

Introduction

- The ability to monitor the contents of one's own memory and use that output to strategically control subsequent behaviors is part of *metamemory* (Nelson & Narens, 1990).
- Metamemory *monitoring* and *control* are often studied separately, despite a long-standing theoretical relationship (Son & Schwartz, 2002).
- Relatively little research has examined the relationship between monitoring and control at retrieval (but see, Hanczakowski, Pasek, Zawadzka, & Mazzoni, 2013; Hanczakowski, Zawadzka, & Cockcroft-McKay, 2014).
- Previous research using high definition transcranial direct current stimulation (HD-tDCS) showed that metamemory monitoring can be improved via stimulation to the left DLPFC (Chua & Ahmed, 2016; Chua, Ahmed, & Garcia, 2017).
- The current study tests the role of the DLPFC in the relationship between metamemory monitoring and control.**
- Hypothesis:**
 - Active stimulation to the left DLPFC will lead to more accurate metamemory monitoring, leading to better metamemory control and memory performance.

Methods

Participants

- 36 participants (25 females) ages 18 – 34 ($M = 24$, $SD = 4.95$) with no contraindications to HD-tDCS.

Behavioral Task

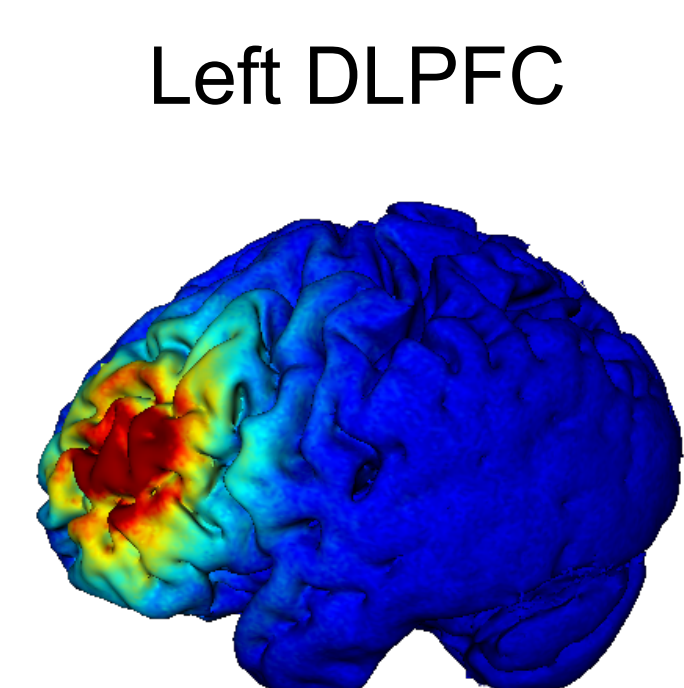
Phase 1: Metacognitive Monitoring Task	"Once-Knew-It" (OKI)	Recall	FOK Rating
	Have you ever known the answer to this question? Where did NASA scientists find rocks they nicknamed 'Yogi' and 'Scooby-Doo'? Please type in "y" for yes or "n" for no	Please type in the answer to the question Where did NASA scientists find rocks they nicknamed 'Yogi' and 'Scooby-Doo'? Press enter when you are finished	How sure are you that you can recognize the correct answer? Where did NASA scientists find rocks they nicknamed 'Yogi' and 'Scooby-Doo'? 1 2 3 4 5 6 7 8 9 10

Phase 2: Metacognitive Control Task	Re-answer Choice	Counter	Cued-Recall Stimuli
	Would you like to answer the question again with a hint? Where did NASA scientists find rocks they nicknamed 'Yogi' and 'Scooby-Doo'? Please type in "y" for yes or "n" for no	Choices remaining: 32 Questions remaining: 65	<ul style="list-style-type: none"> 33 participant chosen from Phase 2 33 researcher chosen

