Psychophysiology and Homeokinesis. Synchronization of Stimuli Presentation to Chronobiological Processes

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Abstract: *The study of chronobiological processes influence (brain activity) on unconscious (psychophysiological) and conscious responses of subjects during periodic external stimuli presentation using the vibraimage technology was carried out. Shown that conscious and unconscious responses of subjects to presented stimuli differ significantly at opposite moments of brain activity (maximum and minimum of brain activity). Inverse dependence was established between brain activity period and the period of external stimuli presentation in the range from 5 to 18 seconds. Comparative psychophysiological tests of subjects were carried out with various questionnaires of VibraNLP program and the dependences between the investigated factors and program settings (period of external stimuli presentation, the moment of presentation stimuli start relative to brain activity moment) were obtained. Presented results confirmed the hypothesis that the variability of subject conscious and unconscious responses to the stimulus depends on current brain activity process. Proposed the method for synchronizing of stimuli presentation to chronobiological parameters minimizing the difference in human responses caused by periodic changes in physiological parameters.*

Keywords: *vibraimage, psychophysiology, homeostasis, homeokinesis, chronobiology, psychophysiological state, PPS, PPR, stimulus, brain activity period, BAP, VibraNLP.*

Introduction

The concepts of homeostasis, allostasis, and homeokinesis have now been studied in sufficient detail and number thousands of research papers (Novoseltsev, 1978). “Now let’s look at the regulation of income with consumption in particular. There are a lot of mechanisms that maintain the balance between these two quantities in the animal body” — said Ivan Sechenov back in 1860 (Sechenov, 1953). The study of regulatory mechanisms were significantly influenced by the work of Claude Bernard (Bernard, 1865) and Walter Cannon, who proposed the term homeostasis to describe the ability of organisms to maintain the constancy of the internal environment (Cannon, 1932). Norbert Wiener (Wiener, 1948) suggested that the regulation and maintenance of balance in the body is provided by the feedback principle. More recent physiological studies have shown that all variables in the body are subject to regular cyclical changes, for example, circadian and shorter rhythms (Halberg, 1969; Blank & Blank, 2010). Almost all known physiological signals have pronounced temporal rhythms, the most studied of which are the heart rhythm and a separate direction — heart rate variability (HRV) (Baevsky et al., 2001).

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Studies carried out by vibraimage technology have shown that a person has a temporal rhythm associated with brain activity (Minkin & Blank, 2019), the brain activity period (BAP) is determined not only by the physiology of the body's functioning, but also by consciousness. Modern psychophysiology (Cacioppo, 2007; Danilova, 2012) is based on the registration of various physiological signals of EEG, EMG, heart rate, HRV, GSR, BP, ECG, PPG (Liu et al., 2008; Giannakakis et al., 2019; Avdeeva et al., 2020), the concentration of certain enzymes or hormones — testosterone, serotonin, cortisol, alpha-amylase (Canli & Lesch, 2007; Minowa & Koitabashi, 2012) and behavioral responses — facial expressions, speech tonality, micromovements, etc. (Tao & Tan, ed., 2009; Zhou et al., 2011). Presentation of stimuli to a subject is standard method in psychophysiology.

On the one hand, psychophysiology recognizes that all processes of consciousness, emotions, decision-making depend on the parameters of psychophysiological state (PPS). At the same time, modern psychophysiology almost does not take into account the natural mechanisms of physiological regulation and constant changes in physiological characteristics, only circadian rhythms are taken into account when conducting psychophysiological tests.

We assume that the psychophysiological and conscious responses of a person to stimuli are largely determined by the current PPS of a subject in his chronobiological activity and, above all, by the rhythm of brain activity. Since it was previously found that BAP, depending on many factors, can vary from several seconds to hundreds of seconds (Minkin & Blank, 2019), accordingly, the psychophysiological response (PPR) to the same stimuli can vary significantly depending on the current positions during a short time.

