Pump up the volume!
Can transcranial Direct Current Stimulation (tDCS) enhance Cognitive Bias Modification in Addiction?

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Overview

1. Background: Dual Process Models of Addiction

2. tDCS

3. New: tDCS and CBM
Background: Dual process models in Psychology today (e.g., Strack & Deutsch, 2004)

Dual Process Theories Addictions
(Evans & Coventry, 2006; Strack & Deutsch, 2006; Wiers & Stacy, 2006; Wiers et al., 2007)

• Addictions as conflict between system 1 (impulsive – associative - reflexive) and system 2 (reflective – propositional)
• System 1: with repeated use sensitization (stronger arousal reactions with addiction cue)
  > automatic appetitive action tendency (approach)
  > sensitive to current needs (craving, thirst)
Metaphor: Impulse (horse) Reflection (horseman)

Addiction: Horse that easily runs wild... (strong horse, weak horseman, or both...)

Individual Differences in Impulse Regulation

Interactions between implicit and explicit cognition and working memory capacity in the prediction of alcohol use in at-risk adolescents

Carolien Thusha, Reinout W. Wiersa, Susan L. Amesb, Jerry L. Grenardb, Steve Sussmanb, Alan W. Staceyb

N = 88 adolescents
low level education
Implicit Cognition: Unipolar IAT

Unipolar Excited – Neutral IAT
(cf. Houben & Wiers, 2006)

Excited
Alcohol
energetic

Neutral
Soda

relative
association strength
= RT2 - RT1

Neutral
Alcohol
energetic

Excited
Soda

Reflective processes:
Why do I use?
Pros vs. Cons (short term, long term), Motives, Expectancies

Pros: Fun, relaxing, etc.

Cons: health, money, Work, relationships, etc.
Working Memory: SOPT

Prediction of Drinking

Low WM: Associations Predict alcohol Use/problems

High WM: Explicit expectancies Predict alcohol Use/problems
More Evidence: Many Recent Studies

Relatively automatic processes predict alcohol/drug use in individuals with relatively low executive control (e.g., low working memory capacity, high Stroop interference)

Suggestion from the simple metaphor:

On taming horses and strengthening riders: Recent developments in research on interventions to improve self-control in health behaviors

Malte Friese¹, Wilhelm Hofmann², and Reinout W. Wiers³
Both possible:

“Taming horse” works in alcohol-dependent patients (reducing automatic alcohol-biases)
- Attentional re-training (Schoenmakers et al., 2010)
- Approach bias re-training (Wiers et al., 2010; 2011; Eberl et al., in press)

“Training rider” (strengthening control over biases)
- Working memory training in problem drinkers (Houben et al., 2011) & and in stimulant addicts (Bickel et al., 2011)

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Introduction

• tDCS: Transcranial Direct Current Stimulation
  – The application of weak constant current between two electrodes placed on the scalp

Basic Effects of tDCS and Safety

• Convergent evidence shows that effects of tDCS are polarity-dependent:
  – Anodal excites neurons
  – Cathodal inhibits
• Only mild side effects (itching, headache) of common protocols
tDCS and Addiction

• Reduction of cue-induced craving for alcohol in dependent patients
  – With dorsolateral prefrontal cortex (DLPFC) stimulation
  – tDCS – craving assessment (T2) – alcohol video – craving assessment (T3)
  – Craving: AUQ (Alcohol Urge Questionnaire), e.g. “I have an urge to drink”

• Also found with craving for food and cigarettes

DLPFC and Addiction

• Enhanced response to drug cues
• Correlates with craving
• Decrement in DLPFC has been found in addicts and is related to cognitive functioning

• DLPFC very important for cognitive control
  – Behavioural monitoring
  – Flexibility and attention
  – Decision making

### tDCS enhances working memory

- Stimulation of dorsolateral prefrontal cortex
- Improved working memory task performance in stroke patients, Alzheimer’s, Parkinson’s, depression

### tDCS and Addiction

- Addiction: Relative deficit in the ability to control impulsive responses
  - If tDCS can reduce craving, perhaps this could reduce the “impulse” side of the equation
  - If tDCS can enhance working memory, perhaps this could improve the “control” side of the equation
- Or both!
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Recent and Current Work

- tDCS improved working memory performance specifically in the presence of interference (Gladwin et al., 2012)

- So: tDCS does not improve memory span per se, but enhances **executive function**
  – Confirms potential role in addiction from the dual-process theory perspective
Recent and Current Work

• Ongoing and planned studies
  – Effects on an Alcohol Approach – Avoidance Task
  – Effects on an Alcohol Implicit Association Test
  – Effects on an Alcohol-Avoidance CBM training in students and in a clinical population at Lindow

• Prediction: tDCS will improve CBM effects

Planned Study in Lindow
tDCS with Training

3 Experimental groups:

• Real tDCS during AAT-training + sham tDCS during cue reactivity
• Sham tDCS during AAT-training + real tDCS during cue reactivity
• Sham tDCS during AAT-training + sham tDCS during cue reactivity

• Differentiate enhanced training effects from direct effects on cue reactivity
Thank you for your attention