Does Inhibitory Control Promote Spatial Reasoning in Preschoolers?

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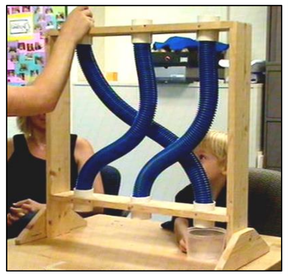
INTRODUCTION

- The ability to inhibit a prepotent response is related to the development of important cognitive and social skills in children (Carson, 2005).
- Spatial reasoning—anticipating the movement of objects and people—is critical for everyday activities and also develops gradually in early childhood.
- Theories suggest a link between spatial reasoning and inhibitory control, but this relationship has yet to be tested directly (Freeman, Hood, & Meehan, 2004).
- **Goal:** Examine the relationship between inhibitory control and spatial reasoning in preschool-age children.
- **Participants:** 3.5- to 4-year-old children (*n* = 82; 40 girls).
- **Experimental tasks:** One measure of spatial reasoning and three classic measures of inhibitory control during a single laboratory session.

SPATIAL REASONING TASK

- Adapted from Hood (1995); used by Joh & Spivey (2012).
- Predict the location of a ball dropped down one of three intertwined tubes.
- Most 3-year-olds fail to follow the path of the relevant tube and instead make "gravity bias" errors.



Training: 3 single-tube practice trials.

Test: 12 trials; frame is rotated and drop location is changed to a novel one before each trial.

INHIBITORY CONTROL TASKS

Day-Night Task (DN)

- Gerstadt, Hong, & Diamond (1994).
- Stroop-like task.
- Respond "day" to card depicting moon and stars; respond "night" to card depicting sun.

Training: 2 practice cards, one of each type, with feedback.

Test: 16 cards (8 of each) presented in a predetermined order.

Dimensional Change Card Sort Task (CS)

- Frye, Zelazo, & Palfai (1995).
- Sort cards with red trucks or blue rabbits into trays marked by a red rabbit or blue truck.

Training: sort 6 cards by color.

Test: sort 6 cards by shape, with a reminder after each trial.

Frog-Monkey Task (FM)

- Reed, Pien, & Rothbart (1984).
- Alternately perform or inhibit gross motor actions instructed by Friendly Frog or Mean Monkey.

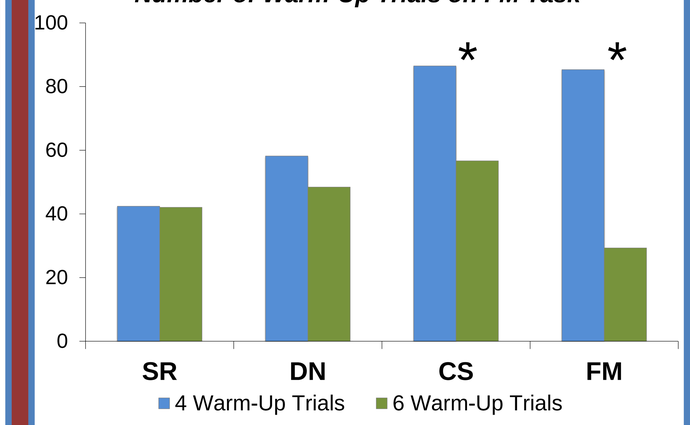
Training: 4 or 6 trials (PTG) with feedback.

Test: 12 trials, alternating between commands given by Frog or Monkey.

PERFORMANCE ON TASKS

			Inhibitory Control Tasks		
		SR	**DN**	**CS**	**FM**
Correct Responses	Mean (*SD*)	6.08/12 (3.99)	8.59/16 (5.05)	4.28/6 (2.35)	3.69/6 (2.58)
	% of Trials	50.7%	53.7%	71.3%	61.5%
% Meeting Passing Criterion		42.7%	37.8%	53.7%	63.4
% Succeeding on All Trials		9.8%	7.3%	53.7%	41.5%

Percent Correct Responses Grouped by Number of Warm-Up Trials on FM Task



PREDICTORS OF SPATIAL REASONING SKILLS

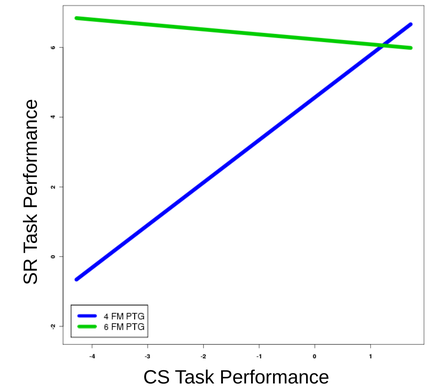
- SR task performance was regressed onto mean-centered performance on each inhibitory control task, FM practice trial group, and interaction between each inhibitory control measure and practice trial group.
- Model explains 17.8% of variance in SR performance, $F(7, 74) = 2.29$, $p = .036$.

Predictors of SR Performance

Variable	***B***	***SE B***	***β***	**95% CI**
Intercept	5.399	.822		[3.762, 7.037]
DN Task	.077	.09	.098	[-.101, .256]
CS Task	**.539***	.237	.317	[.068, 1.01]
FM Task	.312	.395	.202	[-.475, 1.10]
FM PTG	1.666	1.644	.21	[-1.61, 4.94]
DN × FM PTG	-.078	.179	-.049	[-.435, .28]
CS × FM PTG	**-1.363****	.473	-.372	[-2.31, -.421]
FM × FM PTG	-.082	.79	-.019	[-1.66, 1.49]

*$p < .05$, **$p < .01$; FM PTG = FM Practice Trial Group

Effect of FM PTG on the Association Between CS and SR Task Performance



- Conditional main effect of CS performance was qualified by a significant interaction between CS performance and FM PTG due to a significant, positive association between CS and SR performance for the 4 FM PTG, and a non-significant association for the 6 FM PTG. Simple slopes were computed using the on-line utility for Preacher, Curran, and Bauer (2006).
- **Conclusion:** The relationship between inhibitory control and spatial reasoning is complex, and at least partly dependent on individual differences in cognitive skills.