The aim of this study is to test the hypothesis of significant variability of the subject's conscious and PPR to a stimulus, depending on the state or position of brain activity, within a short time interval about one minute.

Materials and Methods

As materials for this work, we used the results of two studies carried out earlier by vibraimage technology (Minkin, 2020; Minkin & Nikolaenko, 2020) and provide the third new research. Earlier results were re-analyzed with respect to the synchronicity of physiological processes and stimuli, and the third group of research results was added.

The first material presents the results of an open extended database (Minkin, 2020) of emotional and psychophysiological parameters (the age of the subjects is 14–80 years old, approximately 50% Russians, 15% Koreans, 10% Chinese, 10% Japanese, 5% Iranians). A common database that includes 12494 measurement results (file 12494All.xlsm), a database for measuring the free state of a person by the VibraMed program (file 12494MED.xlsm), a database of questionnaires passing by the VibraMI and PsyAccent programs (12494MI.xlsm and 12494PA.xlsm). Databases of the results of measurements of emotional and psychophysiological parameters are given in the files at the link (Minkin, 2020b): http://www.psymaker.com/downloads/CyberVibraV2.zip

The second material presents a psychophysiological study of 10 people (6 men and 4 women, ages from 20 to 65 years old, all of the Caucasian race) using vibraimage technology and the VibraNLP program (Minkin & Nikolaenko, 2020). During the

testing was done the preliminary synchronization of stimuli presented to physiological parameters and various settings of the period of external stimuli presentation (PESP) in 5, 10 and 15 seconds (Minkin, 2021a; 2021b).

In the third material are repeated (50 times) testing of 2 people (man 61 years old, woman 39 years old) carried out with the VibraNLP program with a short questionnaire LOf05_1, which included 12 questions with PESP = 5 seconds.

Results

Using Excel program, were combined the first material results obtained by the VibraMI and PsyAccent questionnaires (Minkin, 2020a; Minkin & Nikolaenko, 2017) into one database and determine the average BAP for stimuli presented with a period of 17–18 seconds. The VibraMI and PsyAccent programs do not have synchronization of stimuli presentation to physiological parameters; therefore, stimulus presentation was carried out in a random order relative to the subjects' chronobiological processes. Before was noted (Minkin & Myasnikova, 2018; Minkin & Myasnikova & Nikolaenko, 2019) that presentation of external stimuli with a fixed presentation period leads to synchronization of BAP under a double period of stimulus presentation. I. e. for PESP of 16–18 seconds, the BAP has a maximum at 34 seconds. It confirms by the spectrogram obtained of fast Fourier transformation (FFT) according to the signal of the PPS change, which is reflected in the distribution density of the histogram of the maxima obtained in the Fourier spectrograms shown in Figure 1 for open bases VibraMI and PsyAccent programs.

