Can the affective perception of fabrics be decoded from the human brain?

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METHODOLOGY

EXPERIMENTAL SETUP: A motor controlled fabric causing device (FCD) was designed and developed to present the fabrics on the forearm of the participants. Strips of the four selected fabrics were mounted on this device and presented in a randomized order for 2 sec with 2 sec rest periods in between fabrics. A brief 5 min break was provided after 25 trials of each fabric and 40 trials of each fabric was performed.

DATA RECORDING: A 32 channel EEG was acquired from 13 subjects (6 males, 7 females, 15 right handed) using a Brain products ActiCap using active electrodes. MR compatible EEG amplifier BrainAmp, was used. EEG was recorded for eye-blank detection. The FCD was interfaced into the trigger channel of the EEG using micro-\n
Figures:

1. Alpha-beta suppression on the somatosensory area
2. Frontal and parietal beta activity
3. Hemispherical alpha power asymmetry
4. Alpha-beta suppression for the four selected fabrics
5. ALPHA BETA SUPPRESSION ON THE SOMATOSENSORY AREA
6. ALPHA BETA SUPPRESSION FOR THE FOUR SELECTED FABRICS
7. HEMISPHERICAL ALPHA POWER ASYMMETRY
8. FRONTAL AND PARITIAL ALPHA ACTIVITY

DATA ANALYSIS

DATA CLEANING: A Principal Component Analysis (PCA) based variance maximization methods was used for raw data and artifact rejection. Artifact removal was done by first applying a PCA that was used to identify (principal) components that correspond to eye-movement related activity as well as motor related artifacts. Such components were subtracted from the data, along with removal of individual heavy trials and channels. This procedure was applied to the entire dataset before splitting the data into conditions.

TIME-FREQUENCY ANALYSIS: MUSIC-based open source toolbox FieldTrip was used to compute subjective-time-frequency representation (STFRs) of power to investigate the event related potentials with 1 sec post and pre stimulus time. Flattening windows with a window length of 0.4 sec was used for frequency analysis until 38 Hz with a resolution of 0.25 Hz. Trials were sorted into conditions and a grand average of STFRs was calculated across all 13 subjects.

RESULTS

TFR: grand average of all subjects clearly exhibited a clear alpha-beta power suppression over the somatosensory area, just after stimulation at t=0. Since all but two of the subjects were right handed this effect was pronounced on the C3 electrode.

CONCLUSIONS & FUTURE SCOPE

Affective touch is one of the less researched areas in neuroscience. One of the reasons is the challenge to decode the touch initiated complex instructions as well as simultaneous emotion and affective processes. The difficulty lies in to separate the purely physical aspects of the different fabrics and their movement over the skin (their impact on somatosensory system) from the impact on affective sensation. The results show that the main difference of fabrics (most pleasant versus unpleasant) are not only in primary somatosensory cortex but in more frontal and also parietal areas - which is ideally explained by such pure physical aspects. Further investigations by using the subjects specific subjective ratings and the within individual variation in subject’s responses to different fabrics will be conducted to confirm this relative independence of physical and subjective aspects. Machine learning algorithms will be utilized to extract features of electrophysiological brain activity to automatically detect the emotional sensations related to touch.

REFERENCES

Hemispherical asymmetry of the human brain. Can the affective perception of fabrics be decoded from the human brain?