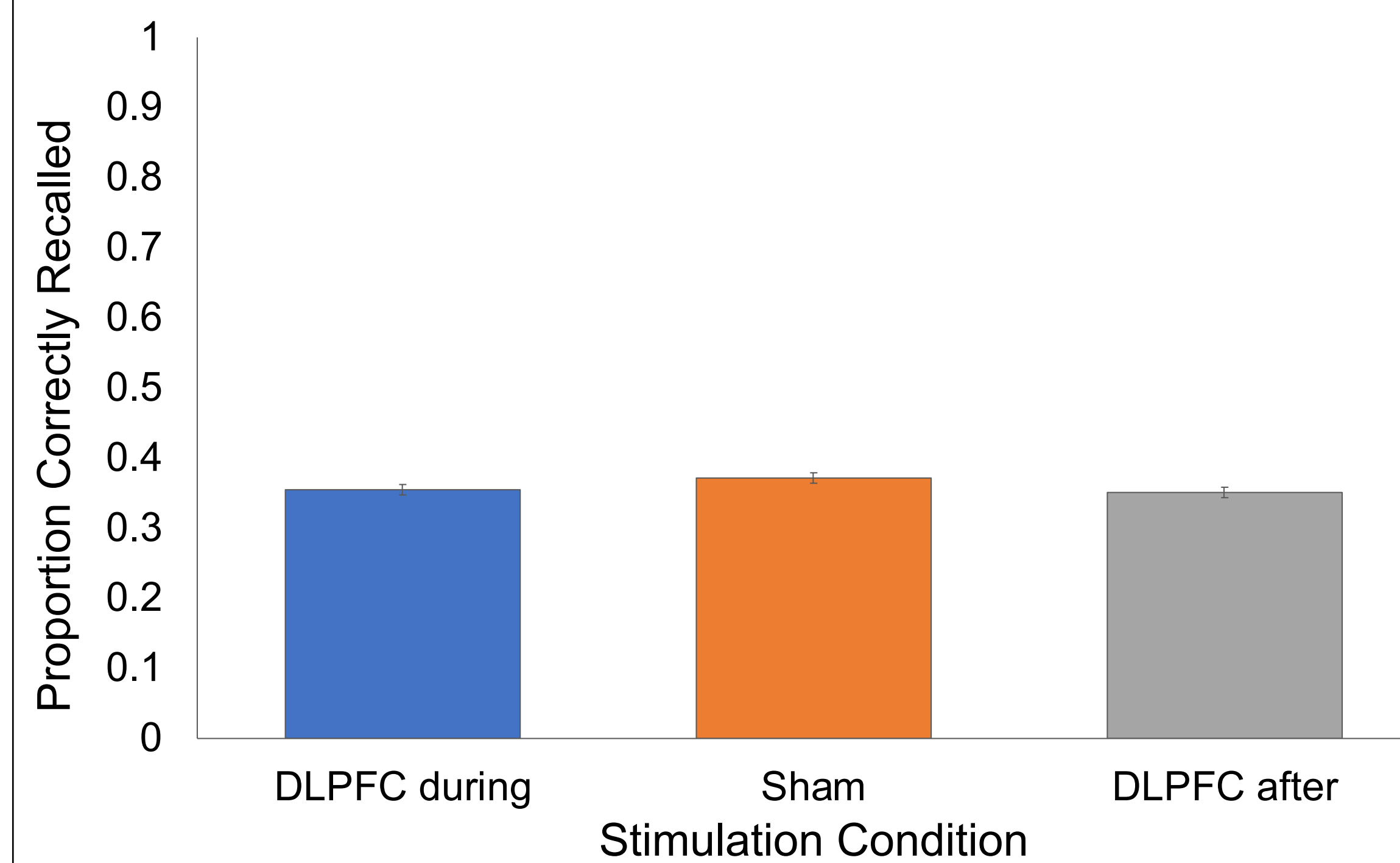
Phase 3: Cued-Recall and Recognition tests	Cued-recall	Feedback	Recognition
	Please type in the answer Starts with "m" Where did NASA scientists find rocks they nicknamed 'Yogi' and 'Scooby-Doo'? Press enter when you are finished	Great Job! 1 Correct	Choose the correct answer Where did NASA scientists find rocks they nicknamed 'Yogi' and 'Scooby-Doo'? Moon Yellowstone Mars Nevada 1 2 3 4

3 HD-tDCS Sessions

- Stim A (DLPFC during):** 15 min during Phase 1
- Stim B (Sham):** 15 min during Phase 1
- Stim C (DLPFC after):** 15 min after Phase 1, but before phase 2

