



Learning Through App Play: Can Preschoolers Transfer STEM Problem Solving From 2D to 3D Sources?

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Introduction

- Mobile apps provide 21st century platforms for learning STEM skills.
- However, challenges for learning from mobile devices include:
 - Transfer of knowledge from a 2D virtual to the 3D physical world ¹ &
 - Mechanics skills for navigating the touchscreen interface (e.g., tapping, swiping on an iPad).²
- Children’s emotionally-tinged parasocial relationships (PSRs) with media characters can bridge the 2D to 3D transfer divide for boys & girls,³ thereby improving STEM learning.³

Research Questions

- **RQ₁**: Can exposure to a 2D STEM app featuring Curious George lead to 3D STEM transfer skills in preschool-aged boys & girls compared to exposure to a 2D Curious George Art app & a no exposure control group?
- **RQ₂**: In the STEM app, what are the individual differences in game mechanics skills, perceptions of the game, PSR with Curious George, and gender that are associated with transfer skills?

Method

- 87 children (*Mage* = 60.53 months, 47 boys) played a Curious George (CG) STEM app (n = 37) or a CG Art app (n = 30) for up to 20 minutes (see Figure 1), or participated in a no app play control condition (n = 20).
- Children then completed a 3D transfer task (see Figure 2).
- Children also completed the Child PSR Measure⁵ with CG, the Shape School Executive Functioning (EF) Task⁶, & a perceptions of app play measure (e.g., how fun, how difficult, how much they liked the app).
- Research assistants coded children’s knowledge of the STEM concepts in transfer performance ($\alpha = .92$) and game mechanics skills ($\alpha = .85$)

