with no moderation of SES
- Low-SES children’s spatial and math skills benefited from spatial training at immediate posttest, but were not retained 9-mo later
- Supports malleability of spatial skills (Uttal, et al., 2013), but not long-term durability
- Current training was low-intensity (15 min 1x/week for 5 weeks) so maybe this was not enough ‘dosage’ for long-term impacts

Future Directions

- Examine whether digital spatial training with an app has similar immediate posttest effects compared to the concrete spatial training
- Examine training effects on general cognitive processes (e.g., executive function) and other transfer spatial skills
- Identify/understand types and dosage of early spatial skill interventions and their influences on math achievement

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 dose: A 25-year longitudinal study. Journal of Educational Psychology

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