

THE PREMOTOR ROOTS OF MUSICAL BEAT PERCEPTION AND IMAGERY: A NEUROPHYSIOLOGICAL INVESTIGATION

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Background: Humans can flexibly extract a regular beat from complex auditory patterns, such as music. Contemporary models of beat perception and imagery suggest that the premotor cortex (PMC) and the supplementary motor area (SMA) are integral to this process. However, how these motor planning regions actively contribute to beat perception and imagery, along with any potential hemispheric specialization, remain open questions.

Aims: To fill this gap, in our study, we conducted a series of experiments combining behavioral assessments with transcranial magnetic stimulation (TMS) to elucidate the role of the PMC in beat perception and beat imagery.

Method: Therefore, following the validation of stimuli in two behavioral experiments, we employed transcranial magnetic stimulation (TMS) to causally test the contribution of these regions to beat perception and imagery. We applied repetitive online TMS over a defined grid encompassing the right rostral and caudal dPMC, SMA and pre-SMA, and a sham location over primary motor cortex.

Preliminary results: Results of Experiment I showed that stimulation of the caudal portion of right dPMC selectively disrupted beat perception compared to all other regions. Experiment II showed that only stimulation over right, but not left, dPMC disrupted beat perception. Preliminary results of Experiment III suggested that the same portion of the PMC in the right hemisphere is causally involved musical rhythm imagery. Finally, across all three experiments, individual differences in musical reward sensitivity predicted beat perception and beat imagery performance. These outcomes align with recent models emphasizing the dorsal auditory stream's role in auditory beat-based temporal perception and imagery and highlight the dPMC's significance in generating internal action predictions and perceptual expectations regarding ongoing sequential events. Furthermore, they fit with the dominant role of the right dorsal stream in auditory-motor integration in the context of music, including rhythm perception and imagery.

Keywords: Transcranial magnetic stimulation, Premotor cortex, Supplementary motor areas, Rhythm perception, Rhythm imagery

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