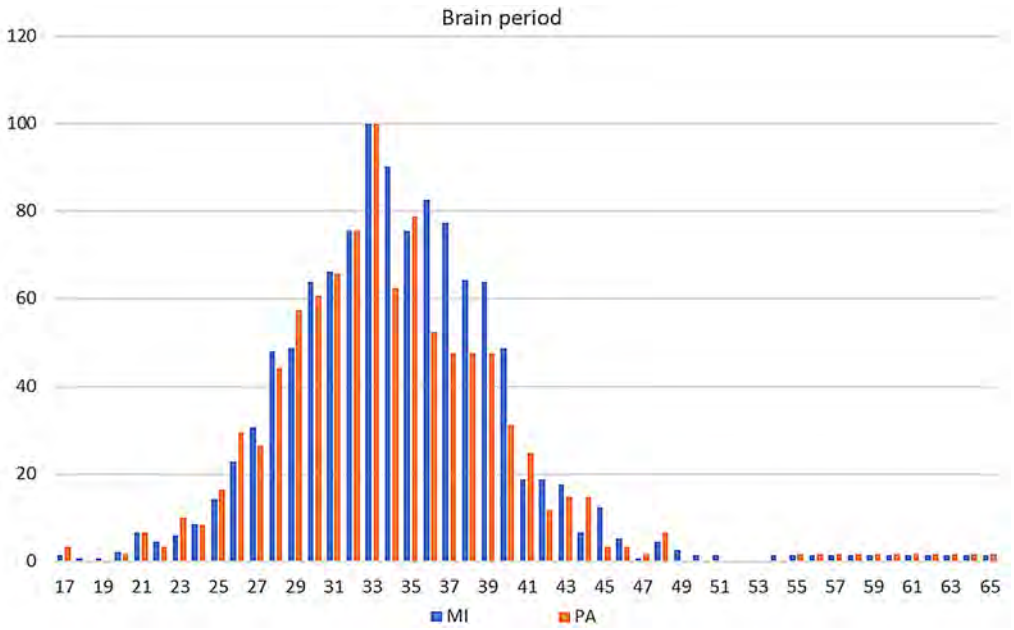

Fig. 1. *Density of BAP distribution during stimuli presentation by VibraMI (4668 tests) and PsyAccent (2314 tests) programs, 6972 tests with stimuli period of 16–18 seconds*

Note that PESP of at least 16 seconds automatically leads to synchronization of physiological processes, and we observe a pronounced maximum of the distribution of BAP at the level of 32–34 seconds. In the studies carried out by the VibraMI and PsyAccent programs, the PESP was at least 16 seconds, and the question of what would happen with a decrease in the stimuli presentation period remained open (Minkin, 2020).

In the second material presented at this conference (Minkin, 2021a; 2021b) were noted that a decrease in PESP leads to an increase BAP and the brain is somewhat inhibited with an increase for information. However, in (Minkin, 2021a) the change in BAP from PESP was studied at various program settings, which does not allow to clearly identify the dependence of BAP only on PESP. To determine the dependence of BAP and investigated factor score (IFS) on the PESP with the fixed program settings (N = 25; and the start of stimuli with Min PPS value), consider the histogram shown in Figure 2. IFS calculation described on this conference paper (Minkin, 2021b).

Fig. 2. *Dependence of BAP and IFS assessment for PESP (T = 5, 10, 15 s) and the start of stimuli presentation from (Min, Max) PPS with fixed VibraNLP program settings N = 25. The left vertical axis shows BAP value, the right vertical axis shows IFS value*

From the histogram shown in Figure 2, follows that the accelerated presentation of stimuli noticeably increases BAP and decreases IFS, since the human consciousness does not have time to cope with the large flow of processed information.

Also in the work (Minkin, 2021a), data were given that starting from the minimum PPS value leads to an increase in the accuracy of the score assessment of the predisposition to the factor, but this dependence was again shown for various program settings. To study the processes of synchronization of current PPS to stimuli is necessary to fix the rest of the program settings. Since one of the main tasks of any testing is to reduce the time while maintaining the accuracy of the result obtained

(Minkin, 2019), I limited this study to the minimum PESP = 5 s and the minimum number of PPS integration frames N = 25.

Let's continue the PPR study of second material 10 people database, selecting fixed settings results (T = 5; N = 25), shown in Figure 3 for the start at the maximum PPS value (Max).

