Does premotor cortex influence auditory perception?

- The Action Simulation for Auditory Prediction (ASAP) hypothesis proposes that auditory timing perception depends on the motor system, requiring bidirectional interchange, using the dorsal auditory stream, between auditory representations and endogenous timing expectations generated in motor planning systems (Patel & Iversen, 2014). In a previous study, we found evidence for a causal role of posterior parietal in beat-based timing perception, supporting ASAP.
- It is unknown what role premotor cortices play for auditory timing. Dorsal PMC is part of the dorsal auditory stream, but ventral PMC has been implicated for internal simulation of actions.
- Method: Directly tested for descending premotor influence on auditory timing perception using transcranial magnetic stimulation (TMS) cortical down-regulation (cTBS protocol) of left dorsal and ventral premotor cortices.

RESULTS

- Individual and mean pre- and post-cTBS thresholds. Error bars represent ±1 standard error from the mean. We show an increase in detection thresholds pre- to post-stimulation in interval discrimination with cTBS to left dPMC and left vPMC. We show a decrease in detection thresholds in IBI augmentation detection with musical stimuli with cTBS to left vPMC.

- Post/pre threshold ratios for the three timing tasks in the two stimulation conditions and sham stimulation. Error bars represent ±1 standard error from the mean.

CONCLUSIONS

- To our surprise, we are not finding evidence for a causal contribution of dPMC to beat-based timing perception, as predicted by ASAP.
- Dorsal and ventral premotor down-regulation impairs interval perception: We show (N=14) that cTBS down-regulation of left dPMC or left vPMC reduces interval perception performance, supporting a causal influence of left premotor cortex on auditory timing perception.
- Ventral premotor down-regulation improves beat perception: We show (N=14) that cTBS down-regulation of left vPMC increases inter-beat interval perception performance with musical stimuli, supporting a causal influence of left ventral premotor cortex on auditory timing perception, and suggesting an inhibitory role in musical rhythm perception.