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# SYSTEMIC ANALYSIS OF EEG ACTIVATION RESPONSE IN RIGHT AND LEFT HANDERS

**B. A. Lobasyuk[1], L. B. Bartsevich[2]**

**[1]I. I. Mechnikov Odessa National University;**
**[2]Odessa Regional Medical Center for Mental Health**

B.A. Lobasyuk https://orcid.org/0000-0001-9344-4513, blobasuk@gmail.com
L.B. Bartsevich https://orcid.org/0000-0001-6900-9976, hbarcewicz2805@gnail.com

## Abstract

Most researchers in the study of the EEG activation response studied changes in alpha activity, while the dynamics of changes in other EEG rhythms and functional interhemispheric asymmetry (FMAA) was described and analyzed to an immeasurably lesser extent. Considering electrogenesis as a systemic category, it is advisable to study the relationships between the amplitudes of EEG rhythms using multiple regression and correlation methods of analysis. The EEG was studied on practically healthy people, students, in the state of PR and OR. Lateralization (right-handed-left-handed) was determined by EEG parameters. Activation coefficients (AC) were determined by dividing the beta-2 rhythm duration index by the alpha rhythm duration index. Relationships formed between the amplitudes of EEG rhythms were studied using calculations of multiple linear regression and correlation.

In own research we was show: when opening the eyes, the amplitude of alpha and beta-1 rhythms in right-handers and left-handers decreased statistically signifiantly. Changes in the parameters of beta-2 EEG rhythms when opening the eyes in right-handers were determined to be increased in the left and right hemispheres, and in left-handers only in the forehead-temporal abduction of the left hemisphere - an increase in the duration index. Indicators of theta rhythm in right-handed people decreased in the left and right hemispheres when opening the eyes, and in left-handers, changes in theta rhythm were manifested only in the crown-occiput abduction of the right abduction. The amplitude and frequency of the EEG delta rhythm in right-handers decreased in the left and right hemispheres, and the duration indices were determined to be statistically significantly increased in all leads, with the exception of the forehead-temporal of the left hemisphere, while in left-handers, changes in the delta rhythm were observed mainly in the right hemisphere and were expressed in a decrease in amplitudes and rhythm frequencies. In the study of FIA, the alpha-rhythm index of right-handers under PR conditions was determined to be negative, and in left-handers it was positive. Under conditions of operational rest, this indicator was positive for both left-handers and right-handers. When opening the eyes, the AC in most leads increased statistically significantly in both right-handers and left-handers.

The regression analysis revealed that the number of statistically significant regression coefficients increased significantly in the left hemisphere in right-handers under OP conditions, while in left-handers it decreased in the right hemisphere.

**Keywords: activation; EEG rhythms; left-handed-right-handed; multiple linear regression; polycyclic multigraphs**.

**Introduction.** Since Berger's description of the EEG activation reaction in 1929, its neurophysiological mechanisms have been (and continue to be) intensively studied [1, 4-6, 11, 16, 17, 19].

The attention of most researchers of various aspects of the EEG activation reaction was focused on studying the depression of EEG oscillations in the α range after opening the eyes [4], while the dynamics of changes in other EEG rhythms was described and analyzed to an immeasurably less extent [10].

Functional interhemispheric asymmetry of ECoG parameters (FIA) is currently considered as one of the fundamental patterns of organization and activity of the human and animal brain [3]. In this regard, the study of FIA in conditions of psychosensory (PP) and operational rest (OP) is of particular relevance.

It is of interest to study the relationships between individual indicators of electrogenesis - EEG amplitudes, determined as a result of multiple regression and correlation methods of analysis, followed by a geometric interpretation of multiple linear regression equations using polycyclic multigraphs [8] - a mathematical language for formalized designation of concepts related to analysis and synthesis of structures, systems and processes, with the aim of their subsequent structural analysis.

This approach will allow us to consider electrogenesis under conditions of psychosensory and operational rest as systemic categories.

**Aim.** Elucidation and description of EEG features and FIA parameters in the conditions of psychosensory (PP) and operational rest (OP), as well as the study of the relationships that are formed between the amplitudes of EEG rhythms during these periods using the techniques of multiple linear regression and polycyclic multigraphs.

