Does Change in Attention Control Mediate the Impact of tDCS on Attentional Bias for Threat?

Limited Evidence from a Double-blind Sham-controlled Experiment in an Unselected Sample

Charlotte Coussement[a,b], Pierre Maurage[b,c], Joël Billieux[d] and Alexandre Heeren[b,c]

[a] Cellule de Recherche et Publications Scientifiques (CRPS), Hôpital Psychiatrique du Beau Vallon, Namur, BE
[b] Psychological Science Research Institute, Université catholique de Louvain, Louvain-la-Neuve, BE
[c] Clinical Neuroscience Division, Institute of Neuroscience, Université catholique de Louvain, Brussels, BE
[d] Integrative Research Unit on Social and Individual Development (INSIDE), University of Luxembourg, Esch-sur-Alzette, LU

Contact : charlotte.coussement@uclouvain.be

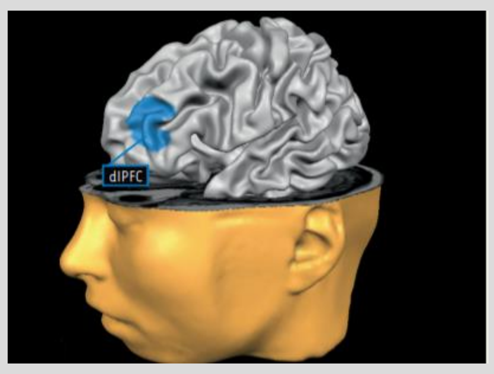
INTRODUCTION

ATTENTION CONTROL

Ability to voluntarily regulate the allocation of attentional ressources
(e.g., Eysenck & Derackshan, 2011; Heeren et al., 2013; Peers et al., 2013)

?

Reduced left dorsolateral prefontal cortex (dlPFC) activation
(e.g., Bishop, 2009; Britton et al., 2011; Browing et al., 2010; De Raedt et al., 2010)



Attentional bias for threat (AB)
Differential allocation for threat-related stimuli in comparison to neutral ones
(e.g., Bar-Haim et al., 2007; Cisler & Koster, 2009; McNally et al., 2015)

METHOD

20 right-handed healthy volunteers

Experimental Manipulation

Transcranial direct current stimulation (tDCS)

Application of a weak DC of **2mA** via 2 electrodes:

Anode (+) Cathode (-)

Anodal stimulation increase cortical activity.

The anode electrode was positioned over the F3
(i.e., corresponding to left DLPFC regions) according to the 10-20 EEG system.

The reference electrode was placed on ipsilateral arm
(e.g., Cogiamanian et al., 2007; Priori et al., 2008)

Research Design and Materials

Double-blind sham-controlled within-subject design

Before the first session

Descriptive measures:
Beck Depression Inventory (BDI-II; Beck et al., 1998)
Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987)
Trait-Anxiety Inventory (STAI-T; Spielberger et al., 1983)

Counterbalanced order

First session

Anodal-tDCS
Intensity: 2mA
Total duration: 25 min

Attention Network Task (ANT) (Fan et al., 2002) measuring attention control (alerting, orienting and executive control)

Probe discrimination task (MacLeod et al., 1986) assessing AB

2day-interval

Second session

Sham-tDCS
Ramp up/down: 30 sec
Intensity: 2mA
Total duration: 25 min

Attention Network Task (ANT) (Fan et al., 2002) measuring attention control (alerting, orienting and executive control)

Probe discrimination task (MacLeod et al., 1986) assessing AB

Debriefing of the study

RESULTS

- **Impact of tDCS on attentional networks**
  The Stimulation x Network interaction was not significant
  $F(2,38) = 0.07$, $p = .93$, $\eta 2p < .01$
- **Impact of tDCS on attentional bias**
  No significant difference regarding attentional bias between anodal and sham stimulations
  $t(19) = .34$, $p = .74$, $d = .33$.

Neither attention control nor attentional bias did improve following anodal tDCS

POST-HOC ANALYSES

Anodal tDCS over left dlPFC may yield larger improvement (i.e.effect sizes) on cognitive tasks among either depressive or anxious samples than healthy ones.

(e.g., Brunoni & Vanderhasselt, 2014; Dedoncker et al., 2016; Hill et al., 2016)

	Alerting gains	Orienting gains	Executive gains	Bias score gains
Orienting gains	-.29			
Executive gains	-.08	-.03		
Bias score gains	.29	.06	-.01	
LSAS	.34	.19	.55**	.04
BDI	.25	.03	.56**	.08
STAI-T	.29	.12	.46*	.04

*, $p < .05$; **, $p < .01$ after correction for multiple comparisons using the Benjamini–Hochberg false discovery rate procedure.

ADDITIONAL STUDY

OSF Preregistered study – NEW results still not published
Coussement, Riesco de Vega, Heeren (in prep)
Doi:osf.io/x4quy

	Alerting gains	Orienting gains	Executive gains
LSAS	.15	.13	.08
BDI	.14	.02	.39**
STAI-T	.10	.12	.34*

*, $p < .05$; **, $p < .01$ after correction for multiple comparisons using the Benja
Hochberg false discovery rate procedure.

Larger sample size (n = 50)

Sham vs Anodal tDCS during ANT

BDI, LSAS, STAI-T at baseline

Role of both anxious and depressive symptoms in tDCS-induced improvement in executive control

DISCUSSION

- **Impact of tDCS on AB : At odds with previous research in clinical samples**

BUT

- **Our two studies demonstrate that the impact of tDCS on executive control is modulated by the intensity of depressive and anxiety symptomatology**
- **Future research has to clarify the impact on clinical vs. healthy samples**