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Background & Objectives

- The left ventrolateral prefrontal cortex has been implicated in higher-order cognitive tasks, in which one has to exert cognitive control over available information to achieve optimal performance (e.g., working memory, rule switching, resolving interference from unwanted information, Thompson-Schill, Bedny, & Goldberg, 2005).
- Certain cognitive tasks may benefit from a tradeoff between brain regions involved in rule-based processing (i.e., prefrontal cortex, PFC) and regions involved in object processing, particularly of object attributes or features (i.e., visual cortex; Thompson-Schill, Ramscar, & Chryssikou, 2009).
- Recent findings from neuroscience offer support for such tradeoffs between PFC and posterior brain regions in open-ended tasks (Chryssikou & Thompson-Schill, 2011; Fink et al., 2010; Limb & Braun, 2008; Seeley et al., 2008).
- In the present study we explored the hypothesis that inhibitory transcranial direct current stimulation (tDCS) over left PFC will facilitate performance in a flexible use generation task.

Method

Participants

- Forty-eight ($N = 48$) right-handed, native English speakers were randomly assigned to one of six conditions (Figure 1).

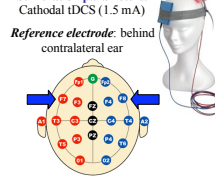
Materials

- Object Use Task:** A set of 60 black-and-white photographs of everyday objects were used as experimental stimuli. Examples of representative stimuli are presented in Figure 2.
- Forward Digit Span:** A version of the task from the Wechsler Adult Intelligence Scale (WAIS) was used.
- tDCS Device:** A Magstim portable DC stimulator was used for tDCS. TDCS is a noninvasive technique that involves the application of small currents to the scalp for a few minutes through two surface electrodes, which can modulate cortical excitability (see Hamilton, Chryssikou, & Coslett, in press).

Figure 1. Study design & stimulation parameters

	Common Use Task	Uncommon Use Task
Left (F7) cathodal stimulation (1,200 seconds)	$n = 8$	$n = 8$
Right (F8) cathodal stimulation (1,200 seconds)	$n = 8$	$n = 8$
Sham (over F7 or F8) stimulation (90 seconds)	$n = 8$	$n = 8$

Stimulation parameters: Cathodal tDCS (1.5 mA)



Procedure

- Participants were asked to generate aloud either the object's common use (e.g., *belt* to keep one's pants up) or an uncommon use for it (e.g., *belt*: to use as a tourniquet). Participants received the Forward Digit Span either before or after the Object Use Task (Figure 3).



Figure 2. Examples of stimuli for the Object Use Task

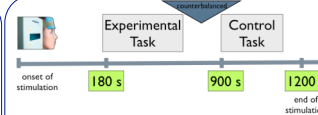


Figure 3. tDCS stimulation procedure

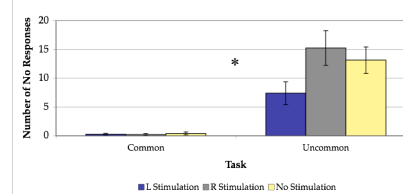


Figure 6. Effects of Stimulation on the Number of No Responses for the Object Use Task

Categorization System for Object Function

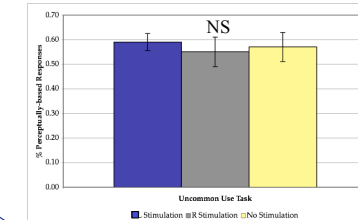
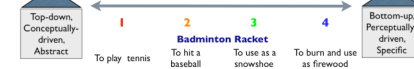


Figure 7. Effects of Stimulation on the Type of Generated Responses for the Uncommon Use Task

Results

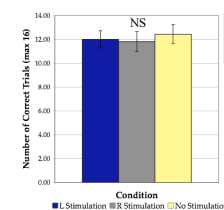


Figure 4. Stimulation Effects for the Control Task

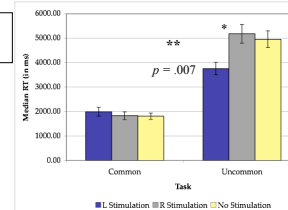


Figure 5. Stimulation Effects for the Object Use Task

Discussion

- These results show facilitative effects of left PFC stimulation for the uncommon (but not for the common) use generation task, and no effects of stimulation on the control task.
- In conjunction with recent neuroimaging findings, the study supports the hypothesis that certain tasks may benefit from tradeoffs between PFC and other brain regions.

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Contact Information

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