Helping Children See Patterns: Visual Support as a Tool to Understanding Repeating Patterns

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Background

- Perceptual information is helpful to cue learners to pay attention to the specific relevant features in a mathematics problem (Alibali, Crooks, & Mcneil, 2018; Flynn, Guba, & Fyfe, 2020; Jiang, Cooper, & Alibali, 2014; Landy & Goldstone, 2010; Yeo et al., 2018)
- However, past research has focused on school-age children and limited to operations and algebraic thinking
- Repeating pattern knowledge is an early math concept foundational to later math learning (Fyfe, Evans, Matz, Hunt, & Alibali, 2017; Rittle-Johnson, Fyfe, Hofer, & Farran, 2017; Rittle-Johnson, Zippert, & Boice, 2019).
- The current study examined whether adding visual support helped preschoolers understand repeating patterns

Questions

- Does adding a visual support (via a frame) help preschoolers understand repeating patterns?
- Does adding a visual support (via a frame) effect the incorrect response options preschoolers choose?
- The primary dependent variables are 1) children's accuracy on training trials, 2) children's accuracy on posttest trials

Participants

- 64 four- and five-year-olds (M=4.3 years, SD=.57; 50% female) were recruited from local preschools & a research database.
- Most were enrolled in a pre-K program (59%), White (69%) and did not receive financial assistance (89%) or early intervention services (91%)

Method

- Randomly assigned control condition with no visual support or a frame condition with visual support
- Adapted version of the Early Patterning Assessment Online Repeating Subscale (Rittle-Johnson, Douglas, Zippert, Özel, & Tang, 2020)
- 19 multiple choice items: 3 baseline items; 10 training items; and 6 post-test items
- Data was collected on a synchronous zoom session lasting 20-30 minutes with parent present.

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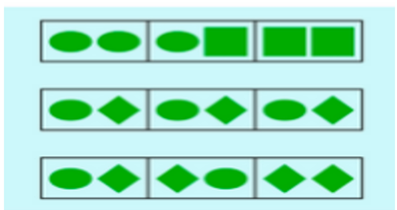
Example Patterning Items

Frame Condition received items as shown below. Control received same items without box frame

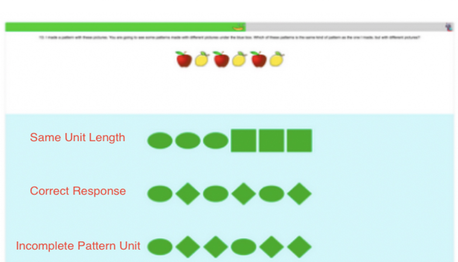
Identify

Extend

Abstract

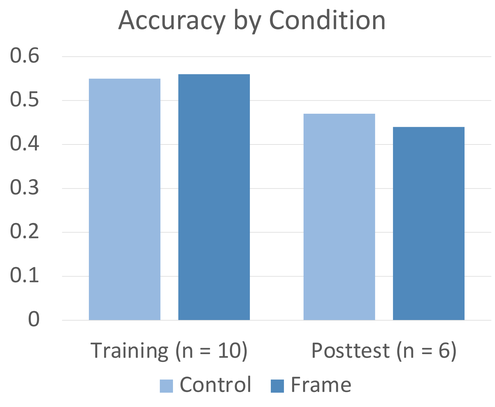


Response Options



Results

- Baseline performance correlated with training and posttest performance
- Age correlated with accuracy on each trial
- Given these results, we used baseline performance and age (in months) as covariates for subsequent analyses.
- Baseline performance did not differ by condition (t(59) = -.255, p = .80)



Linear Regressions of Baseline, Condition and Age on Accuracy

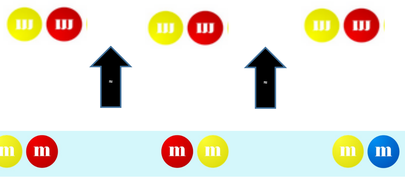
	Training Accuracy		Posttest Accuracy	
	β	Std. Error	β	Std Error
Condition	.03	.05	.01	.06
Baseline	.39**	.09	.26*	.11
Age	.01*	.00	.02**	.01

Proportion of Response Options by Item Type and Condition

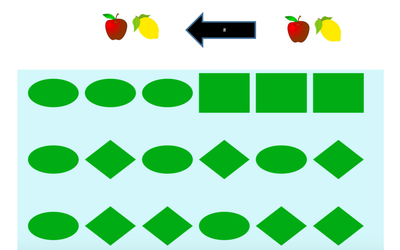
	Extend Items		Abstract Items	
	Control	Frame	Control	Frame
Correct	0.62	0.65	0.58	0.55
Midpattern Error	0.31	0.27	NA	NA
Incomplete Error	0.07	0.08	0.12	0.16
Same Unit Length Error	NA	NA	0.30	0.28

Discussion

- The frame condition did not improve the participant' performance on any of the patterning trials, although there was an effect of age.
- Type of incorrect response options chosen by participants was not affected by condition or item type
- Future research is needed to better understand which perceptual supports are best for preschoolers learning patterns.
- Based on these null results, the frame condition may have been visually confusing for participants, specifically since previous research tended to change existing information (e.g., color, spacing) and not add extra information
- Alternate visual supports should explore::
  - Spacing between the pattern unit



  - Animating the pattern unit to appear one by one



References

- Alibali, M. W., Crooks, N. M., & McNeil, N. M. (2018). Perceptual support promotes strategy generation: Evidence from equation solving
- Flynn, M. E., Guba, T. P., & Fyfe, E. R. (2020). ABBABB or 1212: Abstract language facilitates children's early patterning skills.
- Fyfe, E. R., Evans, J. L., Matz, L. E., Hunt, K. M., & Alibali, M. W. (2017). Relations between patterning skill and differing aspects of early mathematics knowledge.
- Jiang, M. J., Cooper, J. L., & Alibali, M. W. (2014). Spatial factors influence arithmetic performance: The case of the minus sign
- Landy, D., & Goldstone, R. L. (2010). Proximity and precedence in arithmetic
- Rittle-Johnson, B., Fyfe, E. R., Hofer, K. G., & Farran, D. C. (2017). Early math trajectories: Low-income children's mathematics knowledge from ages 4 to 11
- Rittle-Johnson, B., Zippert, E. L, & Boice, K. L. (2019). The roles of patterning and spatial skills in early mathematics development
- Rittle-Johnson, B., Douglas, A., Zippert, E., Özel, S. & Tang, J. (2020) Early Patterning Assessment
- Yeo, A., Cook, S. W., Nathan, M. J., Popescu, V., & Alibali, M. W. (2018). Instructor gesture improves encoding of mathematical representations

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