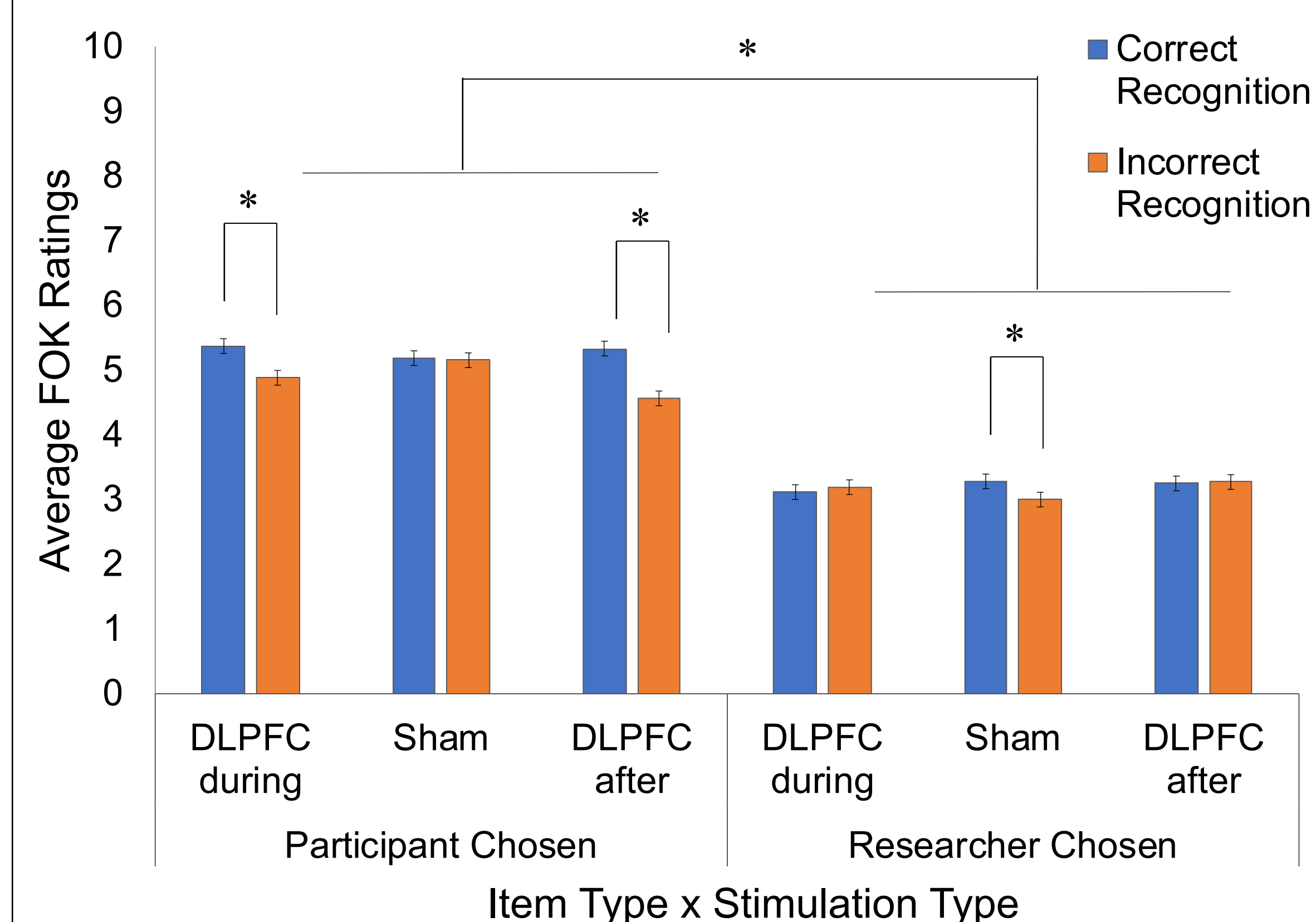


Initial Memory Performance Matched Across Stimulation Conditions



Initial Recall did not differ by stimulation condition ($p = .109$).