**Research methodology**. EEG was studied on 27 practically healthy people, students, average age 20±0.5 years. The EEG was recorded on a computer hard disk using an analog-to-digital converter at a sampling rate of 256 per 1 sec for 2 minutes in the state of psychosensory rest (PR) - eyes closed and operational rest (OR) - eyes open. EEG was recorded bipolar in the following leads: 1-forehead-temporal (F-T), 2-temporal-crown (T-C), 3-crown-occiput (C-O), left and right, with a time constant of 0.1 sec. The analysis of EEG files was carried out after the end of the experiments using the Analist2 program according to the amplitude-interval (half-period) analysis algorithm. Five physiological rhythms were distinguished: beta-2 - 21-32 Hz, beta-1 - 14.22-18.3 Hz, alpha - 8.0-12.8 Hz, theta - 4-7.53 Hz and delta - 0 .5-3.87 Hz. For each of the ranges, the following parameters were determined: 1) amplitude in microvolts, 2) frequency in hertz, 3) time index in percent. During statistical analysis, mean values, standard (root mean square) deviation, and error of the mean were calculated.

Lateralization (right-handed-left-handed) was determined by EEG parameters using the coefficient of functional interhemispheric asymmetry [13]. There were 16 right-handers and 11 left-handers.

The relationships formed between the amplitudes of EEG rhythms were studied using calculations of multiple linear regression and correlation [12]. The levels of statistical significance were taken within $P < 0.05$ and $P < 0.1$. To form mathematical models, each indicator from the set of EEG amplitude indicators selected for analysis was considered as a whole feature (Y), and the remaining indicators were considered as influencing variables (X sets), after which oriented effects were determined using multiple linear regression

calculations. As a result of such a procedure, equations of multiple linear regression of the form were obtained:

$$Y' = a_0 + b_1X_1 + b_2X_2 \ldots + \ldots b_nX_n + e,$$

where $a_0$ is a free term, coefficients $b_1$, $b_2$ ... bn are regression indicators reflecting the degree of influence of the remaining elements of the set ($X_1$, $X_2$ ... $X_n$) of indicators on the analyzed indicator ($Y$), e is an error, meaning any fluctuation $Y'$, not caused by a change independent variables in the model.

The adequacy of the regression coefficients was assessed using the sigmal deviations of the regression coefficients, and the effectiveness of the regression as a whole was assessed by calculating the multiple correlation coefficient. Geometrically, multiple linear regression equations were interpreted using polycyclic multigraphs [8]. Within the framework of this approach, graph nodes display EEG indicators.

Activation coefficients (CA) were determined by dividing the beta-2 rhythm duration index by the alpha rhythm duration index [7]. SC errors were determined by the formula:

$m_{ка}$=Ka*radix (mibeta-2/Mibeta-2)^2+(mialpha/Mialpha)^2

where:

mka – activation coefficient error

mibeta -2 – beta-2 rhythm duration index error

Mibeta -2 – beta-2 rhythm duration index

mialpha - alpha rhythm duration index error

Mialpha - index of alpha rhythm duration

**Own research**

*Changes in EEG parameters. right-handers.* In the conditions of OR (eyes open) in comparison with the state of PR (eyes closed) (Table 1), in right-handers, the amplitude of the alpha rhythm significantly decreased in the temple-vertex and vertex-occiput leads, both in the right and left hemispheres. The alpha rhythm frequency was determined to be statistically significantly reduced in the temple-vertex and vertex-occiput leads of the right hemisphere, and the alpha rhythm duration index in the forehead-vertex, temple-vertex and vertex-occiput leads of the right hemisphere and the temple-vertex and vertex-occiput leads of the left hemisphere was determined statistically significantly smaller.

The amplitude of the beta-1 EEG rhythm during eye opening decreased statistically significantly in the same leads as the amplitude of the alpha rhythm - in the temple-vertex and vertex-occiput leads, both in the right and left hemispheres. The frequency of the beta-1 rhythm was determined to be statistically significantly increased in all EEG leads, and the

duration index was determined to be decreased in the vertex-occiput leads of the right and left hemispheres.

Table 1.

