

# A combined method for detecting consciousness

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The combination of transcranial magnetic stimulation and electroencephalography constitutes a new method allowing the traces of conscious activity to be revealed in brain injured patients.

Thanks to joint work carried out between the group led by Marcello Massimini at the University of Milan (Italy) and the group directed by Steven Laureys of the University of Liège (Belgium), a study published this week in the journal *Brain* shows that measuring the level of cerebral communication enables a patient in a [vegetative state](#) to be distinguished from a patient in a minimally [conscious state](#). Crucially, this measurement can be carried out at the patient's bedside and does not depend on the integrity of the sensory or motor pathways, nor on the subject's ability to understand or carry out instructions. This discovery is important as the distinction between patients in a vegetative state and those in a minimally conscious state can be extremely difficult to establish, leading to diagnosis errors in 40% of cases.

The combination of TMS/EEG allows a direct and non-invasive measurement of internal brain communication, a theoretical condition required for the emergence of consciousness. As shown by previous studies, this approach allows a distinction to be easily made between the conditions in which consciousness is present (when we are awake and

conscious or when we are dreaming) and those in which consciousness is reduced or absent (whilst sleeping or under anesthesia).

In patients in a vegetative state, who are awake (open-eyed) but unconscious, the TMS/EEG has shown a breakdown in internal cerebral communication, similar to that previously observed during sleep or when patients are anesthetized. On the other hand, in patients in a minimally conscious state the TMS/EEG has invariably revealed an effective communication between the different regions of the brain, irrespective of the patients' ability to communicate.

These results suggest that directly stimulating the brain (through TMS) allows an evaluation of the internal communication between the different sections of the brain (thanks to EEG) and represents an excellent means of evaluating the neuronal correlates of the recovery of consciousness in non communicating and severely [brain](#) injured patients.

**More information:** Recovery of cortical effective connectivity and recovery of consciousness in vegetative patients, *BRAIN*, 2012, doi :10.1093/brain/awr340

Provided by University de Liege

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