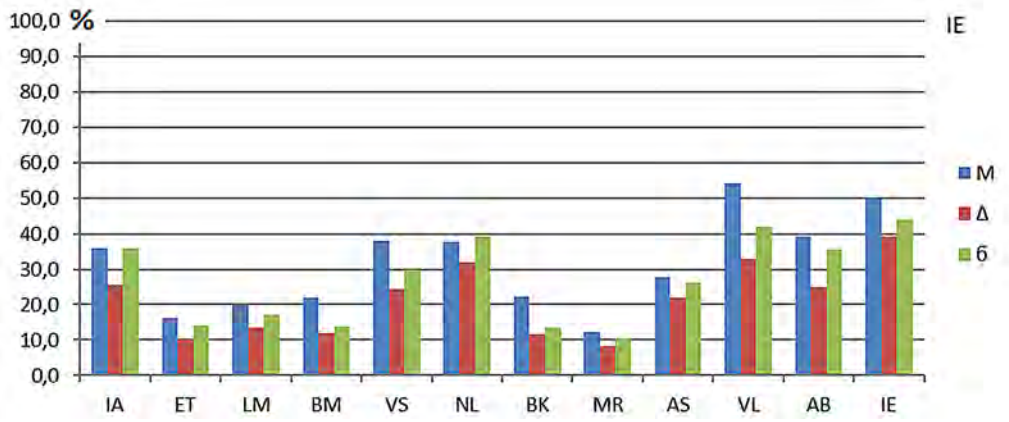

Fig. 3. *Average PPR (for 10 persons) of VibraNLP processing with the fixed program settings: start Max, N = 25, PESP = 5 s*

Given on Figures 3–5 sequence of 12 responses AI; ET; LM; BM; VS; NL; BK; MR; AS; VL; AB; IE named according to MI types abbreviation (Minkin&Nikolaenko, 2017), however in our processing we will look only on comparison of left 6 PPR corresponding to pretesting and right PPR corresponding to basic testing.

Further, in Figure 4, shows average PPR of subjects during VibraNLP testing with the same fixed settings (T = 5; N = 25) only for the start of measurements from the minimum PPS value (Min).

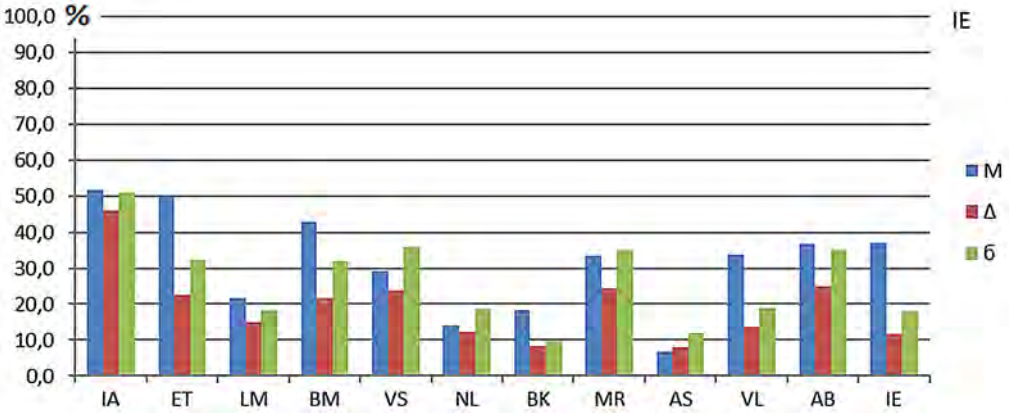

Fig. 4. *Average PPR (for 10 persons) of VibraNLP processing with the fixed program settings: start Min, N = 25, PESP = 5 s*

When comparing the results shown in Figures 3 and 4, we note that in Figure 3, the response to the stimuli on basic testing has an advantage (13–24), while in Figure 5 there is a clear preferential response to the stimuli on pretesting (1–12).

Next, present the statistics of the distribution of the conscious reaction in the same study of 10 people using the VibraNLP program. Figure 5 shows a histogram of the conscious response to presented stimuli when starting from the maximum PPS value.

