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Cognition and Face Decoding A Bands Frequency Analysis

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Introduction

EEG frequencies are traditionally subdivided in frequency bands such as theta (4-8 Hz), alpha (8-12 Hz), beta (about 14-30 Hz) and gamma (around 40 Hz). During stimulation, the simultaneously recorded responses of different EEG frequency bands differ from each other (Pfurtscheller and Neuper, 1992), and reflect different cognitive and mental processes or states (Klimesch et al., 1998). Oscillations of different EEG frequencies are associated with different mental processes. Episodic memory processes seem to be reflected as oscillations in the EEG theta frequencies (4-8 Hz). In contrast, 8-10 Hz alpha activity seems to be modulated as a function of attentional demands whereas 10-12 Hz alpha activity is modulated by stimulus-related aspects, and/or semantic memory processes. The event related decrease in EEG power is termed "event-related desynchronization" (ERD) (Pfurtscheller, 1977) while synchronization, or "event-related synchronization" (ERS) denotes the increase in power (Pfurtscheller, 1992). The aim of our study was to analyse the emotional decoding in face processing through EEG indexes. In particular, we aimed to study the differences between the EEG activity elicited by emotional stimuli vs neutral stimuli. By analyzing event-related changes in induced band power in narrow frequency bands of the human electroencephalograph, the present study explored a possible functional role of the alpha and theta rhythms during the processing of face with an emotional content.

Methods

Event-related synchronization (ERS) in response to neutral, positive and negative emotional faces were measured in theta and alpha frequency bands in 20 healthy right-handed subjects. A 14-channel EEG was recorded while subjects viewed a sequence of 70 face pictures displayed by a computer station. An EOG channel monitored eye movements. Artefacts were rejected by an automatic rejection procedure and a following morphological analysis. The effects of the emotional decoding process was evaluated between 200 and 300 ms post-stimulus in relation to the N230 ERP component (Helgren and Marinkovic, 1995).

Results and Discussion

Theta ERS revealed a significant valence by hemisphere interaction for anterior sites indicating a relatively greater right hemisphere ERS for negative and a left hemisphere ERS for positive stimuli in comparison to neutral ones. In the alpha band, negative stimuli induced a left hemisphere ERS increase not observed for neutral and positive stimuli. The results obtained along with the earlier observations on EEG correlates (Balconi & Pozzoli, 2003; Balconi & Lucchiari 2005) of affective processing shows that emotional decoding from face elicits specific EEG activity, particularly in theta and alpha frequency bands.

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