

## Background

- Counterfactual Reasoning (CF Control of Variable Strategy (CVS) Ability to imagine how reality could have • Ability to create a controlled experiment by isolating a single variable. Found in children as young as 4 years of  $\bullet$ • Children do not tend to engage in CVS without instructional scaffolding.<sup>1,2.</sup>

## Does prompting children to think counterfactually scaffold their ability to control variables during experimentation?

## Method

- $\bullet$ score out of 2 at each test phase.



## Results

- *p*s ≤ .002.



# Thinking counterfactually supports children's ability to conduct a controlled test of a hypothesis

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Generalized Estimating Equation: Children's CVS scores improved from pre- to post-test in both conditions, Wald  $\chi^2(1) \ge 9.70$ ,

• Post-hoc Chi-square tests of independence: Children in the counterfactual condition performed significantly better than those in the control condition both at post-test similar,  $\chi^2(2) = 7.28$ , p = .026 and post-test transfer,  $\chi^2 = 6.04$ , p = .049.



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e been different. <sup>3</sup>	•	Both involve intervening on a causal sys
age. <sup>4</sup>		investigating its effect. <sup>3,5,6</sup>
	•	We propose that engaging children in C
		that will scaffold their ability to design a

## Conclusion

- Counterfactuals confer a benefit for children's ability to control variables, when designing experiments using both familiar and novel variables.
- This result suggests that counterfactuals may activate a control-of-variables mindset that is not tied to the specific variables that have been considered.
- a short, simple demonstration.

1. Schwichow, M., Croker, S., Zimmerman, C., Hoffler, T., & Hartig, H. (2016). Teaching the control-of-variables strategy: A meta-analysis. Developmental Rev *39*, 37–63.

2. Chen, Z., & Klahr, D. (1999). All other things being equal: Acquisition and transfer between Causal Learning and Pretend Play. American Journal of Play, 6(1), 15-28.6. of the control of variables strategy. Child development, 70(5), 1098-1120. 6. Wenzlhuemer, R. (2009). Counterfactual Thinking as a Scientific Method 3. Rafetseder, E., & Perner, J. (2014). Counterfactual reasoning: Sharpening Introduction – The Psychology of Counterfactual Thinking. conceptual distinctions in developmental studies. *Child Development Perspectives*, Historical Social Research, 34(2), 27–54. 8(1), 54–58.





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### cting CVS + CFR

stem by changing the value of a variable and

CFR will activate a parallel underlying mechanism a controlled test (CVS).

It is also notable that children in both conditions improved from pre- to post-test after

	4. Nyhout & Ganea (2019). Mature counterfactual reasoning in 4- and 5-year-
view,	olds. Cognition.
	5. Gopnik, A., & Walker, C. M. (2013). Considering Counterfactuals: The Relation
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