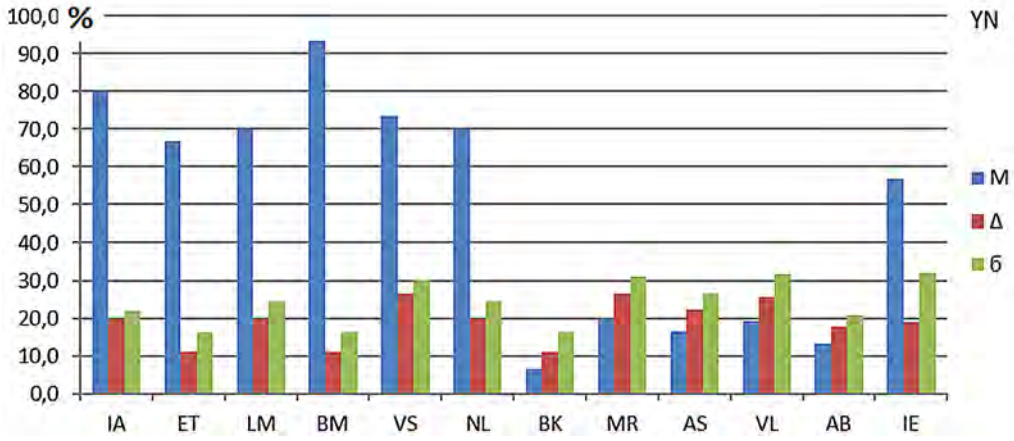

Fig. 5. *Average value of conscious response to stimuli for subjects with fixed program settings: start Max, N = 25, PESP = 5 s*

Figure 6 shows a histogram of the conscious response to presented stimuli when starting from the minimum PPS value.

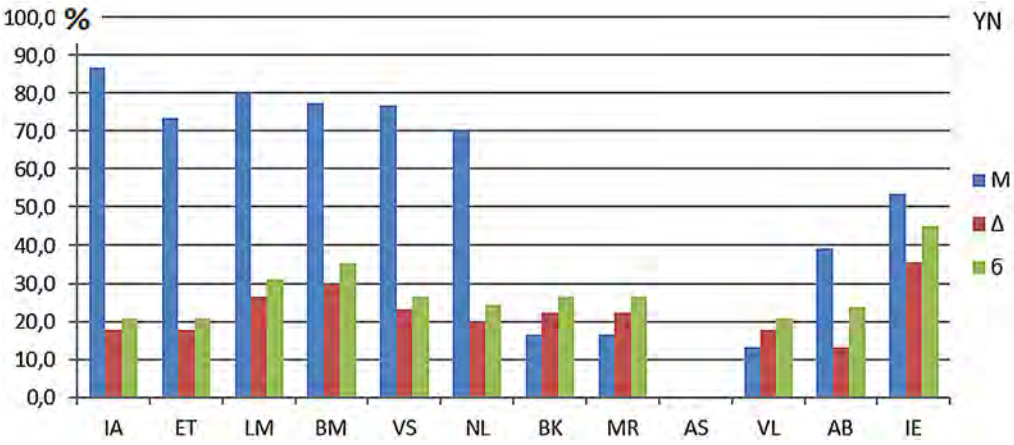

Fig. 6. *Average value of conscious response to stimuli for subjects with fixed program settings: start Min, N = 25, PESP = 5 s*

Pay attention to the pronounced different nature of preferences in the conscious responses with the leadership of the 4th pair when starting from the maximum PPS value and the leadership of the first pair when starting from the minimum PPS value.

Based on third material consider the statistics of 50 personal testing from one of the authors of this publication with the VibraNLP program with the LOf05_1 questionnaire, which includes 12 questions with a stimulus presentation period of 5 seconds at two start values from the minimum and maximum PPS values. 50 measurements were made in both start positions (50 measurements for Max PPS start and 50 measurements for Min PPS start), since it was proved in (Minkin, 2019b) that the total measurement error or SD for 50 measurements of vibraimage parameters does not exceed 6%.

Figure 7 shows a histogram of SD distribution for psychophysiological parameters of the authors of this publication (male, 61 years old) depends on stimuli start by VibraNLP program with the LOf05_1 questionnaire for a Max PPS start (S1, blue bars) and a Min PPS st6art (group 2, red bars).

