Calculation of Psychophysiological Responses to Multifactorial Stimuli in the Adaptive Questionnaire of Personality Characteristics Dispersion into Independent Components. Kuleshov Effect Comeback to Psychophysiology

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Abstract: *Given equations for the assessment of subject's predisposition to multifactorial stimuli during adaptive testing by vibraimage system (VibraNLP). Typical dependences of brain activity during stimuli presentation controlled by consciousness (the period of stimuli presentation more than 16 seconds) and with partial transfer of consciousness functions to unconscious processing (period of stimuli presentation 5–15 seconds) are given. The calculation of psychophysiological responses to paired stimuli with partial functions transfer of consciousness to unconscious processing has been corrected. Various options for calculating the conscious and unconscious responses of a subject to stimuli are presented. Brain activity period used as an indicator of the relationship between the conscious and the unconscious processing. Shown that a significant increase in brain activity period relative to the double period of stimulus presentation indicates the transfer of conscious functions processing to unconscious and intuitive processes. The accurate assessment of subject predisposition to the investigated factor for short testing time (stimulus period of 5 seconds) and standard testing time (stimulus presentation period of more than 16 seconds) were confirmed.*

Keywords: *vibraimage, psychophysiology, chronobiology, response to stimulus, brain activity period, comparative testing, conscious and unconscious response, multiple intelligences, Kuleshov effect.*

Introduction

At this conference presented several works devoted to theoretical and empirical studies of the influence of the process of changing brain activity on the psychophysiological reactions of the subject. The first work analyzed the influence of the period of external stimuli presentation (PESP) and other program settings on the psychophysiological responses (PPR) of a subject (Minkin, 2021a). The aim of the second study (Minkin & Blank, 2021) was research mutual synchronization of chronobiological rhythms (Halberg, 1969; Minkin & Blank, 2019) of subject conscious and unconscious responses to periodic stimuli. The results obtained in these works complement early studies with vibraimage technology (Minkin, 2007; 2020; Minkin & Nikolaenko, 2008) and require the creation of a new mathematical apparatus and mathematical models to determine the subject's response to stimuli.

In classical psychophysiology, it is customary to separate the response between consistent stimuli and wait for the subject's psychophysiological state to return to

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its original state after the presentation of the first stimulus (Cacciopo, 2007; Baur, 2006). However, Kuleshov effect has been known for a long time (Kuleshov, 1929; Prince & Hensley, 1992; Bruni, 2015), which argued that the subsequent frame (stimulus) changes the meaning of the previous one. In psychophysiology, this means that after the presentation of a significant stimulus, the psychophysiological state of a subject does not return to its previous state in the near future, which was also confirmed in a number of studies by vibraimage technology (Minkin & Myasnikova & Nikolaenko, 2019). Thus, the analysis of the psychophysiological response to a stimulus should be considered not as a single ideal phenomenon (Tao & Tan, ed. 2009; Giannakakis et al., 2019), but as a process interconnected with internal chronobiological rhythms constantly occurring in the human body and with external stimuli taking into account their semantic and informational load. In the works (Minkin & Mysnikova, 2017; Minkin & Myasnikova & Nikolaenko, 2018), it was proved that not only a new stimulus can change the meaning of the previous one, but the previous stimulus also determines the direction and magnitude of the change in the following psychophysiological response, since all psychophysiological responses are different deviations from the integral center of psychophysiological state.

Those the psychophysiological response to the stimulus should be assessed not by a single response, but by the change in amplitude over the period of the psychophysiological state (PPS) change. In vibraimage technology, fluctuations of PPS relative to the center of mass under the influence of stimuli are measured in the form of temporal or information-energy dependences, the ideal form of which is presented in Figures 1 and 2 follows below.

Vibraimage programs of the first and second generation (Minkin, 2021b) analyzed the response to stimuli at the intervals between stimuli adopted in modern psychophysiology. However the third-generation adaptive program VibraNLP (Minkin & Nikolaenko, 2020), which determines the profile of multiple intelligences (MI) during preliminary testing (Minkin & Nikolaenko, 2017), allows to conduct psychophysiological studies in different time ranges, which should also be taken into account when developing a mathematical apparatus for psychophysiological reactions analyzing.

The aim of this work is to develop and modify a mathematical and stimulus algorithm that takes into account the dividing of personality characteristics into independent components at the stage of pretesting by an adaptive program, including irrelevant questions and stimuli. Than on basic test to modify processing by comparison of irrelevant and relevant psychophysiological response to multifactorial stimuli to predict a subject predisposition to the investigated factor and to calculate investigated factor score (IFS).

