PAIN SUBJECTIVE DIMENSIONS AND EVENT-RELATED POTENTIALS MODULATED BY MEDITATION STATES AND TRAITS

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Background: The experience of pain is a combined product of bottom-up and top-down influences mediated by attentional and emotional factors. Meditation states and traits are characterized by enhanced attention/emotion regulation and expanded self-awareness that can be expected to modify pain processing.

Aims: We conducted three related studies. In Study 1, we investigated three dimensions of pain and related affective experience, i.e. pain, aversion and identification, in short-term meditators (STMs) and long-term meditators (LTMs), in three forms of meditation, i.e. Focused Attention Meditation (FAM), Open Monitoring Meditation (OMM), Loving Kindness Meditation (LKM), and in a non-meditative Rest condition. In Study 2, EEG pain-related oscillations (PROs) were analysed in STMs and LTMs during a non-meditative resting state. In Study 3 we explored the effects of the three forms of meditation on the neurophysiologic mechanisms of pain processing in terms of PROs.

Methods: In Study 1, nociceptive electrical stimulation was administered during FAM, OMM, and LKM, and in a non-meditative rest condition to STMs and LTMs. Experience reports of pain, aversion, and identification were collected in each trial. In Study 2, EEG pain-related oscillations (PROs) were analysed during a non-meditative resting state with respect to local frequency-specific and temporal synchronizing characteristics, synchronizing patterns to reflect the neural communication of noxious information, pre-stimulus oscillations to reflect top-down mechanisms during pain expectancy, the P3b component of the pain-related potential. In Study 3, EEG responses were analysed to characterize bottom-up processes, pro-active modulation of cortical excitability, cognitive/affective appraisal, and the connectivity of performance monitoring and attentional networks during pain processing in FAM, OMM and LKM in STMs and LTMs.

Results: Study 1 revealed relationships and causal influences between pain, aversion and identification. Study 2 found that even when subjected to pain outside of meditation, experienced meditators exhibit a pro-active top-down inhibition of somatosensory areas resulting in suppressed processing and communication of sensory information at early stages of painful input. Study 3 showed that different meditation states do not influence bottom-up sensory pain processing; however, they significantly alter cognitive/affective pain mechanisms in state- and trait-dependent ways.

Conclusions: Taken together, our findings shed new light on the effects of meditation traits and states on the relationships between pain and affective experiences, as well as on implicated neurophysiological bottom-up and top-down mechanisms.

Keywords: Pain, Meditation, EEG

Publications:

Chiarella, S. G., Ortame, L., Simione, L., Pazzaglia, M., Di Pace, E., & Raffone, A. (2025). The effects of focused attention and open monitoring meditation on interval duration estimation and passage of time judgments in non-meditators. *Mindfulness*. Advance online publication. https://doi.org/10.1007/s12671-025-02650-4

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