Independent modulators of regional EEG alpha sub-band power during a working memory task

Julie Onton[1] and Scott Makeig[1]

[1]Institute for Neural Computation, University of California San Diego

Previous studies have suggested that upper and lower alpha-band power are separately regulated during certain cognitive processes. A shortcoming of those studies was that alpha power was summed across several scalp channels. Here we show that alpha sub-bands are, indeed, separately regulated and occur *within* single EEG independent component or source domains. EEG data from a "two-back" working memory task was first decomposed by extended-infomax independent component analysis (ICA) to isolate temporally independent EEG activities from the signal mixtures recorded at the scalp channels. Activation time series of brain-generated independent component (IC) processes were transformed into log spectrograms using 4-cycle (at 4 Hz) to 42-cycle (at 125 Hz) wavelets moved at 50-ms intervals through each stimulus-response trial. The mean log power spectrum over all time windows was removed for each IC, leaving spectral fluctuations from the mean log spectrum in each window. Spectral data from all ICs were reduced by principal component analysis (PCA), and then again decomposed by ICA to separate the spectral data into a log mixture of independent modulator processes (IMs) with maximally distinct spectral profiles across ICs and frequencies. Some of the resulting IM templates accounted for activity in distinct alpha sub-bands. Because each IM template was associated with IM time weights for each trial and latency, we could test whether these alpha sub-band modulators had different mean time courses relative to task events and whether the patterns of alpha power modulation were brain-region specific.

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