Materials and Methods

The study includes 20 subjects (10 men and 10 women, age 21–70 years old, Caucasian race) using vibraimage technology (Minkin, 2007; 2020) with the VibraNLP program (Minkin & Nikolaenko, 2020) with default settings.

The calculation of PPR assessment to paired stimuli and predisposition to the factor under study was carried out according to the following formulas:

1. MI+, F+ for integral (conscious + unconscious) PPR (main result)

MI+ reduced total PPR for MI stimuli (sum of blue bars divided by the sum of blue and red bars) in VibraNLP program Final page (Minkin & Nikolaenko, 2020).

$$MI+ = \frac{\sum_{1}^{6} MI_i}{\sum_{1}^{6} \left(MI_i + F_i\right)}$$

Where: MI+ shows the ratio of the integral PPR for MI stimuli to the total PPR during testing;

F+ reduced total PPR on MI stimuli (sum of blue bars divided by the sum of blue and red bars)

$$F+ = \frac{\sum_{1}^{6} F_i}{\sum_{1}^{6} \left(MI_i + F_i\right)}$$

Where: F+ shows the ratio of the integral PPR for the Factor stimuli to the total PPR during testing.

Test passing criteria:

$(MI+) - (F+) > 0$ **NDI**

The subject has no predisposition to the investigated factor (score 1) if his PPR for neutral MI stimuli is greater than for the Factor's stimuli. In the opposite case, the assessment of the predisposition to current IFS is 0.

2. MI(3), F(3) for integral (conscious + unconscious) PPR (main result).

MI(3) reduced total PPR for significant MI stimuli for three maximum responses to MI stimuli (the sum of 3 maximum blue bars divided by the sum of 3 maximum blue bars and the corresponding red bars)

$$MI(3) = \frac{\sum_{1}^{3} MI_s}{\sum_{1}^{3} \left(MI_i + F_i\right)}$$

Where: MI (3) shows the ratio of the integral PPR for significant MI stimuli to the total PPR during testing.

F(3) is the reduced total PPR for significant Factor stimuli for the three maximum responses to Factor stimuli (the sum of 3 blue bars corresponding to the maximum red bars, divided by the sum of the 3 maximum blue bars and the corresponding red bars).

$$F(3) = \frac{\sum_{1}^{3} F_s}{\sum_{1}^{3} \left(MI_s + F_s \right)}$$

Test passing criteria:

$$MI(3) - F(3) > 0 \text{ NDI}$$

The subject has no predisposition to the investigated factor (score 1) if his PPR is by 3 leading MI stimuli more than the PPR from the corresponding Factor stimuli. In the opposite case, the assessment of the predisposition to current IFS is 0.

3. MI + (IE), F + (IE) the calculation of this parameter is similar to the calculation of the previous parameter MI(3), F(3) only the psychophysiological responses are summed up over 6 relevant pairs of MI and 6 pairs of multifactorial stimuli responses without conscious responses.

The subject has no predisposition to the investigated factor (score 1) if his total PPR for all 6 MI stimuli is greater than the total PPR for multifactorial stimuli.

4. MI(3IE), F(3IE) for stimuli of unconscious PPR (tables — IE Result, Main Result).

MI(3IE) reduced unconscious PPR to MI stimuli (the sum of blue bars divided by the sum of blue and red bars of the unconscious reaction).

$$MI(IE) = \frac{\sum_{1}^{6} MI(IE)_i}{\sum_{1}^{6} \left(MI\,(IE)_i + F(IE)_i \right)}$$

Where: MI(3IE) shows the ratio of the integral PPR for 3 significant MI stimuli to the total PPR during testing.

F(3IE) is the reduced total PPR for significant stimuli for the three maximum responses to Factor stimuli (the sum of 3 blue bars corresponding to the maximum red bars, divided by the sum of the 3 maximum blue bars and the corresponding red bars).

$$F(IE) = \frac{\sum_{1}^{6} F(IE)_i}{\sum_{1}^{6} \left(MI\,(IE)_i + F(IE)_i \right)}$$

Test passing criteria:

$$MI(IE) - F(IE) > 0 \text{ NDI}$$

The subject has no predisposition to the investigated factor (score 1), if his unconscious PPRfor MI stimuli is greater than that for the Factor's stimuli.

$$MI(IE) - F(IE) < 0$$

$$F(U) - F(S) > 0 \text{ NDI}$$

A subject has no predisposition to the investigated factor (score 1), if his unconscious PPR for corresponding of MI stimuli is greater than PPR for significant stimuli of the Factor. In the opposite case, the assessment of the predisposition to current IFS is 0.

