

CLOSING THE LOOP: USING REAL-TIME EEG TO MUTUALLY ENLIGHTEN FIRST AND THIRD-PERSON PERSPECTIVES ON THE SELF

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Background: A fundamental question in science and philosophy concerns the relation between first-person experience and brain activity. A promising approach uses neurofeedback to create a closed loop between brain activity and conscious phenomenology. This method has been applied to study the neurophenomenology of effortless awareness in meditation.

Aims: We aimed to replicate this study and extend the paradigm to other experiential meditation characteristics, including the sense of self. We also tested both visual and auditory feedback modalities.

Methods: Across 34 high-density EEG sessions, experienced meditators (n=9) received feedback of source-localized brain activity. The feedback was based on signals previously associated with meditation states (high beta and gamma activity in the posterior cingulate cortex for self-boundary dissolution and effortless awareness, respectively; midfrontal theta for focused attention; occipital alpha for relaxation). All conditions were tested with auditory feedback, and the gamma condition additionally with visual feedback. Participants were blind to which signal direction corresponded to deeper meditation, which was randomly flipped across 12 repeated trials. They identified the direction by comparing their meditation experience to the feedback. Phenomenological interviews explored participants' experiences and strategies in influencing the signal.

Results: Only the gamma condition showed above-chance accuracy for identifying the expected feedback direction, both for auditory and visual feedback. Whole-brain source localization and correlations with surface time courses indicated driving effects by frontolateral generators, suggesting potential muscular confound. Interviews revealed differential patterns of enacted meditative gestures, with "letting go of control and effort" dominant in the gamma condition.

Conclusions: We replicated the correspondence between effortless awareness in meditation and visually presented neurofeedback of gamma activity from posterior cingulate cortex and extended it to auditory feedback. However, meditators could not establish correspondences for other frequency bands or regions. Findings suggest replicated gamma effects may be driven by muscular (de-)activation.

Keywords: Self, Neurophenomenology, Neurofeedback, Meditation

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