

Young Men's EEG Reactions to the Smells of Girls Collected Intactly and While Listening to Rock Music

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Abstract: The work was performed on two groups of young men aged 18-22 years with and without sexual experience. Boys conducted a subjective olfactory assessment of body odors of girls located in different phases of the menstrual cycle, collected in an intact state, and while listening to rock music for an hour while recording multichannel EEG. The obtained data on a subjective assessment and change in spectral power in narrow frequency ranges in response to olfactory stimulation were subjected to multivariate analysis of variance. It was found that the olfactory attractiveness of receptive odor tests of girls for boys is higher and decreases under the influence of rock music mainly for odor samples collected in the non-receptive phase of the menstrual cycle of donors. The background electrical activity of the brain of young men who engage in regular sex life is characterized by a lower spectral power in all frequency ranges except beta rhythms. EEG reactions to intact odor stimuli in all young men are accompanied mainly by a decrease in spectral power in the theta1 rhythm and an increase in the delta and alpha2 frequency ranges. The detected EEG reaction is characteristic of non-receptive odor samples of girls. In young men with a lack of sexual life, the EEG reaction to intact odor tests is more generalized. When young men with regular sexual life are presented with the smells of girls collected while listening to rock music, the spectral power decreases in theta2 and alpha1 rhythms. Young men with a lack of sexual life react to the smells of girls collected while listening to rock music, with only a slight increase in the average spectral power in theta1 and alpha1 rhythms, and a decrease in the alpha1 frequency range. Apparently, the influence of rock music did not have a significant effect on girls who are in the receptive phase of the ovarian-menstrual cycle, and the lack of reliable EEG reactions in boys of both groups can be explained by the significant effect of the girls' individual smell on a particular boy.

1. Introduction

At present, the question of the relationship between the informational significance of olfactory signals in solving the problem of smell attractiveness and factors that can change it remains insufficiently studied and requires a deeper analysis. One such factor is music.

For most modern young people, rock culture most adequately performs the function of a means of achieving the emotional balance of a person with the outside world and has a profound effect on the subconscious of people [1, 2]. Some authors consider the influence of "rock music" on the human body to be negative. [3]. Other authors believe this influence is positive, that such music relieves emotional stress, allows one to abstract from the everyday hustle, gives a feeling of ease in communicating with people around, and allows you to experience vivid emotions [4, 5]. Such music can be recommended as a corrective action in order to improve the psychophysiological state [6, 7].

In this regard, the purpose of this study was to determine the bioelectric activity of the cerebral cortex in young men in response to the presentation of female odors collected while listening to rock music.

2. Materials and Methods

The object of the study was the selected individual odors of axillary sweat of girls, collected at rest and during an hour of listening to rock music. In total, 12 girls aged 18-22 years who are in two phases of the ovarian-menstrual cycle (recipient and non-recipient) acted as donors of odor samples. Young men with different

sexual experiences aged 18-22 are selected as recipients of odor samples. All subjects gave voluntary consent to participate in the study. Based on the data of the annual medical examination, all subjects can be classified as conditionally healthy people.

Participants in the study did not use hormonal contraceptives for three months before it began and kept calendars to determine their physiological state. Girls participated in the study in two phases of the ovarian-menstrual cycle. The middle phase of the plus or minus two days was considered the receptive phase. Among young men, two groups were identified by the sexual experience of 6 people: 1 group - not having a sexual experience, 2 group – having regular sex contacts one time per week or more.

The study was conducted in two stages. The first stage included the questionnaires and collection of odor samples from donor girls in the morning. The second stage included olfactory testing by recipients of odors with the simultaneous recording of the electrical activity of their brain by electroencephalography (EEG) and subsequent subjective assessment of the strength and attractiveness of smells.

The olfactory testing was carried out for three experimental days. On one experimental day, the recipient was presented with 12 odor samples collected from 4 donors. During the study, the subject was in a darkened room, without extraneous noise, in a comfortable chair, with his eyes closed. During the registration of the electrical activity of the brain, the background recording of EEG at rest for 5 minutes was originally taken. After recording the background, one of the experimenters began the presentation of odor samples, and the second accurately recorded the time of smell supply to the EEG. Each of 12 odors was presented to the recipient for 10 seconds with a 30-second interval in the following order: intact non-receptive and receptive samples, non-receptive, and receptive odor samples collected while listening to rock music.