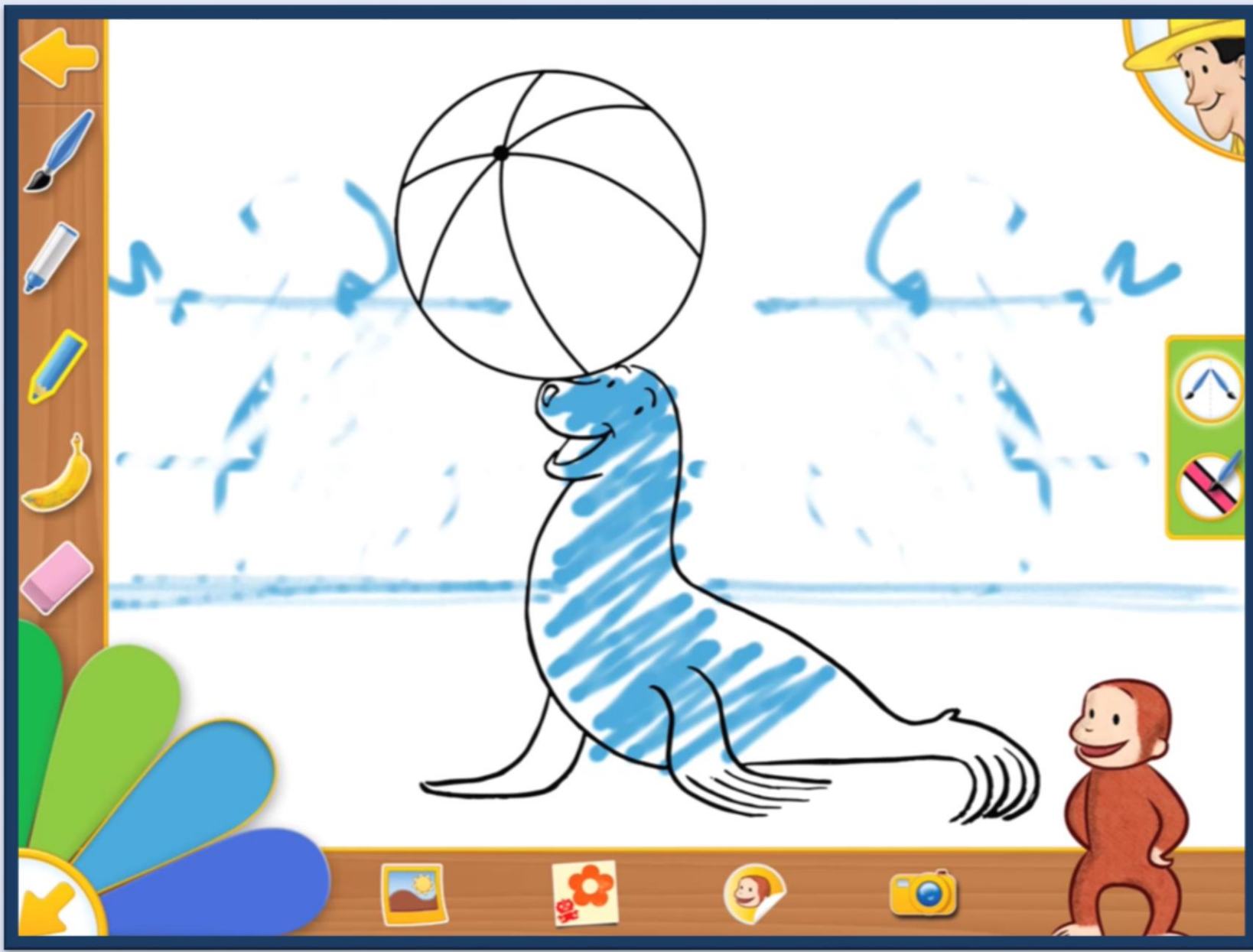
