From State to Trait Meditation Functional Connectivity: Default and Executive Network implications

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\textbf{Background:} Intrinsic and extrinsic resting-state functional connectivity (rsFC) in the default mode network (DMN) is altered by meditation practice. The most reliable finding amongst meditation studies have found that both, within-network connectivity of the DMN as well as between-network connectivity of DMN and central executive network (CEN) is increased during meditation in experienced meditators. However, during normal resting-state the findings have not been so clear, with mixed results. Here we investigated the stages of intrinsic and extrinsic FC of the cortical midline structures (CMS) of the DMN, specifically (medial prefrontal cortex: MPFC and posterior cingulate cortex: PCC) in experienced meditators during three back-to-back runs: at baseline (rsBase) compared to a meditation naive group (rsContr), during meditation (Med) and post meditation (rsPost).

\textbf{Methods:} 15-experienced meditation practitioners (MP) (average of 1396 h +/- 332 h of meditation experience) 15 healthy controls participated in this study. rsFC analysis was performed using the Conn toolbox. Connectivity strength for the CMS was calculated from MPFC and PCC ROI’s amongst following conditions: a) rsBase>rsContr b) Med>rsBase, c) rsPost>rsBase. All analyses are cluster p-FDR corrected <0.05.

\textbf{Results:} MP exhibited significantly reduced FC between CMS and the left frontopolar cortex, left inferior parietal lobule and MPFC at rsBase compared to rsContr. The stages for the changes in FC for MP were the following: Med>rsBase: increased FC of MPFC, PCC, right dorsolateral prefrontal cortex, anterior cingulate cortex and right inferior frontal; rsPost>rsBase: reduced FC of right middle frontal gyrus and increased FC of middle frontal gyrus, bilateral somatosensory cortex.

\textbf{Conclusions:} These findings contribute to the progression of FC in experienced meditators for the CMS of the DMN at baseline (trait), during meditation (state) and after meditation (state-to-trait). This suggests A) that regions of the CEN are actively recruited during a meditation state in order to control the focus of attention, the emotional evaluation of both externally as well as internally derived processes, B) that this relation underlies the strengthened present-moment awareness, increased discrimination of internal-self related vs. externally derived processes and emotional appraisal that lead to better self-awareness, emotional reactivity and overall monitoring ability observed in meditators. Importantly, the increased connectivity during meditation effectively “rebounds” to a reduced connectivity after meditation. We propose that this “rebound” accounts for the latent-trait FC differences observed in MP. This study represents a first step in elucidating the potential neurobehavioral mechanisms mediating the practice of meditation on the FC of the CMS. Moreover, it documents for the first time a spontaneous FC “rebound” within the CMS after meditation, pointing to homeostatic/compensatory mechanisms operating in the brain that may account for the trait changes in meditators.