How exploration supports children's pattern learning

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Patterns exist all around us, from the parallel veins on a leaf to the black and white stripes of a crosswalk to the polka dots on wrapping paper. Knowledge of repeating patterns is also a foundational skill for the development of early mathematical thinking. Interventions designed for young children often rely on direct instruction or demonstration to teach pattern learning, often explicitly informing children of the underlying repeating unit. Though patterning interventions improve children's mastery of *specific* patterns, children still often struggle to transfer their knowledge to new patterns, especially when they are assessed on their recognition of the unit of repeat. One potential reason is because direct instruction represents a passive form of learning in which children do not need to actively construct their own knowledge. Using self-guided exploration as a learning strategy may better support transfer than direct instruction because it can support active engagement and discovery learning. In the current study, we hypothesize that guided exploration will better support children's ability to abstract patterns and transfer their patterning knowledge to a novel context than watching a demonstration.

Children aged 5-6 years old (n=68) were presented with a three-unit repeating shape pattern (ABB) with stars hidden under every third shape in each unit. Children were instructed that they could find the stars (up to 3) using a pattern without explicitly mentioning what the pattern is. *Exploration* condition participants (n=34) engaged with the pattern materials directly, revealing the hidden contents under the shapes. *Demonstration* condition participants (n=34) watched a demonstration of the experimenter revealing the hidden contents under the shapes. We used a yoked experimental design, in which *demonstration* condition participants would see the same information in the same order as an age-matched *exploration* condition counterpart. In a transfer task, participants were given the same ABB pattern with a different set of shapes and colors. Participants had five chances to find all three hidden stars. Performance was measured by the number of stars each participant found.

Overall, 6-year-olds performed better than 5-year-olds in both conditions. In the *exploration* condition, 8 out of 17 5-year-olds found all three stars compared to 11 out of 17 6-year-olds. In the *demonstration* condition, 5 out of 17 5-year-olds found all three stars compared to 8 out of 17 6-year-olds. We also found evidence that 6-year olds relied on more sophisticated strategies in the transfer task compared to 5-year-olds, with a slight trend towards *exploration* condition children using more advanced strategies. 11 6-year-olds (7 in *exploration* condition) used the most advanced strategy of finding all three stars in a row, demonstrating an understanding of the underlying pattern. In contrast, 5 5-year-olds (3 in *exploration* condition) used this same strategy. Our preliminary findings suggest that exploration may encourage more active engagement and advanced learning strategies for understanding the underlying structure of repeating pattern units.

These results may also suggest that different learning interventions may be more beneficial depending on a child's age and development.

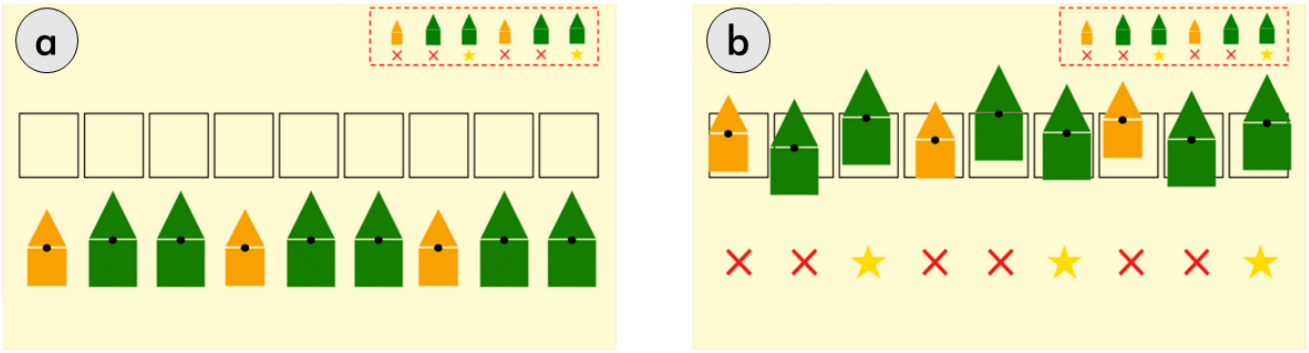

Figure 1. a) In our experiment, children saw a three-unit repeating shape pattern (ABB) with b) stars hidden under each third shape in each ABB unit. Children either engaged with the shapes directly to find the location of the hidden stars in the *exploration* condition or watched an experimenter engage with the shapes in the *demonstration* condition.

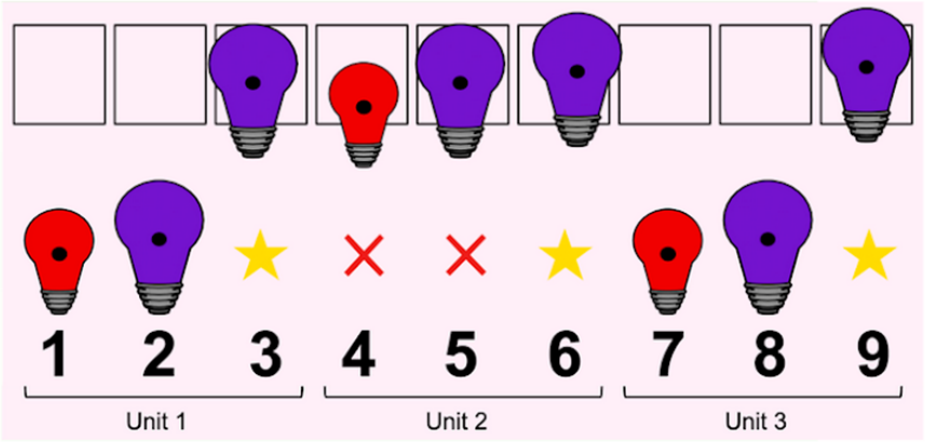

Figure 2. In the transfer task, children saw the same three-unit repeating shape pattern with stars hidden in the same locations as in Figure 1 with a different set of shapes. Children were given five tries to find the three hidden stars.