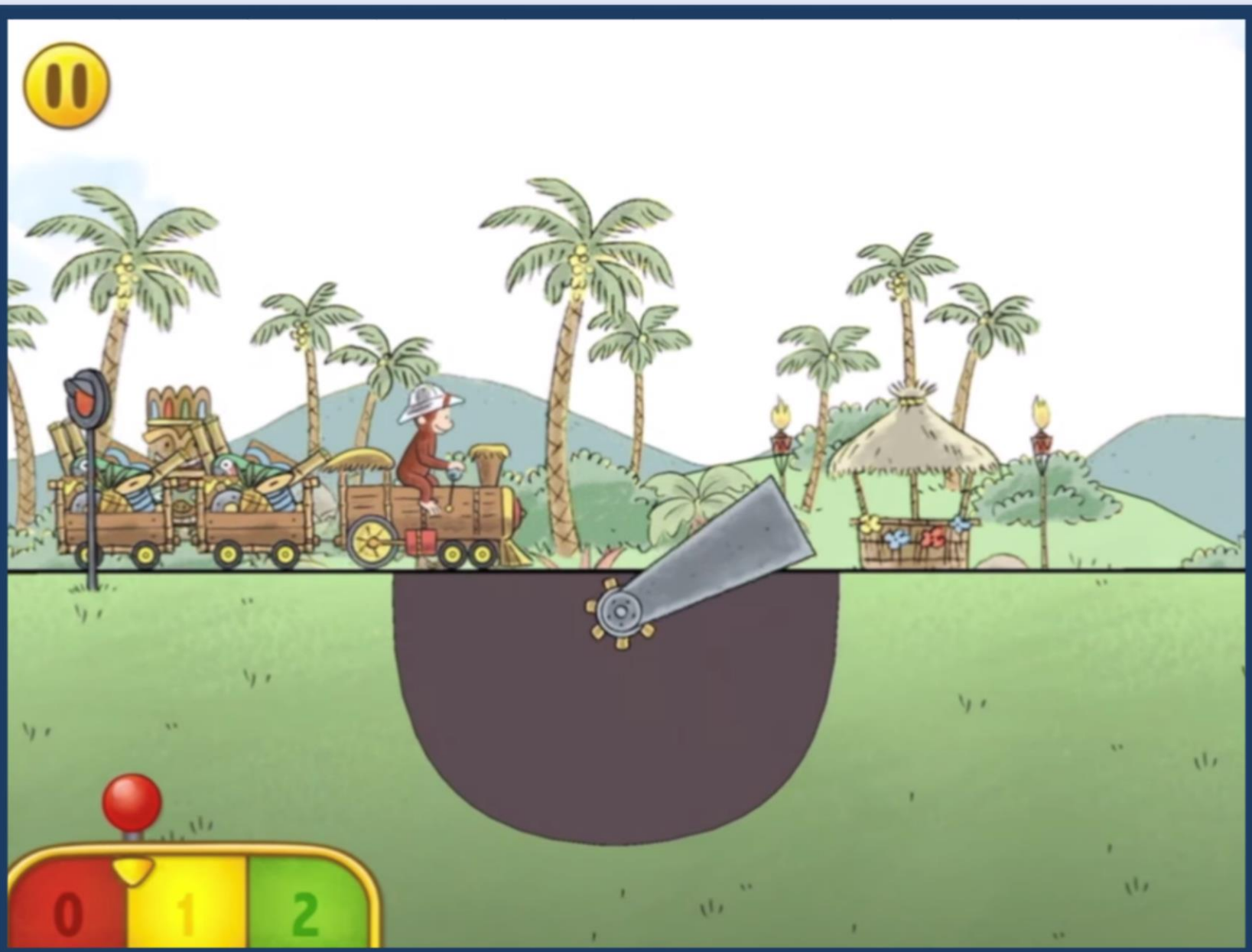