Recordings were made on a “Neurovisor-40U” encephalography analyzer, monopolar in 16 standard leads according to G. Jasper's international system “10-20%,” in the frequency band from 0.5 to 30 Hz, the sampling frequency was 1000. To calculate the spectral power, 8-10 non-artifact 1-second epochs were taken before and during the presentation of each odor and from the middle of the rest record at the beginning of the experiment. The spectral power for each lead was calculated by the method of fast Fourier transform in 7 frequency ranges: delta - δ ; theta - θ_1, θ_2 ; alpha - α_1, α_2 ; beta - β_1, β_2 . Each range was then normalized by logarithm.

Statistical processing of the results was performed using the analysis of variance (ANOVA-MANOVA). The change in the spectral power of various rhythms at rest and in response to the presentation of odor signals was studied by the interaction of the following factors: STIM (2: background, smell), ZVUK (2: intact smell and smell, collected while listening to rock music), BAND (7: delta, theta1-2, alpha1-2, beta1-2), LOC (8: Fp1-2, F3-4; C3-4; P3-4; O1-2; F7-8; T3-4; T5-6), SE recipients (2: Group 1, Group 2).

3. Results and Discussion

During olfactory testing, an increase in the subjective assessment of the strength of the smell samples of girls collected in the non-receptive phase of the ovarian-menstrual cycle while listening to rock music was revealed, compared with intact smells, regardless of the sexual experience of the boys. At the same time, the subjective assessment of the attractiveness of smell samples of girls collected while listening to rock music, on the contrary, decreases compared to intact smells. The girls' odor samples collected in the receptive phase are estimated by boys as more attractive. More pronounced differences were found in young men who did not have a sexual experience, regardless of whether the collection of odor samples was conducted with rock music or not.

In the delta ($p = 0.003$), theta 1- ($p = 0.002$), theta 2- ($p = 0.007$), alpha1- ($p = 0.002$), and alpha2- ($p = 0.038$) frequency ranges, background values of the EEG spectral power of young men with eyes closed are significantly higher (LSD test) in the group of young men who do not have sexual experience, compared with young men with regular sex life. The spectral power of high-frequency rhythms did not differ significantly. In low-frequency rhythms, including the alpha1 frequency range, differences were detected in most localizations, with the exception of the prefrontal and frontal. In the high-frequency alpha rhythm, differences are revealed only in the occipital and temporal localization. The leading rhythms in the background EEG in young men is the high-frequency alpha rhythm, with the most pronounced anteroposterior gradient in young men with regular sex life.

As a result of analysis of variance, significant differences in the EEG responses of young men to the smells of girls in two states (intact smell and smell collected while listening to rock music) taking into account the narrow frequency range (ZVUK * STIM * band; $F_{6, 910} = 2, 4, p = 0.02$) were identified. An additional post hoc analysis (LSD – test) revealed a significant increase in the average spectral power in the delta ($p = 0.03$) and alpha2- ($p < 0.001$) rhythms and a decrease in the low-frequency theta1 range ($p = 0.01$) in all boys in response to the intact smells of girls (Fig.1). Significant differences were revealed in the form of a decrease in the average spectral power in the high-frequency theta2- ($p = 0.02$) and low-frequency alpha1-rhythm ($p = 0.04$). In high-frequency rhythms, significant differences in EEG reactions to odors were not found. The disappearance of the EEG reaction in the delta rhythm can be interpreted as a decrease in the biological significance of the olfactory signal [8]. The shift of the EEG reaction in the theta range from the lower frequency to the high rate can be explained by a different method of processing sensory information in the first case, in terms of emotional coloring. In contrast, the second signal is perceived more from the perspective of cognitive significance [9].

