Independent modulations of high gamma band spectral activity in human scalp EEG distinct from scalp muscle activity

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1. Does high frequency activity (>40 Hz) from scalp EEG contain meaningful information?
2. Can high-frequency EEG activity be distinguished from scalp muscle artifact?

METHODS

Young adults from the San Diego area (4 male, 10 female age range: 18-60) were gathered through a series of experimental sessions by a pre-registered all-female team. Data were introduced with a short tutorial that described the aim of the experiment and the measures used. A pre-recorded 5 Hz auditory tone was used for stimulus duration. The EEG was recorded with 32 channels using the sccn Makeig et al., 1997, at the EEGLAB toolbox (Delorme, 2004).

RESULTS

For each subject data were extracted from three sets of data, including: scalp muscle IMs (EMG activity), scalp muscle IMs (resulting from the joint action of the subject's eyes), and eye-blink IMs. Each IM was then subjected to a series of transformations including: (1) variance normalization, (2) mean subtraction, (3) auto-regressive modeling, and (4) ICA. ICA was used to identify the ICs that best explained the joint action of the eye movements and the scalp muscle activity.

LIMITATIONS

The limitations of this study include the use of a small sample size, the absence of control groups, and the lack of long-term follow-up. These limitations could be addressed in future studies by increasing the sample size and including control groups.

SUMMARY

Second-to-second changes in the levels of very high-frequency EEG activity (>100 Hz) of EEG sources in these data reflect the actions of broadband modulations in EEG power across both low and high frequencies. These broadband modulations do not reflect changes in scalp muscle activity, but rather adjustments in the high-frequency slope or fall-off in the activity spectra of one or more independent brain EEG processes. Some broadband modulations shift the balance of high- and low-frequency power in brain IC spectra. The broadband modulations reveal the actions of brain systems that control non-periodic / non-oscillatory modes of EEG activity.