5. F(U), F(S) for the stimuli of the unconscious PFR (tables — IE Result, Main Result).

F(U) reduced total unconscious response to 3 insignificant factor stimuli.

$$F(U) = \frac{\sum_{1}^{3} F(IE)_u}{\sum_{1}^{6} F(IE)_i}$$

Where: F(U) shows the total response to insignificant stimuli of the factor. The significance of the factor stimuli is determined by the unconscious response to the MI stimuli.

F(S) reduced total unconscious response to 3 significant factor stimuli.

$$F(S) = \frac{\sum_{1}^{3} F(IE)_s}{\sum_{1}^{6} F(IE)_s}$$

Where: F (S) shows the total response to significant stimuli of the factor. The significance of the factor stimuli is determined by the unconscious response to the MI stimuli.

Test passing criteria:

$$F(U) - F(S) > 0 \text{ NDI}$$

The subject has no predisposition to the investigated factor (score 1), if his unconscious PPR for insignificant stimuli of the Factor is greater than that of PPR for significant stimuli of the Factor.

The high sensitivity of the subject's PPR to insignificant stimuli of the factor indicates the absence of dependence on the Factor.

Thus, 5 independent assessments of the subject's predisposition to the investigated factor are determined.

The main result of psychophysiological testing is the investigated factor score (IFS) showing the predisposition of a subject to the investigated factor, which includes the sum of all 5 independent assessments, each of which gives 1 point in the absence of the subject's predisposition to the investigated factor, or 0 in the presence of such a predisposition. Thus, the complete absence of predisposition to the investigated factor is estimated at 5 scores, and the complete dependence of the subject on the factor will give a zero score.

Results

The described method of psychophysiological testing is based on obtaining a single assessment of the paired stimulus, and in the work (Minkin & Myasnikova & Nikolaenko) it was shown that it is not necessary to use oppositional stimuli in a pair. The reverse direction of movement and regulatory fluctuations relative to the center of the PPS occurs both with sequential presentation of oppositional and non-oppositional stimuli when adjusting the rhythm of brain activity to PESP. The ideal picture of the PPS response to a paired stimulus, displayed in time coordinates and information-energetic axes, is shown in Figure 1.

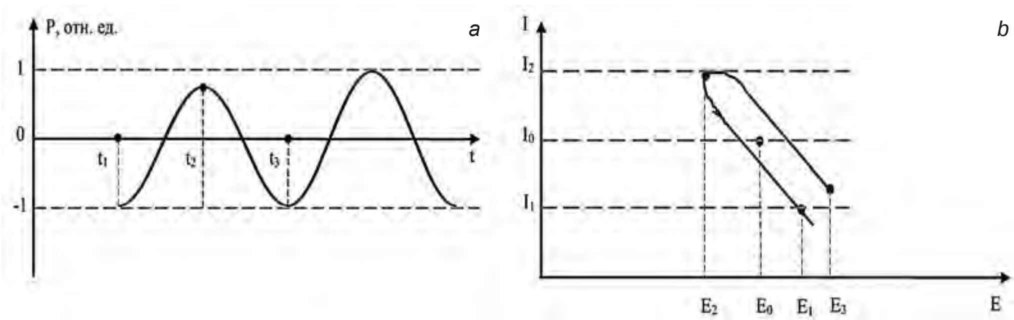

Fig. 1. *Ideal psychophysiological response to stimuli, displayed along the time axis (a) and in the information-energy axes (b).*

T1 is the moment of the beginning of the presentation of the first stimulus, T2 is the moment of the beginning of the presentation of the second stimulus, T3 is the moment of the beginning of the presentation of the third stimulus, I0 E0 are the coordinates of the center of the PPS, relative to which the current PPS oscillates

A slightly different amplitude of the PPS change for the first and second periods (Fig. 1) characterizes the different psychophysiological reaction of the subject to the stimuli presented. Of course, the real change in PPS does not occur as evenly as in the presented ideal Figure 1. Figure 2 shows the change in PPS measured by the VibraNLP program in the same axes during real testing with 24-stimulus questionnaire LOf15.ldq with PESP of 15 seconds.

