
The supplementary motor area in motor timing: an intracerebral EEG study

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R esum e

The supplementary motor area (SMA) has been shown to be involved in interval timing but its precise role remains a matter of debate. The present study was aimed at examining, by means of intracerebral EEG recordings, the time course of the activity in this structure, as well as in other functionally connected cortical (frontal, cingulate, insular and temporal) areas, during a visual time reproduction task. Four epileptic patients were selected on the presence of depth electrodes implanted within the SMA. They were instructed to encode, keep in memory and then reproduce the duration (3, 5, 7 s) of emotionally-neutral or negative pictures. Event-related potentials (ERPs) were analyzed during three periods: At the beginning and at the extinction of the target interval (TI) and at the beginning of the reproduction interval (RI). Electrophysiological data revealed an ERP time-locked to TI-offset whose amplitude decreased monotonically with TI-duration. This effect was observed in three out of the four patients, especially within the SMA and the insula. It also involved the middle and anterior cingulate cortex, the superior, middle and inferior frontal gyri and the paracentral lobule. These effects were modulated by the prior TI-duration and predicted variations in temporal reproduction accuracy. Furthermore, a time-frequency (TF) analysis revealed in the same cortical regions concomitant increases in gamma-band (40-80 Hz) and decreases in alpha-band (8-13 Hz) activities which were also inversely proportionate to TI-duration. Modulations of ERPs with TI-duration, emotion or temporal performance during the target or the reproduction interval were modest and less consistent across patients. These results demonstrate that, during reproduction of supra-second time intervals, the SMA, in concert with a fronto-insular network, is involved at the end of the target interval, and suggest a role in the duration categorization and decision making operations or alternatively in the preparedness of the timing of the future movement that will be executed during the reproduction phase.

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Mots-Clés: Time Perception, Stereoelectroencephalography, Supplementary motor area, Insular cortex, Frontal cortex, Duration categorization