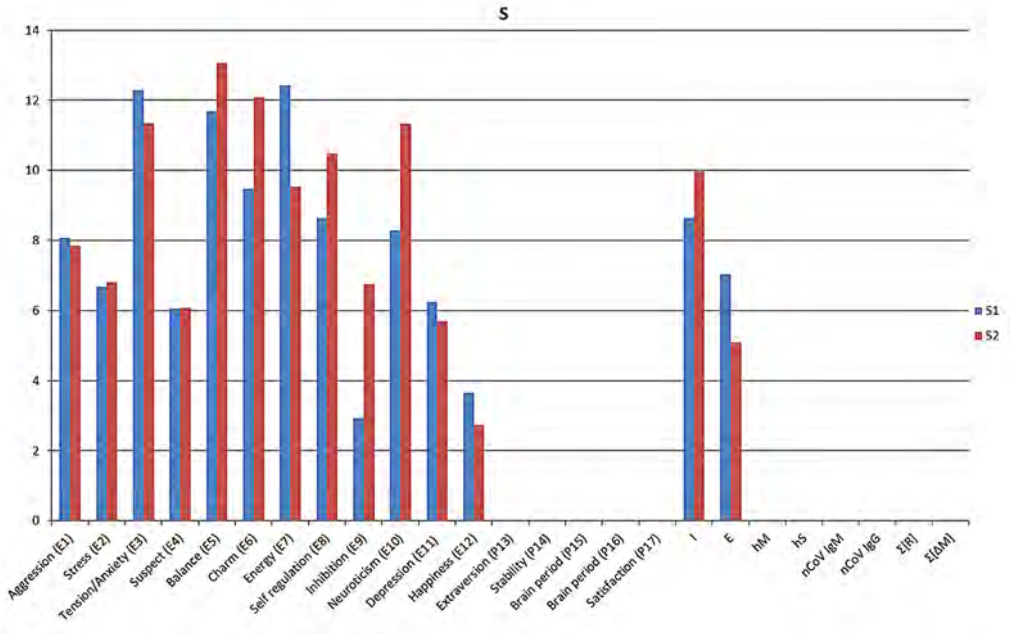

Fig. 7. *Average SD values of vibraimage parameters for Max and Min PPS start (S1, blue bars) and (S2, red bars) respectively*

From the histogram shown in Figure 7 follows that some of the psychophysiological parameters have minimal changes at different start of stimuli relative to PPS. While the other part of the psychophysiological parameters E6–E10 (dE6 = 30%; dE7 = 31%; dE8 = 16%; dE9 = 40%; dE10 = 28%) and information and energy components (Minkin et al., 2019) differ significantly for Max and Min start moment. Similar differences were observed in the second subject in this group (woman, 39 years old), but we do not average personal data in this case, since the dependences must have the personal character.

Discussion

The results obtained cover, perhaps, too many different tests and I will try to explain why I did not limit myself to one or another option. The issues of the interaction of consciousness and the unconscious have been the subject of scientific study for a long time (Freud, 1900; Penrose, 1994). It is even more surprising that only studies carried out by vibraimage technology have shown the possibility of measuring the degree of physiological processes synchronization using the work of consciousness. Although experimentally and intuitively, the period of stimulus-questions presentation (more than 15 s) used psychophysiological lie detection (Baur, 2006) was set in such a way as not to change the natural physiological rhythms of a person. If no one denies the presence of chronobiological rhythms, then it becomes obvious that a person cannot respond in the same way to the same stimulus, being at the lower or upper point of his internal physiological rhythm. Of course, if only circadian rhythms are taken into account, then the change in PPS within one minute can be neglected.

However, the frequency of PPS changes associated with PMA (Minkin & Blank, 2019; Minkin & Kachalin, 2019) has a period of less than one minute, which is clearly manifested by vibraimage technology testing, and should have a scientific explanation. Therefore, in these studies, we tried to measure as many different characteristics of a personality as possible, including conscious responses and unconscious or psychophysiological characteristics.