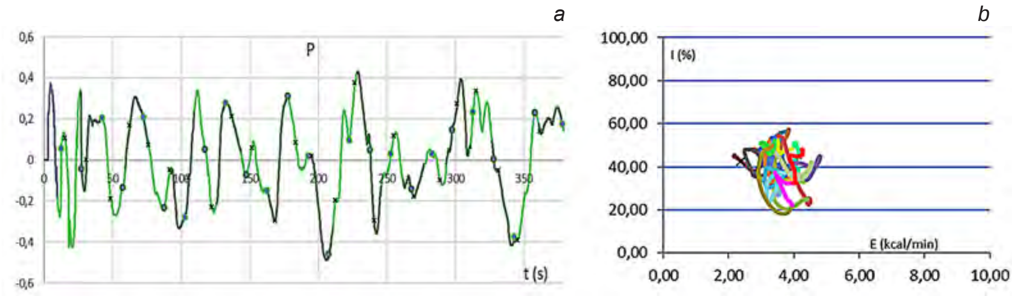

Fig. 2. *Real psychophysiological response to stimuli, displayed along the time axis (a) and in the information-energy axes (b). The result of current PPS, file M, VibraNLP program, testing with the LOf15.ldq questionnaire*

For the classical methods of psychophysiological testing with a high level of PESP, the paired response was calculated as the difference between the first and second responses to stimuli (Minkin & Nikolaenko, 2017), since the directions of PPS changes during the first and second stimuli were mainly opposite. In this case, BAP is close to the doubled PESP and is approximately 30 seconds (Minkin, 2020).

In the work presented at this conference (Minkin, 2021a), was shown that in most cases, a decrease in PESP of the same stimuli leads to an increase in BAP, since consciousness cannot cope with the processing of incoming information and transfers part of the functions for analyzing stimuli to the unconscious physiological processes. If BAP increases and the ISPP decreases, then this naturally leads to the fact that during the regulatory fluctuations of the PPS, there are several stimuli per deviation in one direction from the center.

Even if BAP does not increase, but slightly decreases, it still cannot catch up with the reduced period of presentation of stimuli, and there are several stimuli for one half-period of the PPS change. A schematic picture of the change in brain activity for several stimuli with a shift in processing from consciousness to unconscious shown on Figure 3.

In the case of transferring the processing of stimulus information from consciousness to the unconscious, there are several stimuli for one drop in the change in brain activity from minimum to maximum (or from maximum to minimum), as shown in Figure 3.

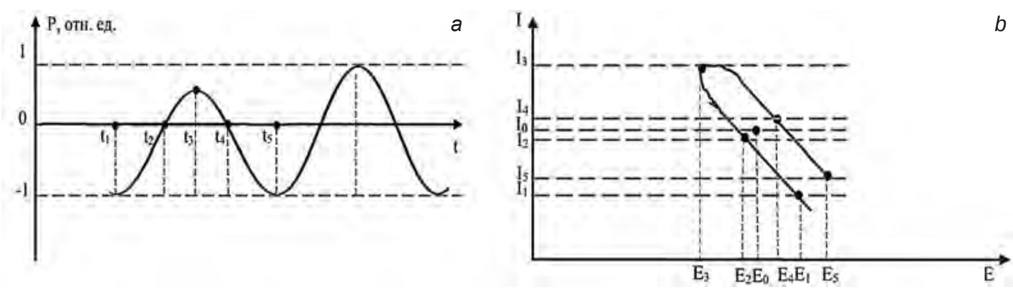

Fig. 3. *Schematic PPR to stimuli, displayed along the time axis (a) and in the information-energy axes (b).*

T1 is the moment of the first stimulus presentation start, T2 is the moment of the beginning of the presentation of the second stimulus, T3 is the moment of the beginning of the presentation of the third stimulus, I0 E0 are the coordinates of the PPS center, relative to which the current PPR oscillates

The real picture of the transfer of functions from consciousness to the unconscious with a change in the PPS close to sinusoidal is shown in Figure 4 for a reduced PESP relative to the possibilities of conscious processing.

