

Abstract

Neurocomputational mechanisms of meditative practice: investigating an intensive mindfulness meditation retreat within a predictive processing Bayesian framework

The idea of meditation as a scientific tool to understand the “embodied mind” was initially suggested by neuroscientist Francisco Varela and his collaborators in a ground-breaking publication in 1991. Thirty years later, a growing amount of scientific evidence confirms that meditation can have beneficial impacts on the body and mind. Despite encouraging physiological and psychological models, a general understanding of the mechanisms at play during meditative practices, grounded in neurosciences, is still lacking. Additionally, the comprehension of human cognition based on the *predictive processing theory*, and its cerebral implementation, could offer a unifying explanation for processes as diverse as perception, attention, learning, and action. Founded on Bayesian statistics, this theory models the brain as an “inference organ” which simultaneously predicts and constrains, proactively, the sensations the organism receives from both its own body and the outer world, with the main purpose of maintaining itself in a viable state.

The primary objective of this PhD was to elucidate, within this theoretical framework, some of the neuronal and computational mechanisms of different meditative practices. Our general hypothesis is that the regulation of attention and emotions by meditation is associated with an adjustment of the brain's predictive processes. The degrees of confidence in the validity of predictions and sensations, among other factors, would be differently altered, leading to more malleable and adaptive cognitive priors. This transformation of the way of approaching mental experience as well as external influences, may explain the proven psychotherapeutic effects of mindfulness meditation to cope with depressive relapse, anxiety, chronic pain or addictions.

Keywords: meditation, mindfulness, meditation retreat, embodied cognition, predictive processing, predictive coding, Bayesian inference, perceptual inference, active inference, electroencephalography, event-related potentials, mismatch negativity, Bayesian modeling, computational modeling, pain, pain catastrophization, cognitive defusion