One type dependence of PPS on presented stimuli, measured in the VibraNLP program (material 3), shown on Figure 8. In the first (gray) part of testing (from 0 to 10 seconds), internal physiological rhythms are measured and stimuli are synchronized in response to changes in brain activity. The start of stimulus presentation and the beginning of testing (green graph) begins 3 seconds after passing the minimum PPS value.

Of course, it would be good to start at the real moment of the maximum decline, but in order to make sure that the minimum point of the current PPS is really passed and the growth begins, it takes some time (3 seconds). The points on the graph (Fig. 8a) mark the moments of presentation of stimuli, the cross marks the moment of the subject's response to the stimulus.

Figure 8 clearly shows the connection of the change in current PPS direction to external events (the points on the graph fall on the moments of minimum and maximum), moreover, at 12 seconds of testing, the direction change occurs when answering a question, and at 20 and 25 seconds when new stimuli are presented. However, such a clear severity of the PPS binding to external stimuli is far from always taking place. Figure 9 shows another typical example, where the subject response more intensive on multifactorial stimuli, while the frequency of changes in the psychophysiological state is not so clearly expressed outwardly.

Both of these examples, for all the dissimilarity, have much in common, they show a different period of PPS change, in Figure 8, which coincides with the double period of stimulus presentation (10 s), in Figure 9, which significantly exceeds the double period of stimulus presentation and is about 25 s. There is probably a certain limit to the possibilities of each person in the conscious processing of information, and an increase in the flow of information leads to an increase in BAP. If in the work (Minkin & Blank, 2019) it was

proved that consciousness adjusts the BAP for the double PEPS, then the results of this work show that this adjustment has certain limits. The dependence shown in Figure 2 shows that a small shift in the average value of BAP begins already with 15-second PEPS, and with a 5-second presentation of external stimuli, the average value BAP reaches 44 seconds.

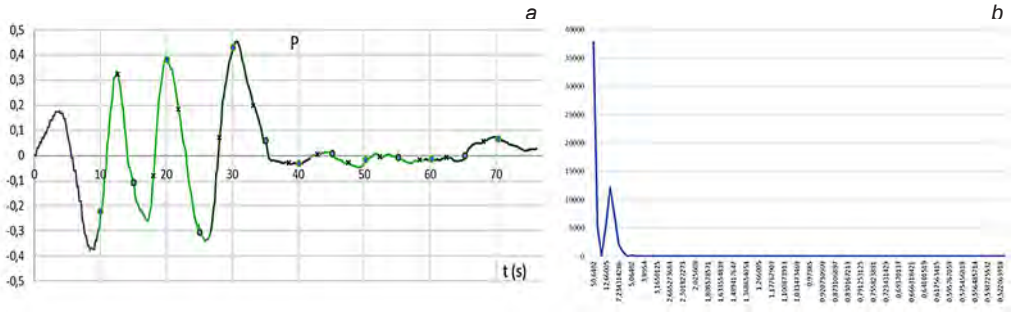

Fig. 8. *Time dependence of PPS (a) and spectrogram of PPS (b) upon presentation of neutral (10–35 s) and multifactorial (40–70 s) stimuli (12 stimuli, PEPS = 5 seconds, N = 25, start from Min PPS).*

The moment when the stimulus was presented is shown by a dot on the graph. A cross shows the moment of response to the stimulus. Maximum PPR to neutral stimuli. VibraNLP program M file, IEG and FFT pages

