[0176]

THE PHYSIOLOGICAL AND NEUROBIOLOGICAL EFFECTS OF TRANSCUTANEOUS AURICULAR VAGUS NERVE STIMULATION (TAVNS)

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Introduction: taVNS trials demonstrate promising behavioural effects, although two issues are still debated: 1) whether taVNS truly stimulates the vagus system 2) which stimulation parameters are optimal. The vagus nerve is highly involved in the parasympathetic nervous system and physiological recordings during stimulation can determine whether taVNS has vagus-mediated effects. We tested the physiological effects of 9 different stimulation parameter combinations in order to systematically determine the optimal parameters. We have also developed a novel taVNS/fMRI paradigm to investigate the neurobiological effects of stimulation.

Methods: 15 healthy participants attended two separate physiological taVNS visits (counterbalanced crossover design). Subjects laid supine while constant current taVNS was delivered to either the left tragus (active) or left earlobe (sham). Nine discrete stimulation parameter combinations were tested of varying pulse width and frequency while physiological recordings were measured. In a follow-up study, 20 healthy participants attended two separate concurrent taVNS/fMRI sessions (similar crossover study design) exploring direct brain effects of the two optimal parameters.

Results: Mean stimulation current varied by pulse width (1.98-9.28mA). Mean pain VAS scores, ranged from 0.2 to 1.94. Upon individual parameter inspection, two of nine taVNS parameters had significant decreases in heart rate when compared to sham using repeated measures ANOVA (500µs, 10Hz: 4.3BPM mean decrease, $P<0.01$; 500µs, 25Hz: 1.1BPM mean decrease, $P<0.05$). Using these data we were able to rank parameters based on effect size in order from best (1) to worst (9) with the top two being: 500us 25Hz & 500us 10Hz. Concurrent taVNS/fMRI BOLD findings will be reveleaed in this presentation.

Discussion: The problem of the infinite parameter space is one that can be solved by using physiological recordings and fMRI as surrogates of vagus system activation. These findings are key to determining optimal stimulation parameters and guiding all future taVNS clinical trials.

Keywords: transcutaneous auricular vagus nerve stimulation, taVNS, fMRI, physiological response

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TOWARDS A PERSONALISED MODEL FOR TRANSCRANIAL DIRECT CURRENT STIMULATION (TDCS)

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Transcranial direct current stimulation (tDCS) it is a relatively new technique that alters brain activity by injecting low dosages of direct current through electrodes placed over the scalp. In order to define the areas to be targeted and maximize current intensity at the target, the approaches used in the last few years are to create a high-resolution discretization of the brain using tetrahedral or hexahedral elements and simulate the electrical field using the boundary element method (BEM) or the finite element method (FEM) and assigning isotropic or, more recently, anisotropic conductivity properties.

These approaches require a complex processing pipeline which renders the use in the context individualized models challenging, especially important in those cases where there the tDCS is widely used (e.g. stroke and TBI).

With the aim of providing a personalized approach to tDCS, we propose a robust modeling pipeline that allows to obtain a realistic, fully individualized model for tDCS from medical imaging data in an automated fashion and with computational efficiency. Starting from multi-channel MR data, including DTI, we automatically provide a segmentation of skin, skull, white matter, gray matter and cerebrospinal fluid, as well as map Brodmann areas onto the cortex using a deformable registration approach. We then automatically generate a discretized computational domain, including the electrodes, using an octree-based approach, which produces a non-conforming mesh of hexahedral elements which are adaptively refined according to the geometry as well as the rate of change in conductivity properties, particularly within the brain. Conductivity is assumed anisotropic in the white matter and gray matter, with conductivity tensors estimated from DTI MR sequences.

The anisotropic Laplace equation is efficiently resolved using non-conforming Discontinuous Galerkin finite elements, using a stable numerical scheme to obtain potential field and electrical currents throughout the domain for a unitary stimulation per electrode. The mix of electrode currents to optimize the stimulation at target (identified by absolute location or through the specification of a particular Brodmann area) is then optimized by solving a convex optimization problem, following the method proposed by Guler et al. (2016).

The results show that our method is particularly effective in providing an end-to-end pipeline for tDCS modeling and individualized prescription.

Keywords: TDC, Personalized Model, Source Reconstruction, Real Time

[0179]

SOCIAL COGNITION AND THE TEMPOROPARIETAL JUNCTION: A DOUBLE-BLIND HD-TDCS EEG STUDY

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Background: The temporoparietal junction (TPJ) has been implicated in aspects of social cognition such as mentalising and self-other processing. Previous studies have shown some promise in terms of modulating aspects of social cognition via TPJ transcranial stimulation. However, no studies have used high-definition transcranial direct current stimulation combined with electroencephalography (EEG) to explore right TPJ function.

Objective/Hypothesis: The aims of the present study were to explore whether anodal and/or cathodal HD-tDCS would influence social cognition task performance relative to sham stimulation, and whether task performance changes were related to EEG outcomes, depending on stimulation condition.

Methods: Participants completed mental state and facial emotion attribution tasks, as well as a self-other face morphing task, before and after rTPJ HD-tDCS (anodal, cathodal, or sham). Resting state EEG and event-related potentials (ERP) were also recorded pre- and post-stimulation.

Results: Anodal rTPJ HD-tDCS improved facial emotion processing performance only when images were static and the expression was fear (not surprise). Stimulation condition also influenced N170 and P300 ERP components, as well as resting state power, with hemispheric differences. Right hemisphere N170 latency had a strong positive relationship with reaction times for fearful faces (after anodal stimulation only). Performance on other tasks was not modulated by stimulation condition.

Conclusion: Results suggest that rTPJ anodal HD-tDCS might influence facial emotion recognition, as well as the nature and distribution of relevant underlying processes. Stimulation effects might depend on the intensity and salience/valence (negativity/threat) of the emotion, however, and may involve excitation/inhibition balance between the left and right TPJ. Results are discussed further with reference to existing theories of TPJ function and literature concerning the resting state and default mode networks.

Keywords: HD-tDCS, EEG, Temporoparietal junction, Social cognition

[0180]

PRELIMINARY RESULTS FROM A RANDOMIZED SHAM-CONTROLLED TRIAL OF AUGMENTATIVE NEURO-NAVIGATED RIGHT-DORSOLATERAL PREFRONTAL CORTEX LOW-FREQUENCY REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION FOR ANTIDEPRESSANT NON-RESPONDING BIPOLAR DEPRESSION

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Introduction: Depressive and anxiety symptoms in bipolar disorders respond poorly to antidepressants and mood stabilisers. Single-arm evidence showed >50% bipolar depressed patients responded to right DLPFC 1Hz Repetitive Transcranial Magnetic Stimulation (rTMS). We report preliminary results from a study aiming to determine the acute anti-depressive and anti-anxiety effectiveness of 3-week, 5 sessions/week of neuronavigated 1-Hz Right DLPFC rTMS for antidepressant non-responding bipolar depressed patients already on mood stabiliser.