Navigated Brain Stimulation as a Probe of Brain State

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Brain states, including conscious states, can be modulated and changed in harmless ways by transcranial magnetic stimulation (TMS [1, 2]). We have built a tool called Navigated Brain Stimulation (NBS) that allows one to perform this modulation in a precise, controlled way.

NBS allows targeting TMS pulses very accurately to selected anatomical or functional sites on the basis of MRI [3, 4]. In addition, the reaction of the brain to TMS can be measured with multichannel EEG just milliseconds after the electromagnetic pulse [5].

TMS-evoked EEG is a probe of the local excitability and area-to-area functional connectivity of the cortex [5,6]. This has made it possible to develop new ways to study the functional state and well-being of the cortex and its circuits.

Suggestions for the use of TMS–EEG in new ways include that of Nikulin et al. [7] who proposed that the TMS-evoked component N100 reflects inhibition and could be used to map the excitation state of the cortex. When measured from the motor cortex, N100 was found to be reduced markedly when the subject was about to perform a visually timed finger movement. Another new proposal comes from Komssi et al. [8], who deliberated on how the EEG response amplitude depends on TMS intensity. They conclude that the measured intensity–amplitude curve can reveal significant information about the distribution of membrane potentials in the area under study. This may be useful, for example, in the study of the efficacy of new pharmaceuticals in humans.

Techniques such as MEG, EEG or fMRI are able to reveal the function of the human brain *in vivo*. NBS is different from these in the sense that, instead of merely observing the brain in operation, neurons are triggered into action. It is expected that NBS, in particular in combination with EEG, will have wide applications both in basic research and in clinical applications, including diagnosis and therapy.

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