Figure 1. CG STEM Train app

CG Art app

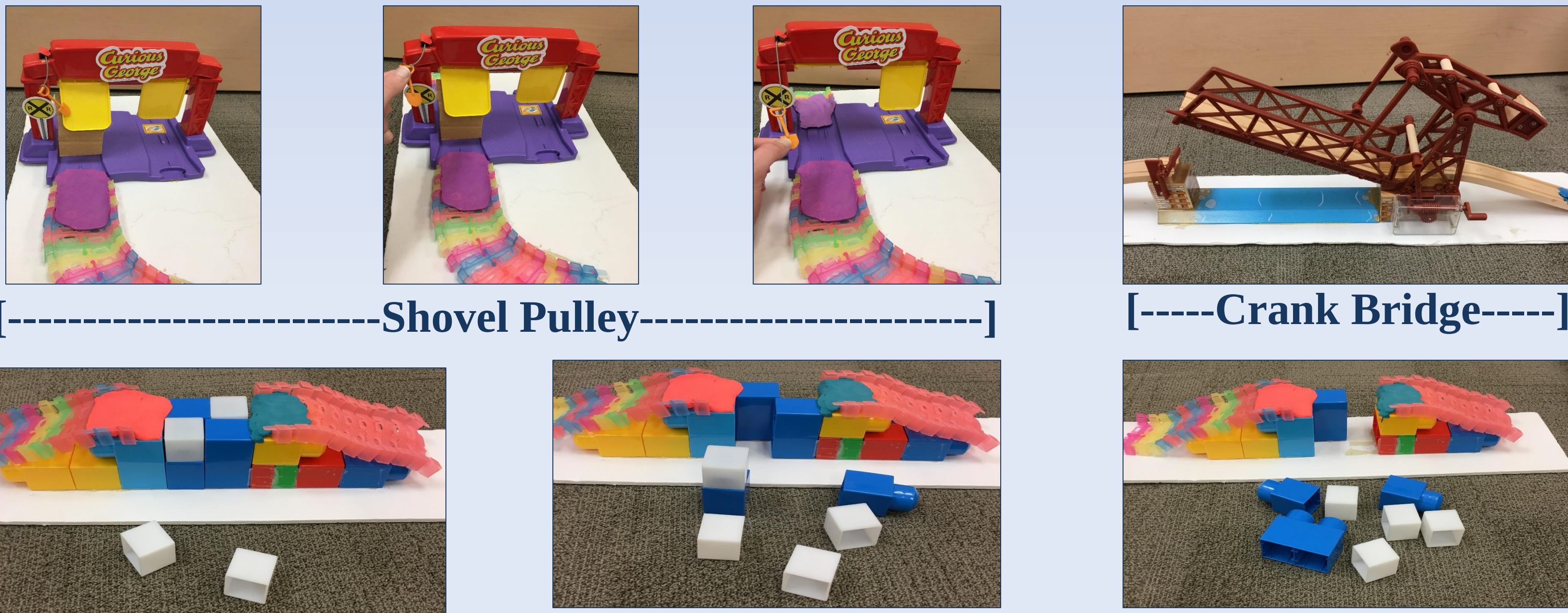


Figure 2. STEM transfer tasks with pulleys, cranks, and bridges

Results

- **RQ₁**: A 3 (condition) $\times$ 2 (sex) ANCOVA controlling for age yielded main effects of condition, sex, & age on transfer scores. The control group ($p = .03$), boys ($p = .01$), & older children ($p = .03$) performed better on the 3D transfer task with physical objects.
- **RQ₂**: Within the CG STEM app condition, better transfer scores were positively correlated with liking the app.

	Like Game	Fun Game	Hard Game	Game Mechanics	PSR	Transfer
Like Game	1					
Fun Game	.59**	1				
Hard Game	-.28	-.17	1			
Game Mechanics	.30+	.12	-.41*	1		
PSR	.57**	.48**	-.04	-.14	1	
Transfer	.44*	.05	.19	.24	.17	1

+ $p < .10$ * $p < .05$ ** $p < .01$ Correlations are controlling for age

- **RQ₂**: For boys, transfer scores were higher when they liked the app & tended to be higher when PSRs with CG were stronger.

	Like Game	Fun Game	Hard Game	Game Mechanics	PSR	Transfer
Like Game	1					
Fun Game	.75**	1				
Hard Game	-.13	-.17	1			
Game Mechanics	.27	.24	-.40 ⁺	1		
PSR	.75**	.52*	-.03	-.20	1	
Transfer	.58**	.16	.28	.30	.41 ⁺	1

+ $p < .10$ * $p < .05$ ** $p < .01$ Correlations are controlling for age

- **RQ₂**: For girls, transfer scores were higher when they had better game mechanics scores.

	Like Game	Fun Game	Hard Game	Game Mechanics	PSR	Transfer
Like Game	1					
Fun Game	.29	1				
Hard Game	-.62**	.08	1			
Game Mechanics	.36	-.38	-.32	1		
PSR	.25	.26	.16	-.20	1	
Transfer	.28	-.21	-.38	.55*	-.16	1

+ $p < .10$ * $p < .05$ ** $p < .01$ Correlations are controlling for age

Discussion

- Preschool-aged children had difficulty transferring their 2D STEM app play experiences to a 3D task that mirrored the game content.
- Gender differences in perceptions of the STEM app were associated with transfer from 2D experiences to the 3D world.
 - For boys, better transfer scores were associated with liking the STEM app & the tendency to have stronger PSRs with Curious George.
 - For girls, better transfer scores were linked to better game mechanics skills.
- Curious George is a male character who was performing a traditionally male task, which may have influenced how well girls related to him & learned the STEM skills embedded in the app.
- Future research should examine how to promote transfer of 2D app learning experiences to the 3D world, as well as how to promote girls’ interest & enjoyment in challenging STEM games.
- Familiarization of the mechanical skills needed to navigate the interface might also help reduce cognitive demands, particularly for girls.

References

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Acknowledgments

Poster presented at the Bi-Annual Society for Research in Child Development Conference in Baltimore, Maryland. We very much appreciate the families, children, and schools who participated in this research. We also thank the CDMC researchers, particularly Marisa M. Putnam, Emily Zuckerman & Montana Boone, who made this project possible. Support for this research was provided by NSF grant #1252113 to Dr. Sandra L. Calvert.