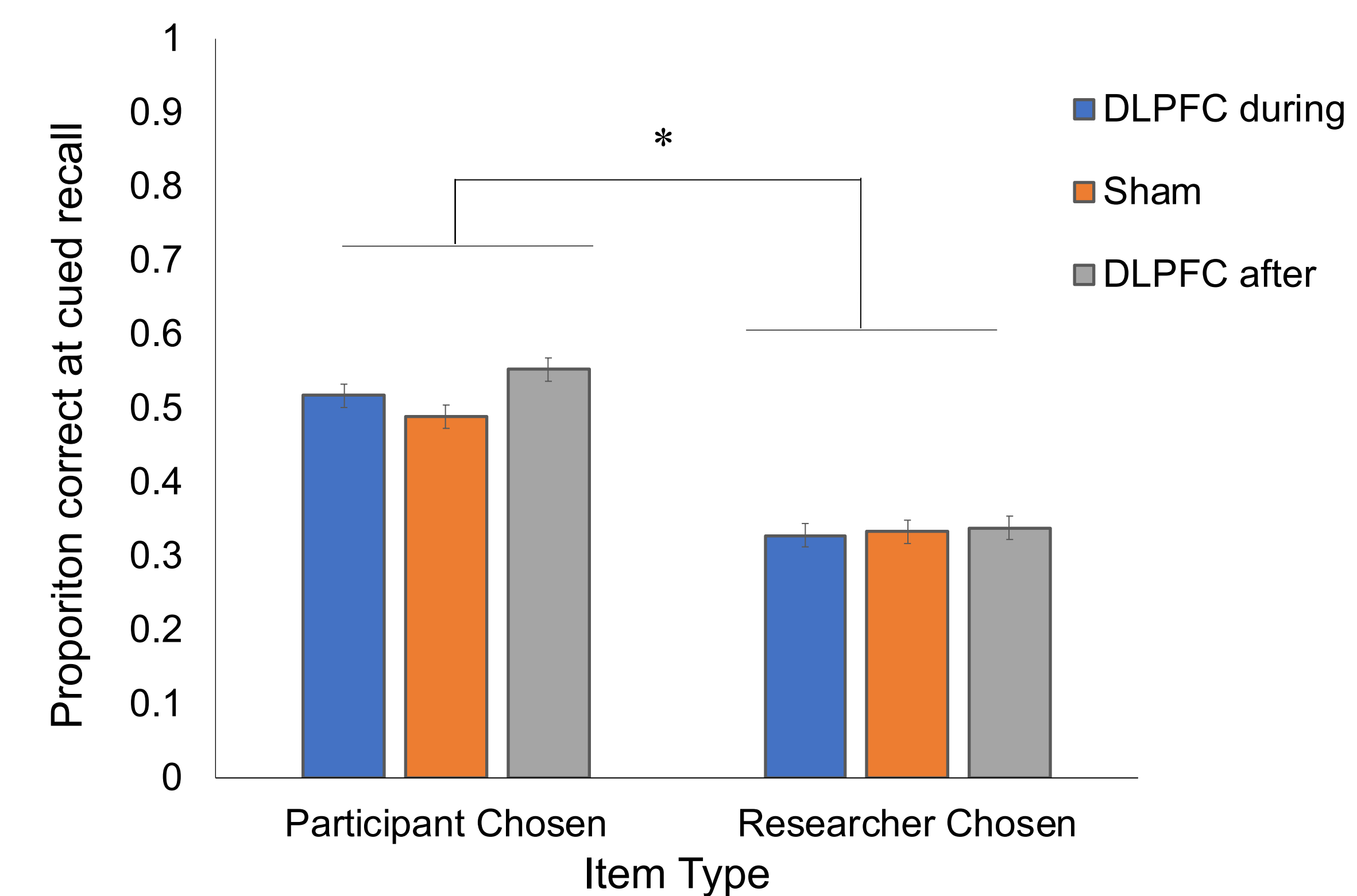
Choice and Stimulation Affects Relationship Between FOK Ratings and Memory Performance



- Higher FOK ratings for Participant vs. Research Chosen
- Item Type x Stimulation Type x Recognition interaction
 - Participant Chosen Items: higher FOK ratings for correct vs. incorrect recognition during active stimulation
 - Researcher Chosen Items: higher FOK ratings for correct vs. incorrect recognition for sham.