Statistically significant correlation coefficients reflecting changes in EEG parameters in conditions of operational rest compared with conditions of psychosensory rest in right-handers

| EEG parameters | | Leads | | | | | |
|---|---|---|---|---|---|---|---|
| | | Right hemisphere | | | Left hemisphere | | |
| | | Forehead-vertex | Temple-vertex | Vertex-occiput | Forehead-vertex | Temple-vertex | Vertex-occiput |
| Beta -2 | A | 1,45 | | | | | |
| | F | 1,42 | 1,46 | | | 1,46 | |
| | I | 2,14 | | | 2,57 | | |
| Beta -1 | A | | -1,48 | -1,52 | | -1,29 | -1,31 |
| | F | 1,09 | 1,07 | 1,04 | 1,06 | 1,06 | 1,05 |
| | I | | | -1,45 | | | -1,42 |
| Alpha | A | | -2,08 | -1,84 | | -1,60 | -1,57 |
| | F | | -1,04 | -1,04 | | | |
| | I | -1,92 | -4,22 | -3,75 | | -3,42 | -3,46 |
| Theta | A | | -1,32 | | | | |
| | F | 1,23 | | | | 1,09 | 1,10 |
| | I | | | | | | |
| Delta | A | | -1,40 | -1,35 | | | |
| | F | | -1,11 | -1,15 | | -1,13 | |
| | I | 1,23 | 2,04 | 1,83 | | 1,62 | 1,58 |

Changes in the parameters of beta-2 EEG rhythms upon opening the eyes OR were statistically significantly increased in the forehead-vertex lead on the right - amplitude, frequency and duration index, in the temple-vertex lead on the right - frequency, in the left forehead-vertex lead - duration index, and in the lead temple-vertex on the left is the frequency.

The amplitude of the theta rhythm in right-handers when opening the eyes decreased in the temple-vertex lead of the right hemisphere, while the frequency in the forehead-vertex leads on the right and temple-vertex and vertex-occiput leads in the left hemisphere increased.

The amplitude of the EEG delta rhythm in the temple-vertex and vertex-occiput leads of the right hemisphere decreased when the eyes were opened, the frequency also decreased in the temple-vertex and vertex-occiput leads of the right hemisphere and the temple-vertex of the left hemisphere, and the duration indices were determined to be statistically significantly increased in all leads, with the exception of the forehead-vertex of the left hemisphere.

**Left-handeds.** In left-handers, the activation reaction was manifested by a statistically significant decrease in the amplitude and duration indices of the alpha rhythm in all EEG leads, the frequency of the alpha rhythm was determined to be reduced only in the vertex-occiput lead of the left lead (Table 2).

Table 2.

Statistically significant correlation coefficients reflecting changes in EEG parameters in conditions of operational rest compared with conditions of psychosensory rest in left-handers

| EEG parameters | | Leads | | | | | |
|---|---|---|---|---|---|---|---|
| | | Right hemisphere | | | Left hemisphere | | |
| | | Forehead-vertex | Temple-vertex | Vertex-occiput | Forehead-vertex | Temple-vertex | Vertex-occiput |
| Beta -2 | A | | | | | | |
| | F | | | | | | |
| | I | | | | 2,13 | | |
| Beta -1 | A | | -1,45 | -1,51 | | | -1,47 |
| | F | | | | | | |
| | I | -1,51 | | -1,66 | | -1,47 | -1,77 |
| Alpha | A | -1,56 | -1,70 | -1,81 | -1,97 | -1,59 | -1,70 |
| | F | | | | | | -1,09 |
| | I | -2,72 | -3,88 | -3,98 | -3,53 | -2,53 | -3,10 |
| Theta | A | | | -1,40 | | | |
| | F | | | | | | |
| | I | | | -1,64 | | | |
| Delta | A | -1,46 | -1,43 | -1,37 | | | |
| | F | -1,23 | -1,19 | -1,26 | | | -1,20 |
| | I | | 1,56 | 1,36 | 1,41 | 1,68 | |

The amplitude and duration indices of the beta-1 rhythm when opening the eyes also decreased, as in right-handers, but not in all leads - the amplitudes decreased in the leads of the temple-vertex and vertex-occiput of the right hemisphere and the vertex-occiput of the left hemisphere, and the duration indices - in the leads forehead-vertex and vertex-occiput of the right hemisphere and temple-vertex and vertex-occiput of the left hemisphere.

Changes in the beta-2 rhythm during the activation reaction in left-handers were observed only in the forehead-vertex abduction of the left hemisphere - an increase in the duration index.

Changes in the EEG theta rhythm upon eye opening were manifested in a decrease in amplitude and duration index in the vertex-occiput lead of the right lead.

