

# **Impact of cerebellar beta entrainment using non-invasive brain stimulation: Insights from an ongoing rhythmic TMS-EEG study in healthy human participants**

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Oscillations play a pivotal role in shaping cerebellar local activity and its communication with neocortical areas involved in learning motor skills. Previous studies have emphasized the presence and the potentially important role of beta (15-30 Hz) cerebellar oscillations in such processes. Yet, the distribution and causal nature of local and interregional synchronization patterns at such frequencies remain elusive. The present study aims to better understand the functional mechanisms by which the cerebellum synchronizes with widespread cortical regions. This will pave the way to identify and better modulate the specific electrophysiological properties of these networks.

To this end, we sought to entrain beta frequency cerebellar oscillations with transcranial magnetic stimulation (TMS) and to characterize the cerebello-cortical synchronization patterns in the sensory-motor networks. A cohort of 20 healthy adult participants received trial-by-trial blocks of 4-pulses bursts of either rhythmic (20 Hz, experimental condition) or arrhythmic (control condition) TMS delivered over the right cerebellum, while EEG was also recorded. The stimulation of a right occipital/parietal cortical site performed in separate blocks served to assess the specificity of cerebellar stimulation.

After cleaning and pre-processing, we computed and averaged the power and the inter-trial coherence of EEG signals elicited by TMS in frontal, central and parietal areas. Current interim analyses support the tolerability and feasibility of cerebellar TMS—EEG recordings, and our ability to assess signs of beta-induced entrainment while ruling out unspecific effects (artifacts triggered by the TMS clicking-sound, scalp-tapping, etc).

This is the first study overcoming the limitations of 'offline' repetitive TMS approaches assessing effective connectivity between cerebellar and cerebral systems using TMS—EEG approaches. The outcome of this study will characterize the neurophysiological properties of cerebello-cortical communication based on frequency-specific synchronization mechanisms, which would ultimately influence learning processes.