

Abstract

Examining Neural Oscillatory Changes and Challenges During Breath-Based Intervention in Novice Meditators

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Breath-based meditation techniques generally utilize rhythmic breathing to aid practitioners in achieving a profoundly meditative, calm mental state (Carter & Carter III, 2016). The study assessed EEG spectral dynamics among Indian novice adult students (N=89) over three stages of a breath awareness meditation paradigm: resting state (RS), breath counting (BC), and breath focus (BF). EEG data were collected using 64 electrodes; subsequently, preprocessing was executed using the ASR-ICA pipeline (Artefact Subspace Reconstruction - Independent Component Analysis) (Plechawska-Wójcik et al., 2023). Fourier analysis was applied, yielding spectral powers across the stages. A ‘3x3x5’ repeated measures factorial design was used to analyze neural oscillations across three brain regions (Midline-Default Mode Network [DMN], Prefrontal Cortex [PFC], Occipital Cortex [OCC]), three stages (RS, BC, BF), and five oscillation bands (delta, theta, alpha, beta, gamma). Significant differences were observed across oscillation bands ($F(1.77)=77.69$, $p<0.001$, $\eta_G^2=0.277$). Alpha power was notably higher, given the resting-type nature of the stages, validating the effectiveness of the intervention. Main effect for ‘brain regions’ ($F(1.36)=41.31$, $p<0.001$, $\eta_G^2=0.013$), and interaction effect for ‘regions x power bands’ ($F(3.07)=28.43$, $p<0.001$,

$\eta_G^2=0.018$) were also significant. Post-hoc analyses for the former revealed that PFC depicted the peak brain activity, followed by DMN and OCC; the latter revealed greater delta and theta power in PFC, ensuingly DMN and OCC.

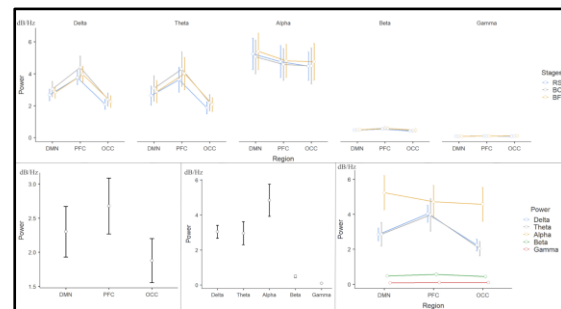


Fig. 1. EEG Spectral Analysis Marginal Means Plot

This indicates a heightened engagement of DMN and especially the PFC during the BC-BF stages owing to working memory and memory retrieval processes (Cavanagh et al., 2012; Huijbers et al., 2011). No significant differences were found across the ‘stages’ or in their respective interactions, indicating that novice meditators did not exhibit substantial modulation of brain activity across the distinct stages. The results underscore the role of memory processes during breath-focused meditation while highlighting challenges novice meditators encounter across different stages of the intervention.

Keywords: Novice Mindfulness, Breath-Attention, Electroencephalography, Neural Oscillations, Resting State

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