In the delta rhythm range, changes were observed mainly in the right hemisphere and were expressed in a decrease in the amplitudes and frequencies of the rhythm in all leads of the right hemisphere.

The duration indices of the delta rhythm were determined to be increased when opening the eyes in the temple-vertex and vertex-occiput leads of the right hemisphere and the forehead-vertex temple of the crown of the left hemisphere. In the left hemisphere, in the lead of the crown-occiput of the left hemisphere, an increase in the frequency of the rhythm was noted.

*Changes in functional interhemispheric asymmetry during the activation reaction.*

*Right-handers.* In right-handers, the FIA alpha rhythm index under PR conditions (eyes closed) was negative in all leads (Table 3, Fig. 1).

Table 3

Indicators of functional interhemispheric asymmetry in conditions of operational and psychosensory rest in right-handers (%)

| EEG parameters | Forehead-vertex | Temple-vertex | Vertex-occiput |
|---|---|---|---|
| | Eyes closed | | |
| Beta -2 | 4,73±0,92 | 1,08±0,24 | -9,57±1,71 |
| Beta -1 | 3,33±0,30 | -1,26±0,14 | -9,16±0,77 |
| Alpha | -5,87±0,73 | -6,92±0,80 | -8,04±0,80 |
| Theta | 6,98±1,00 | 7,33±0,98 | -2,42±0,27 |
| Delta | -1,31±0,19 | 8,74±1,07 | -1,65±0,18 |
| | Eyes are open | | |
| Beta -2 | 1,95±0,5* | 5,97±0,65* | -1,28±0,17* |
| Beta -1 | 3,56±0,30 | 5,53±0,44* | -1,54±0,11* |
| Alpha | 5,18±0,49* | 6,19±0,69* | -0,14±0,01* |
| Theta | 2,98±0,24* | 11,11±0,97* | -2,54±0,24 |
| Delta | 3,47±0,34* | 10,21±1,20 | 2,51±0,21* |

Under OR conditions, when opening the eyes, the FIA indicator of the alpha rhythm inverted and OR was positive in the forehead-vertex and temple-vertex leads, and in the head-occiput lead its negativity decreased from (-8.04±0.80)% to (-0, 14±0.01)%. These changes were statistically significant.

The FIA index of beta-2 and theta rhythm under conditions of the eye closed in the forehead-vertex and temple-vertex leads were positive, and negative in the vertex-occiput lead.

The positivity of the FIA indicator of the beta-2 rhythm under OR conditions in the forehead-vertex lead decreased statistically significantly, and in the temple lead it increased,

and in the vertex-occiput lead the negative sign of this indicator decreased statistically significantly.

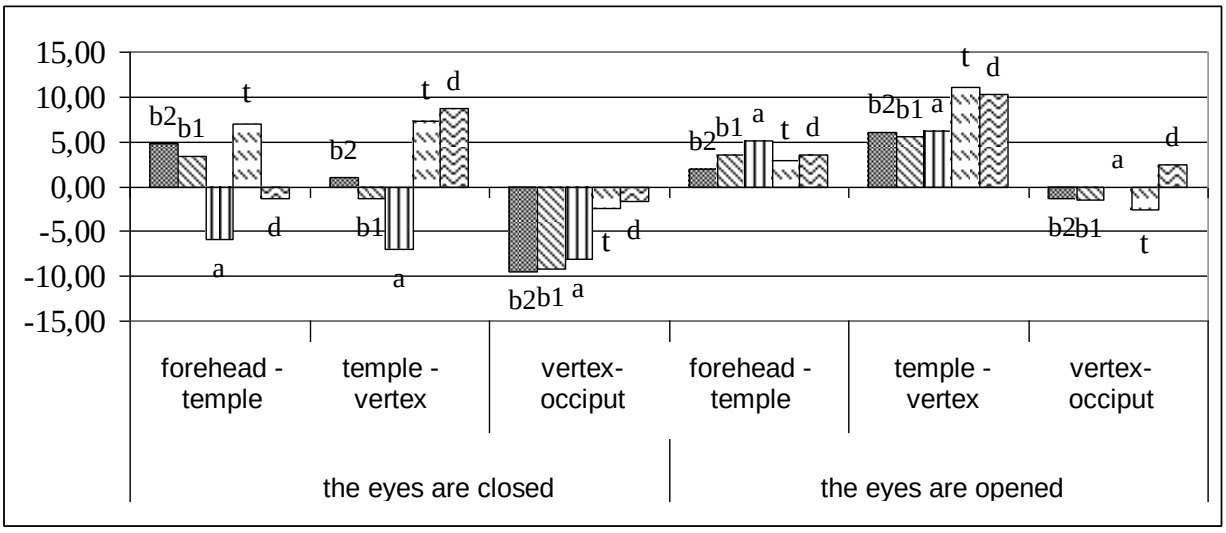


Figure. 1. Functional interhemispheric asymmetry in conditions of operational and psychosensory rest in right-handers.

