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Jensen, Camilla Birgitte Falk; Petersen, Michael Kai; Larsen, Jakob Eg

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Differentiating emotional responses to images and words

Camilla B. Falk Jensen*, Michael Kai Petersen*, Jakob Eg Larsen*

Abstract*— The emergence of low cost electroencephalography (EEG) wireless neuroheadsets may potentially turn smartphones into pocketable labs [1], and enable design of personalized interfaces that adapt the selection of media to our emotional responses when viewing images and reading text. However such EEG responses are characterized by only small voltage changes that have typically been found in group studies involving multiple trials and large numbers of participants. Hypothesizing that spatial filtering might enhance retrieval, we apply independent component analysis (ICA) to cluster scalp maps and time series responses in a single subject based on only a few trials. Comparing our results against previous findings we identify multiple early and late ICA components that are similarly modulated by neutral, pleasant and unpleasant content in both images and words. Suggesting that we might be able to model emotional responses elicited from individual users browsing media content, which could in long term be integrated into cognitive interfaces that adapt to our preferences.

I. Method

The two-part experiment consisted of (1) a picture session presenting 66 IAPS pictures (22 pleasant, 22 neutral and 22 unpleasant) and (2) a word session presenting 66 written words from ANEW (22 pleasant, 22 neutral and 22 unpleasant). All of which have been rated on a 9-scale valence and arousal scale. The setup of the two sessions consisted of a 3s baseline with a scrambled picture/fixation cross followed by a 6s stimuli presentation and a 3s. grey screen resting period. The stimuli were presented in a random order in blocks of 5 pictures/words. Between each block a self-paced pause was included.

The EEG data was collected at 512 Hz from a BioSemi ActiveTwo system, using 64 AgCl electrodes and 2 mastroid electrode as references. The data was analyzed using EEGLAB plug-in for MATLAB; applying a filter from 1-30 Hz, downsampling to 128 Hz, and epoching (1s pre- and 2s post stimuli onset). Noise from muscle activity and sensor artefacts was removed with a +/-150 μV threshold, resulting in rejection of 2.6% of the picture epoch but no word epochs. Eye artefacts were automatically removed with EyeCatch. After which the data was decomposed into ICA scalp maps and time series components following the standard procedure of [2].

II. Results and Discussion

Even in a single subject, our ICA clustering study indicates that we may be able to differentiate emotional responses to images (Fig.1.A) with scalp distributions similar to those found in earlier multi-subject studies [3]. Likewise the emotional responses to words (Fig.1.B) show activity centralized around the parietal right hemisphere with a spatial distribution similar to those found within the 300-450ms window in a multi-subject study [4] as well as an earlier single subject ICA study of responses to action verbs [1]. To sum up, when applying PCA and spatial filtering based on ICA we identify multiple time course components within the EPN and LPP time windows that are modulated by neutral, pleasant and unpleasant content in both images and words. Suggesting that we might be able to retrieve emotional responses elicited from individual users consuming media content, that might longer term be utilized for cognitive interfaces that adapt to our preferences.

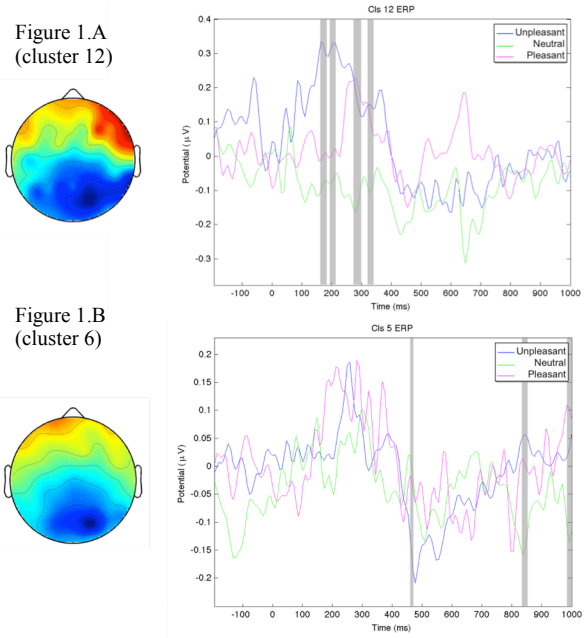

Figure 1. Shows the topography and the temporal distribution of two ICA clusters (A from pictures and B from word stimuli) the blue , green and red line corresponds to unpleasant, neutral and positive stimuli, repectively. The clusers are based on a PCA dimensionality reduction and K-means clustering (K=10, σ=3) of 176 ICA and 189 ICA and consist of 14 and 26 IC's, respectively.The grey areas correspond to a significant difference of valence from anova test with α=0.05.

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*All of the authors are with the Technical University of Denmark, DTU Compute, Cognitive System. Located at xxx, 2800 Kgs. Lyngby, Denmark. Email cbfj@dtu.dk (corresponding author), mkai@dtu.dk, jaeg@dtu.dk.