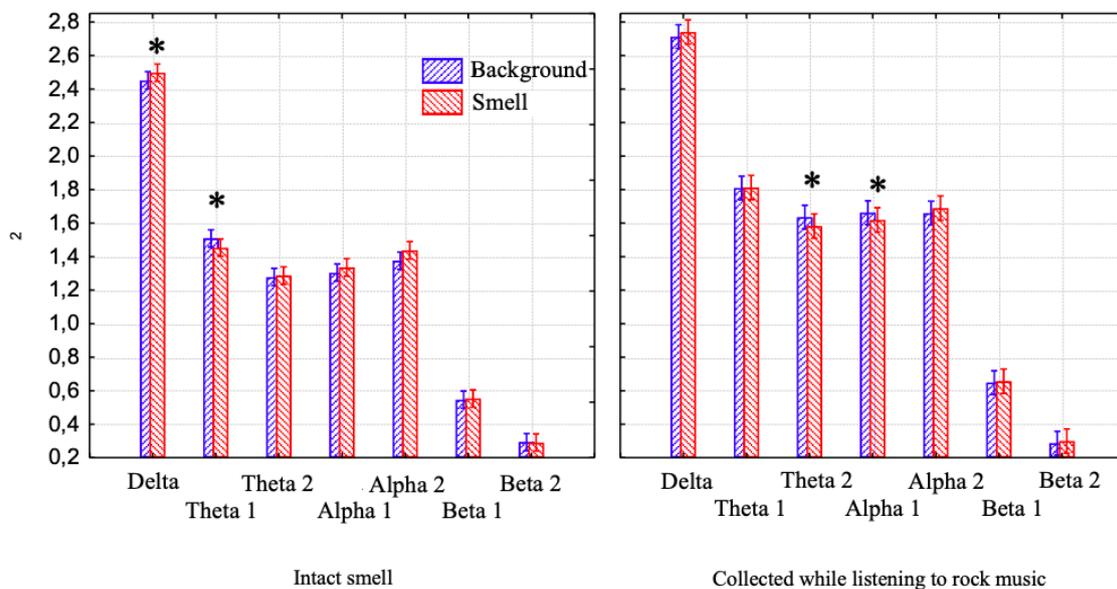


Fig. 1. The EEG averaged spectral power of young men at rest and during olfactory testing of odors, taking into account a narrow frequency range (* - $p < 0.05$ significant differences between background and smell).

Unambiguous and reliable EEG reactions were identified mainly in response to non-receptive odor tests, which is consistent with previously identified data on the subjective assessment of odors, namely: if a young man was attracted to the smell collected in the non-receptive phase of any girl, then, as a rule, he was attractive to all young men, while samples collected from receptive donors were regarded by the young men more differentially [10].

Comparing the EEG reactions of young men with different sexual experiences, we can conclude that the young men respond by increasing the average spectral power in the delta range, in the leading alpha rhythm in response to intact odor tests (Fig. 2). Young men who do not have sexual experience respond to the intact non-receptive tests with a decrease in the low-frequency theta rhythm. Odor samples of girls collected while listening to rock music cause, although unreliable but the opposite EEG reaction in low-frequency theta and alpha rhythms. A decrease in the EEG reaction in the delta range is observed in both groups of young men for the smell samples of girls collected while listening to rock music. If we consider the alpha-oscillatory system as participating in the control of behavior [8], a decrease in the spectral power in the alpha range in response to odors altered by music can be interpreted as a decrease in inhibitory control.