Designations: b2 - MPA of the beta-2 rhythm amplitude, b1 - MPA of the beta-1 rhythm amplitude, t - MPA of the theta rhythm amplitude, d - MPA of the delta rhythm amplitude.

The positivity of the FIA theta rhythm under OR conditions in the forehead-vertex lead decreased statistically significantly, while it increased in the temple-vertex lead, while the occiput crown did not change statistically significantly. The FIA index of the beta-1 rhythm in the forehead-vertex leads was positive, and negative in the temple-vertex and vertex-occiput leads.

The FIA indicator of the beta-1 rhythm in the forehead-vertex lead when opening the eyes did not change statistically significantly, in the temple-vertex lead it inverted from negative to positive, and in the crown-vertex lead the negativity of this indicator decreased statistically significantly from (-9.16± 0.77)% to (-1.54±0.11)%.

The delta rhythm indicator under conditions of the eyes closed in the forehead-vertex and vertex-occiput leads was negative, and positive in the temple-vertex lead.

The FIA indicator of the delta rhythm when opening the eyes in the forehead-vertex and vertex-occiput leads inverted from negative to positive, while in the temple-vertex lead it did not change statistically significantly.

**Left-handers.** In left-handers, the FIA alpha rhythm index under PR conditions (eyes closed) was determined to be positive in the forehead-vertex and temple-vertex leads, and

negative in the vertex-occiput lead (Table 4, Fig. 2). When opening the eyes, the positiveness of the FIA alpha rhythm in the forehead-vertex lead decreased, in the temple-vertex lead it did not statistically significantly change, and inverted from negative to positive in the vertex-occiput lead.

Table 4.

Indicators of functional interhemispheric asymmetry in conditions of operational and psychosensory rest in left-handers (%)

| EEG RHYTHMS | FOREHEAD-VERTEX | TEMPLE-VERTEX | VERTEX-OCCIPUT |
|---|---|---|---|
| | Eyes closed | | |
| Beta -2 | 5,96±1,10 | 24,73±5,50 | -2,68±0,54 |
| Beta -1 | 16,11±2,26 | 15,94±2,41 | -0,37±0,04 |
| Alpha | 15,88±2,88 | 17,26±3,16 | -0,26±0,04 |
| Theta | 22,30±4,74 | 30,37±6,78 | -3,30±0,59 |
| Delta | 17,30±2,17 | 24,25±3,63 | 3,00±0,46 |
| | Eyes are open | | |
| Beta -2 | 13,45±1,83* | 3,02±0,64* | -9,82±2,11* |
| Beta -1 | 14,60±1,72 | 16,38±2,30 | 1,08±0,11* |
| Alpha | 4,15±0,64* | 20,64±4,06 | 2,84±0,38* |
| Theta | 25,61±6,59 | 29,02±7,73 | 1,93±0,32* |
| Delta | 32,86±6,54* | 30,75±7,25 | 5,36±0,71* |

