Effect of tDC stimulation over left Dorsolateral Prefrontal cortex on language production in healthy late bilinguals- Preliminary results

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07.10.2015
Introduction: Bilingualism

- 30-50% of the world population are bilingual
- Number of bilinguals is growing very fast.
- Bilingual brain needs to manage the two languages...
Executive Function

Regulates, controls and manages thought and actions
Introduction: Executive functions and language

Prefrontal Cortex
- Executive functions
- Decision-making
- Response selection
- Response inhibition
- Working memory

Anterior Cingulate Cortex
- Attention
- Conflict monitoring
- Error detection

Basal Ganglia
- Language selection
- Set switching
- Language planning
- Lexical selection

Inferior Parietal Lobule
- Maintenance of representations
- Working memory

Abutalebi & Green 2007
Whether left DLPFC stimulation by tDCS* modulates picture naming in mother language (L1) and even more in the second language (L2).

* tDCS: transcranial Direct Current Stimulation
Methods: Transcranial Direct Current Stimulation

- Non-invasive, portable, well tolerated and safe neuromodulation

- tDCS reliably modulates cerebral cortical function inducing **focal, prolonged and reversible** shifts of cortical excitability

Duration: 20 minutes → after-effect ~30 min.
Methods: Electroencephalography (EEG)

EEG: detects electrical activity in the brain using small electrodes put to the scalp.
Method: Study design

Subjects: healthy, 18-45 y/o, late unbalanced bilinguals (L1 French, L2: English), right handed

Session 1
- tDCS (Anodal or Sham)
  - Offline EEG recording
    - Picture naming (L1 & L2)

Session 2
- tDCS (Anodal or Sham)
  - Offline EEG recording
    - Picture naming (L1 & L2)

One week apart
Methods

• 13 (2 males) participants, age=23.2±6.1
• L1=French, L2= English
• Picture naming task during EEG
**Results: Picture naming (Behavioral)**

2*2 repeated measure ANOVA (Language (L1, L2)*Stimulation (Sham, Anodal))

Main effect of language (p<0.001)
Results: Picture naming (EEG)

2x2 Topographic ERP ANOVA with within-subject factors Language (L1; L2) and Stimulation (Anodal; Sham)

Main effect of Stimulation
Time window of Picture naming

Executive function involvement

Visual & conceptual processing
Lexical selection
Phonological processing
Phonetic encoding

Main effect of Stimulation

P Value

Image onset

Cat
Conclusion

• No effect of stimulation was found on behavioral level

• But, at neural level, tDCS over left DLPFC (associated to executive function) modifies conceptual processing and lexical selection. - the effect is similar on both languages
Thanks for your attention