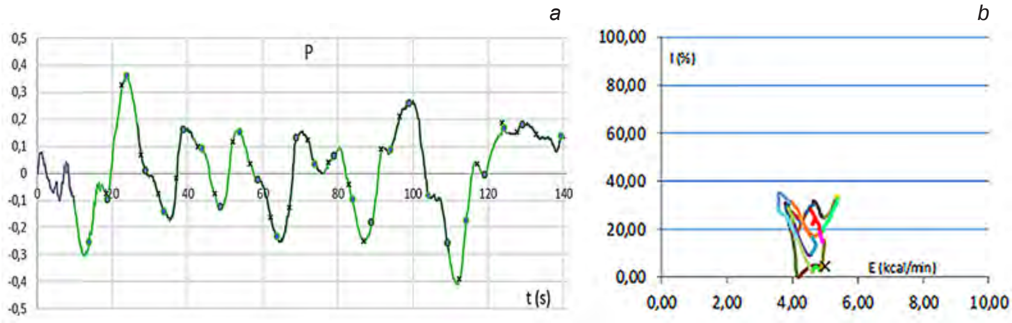

Fig. 4. *Typical psychophysiological response to stimuli, displayed along the time axis (a) and in the information-energy axes (b) when transferring conscious processing to unconscious processes.*

T1 is the moment of the beginning of the presentation of the first stimulus, T2 is the moment of the beginning of the presentation of the second stimulus, T3 is the moment of the beginning of the presentation of the third stimulus, I0 E0 are the coordinates of the center of the PPS, relative to which the current PPS oscillates

It turns out that for such PPS (with a processing bias towards unconscious physiological processes), the usually used differential algorithm for evaluating paired stimuli ceases to work correctly (Minkin & Nikolaenko, 2017; Minkin & Myasnikova & Nikolaenko, 2019) and it needs to be replaced with a total assessment of the PPS change modules for paired stimuli. Most likely, this is what caused the decrease in IFS with a decrease in PESP from 15 to 5 seconds, shown in (Minkin, 2021a). Figure 5 shows the IFS-BAP histograms obtained by various algorithms — differential to paired stimuli (a) and summation of paired stimuli modules (b).

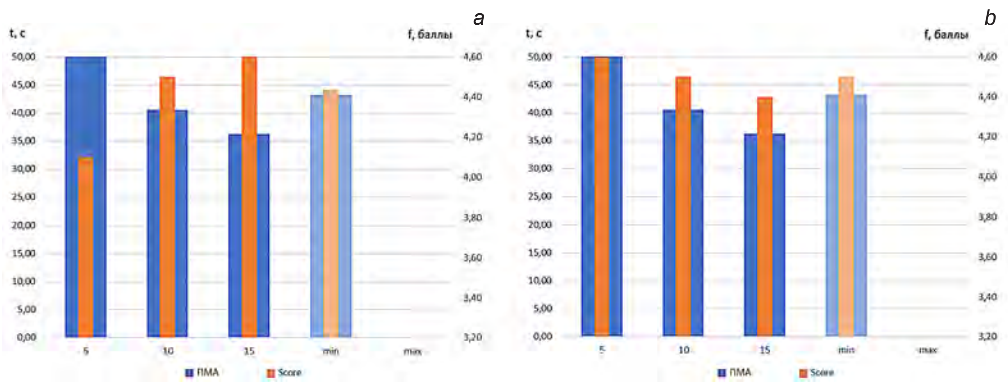

Fig. 5. *Dependence of BAP and IFS (with different algorithmic calculations of paired stimuli) on the PESP (5, 10, 15 s) at the start of program stimuli with Min PPS at fixed program settings. N = 25. The left vertical axis is the BAP, the right vertical axis is the IFS (Score)*

The results on Figure 5 show that the dependence of IFS on the PESP is opposite in the differential and total algorithm for calculating paired stimuli. The maximum IFS = 4.6 with the traditional differential algorithm for calculating paired stimuli (Fig. 5a) corresponds to the maximum PESP = 15 s, which corresponds to the previously known results (Minkin, 2020). However, when the PESP is reduced to 5 and 10 seconds, the differential calculation algorithm stops working correctly, which leads to a decrease in IFS.

In contrast to the traditional differential algorithm for calculating the PPR for paired stimuli, the summary algorithm shows a higher (and therefore correct) score for the response (also 4.6) to paired stimuli with a minimum of PESP.

Discussion

The famous Russian film director and theorist of cinematography Lev Kuleshov argued that editing is the basis of cinematography (Kuleshov, 1929). Almost a hundred years later after Kuleshov effect discovery, it became obvious to me that montage is also one of the psychophysiological testing foundations. The results of this article show, the psychophysiological response to presented stimuli largely depends on the sequence of stimuli and the duration of their presentation. It seems that from a scientific point of view, cinema and psychophysiology solve similar problems.

The task of cinematography is to change the psychophysiological state of the audience due to visual and audio stimuli, and the greater PPS changes of audience occurs during the film and at the end of the film, the more audience would be next and the greater the box office receipts. Cinematography is clearly ahead of psychophysiology in its development, the best films have hundreds of millions of views, therefore, the development of a stimulus series in modern cinema is significantly superior to modern psychophysiological tests.