Comment: * P<0,05

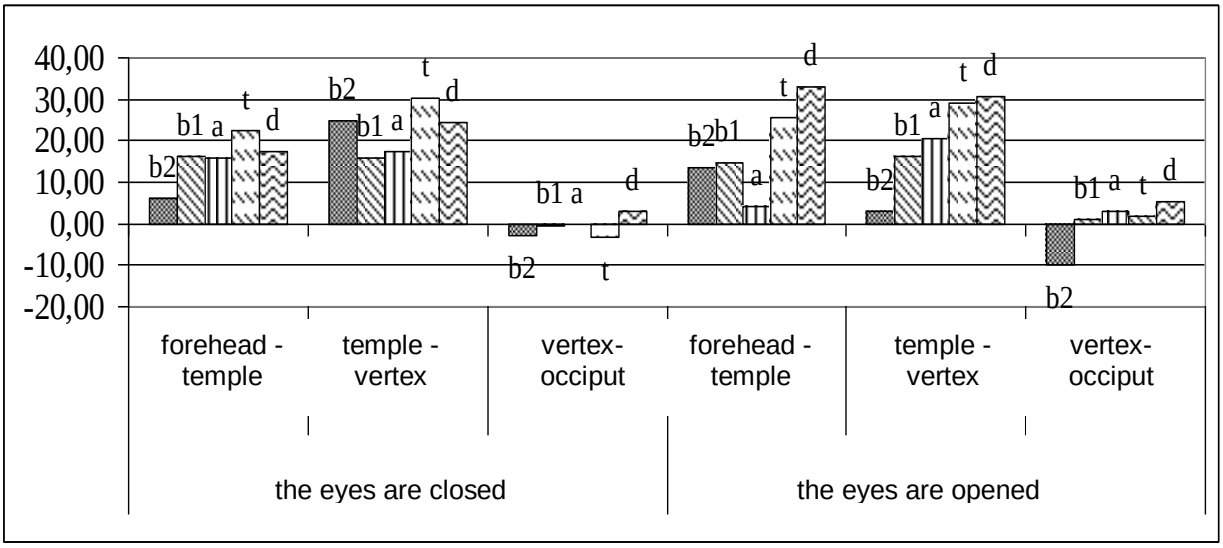


Figure 2. Functional interhemispheric asymmetry in conditions of operational and psychosensory rest in left-handers.

Designations: the same as in Fig. 1.

The FIA index of the beta-2 EEG rhythm under PR conditions in the forehead-vertex and temple-vertex leads was positive, and negative in the vertex-occiput lead. When opening the eyes, the positiveness of this indicator in the forehead-vertex lead increased statistically significantly, while in the temple-vertex lead it decreased, and the negativity of this indicator increased in the crown-vertex lead.

The FIA index of beta-1 and theta rhythms under conditions of the eyes closed in the forehead-vertex and temple-vertex leads were expressed as positive values, and negative in the vertex-occiput lead. When opening the eyes, these indicators in the forehead-vertex and temple-vertex leads did not change statistically significantly, and in the vertex-occiput lead they statistically significantly inverted from negative to positive.

The FIA index of the delta EEG rhythm under PR conditions was positive in all leads. When opening the eyes, the FIA value of the rhythm delta in the forehead-vertex and vertex-occiput leads increased statistically significantly.

*Changes in activation coefficients during the EEG activation reaction*. In right-handers, AC increased statistically significantly after opening the eyes (Table 5) in all leads, except for the forehead-vertex lead of the left hemisphere. In left-handers, AC activation also increased statistically significantly after opening the eyes (Table 5) in all leads, except for the lead of the vertex-occiput of the left hemisphere. Under PR conditions, AC in right-handers was determined to be statistically significantly higher than in left-handers.

Table 5

Activation coefficients in right-handers and left-handers in conditions of psychosensory and operational rest

| Leads | Right-handers | | Left-handers | |
|---|---|---|---|---|
| | Psychosensory rest | Operational calmness | Psychosensory rest | Operational calmness |
| | Right hemisphere | | | |
| Forehead-vertex | 0,44±0,08 | 0,73±0,06** | 0,19±0,07** | 0,92±0,36***** |
| Temple-vertex | 0,24±0,04 | 0,60±0,05** | 0,06±0,02** | 0,51±0,23* |
| Vertex-occiput | 0,33±0,04 | 0,60±0,07** | 0,08±0,03** | 0,25±0,09*** |
| | Left hemisphere | | | |
| Forehead-vertex | 0,54±0,08 | 0,69±0,09 | 0,19±0,07** | 1,46±0,30***** |
| Temple-vertex | 0,28±0,05 | 0,60±0,07** | 0,12±0,04** | 0,51±0,16** |
| Vertex-occiput | 0,32±0,05 | 0,59±0,07** | 0,05±0,01** | 0,17±0,09** |

Comment: **- P<0.05, *-P<0.1 * - difference between right-handers and left-handers, * - the difference between the states of psychosensory and operational rest.