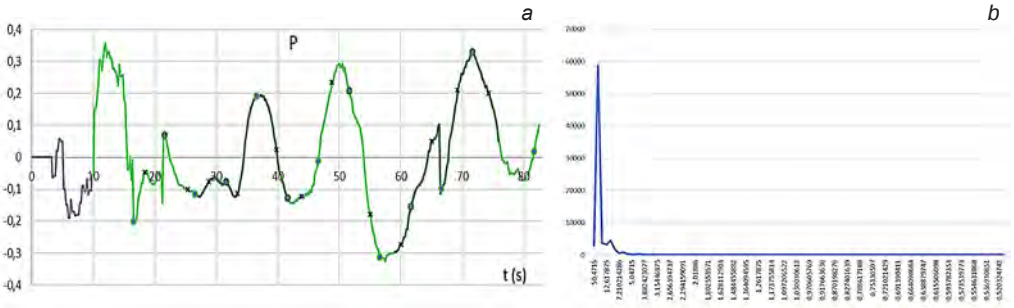

Fig. 9. *Time dependence of PPS (a) and spectrogram (b) PPS upon presentation of neutral (10–35 s) and multifactorial (40–70 s) stimuli (12 stimuli, stimulus presentation period of 5 seconds, N = 25, start from Min).*

The moment when the stimulus was presented is shown by a dot on the graph. A cross shows the moment of response to the stimulus. Maximum PPR to significant stimuli. File M of the VibraNLP program, IEG and FFT pages

Note that in Figure 2, all histogram values (IFS and BAP) combine all the settings used in this study. For example, for a stimulus presentation period of 5 seconds, all values of IFS assessment obtained at the start of stimulus presentation from the minimum and maximum PPS values are averaged, which, as follows from this Figure, have different values. In the other work presented at this conference, it is shown what changes are with the fixed settings and the different algorithms to calculating the response of paired stimuli (Minkin, 2021b).

The results shown in Figures 3–7 clearly show that not only PPS of the subjects, but also their conscious response depends on the moment of stimuli presentation relative to the rhythm of brain activity. Moreover, this reflected in a number of independent psychophysiological parameters (E6–E10) and integral components (information and energy) of PPS.

We do not assert that chronobiological processes and brain activity completely change the current PPS of a person and that at the beginning of the growth and decline of brain activity, a person is an antipode to himself. But the change in personality characteristics at opposite points of growth and decline in PPS are significant in nature, affecting all human reactions.

The results of this article show that the PPS of a person at opposite points of brain activity can change significantly within a few seconds or a minute, and this change is so significant that it cannot be ignored, especially in comparative psychophysiological studies (Baur, 2006). The proposed method for synchronizing the presentation of stimuli to chronobiological parameters makes it possible to minimize the difference in human responses caused by periodic changes in physiological parameters. Accordingly, at the same points of change in the current PPS, the person's reactions to external stimuli are close to each other, and test starting from minimum PPS point gives a more correct assessment of the person's responses (Fig. 2, comparison of the estimates of Min and Max).

Given results make it possible to dispute (after about 2600 years!) the thesis of Heraclitus (Platon, 1990) that one cannot enter the same river twice. It turns out that in a first approximation, this can be done if we take into account the chronobiological rhythms and, first of all, the rhythm of brain activity, which has a significant impact on the conscious and unconscious responses of a person. It is possible that such a chronobiological variability of unconscious and conscious responses provides greater evolutionary stability to a person as a species due to a more complete consideration of surrounding threats within a minimum time.

Conclusion

The studies carried out have shown a significant influence of the chronobiological rhythms, first, the rhythm of brain activity on unconscious and consciousresponses of a person. It has been shown that unconscious and conscious responses of a person differ significantly at opposite points of the rhythm of brain activity — the beginning of growth and the beginning of a decline, and the period of the rhythm of brain activity can vary from several seconds to a minute when the stimuli affecting a person change.

The reliability of the hypothesis put forward about the variability of conscious and unconscious responses of a subject to the stimulus, depending on psychophysiological state or brain activity position, is confirmed by the obtained results.

The lack of accounting for chronobiological rhythms during psychophysiological studies and testing significantly reduces the accuracy and reliability of the results obtained. Synchronization of the stimuli presentation moment start with chronobiological processes and, first, with respect to the BAP, can significantly increase the accuracy and stability of PPR and IFS detection of investigated person.

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