

Title:

TRANSCRANIAL FOCUSED ULTRASONIC BRAIN STIMULATION: A NOVEL NON-INVASIVE TECHNIQUE TO MODULATE OR STUDY PAIN IN HUMANS?

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Background. Transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (TDCS) are the most-used non-invasive techniques to modulate cortical excitability and, thereby, study brain structure-function relationships in humans. Recently, transcranial focused ultrasound stimulation (TFUS) was proposed as an advantageous alternative neuromodulation technique. Compared to TMS and TDCS, TFUS would be more focal, be able to target deeper brain structures. Furthermore, TFUS can be applied in a blinded fashion because it does not generate any auditory or tactile sensation. Furthermore, it does not generate electromagnetic artefacts, and can thus be easily combined with electroencephalography (EEG).

Aim. To develop TFUS and the combination of TFUS with EEG as a new approach to study the cortical processes underlying pain perception in humans.

Methods. After developing a custom TFUS setup, we will validate it by demonstrating that, as shown previously, pulses of TFUS over the primary somatosensory cortex (S1) can generate somatic sensations. The setup will then be used to explore the involvement of S1 in pain processing. First, by assessing whether TFUS over S1 differentially affects the perception and EEG responses to nociceptive and non-nociceptive somatosensory stimuli delivered to the ipsilateral and contralateral hands. Second, by comparing TFUS-evoked EEG responses obtained during sustained concurrent nociceptive or non-nociceptive somatosensory stimulation to assess changes in cortical excitability and functional connectivity related to touch and pain perception.

Expected hypothesis. As compared to TMS and TDCS, TFUS could be used to generate more focal and more controlled neuromodulatory effects, creating new perspectives to study pain in humans.

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