* $p < .05$

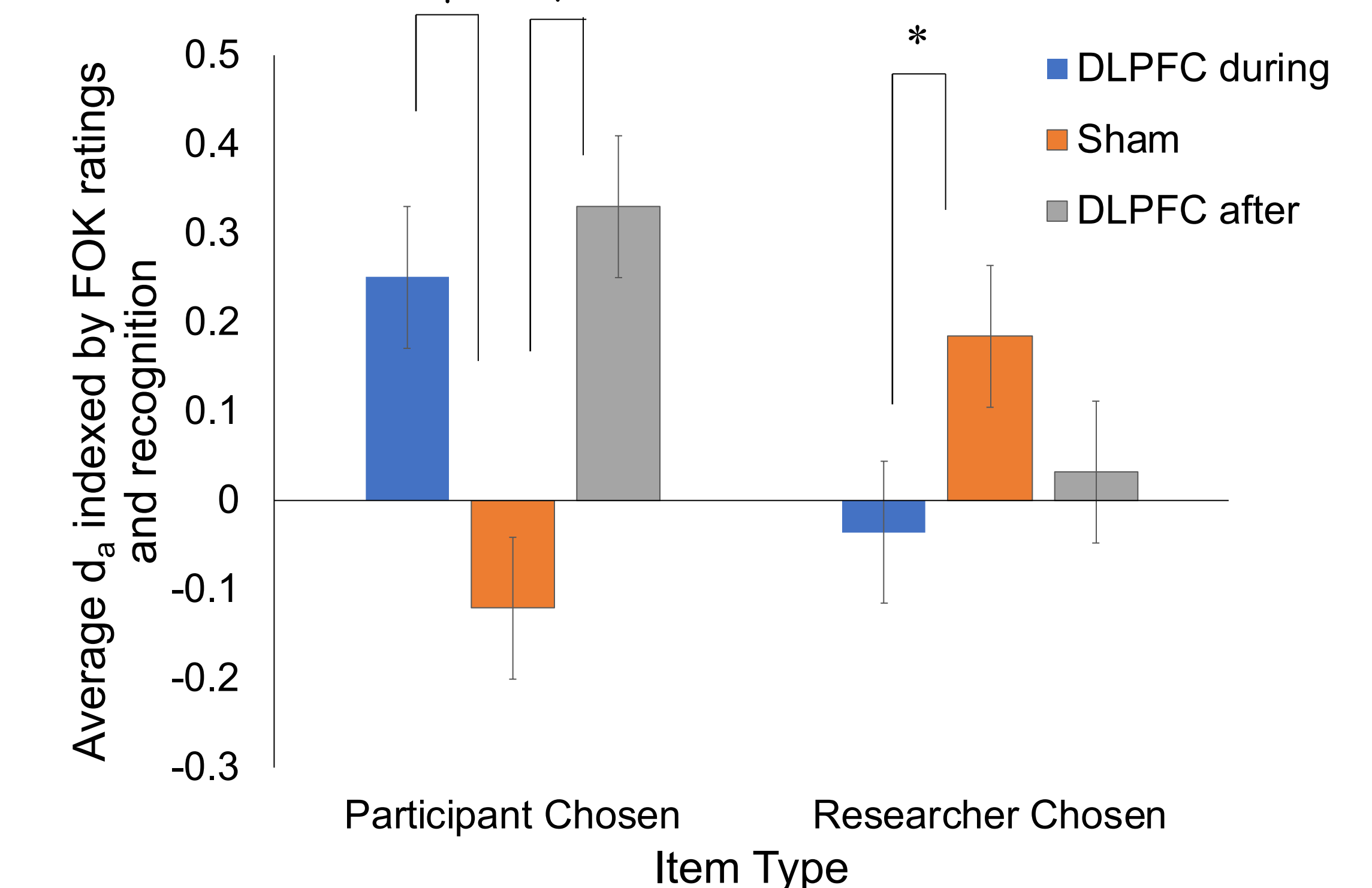
Metamemory Control Improves Cued Recall Performance



- Better cued recall performance for items that participants chose to answer again with a hint, compared to those chosen by the researcher.
- Strategic control of memory does result in improved memory performance.

* $p < .05$

Outputs of Monitoring Used to Strategically Control Memory



- Item Type x Stimulation Type interaction on metamemory accuracy (average d_a , as indexed by FOK ratings and recognition accuracy)
 - Participant Chosen Items: better metamemory monitoring accuracy for both active stimulation conditions compared to sham
 - Researcher Chosen Items: better metamemory monitoring accuracy for sham compared to DLPFC during stimulation.

* $p < .05$

Conclusions

- Strategic control of memory resulted in better memory performance, consistent with previous findings (Hanczakowski et al., 2014; Koriat et al., 2006)
- The interaction between stimulation and strategic choice impacted 1) the relationship between FOK ratings and memory accuracy, and 2) metamemory accuracy.
 - It is unlikely that DLPFC stimulation affected metamemory ratings, *per se*, because similar effects were shown for DLPFC stimulation administered before and after the FOK ratings were given.
 - The effects of DLPFC stimulation on FOK ratings were shown for participant chosen items, suggesting that stimulation may have increased participants likelihood to choose items with FOK ratings that were more diagnostic of memory.