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  Rules of Engagement: Canonical Correlates of EEG across Multiple Movie Viewings

  It has recently been shown that when exposed to the same natural audiovisual stimuli, the neural activity of multiple brains exhibits significant levels of correlation. Moreover, this correlation tends to peak when the stimulus is highly emotionally engaging, such as powerful movie scenes. In this paper, we conduct an extensive analysis of intra-subject correlations (IaSC) in the electroencephalogram (EEG) during free movie-viewing by multiple subjects. Instead of measuring the level of correlation in the raw (noisy) recordings, we employ linear component analysis to filter out the correlated (synchronized) signal components from multiple views of the same movie clip. Namely, we derive a variant of canonical correlation analysis with half of the nominal number of degrees of freedom to automatically extract the correlated components and increase the effective signal-to-noise ratio. By aggregating the data across subjects, we compute the spatial components which are responsible for a vast majority of the population IaSC. Moreover, we apply the algorithm in a sliding time-window fashion to determine the scenes from each film which exhibit statistically significant IaSC, presumably reflecting high levels of engagement. The analysis reveals that such objectively engaging scenes occur at key moments of well-directed critically-acclaimed films, but fail to arise during ``control" films depicting natural scenes from real-life. Thus, our algorithm may serve as a decoder for identifying the level of engagement experienced by the audience during a given film.

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