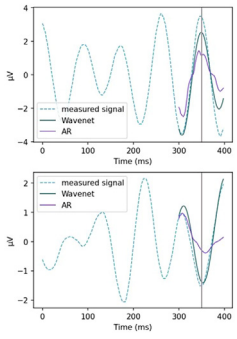

Figure 1a: Examples of predictions

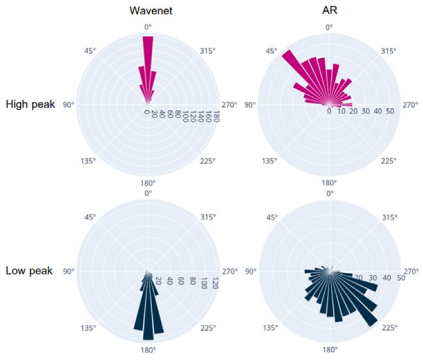

Figure 1b: The distribution of predicted phases when a peak occurred

Keywords: closed-loop stimulation, TMS-EEG, deep learning, signal forecasting

P2.028

TO STIMULATE, OR TO MEDITATE? THAT IS THE QUESTION! A RANDOMIZED, SHAM-CONTROLLED TRIAL EXPLORING THE EFFECTS OF TDCS AND MINDFULNESS ON COGNITION AND CREATIVE THINKING

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Abstract

Background: Our daily cognitive and sensory experiences change exponentially fast, thus requiring individuals to exert a great effort in terms of neural adaptation. Our cognitive system simultaneously needs to be flexible, allowing for prompt switching from routine functioning to Creative-On mode.

Creativity has been defined as humankind's ultimate resource and can be enhanced by using neuroscientific techniques, such as neuromodulation and neurostimulation. This way the Creative-On mode, essentially based on a transitory functional reset of frontal cortices, and in particular the Inferior Frontal Gyrus (IFG), can "unlock" divergent, creative thinking.

Alongside neuromodulation techniques, meditation has been proposed to be associated with a phenomenon known as "transient hypofrontality", with subsequent alterations in perception of self and cognitive capacities that can influence creative skills. Here we describe a study using transcranial direct current stimulation (tDCS) paired with mindfulness meditation to enhance both convergent and divergent thinking.

Methods: We recruited 45 healthy volunteers divided in three experimental groups: A received active tDCS stimulation and real mindfulness meditation (e-meditation), B received sham tDCS and real mindfulness meditation, while the third one (C) received active tDCS stimulation and a relaxing book reading which did not involve specific mindfulness techniques. The participants received their randomized experimental condition 20-minutes daily for 4 consecutive days, with pre-and post-experiment cognitive and creative assessment.

Results: Participants receiving intervention A demonstrated enhanced convergent thinking compared to sham stimulation, whereas intervention C enhanced divergent thinking compared to sham stimulation. Findings will be discussed at light of the neurofunctional models of creativity.

Conclusion: This study demonstrates that pairing tDCS with mindfulness for four days facilitates critical and analytical thinking. Furthermore, tDCS paired with non-mindfulness techniques allow for more divergent and creative thought processes to emerge. These findings suggest that the tDCS-paired behavioral intervention allows for targeting of behavioral outcomes.

Keywords: creativity, divergent thinking, mindfulness, tDCS

P2.029

IN-SITU MULTI-LOCUS TRANSCRANIAL MAGNETIC STIMULATION WITH CONCURRENT FUNCTIONAL MAGNETIC RESONANCE IMAGING AT 9.4 T FOR SMALL-ANIMAL STUDIES

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Abstract

Achieving simultaneous non-invasive brain stimulation and brain imaging for small-animal models would allow the development of new research paradigms, specifically for monitoring functional changes during and after stimulation. However, realising transcranial magnetic stimulation (TMS) with concurrent functional magnetic resonance imaging (fMRI) has proven challenging due to the strong interaction between the static magnetic field of the fMRI (in this study 9.4 T) and the high current density in the TMS windings (here up to 178 kA/cm^2). Lorentz interaction experienced by the moving charges results in a theoretical maximum force density of 1 700 kN/cm^2 along the wire cross-section, which leads to apparent challenges in durability of the components and safety of the animal subjects.

In August 2020, we achieved the first installation of a multi-locus TMS device (mTMS) into a 9.4 T fMRI system with test runs inside the magnetic field. The multi-locus TMS allows manipulation of the stimulation E-field vector orientation without physically moving the transducer inside the fMRI. Later, additional functionalities such as lateral movement of the stimulation vector can be implemented. Recorded fMRI signals exhibit an insignificant level of artefacts from the preceding TMS pulse, which enables practically simultaneous stimulation and imaging.

This study presents an overview of the results from the technical development of the first concurrent mTMS–fMRI system and experiences from the installation and testing phase.

Keywords: TMS, MRI, mTMS, fMRI

P2.030

RELIABILITY OF TMS-DERIVED HAND MOTOR MAPPING ACROSS DEVELOPMENT IN CLINICAL COHORT WITH REFRACTORY EPILEPSY OR BRAIN TUMOR

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Abstract

The reliability of Transcranial Magnetic Stimulation (TMS) motor mapping in typically developing children over short timeframes has been studied. We wanted to expand the understanding of TMS's reliability in a clinical pediatric population across development.

In a retrospective chart review approved by the IRB, we identified patients with refractory epilepsy or brain tumor who had undergone TMS motor mapping. TMS was MRI-guided and used a figure-8 coil to generate a focal electrical field. Subjects included had two TMS sessions with one distal upper extremity (UE) muscle mapped (n=26; mean age 11.5 ± 7.2; 12 male, 14 female; avg. lapse 2.7 ± 1.9 years). Cortical locations where TMS elicited an MEP ≥ 50μV or a cortical silent period were included in determining the center of gravity (COG) of the hand motor representation. Corticomotor latencies were used to estimate conduction velocities (CV). Statistical analysis was completed using MATLAB and SPSS.

Increases in CV were noted in patients retested between 0-10 years of age, when myelination of central and peripheral nervous systems were ongoing and remained stable thereafter. CV of either UE showed excellent reliability (Non-Dominant ICC= 0.935; Dominant ICC= 0.933; p< 0.001). COG in the medial-lateral (ML) direction showed excellent reliability for the dominant hemisphere (ICC= 0.846, p<0.001) and moderate reliability for the non-dominant hemisphere (ICC= 0.663; p= 0.007). The anterior-