*Relationships of EEG Rhythm Amplitudes in the EEG Activation Response.* In right-handers under OR conditions, the number of statistically significant regression coefficients increased significantly in the left hemisphere, while in left-handers it decreased in the right hemisphere (Table 6).

Table 6

Statistically Significant Regression Relationships of Polycyclic Multigraphs Describing Relationships Between EEG Amplitude Indicators in Conditions of Psychosensory and Operational Rest

| Leads | Right-handers | | Left-handers | |
|---|---|---|---|---|
| | Psychosensory rest | Operational calmness | Psychosensory rest | Operational calmness |
| | Right hemisphere | | | |
| Forehead-vertex | 8,00 | 8,00 | 4,00 | 6,00 |
| Temple-vertex | 8,00 | 12,00 | 10,00 | 0,00 |
| Vertex-occiput | 12,00 | 9,00 | 4,00 | 8,00 |
| Total | 28,00 | 29,00 | 18,00 | 14,00 |
| | Left hemisphere | | | |
| Forehead-vertex | 2,00 | 6,00 | 4,00 | 4,00 |
| Temple-vertex | 6,00 | 4,00 | 6,00 | 6,00 |
| Vertex-occiput | 2,00 | 12,00 | 6,00 | 6,00 |
| Total | 10,00 | 22,00 | 16,00 | 16,00 |
| All together | 38,00 | 51,00 | 34,00 | 30,00 |

**Discussion.** When opening the eyes, the amplitude of the alpha and beta-1 rhythms in right-handers decreased statistically significantly. Parallelism in changes in alpha and beta-1 EEG rhythms was also revealed in the work (10). It should be noted that in a multiple regression analysis of the relationship between the amplitudes of EEG rhythms in right-handers, under OR conditions, between the amplitudes of alpha and beta-1 EEG rhythms in the forehead-vertex leads on the right, temple-vertex on the right, vertex-occiput on the right and vertex-occiput on the left, bilateral positive influences were determined.

Under OR conditions, the delta rhythm duration index was determined to be statistically significantly increased compared+ to PR conditions in right-handers and left-handers.

The question of the representation of the delta rhythm in the EEG of an awake person is debatable. There are ideas that in healthy adults, the delta rhythm in the waking state is usually not recorded [14]. However, a number of authors believe that in the EEG of a healthy person, the delta rhythm can be observed both during sleep and during wakefulness [5, 9]. The delta rhythm is associated with eye movements, and some researchers consider the delta

component to be the result of an electrooculogram (EOG) overlay on the EEG [10]. An increase in the duration index of the delta rhythm in our studies was combined with a decrease in its amplitude and frequency. In addition, the delta rhythm amplitude indicator was included in the structure of polycyclic multigraphs describing the relationship of EEG rhythms both under conditions of psychosensory and operative rest. This allows us to consider that the EEG delta rhythm amplitude indicators belong to the set of EEG amplitudes. All of the above allows us to consider the fact of an increase in the index of the duration of the delta rhythm under conditions of OR compared with PR as a physiological manifestation of the activation reaction.

Changes in the beta-2 rhythm during the activation reaction consisted in an increase in amplitude, frequency, and duration index, mainly in right-handed forehead-vertex abduction. Left-handers showed an increase in the duration index in the forehead-vertex abduction on the left.

In [10], a decrease in the spectral power of high-frequency EEG components upon opening the eyes was obtained.

An increase in the representation of the beta rhythm is considered as an indicator of an increase in cortical tone. According to the widely accepted point of view [14], under conditions of OR or the receipt of signals from other sense organs, alpha waves disappear or are greatly weakened (the alpha rhythm is blocked) and are replaced by beta waves, which have a higher frequency and lower amplitude, i.e. there is a blockade of the alpha rhythm and its "transition" into low-amplitude beta activity.

In right-handers under conditions of “eyes closed”, the FIA values of the amplitude of alpha and delta rhythms in the forehead-vertex lead, beta-1 and alpha rhythms in the temple-vertex lead, and all rhythms in the vertex-occiput lead were determined to be negative, i.e. indicators of the right hemisphere were greater than those of the left.

In left-handers, all FIA indices under conditions of psychosensory rest in the forehead-vertex and temple-vertex leads were determined to be positive, i.e. the left hemisphere was larger than the right hemisphere. In the temple-vertex lead, the FIA values of beta-2, beta-1, and theta rhythms were determined to be negative, i.e., the indicators of the right hemisphere were greater than those of the left.

