Time-frequency analysis as a metric for measuring pain in an objective way

Could we achieve an objective system to assess pain by reading information provided by our own brains? If we achieve such system it would bring huge implications and consequences in the way we read and treat pain. Motivited by this we decided to perform an analysis in the time-frequency domain to describe the electrical responses evoked by painful stimuli.

Nowadays it is still quite normal going the doctor and being asked to rate the pain we are feeling from 0 to 10 where 0 is no pain, and 10 the worst pain ever felt. What a tricky question! Isn't it? And it is going to be like that until we finally find the solution to objectively measure pain. However the biggest benefits would be found in the way medicine specialists approach the diseases they are treating, and a better diagnosis for their patients who would get the best part of this. Think about those patients who are not capable to communicate by themselves either after an accident or a brain damage but can still feel pain. Monitoring pain state would bring huge advantages in many situations we are dealing with today.

In this work "Time-frequency analysis for responses evoked by nociceptive and non-nociceptive stimuli based on EEG signals" we addressed the problem of measuring the pain objectively, and we wanted to make this approach by finding the main differences between the electrical responses in our brain after a painful stimulus compared to the responses after a non-painful stimulus, and to do so, experiments were made with volunteers who received both painful and non-painful stimulation at the same time that the electrical signals from their scalps were recorded and we certainly found a good parameter to differentiate these two situations. However there's always going to be a subjective component for pain, and every one of us has a different threshold for which a stimulation turns into a painful one, and that's why the stimulation applied to participants was adjusted individually to ensure that they were feeling pain or that they were not in order to somehow eliminate this subjective component characteristic of pain.

We based our research on the time-frequency domain analysis and the results allowed us to see three main differences:

- The factor of attention may change the way we perceive pain. When the participants were paying attention to the stimulation itself, different responses were obtained even before the stimulus came.
- The frequency of the electrical signals captured in our brain changes depending on the nature of the stimulation (painful or non-painful). For related-to-pain responses the information tends to be processed at higher frequencies compared to the responses provoked by non-painful stimulation.

- The electrical signals captured in our scalp also change in amplitude depending on the type of stimulus (painful or no-painful). The energy reflected in the signals captured from the scalp after a painful stimulus was much larger.

The results found in the present study will take us one step closer to obtain a system capable of matching a signal with some input parameters in order to estimate first of all the presence of pain (whether there's pain or not) and second of all the level of pain.

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