Contribution ID: **10** Type: **not specified**

Visual-premotor connections in the processing of visual duration

Temporal processing relies on a distributed network of brain regions, with evidence indicating a hierarchical organization in which early sensory areas, such as the primary visual cortex (V1), relay information to higher-order regions like the supplementary motor area (SMA). However, the communication between these areas as well as its directionality and timing remain unclear. This study used twin-coil transcranial magnetic stimulation (TMS) and electroencephalography (EEG) to explore V1-SMA interactions during a duration discrimination task. We examined the effect of varying TMS inter-pulse intervals (IPIs) and target order (V1 - SMA vs. SMA - V1) on behavioral measures and neural signatures of temporal processing. Results revealed that TMS disrupted participants sensitivity to temporal differences when was first applied to SMA at stimulus offset and then to V1 0.1 s later. This effect correlated with a change in the quality of duration representation in EEG signal. Furthermore, alpha power predicted criterion scores at long inter-pulse intervals (0.1, 0.15, 0.2 s) in both stimulation orders. Specifically, stronger alpha power was associated with a stricter criterion. Our study provides novel causal evidence on the bidirectional nature of V1-SMA communication in the context of temporal processing, highlighting the role of feedback connections in duration sensory processing and the involvement of alpha oscillations in temporal decision making.

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Session Classification: Contributed Talk