

More Than Just IQ: Exploring the Link Between Patterning and Individual Math Skills

Erica L. Zippert, Kelsey Clayback, & Bethany Rittle-Johnson
Vanderbilt University

For More Information and this Poster:
<http://vu.edu/patterns-and-math>
Erica.L.Zippert@vanderbilt.edu

Abstract

Early math knowledge is critical for later academic achievement; thus, we must identify skills that support young children's math development. This study explored how repeating patterning skills are associated with specific math skills in preschoolers. Correlations showed that patterning skills were significantly related to math skills (i.e. magnitude comparison, verbal arithmetic) after controlling for general cognitive skills, including spatial and fluid reasoning and working memory. These findings provide further support for including patterning instruction in early math standards.

Background

- Math knowledge begins to develop at a young age and is predictive of later math and reading achievement (Duncan et al., 2007; Watts et al., 2014). Thus, it is important to determine foundational skills that support this development.
- Patterning skills are theorized to be important contributors to early and later math development (Charles, 2005; Sarama & Clements, 2004; Steen, 1988).
- Empirically, patterning skills in early childhood have been shown to predict fifth- and sixth-grade general math achievement, even after controlling for a wide range of other math and cognitive skills, including numeracy knowledge (Nguyen et al., 2016; Rittle-Johnson, Fyfe, Hofer, & Farran, 2016).
- Though patterning skills and general math knowledge are linked, little is known about how patterning skills relate to specific early math skills in early childhood. Evidence only exists on this link with older children, and suggests that patterning may be related to certain early math skills, such as calculation skill (Fyfe, Evans, Matz, Hunt & Alibali, 2017).
- Further, patterning items are commonly included on IQ measures (e.g., Wechsler, 2012); thus evidence is needed to distinguish patterning skills from general intelligence. A recent study provides preliminary evidence that patterning skills are moderately correlated with working memory and spatial reasoning (Rittle-Johnson, Zippert, & Boice, 2017).
- Evidence on the link between patterning and mathematics is strongly needed, as current Common Core Standards (2010) exclude patterning in the early grades.

Study Aims

- Aim 1:** Determine the relation between preschoolers' repeating patterning skills and measures of their general cognitive skills, specifically spatial and fluid reasoning and working memory.
- Aim 2:** Determine the relation between preschoolers' repeating patterning skills and specific math skills, above and beyond their general cognitive skills.

Current Study

The current study examined relations between preschoolers' repeating patterning skills and general cognitive skills (i.e., spatial and fluid reasoning and working memory), as well as individual math skills, controlling for general cognitive skills.

Method

Participants:

- 66 four- to five-year-olds ($M_{age} = 4.54$ years, $SD = .36$, 61% female)
- Recruited from three private and two public preschools
- 50% were non-Hispanic White, 38% were African American, 8% were Asian, and 5% were Hispanic White
- Patterning, general cognitive, and specific math skills were assessed in the Fall of the preschool year

Patterning Skills:

- Teacher-Based Pattern Measure (Rittle-Johnson et al., 2017; see Figure 1)
- Research-Based Pattern Measure (Miller, Rittle-Johnson, Loehr, & Fyfe, 2016)

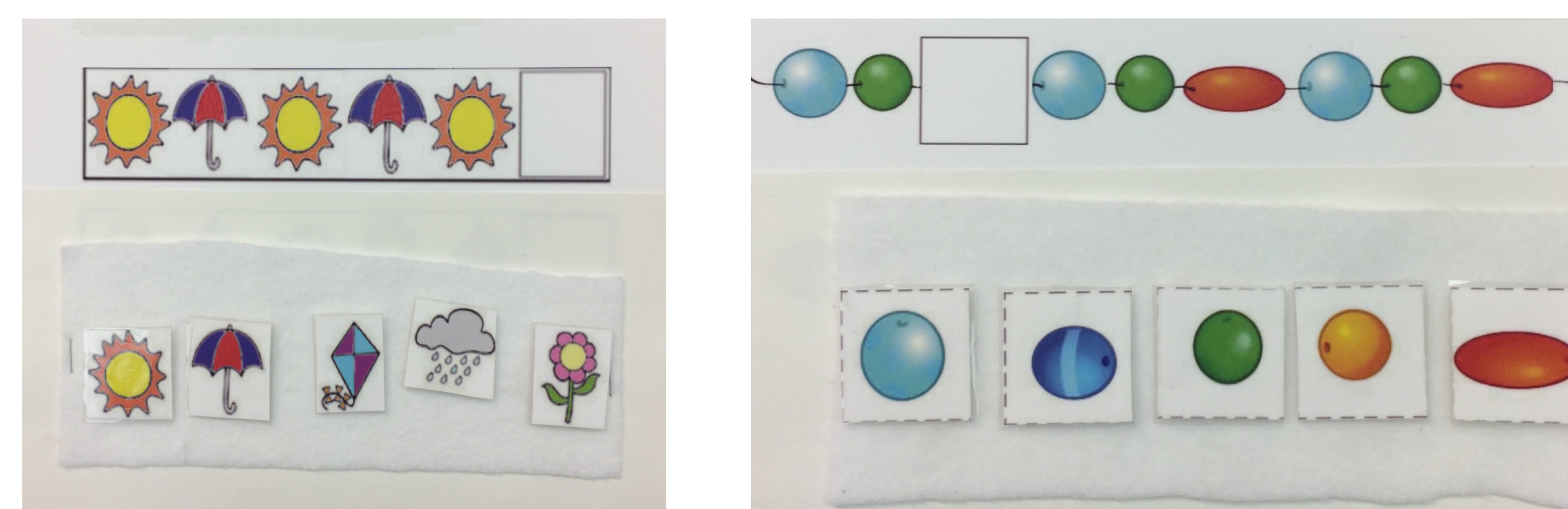
General Cognitive Skills:

