Transcranial Alternating Current Stimulation highlights the role of midfrontal theta oscillations in performance monitoring during human-avatar motor interactions

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Objective: investigating the causal role of midfrontal theta power enhancement related to performance monitoring observed in previous EEG studies on human-avatar motor interactions.

Moreau et al., 2020

Moreau et al., 2021

Methods

Modelling of electric fields using ROAST (Huang et al., 2019)

Extraction of individual theta and beta frequency from resting-state EEG

EEG-informed tACS

Immersive VR motor interaction task

<table>
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<tr>
<th>Experiment 1</th>
<th>Experiment 2</th>
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<td>20 participants</td>
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<tr>
<td>Theta tACS (mean Hz = 5.5 ± 0.65) + Sham</td>
<td>Beta tACS (mean Hz = 17.6 ± 2.5) + Sham</td>
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Intensity: 2 mA – FCz-Pz

Duration: 9 minutes per block (4 blocks)

Motor Interaction task: touch the target as synchronously as possible with the virtual partner.

Conditions: Interactive/Cued, Imitative/Complementary, Correction/NoCorrection

Results

F(1,19) = 5.99 p = .024  Exp 1

F(1,19)= 5.76 p = .027  Exp 1

F(1,19) = 4.86, p = .040  Exp 1

No significant effect of beta tACS in Exp 2

theta tACS (Exp 1)

- asynchrony

+ movement times

- reaction times

Discussion: Theta tACS improved task performance, possibly by hyperactivating the performance monitoring system and promoting proactive cognitive control. The entrainment of midfrontal theta oscillations by means of individualized theta tACS might thus represent a viable tool for facilitating dyadic motor interactions in healthy (e.g. sports, videogames) and clinical (e.g. apraxia) groups.

References: Midline frontal and occipito-temporal activity during error monitoring in dyadic motor Interactions (Moreau et al., 2020, Cortex); The monitoring system is attuned to others’ actions during dyadic motor interactions (Moreau et al., 2021, BioarXiv). Contact: sarah.boukarras@uniroma1.it