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Low Frequency Waves on EEG Recordings during Stimuli of Smells

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Introduction

Ray reported that the highly amused states of a child as well as a state of deep aesthetic appreciation are characterized by large number of pulses, and increased low frequency waves (theta and specially delta waves) (Ray, 1994). Jovanov introduced hypothetical framework of analysis for the wave patterns in theta, delta and sub-delta bands: mental consciousness for theta band, higher level of consciousness for delta band, and collective consciousness for sub-delta band waves (Jovanov, 1977). In this article, we verify, from the EEG recordings during stimuli of smells, our hypothesis that the delta band waves with large spectral power were observed when participants were deeply moved or strongly impressed with stimulation. The difference in gender is shown for the kinds of smells. We can show that the results of the written questionnaires after each measurement support the experimental results.

Experiment

Method

Participants Forty-one students (21 females and 20 males) aged between 21 and 23 years participated in the experiment.

Materials (The numbers in the parentheses indicate the duration of stimulation in seconds.)

Lemon: Smell of lemon dissolved in liquid (30").

Chocolate: Smell of a bar of chocolate (30").

Peppermint: Smell of peppermint dissolved in liquid (30").

Car fragrance: Smell of cool refreshing fragrance for cars dissolved in liquid (30").

Vinegar: Smell of vinegar dissolved in liquid (30").

Vanilla: Smell of vanilla dissolved in liquid (30").

Grapefruit : Smell of grapefruit dissolved in liquid (30").

Procedure

While the participants are exposed to the seven different smells, the EEG data were recorded into ESA-16 from 10 electrodes, which, according to the international 10-20 system, were placed on the scalp at FP1, FP2, F3, F4, T3, T4, P3, P4, O1 and O2 with the reference hooked to the right ear lobe and the ground placed between Fpz and Fz. The EEG data were measured for the participants at rest with the eyes closed. The participants gave answers to the written questionnaires inquiring their feelings after each measurement.

Results and Discussion

The spectral power at peak frequency of delta band waves

was obtained from the EEG data for no stimuli and stimuli conditions. We compared the difference of the spectral power between stimuli and no stimuli with seven kinds of smells. When the females were strongly stimulated by chocolate, peppermint, vinegar, vanilla and grapefruit, the delta band waves with large spectral power were observed, as shown in Fig.1. When the males were strongly stimulated by lemon, chocolate, peppermint, vinegar, vanilla and grapefruit, the delta band waves with large spectral power were observed, as shown in Fig.2. The data matched the results of the questionnaire evaluation. Our hypothesis that the delta band waves with large spectral power were observed when participants were deeply moved or strongly impressed with stimulation has been proved to be correct by these results.

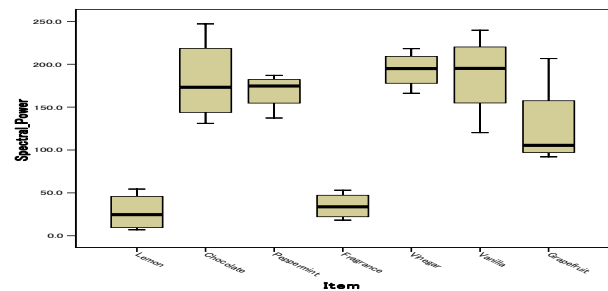


Figure 1: The spectral power of delta waves for females.

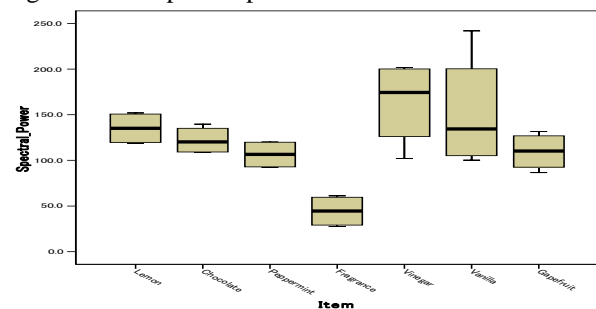


Figure 2: The spectral power of delta waves for males.

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