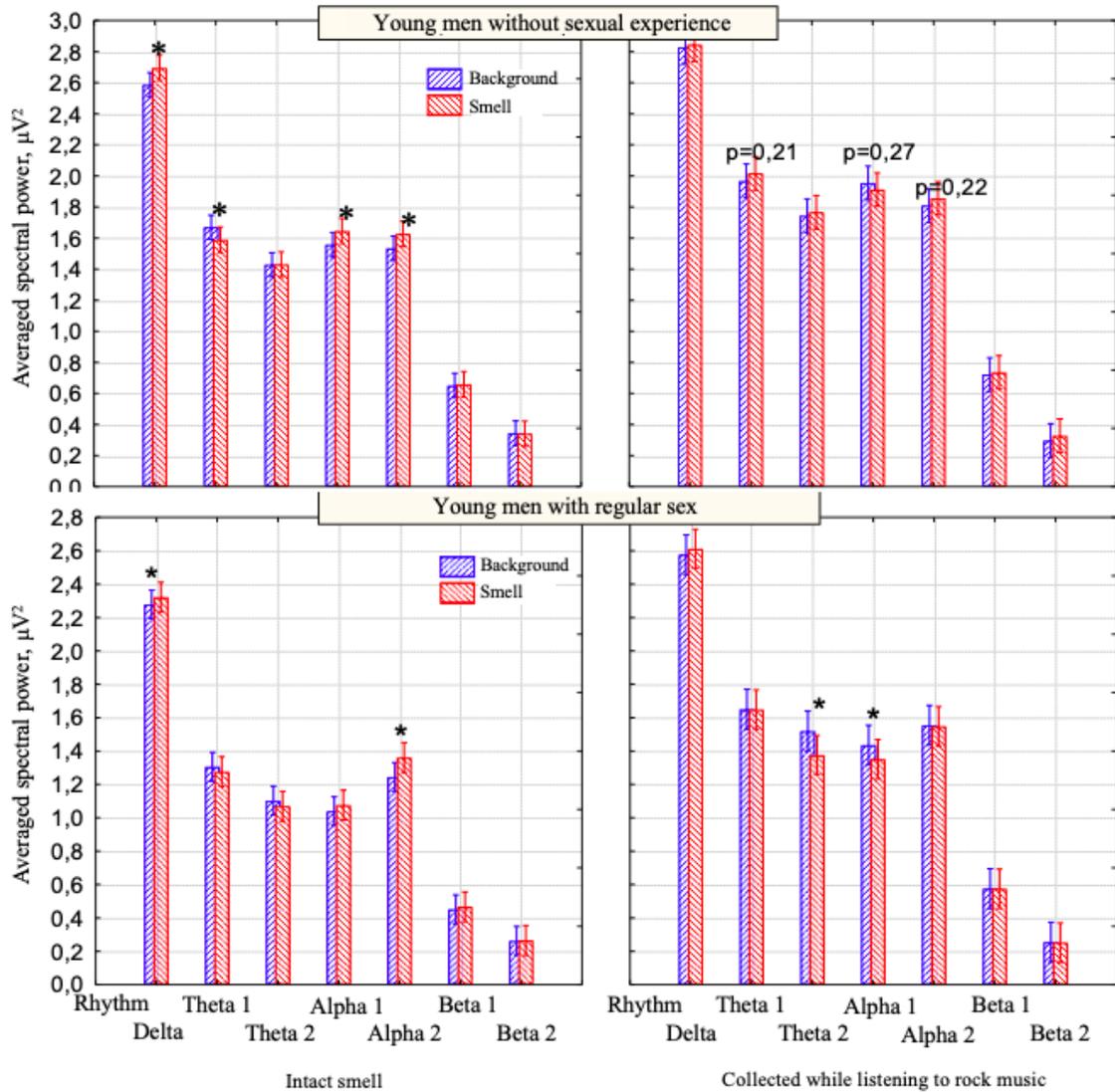


Fig. 2. The EEG averaged spectral power of young men with different sexual experiences at rest and during olfactory testing of non-receptive odor samples, taking into account a narrow frequency range (* - $p < 0.05$, significant differences between background and smell).

Our results allow us to confirm the hypothesis about the informational significance of olfactory signals.

4. Conclusion

Boys' perception of intact female odor tests depends on the phase of the ovarian-menstrual cycle of girls. Odor samples collected in the receptive phase are rated by young men as more attractive. An olfactory assessment of the strength of girls' smell samples after listening to rock music increases and the attractiveness of these samples decreases significantly, but only for smells collected in the non-receptive phase of the menstrual-ovarian cycle.

The background EEG rates of young men with different sexual experiences have significant differences in the spectral power of low-frequency rhythms; people with regular sex life have the lower delta, tat, and alpha 1 rhythms compared to those young men who have no sexual experience.

The following specifics of the EEG response to odor tests of girls revealed. (a) Those young men who do not have sexual experiences respond to intact smells by increasing the spectral power in both alpha rhythms and decreasing in theta 1-, and the reactions to smells collected while listening to rock music are not reliable. (b) Those young men who have regular sex respond to intact samples by increasing the spectral power in the delta and lead alpha 2 rhythms, and they respond to odor samples collected while listening to rock music by lowering the spectral power of the theta 2 and alpha 1 rhythms.

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