The negative FIA values indicate a more pronounced desynchronization (smaller rhythm amplitudes) in the left hemisphere, and the positive - in the right. As is known, the cortex of the left hemisphere has more developed connections with stem structures, while the cortex of the right hemisphere has more developed connections with diencephalic ones [2, 3].

Thus, the differences in FIA scores in right-handers and left-handers can be explained by the difference in the activity of the reticular formation.

After opening the eyes in right-handers, the FIA of all rhythms in the forehead-vertex and temple-vertex leads was positive, the negative FIA values of the temple-vertex lead decreased or inverted. Consequently, desynchronization in the right hemisphere increased compared to the left one, and the rhythm amplitudes in the right hemisphere were determined to be smaller than in the left.

According to A.N. Sokolov and his collaborators, healthy subjects exhibit various patterns of interhemispheric asymmetry when performing different types of activities. In the transition from nonverbal to verbal tasks, the right hemisphere dominance of the activation reaction decreases or the right hemisphere dominance changes to the left hemisphere [15].

In left-handers, when opening the eyes in the forehead-vertex abduction, the positivity of the FIA beta-2 and delta rhythms increased statistically significantly, and the positivity of the alpha rhythm decreased. In the temple-vertex lead, the FIA of the beta-2 rhythm statistically significantly decreased, and in the vertex-occiput lead, the negativity of the FIA of the beta-2 rhythm increased statistically significantly, the FIA of the beta-1, alpha, and theta EEG rhythms were inverted into positive values, and the positiveness of the FIA of the delta rhythm increased statistically significantly.

In right-handed people with eyes open, the positivity of FIA indicators in the forehead-vertex abduction was in the range of 1.95±0.50% - 5.18±0.49%, and in left-handers 4.15±0.64% - 32.86 ±6.54%, in the vertex-occiput lead, the FIA indicators in right-handers were in the range of 5.53±0.44% - 11.11±0.97%, and in left-handers - 3.02±0.64% - 30 ,75±7.25% and in the temple-vertex lead in right-handers, the indicators of beta-1, alpha, and theta EEG rhythms were expressed as negative values, and in left-handers, as positive. Thus, the FIA positivity was more pronounced in left-handers than in right-handers, i.e., the degree of desynchronization of the right hemisphere was greater than that of the left.

In the FIA study, the alpha-rhythm index of right-handers under PR conditions was determined to be negative, and in left-handers it was positive. Under conditions of operational rest, this indicator was positive for both left-handers and right-handers.

When opening the eyes, the AC in most leads increased statistically significantly. It should be noted that in the state of psychosensory rest, the CA in right-handers was determined to be larger than in left-handers in all leads, and in the state of operational rest, in the leads of the vertex-occiput of the right hemisphere, forehead-vertex and vertex-occiput of the left hemisphere.

According to the studies of Boytsov Yu.A. and Danko S.G. [1] when comparing the states of rest, the eyes are open and the eyes are closed in the dark, i.e., in the absence of light exposure to the retina, these states differ significantly in terms of spectral power and EEG coherence. Since in the experimental situation, changes in EEG characteristics cannot be due to external influences on the visual system, therefore, the authors propose to consider them as correlates of the reorientation of involuntary anticipatory attention from internally oriented attention in the eye closed state to externally oriented attention in the eye open state [1].

In right-handers, when moving from PR to OR, the number of regression relationships increased, both in the right hemisphere and in the left, while in left-handers, on the contrary, it decreased or did not change. It should be noted that in right-handers, the number of regression relationships in the right hemisphere was determined to be greater than in the left, while in left-handers, such a difference was not revealed.

Under the conditions of ECoG desynchronization in rats, we detected a greater number of regression relationships than within the ECoG synchronization segments. This result was obtained both for the intact brain and for the preparation of the isolated forebrain [18].

**Conclusions.**

1. In right-handers, changes in EEG parameters during the implementation of the activation reaction are more significant than in left-handers.

2. Differences in FIA parameters in right-handers and left-handers can be explained by the difference in the activity of the reticular formation.

3. After opening the eyes in right-handed people, desynchronization in the right hemisphere increased compared to the left one, and the amplitudes of rhythms in the right hemisphere were determined to be smaller than in the left.

4. In left-handers, the degree of desynchronization of the right hemisphere was greater than that of the left.

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