Emotion-related modulation of high-frequency EEG power

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Discovering the EEG correlates of different emotional states would be useful in many clinical settings, for example to monitor or possibly practice emotion self-regulation through EEG biofeedback. In this study, we show that orderly fluctuations in broadband high-frequency power can be isolated from high-density scalp electroencephalographic (EEG) data and are sensitive to mental and/or emotional state. EEG data from an eyes-closed emotion imagination task were linearly decomposed using independent component analysis (ICA) into maximally independent component (IC) processes to eliminate the confounding effects of mixed EEG signals summed at each scalp electrode. Joint decomposition of IC log spectrograms into source- and frequency-independent modulator (IM) processes revealed two classes of IMs that separately modulated broadband high-frequency (~15-200 Hz) power of brain and muscle IC sources. Multi-dimensional scaling revealed orderly but spatially complex relationships between mean broadband IM effects and the valence of the imagined emotions. Thus, contrary to previous assumption, coherent broadband spectral modulation patterns encompassing the beta, gamma, and high gamma frequency ranges can be isolated from scalp-recorded EEG data and differentially associated with cognitive activities.