- Spatial reasoning was measured using the Position in Space subtest of the Developmental Test of Visual Perception (Hammill, Pearson, & Voress, 1993).
- Fluid reasoning was measured using the Matrix Reasoning subscale of the Wechsler Preschool and Primary Scale of Intelligence-Fourth Edition (Wechsler, 2012)
- Working memory was measured using the Picture Memory subscale of the Wechsler Preschool and Primary Scale of Intelligence-Fourth Edition (Wechsler, 2012)

Specific Math Skills:

- Two subscales of the Preschool Early Numeracy Scales (Purpura & Lonigan, 2015) were used: 1) magnitude comparison and 2) verbal arithmetic

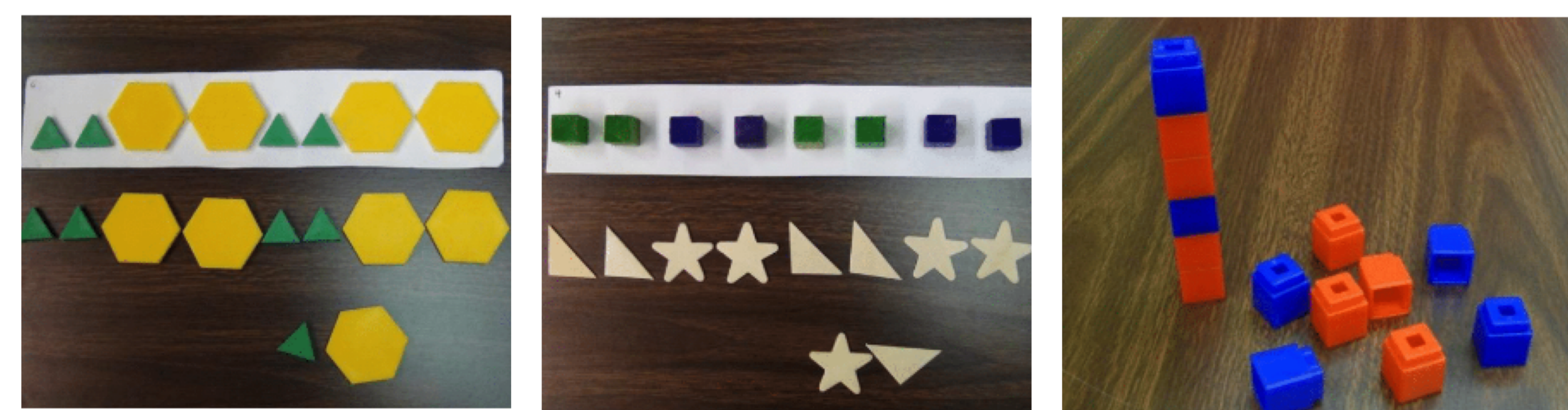
Figure 1: Sample Items from Teacher-Based Patterning Assessment



What Comes Next AB

Missing Item Pattern ABC

Figure 2: Sample Items from Research-Based Patterning Assessment



Pattern Duplication

Pattern Abstraction

Unit Recognition

Results

Table 1: Partial Correlations Between Patterning and General Cognitive Skills

	Patterning skills	Spatial reasoning	Fluid reasoning	Working memory
1. Patterning skills	---			
2. Spatial reasoning	.376**	---		
3. Fluid reasoning	.191	.514**	---	
4. Working memory	.166	.238	.273*	---

Note: Correlations control for age. * $p < .05$. ** $p < .01$. The 2 patterning measures were made into a composite.

Table 2: Partial Correlations Between Patterning Skills and Specific Early Math Skills

	Magnitude Comparison	Verbal Arithmetic
Patterning Skills ¹	.522**	.492**
Patterning Skills ²	.433**	.439**

Note: Patterning Skills¹: Partial correlations control for age. Patterning Skills²: Correlations control for age, spatial and fluid reasoning, and working memory. ** $p < .01$

Conclusion

- These findings suggest that patterning is related to but distinct from general cognitive skills.
- Patterning is linked to early math skills, even after controlling for general cognitive ability.
- As evidence suggests that patterning supports numeracy knowledge (Nguyen et al., 2016; Rittle-Johnson, Fyfe, Hofer, & Farran, 2016), repeated patterning instruction may be important for promoting early development of specific math abilities.
- The current findings, in combination with recent longitudinal and intervention research (Kidd, Pasnak, Gadzichowski, Gallington, McKnight, Boyer, & Carlson, 2014; Papic, Mulligan & Mitchelmore, 2011; Rittle-Johnson et al., 2016), provide further evidence that patterning should be included in early math learning standards.