The task of almost any psychophysiological testing with the presentation of stimuli is to divide the subject's personality into component characteristics (Nikolaenko, 2020). Ideal external stimuli decompose the personality into independent components in the same way as an optical prism decomposes white light into different color spectra. More correct stimuli selection gives clearer responses of the subjects, the optimal task of testing is to decompose personality characteristics into the minimum number of independent components that cover all the properties of the personality.

As in technology, spectral analysis allows to reveal the smallest content of any impurity, so in psychophysiology, correctly selected multifactorial stimuli allow you to identify the smallest pathology of consciousness and unconsciousness, any predispositions and inclinations of a person's character. Psychophysiological laws are just as objective as physical ones, the only difference is that it is necessary to jointly consider the processes of consciousness and the unconscious, and not to be isolated on each of them separately.

The fact that the conscious information processing can be nonlinear (Penrouse, 1994) does not exclude their physical nature and does not interfere with their physical processing, this is how any neural network works (Novoseltsev, 1978). Unconscious information processing processes can most likely be both linear and non-linear or intuitive. Although there is still a long way to go before the creation of standard stimulatory multifactorial prisms that unambiguously decompose a personality into a spectrum, this does not mean that the proposed path is wrong.

The consideration of dynamic responses of consciousness and unconscious should lead to better understanding of the personality. It is necessary to conduct massive research with the registration of dynamic dependences of conscious and unconscious responses to stimuli. Only an integrated approach can provide an understanding of statistical patterns and objective components of a person's personality. A separate measurement of psychophysiological parameters, prevailing in psychophysiology at the present time (Tao & Tan, ed. 2009; Zhou et al., 2011; Giannakakis et al., 2019), does not contribute to the understanding of general patterns between conscious and unconscious, due to the huge number of feedbacks between these processes.

IFS dependences on the PESP shown in Figure 5, of course, need to be confirmed using more statistical material. However, the obtained result is quite interesting, since it shows the possibility of having the same group testing IFS = 4.6 with a minimum PESP = 5 seconds as with a large 15-second period. In this case, it is necessary to change the algorithm for calculating the response to paired stimuli.

This is probably due to the fact that with a decrease in the PESP, an increase in BAP occurs and the physiology of the subject's response to stimuli changes. There is a redistribution of functions from consciousness to unconscious or intuitive processes of evaluating stimuli. It is possible that the absolute coincidence of the maximum BAP determined by the PPR for different calculation algorithms is a random phenomenon, but the tendency for the BAP to change from the PESP is hardly random, since it is also confirmed on a much larger sample with different program settings, although not so clearly expressed (Minkin, 2021a).

The research carried out, of course, does not answer all the questions concerning the work of consciousness. In my opinion, it allows one to measure the dependences connecting conscious and unconscious PPR with dynamic characteristics, external factors and open algorithms for measuring psychophysiological characteristics while combining the inseparable issues of chronobiology and psychophysiology. Carrying out a similar study with the help of other physiological signals could supplement the information obtained by vibraimage technology.

Conclusion

The need to take into account chronobiological signals and synchronize external stimuli to BAP for correct measuring of PPR, shown in (Minkin & Blank, 2021), is confirmed by the results of this work.

It is shown that the amount of information processed by a person affects the organization of its processing; with an increase in the input information flow, part of the processing functions are transferred from conscious reactions to unconscious ones. For complex visual and textual stimuli, such a transmission process occurs (for most of the subjects) when the PESP decreases below 16 seconds. At the same time, there are subjects for whom PESP threshold is much lower and can be 3–5 seconds.

The research of various options for calculating subject's PPR for paired stimuli, depending on BAP, open additional possibilities for the practical analysis of personality characteristics and a person's predisposition to investigated factor. BAP is the indicator of relationship between conscious and unconscious physiological processes during testing. A significant increase in BAP relative to the double PESP indicates the transfer of the functions from conscious processing to unconscious and intuitive processes.

The obtained results confirm the possibility of minimizing the testing time (up to 5 seconds per stimulus) for study the subject's IFS predisposition while maintaining (90–95)% accuracy of obtaining the result (Minkin, 2019) relative to the standard testing time with PESP higher 16 second per stimulus. The total testing time with the presentation of 12 stimuli (6 neutral and 6 multifactorial) can be 60 seconds while maintaining an acceptable accuracy in assessment of subject's IFS.

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