Application of Vibraimage Technology for the Study of Individual Characteristics of Psychophysiological States of a Person During a Long Time

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Abstract: *Research of psychophysiological state changes of a person over a long period of time was carried out with the help of vibraimage technology by the system of psychophysiological control of a person (Vibraimage8.1) and program (VibraStat) produced by Elsys Corp (St. Petersburg, Russia). During processing of the study results, individual features of psychophysiological states of different people were revealed.*

Keywords: *researches, vibraimage technology, personal characteristics, psychophysiological state.*

Psychophysiological State of a Person

The concept of "state" is currently a general methodological category. It is also used by scientists in various sciences (physics, chemistry, philosophy, physiology, psychology, medicine, etc.), and in everyday speech ("I am not able to help you", "This thing is in good state", etc.). In the most general terms, this concept denotes a characteristic of the existence of objects and phenomena, the realization of being at a given and all subsequent moments of time. In the scientific literature, when describing human states, various designations are used: mental states, emotional states, functional states, physiological and psychophysiological states (PPS) of the body. Mental state (MS) as an independent category was identified by Myasishchev (Myasishchev, 1966), but the first fundamental consideration of the problem of mental states was carried out by Levitov in 1964 (Levitov, 1964). Over the next half century, more than two dozen monographs have been published, as well as many articles, which reflect the author's positions in relation to various aspects of the state.

In subsequent years, the study of the problem of normal human states was carried out in two directions: physiologists and psychophysiologists studied functional states, and psychologists — emotional and mental ones. In fact, the boundaries between these states are often so blurred that the only difference is in their name. States characterize different levels of a person: physiological, psychophysiological and mental. However, always a state is a reaction of the body and psyche to external influences. From the standpoint of the problems of working person's health, the approach developed by Ilyin (Ilyin, 2005). The researcher examines the conditions that develop in a person in the process of activity and affect both his physiological and mental structures. He calls such states psychophysiological (separating them from the elementary physiological states of arousal and inhibition) (Levitov, 1964).

The need for a systematic approach to the study of mental or psychophysiological states of a person is because any such state of a person is a reaction not only of the

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psyche, but also of the whole organism and personality as a whole with the inclusion of both physiological and mental levels (subsystems) of regulation in the response. The first attempt to isolate psychophysiology as an independent branch of psychology is associated with the name of the German psychologist Wundt, who introduced the experimental method into psychology (Wundt, 2007). The term "physiological psychology" has become widespread in the West. Peter Milner, one of the closest associates of the Canadian psychologist Hebb, known for his work in the psychophysiology of attraction, published the textbook Physiological Psychology (Milner, 1973). As a new direction, psychophysiology received official status only in May 1982, when the First International Congress of Psychophysiologists took place in Montreal. The International Psychophysiological Association was created on it and the beginning of international congresses on psychophysiology was laid (Danilova, 2001).

In general terms, the structure of the psychophysiological state of a person can be represented in the form of a diagram (Fig. 1).

I. Mental level of response
Experiences, mental processes

II. Physiological level of response
Vegetative response Somatics (psychosomatics)

III. Behavioral level of response
Behavior Communication Activities

Fig. 1. Structure diagram of psychophysiological states

Minkin notes that since each psychophysiological state contains psychological, physiological and behavioral components, then in the descriptions of the nature of behavioral states one can find concepts from different sciences (general psychology, physiology, medicine, biology, labor psychology, etc.). At the same time, there is no single point of view on the problem of the origin and measurement of psychophysiological states, since they are at the same time slices of personality dynamics, conditioned by its relationships, a variety of feedbacks, behavioral needs, motivation, goals of activity and adaptability in the environment and situations (Minkin, 2020).

According to Danilova, the main discussion about the opinion to consider the study of the neural mechanisms of mental processes and states as the subject of psychophysiology, or to limit the task of psychophysiology to the study of the physiological mechanisms of mental phenomena at the macrolevel by registering objective indicators, like EEG, evoked potentials, GSR, etc. (Danilova, 2001). The discussion arose due to the impossibility of using the research methods available at that time to simultaneously assess not only the nature of changes in any individual indicator (physiological or psycho-emotional) of a person's state during the research, but also their relationship. It makes possible to assess

only one component of the psychophysiological state or on the level of psycho-emotional state or emotions, or at the level of physiological (energy) reactions.

The lack of understanding of information-energy mechanisms interaction between human physiological systems under the influence of changing external factors and the limited ways to objectively measure information exchange between human physiological systems leads to the lack of generally accepted approaches to determining the behavioral characteristics of a personality (Minkin, 2020).

In addition to the above factors, the available methods of PPS research: psychodiagnostic tests MMIL, 16 FLO Cattell, Raven test, USC, psychophysiological methods for assessing simple (SMR) and complex (CMR) visual-motor response, response to a moving object (RMO), physiological methods for assessing cardiac variability rhythm (HRV), blood pressure measurement — require significant time.

Many of the above tasks can be solved by the vibraimage technology (Minkin, 2007; 2020; Vibraimage 8PRO, 2015), which was originally (since the discovery of the vestibular-emotional reflex) was developed to control the psychophysiological state of a person. The main advantage of vibraimage technology is that, in addition to the time dependences of physiological parameters, it allows obtaining multidimensional psychophysiological dependences. At the same time, the time for recording the parameters of the vibraimage for one subject is only 1 minute.

Methods and Materials

The studies were carried out using a system for monitoring the psycho-emotional state of a person (Vibraimage 8PRO, 2015). The system for monitoring the psycho-emotional state of a person (hereinafter referred to as the vibraimage system or vibraimage) is intended for registration, analysis and research of the psycho-emotional state of a person, quantifying the levels of emotions, detecting lies, psychophysiological diagnostics and remote detection of potentially dangerous people. The system allows visually and automatically assess the psychophysiological state of a person based on the vestibular-emotional reflex, using the programmed visualization of vibra-aura, obtained by processing the components of the amplitude and frequency vibraimage. In the research, the M mode was mainly used. The M mode allows you to control the average values of the parameters of the psycho-emotional state of a person and their deviation from the established norm over the period. Vibraimage system analyzes various parameters of micromovements and motor activity of the human head at the physiological level, associated with the psycho-emotional state. The main purpose of this mode is to use the vibraimage system for medical diagnostics and psychological research.

The studies have been carried out over several years with a wide variety of age groups of people. The PPS characteristics were measured for different time periods from 6 months to several years. The frequency of measurements varied from 2 weeks to 1 month. The measurement results were processed using the VibraStat program (VibraStat, 2020), which is designed to statistically process the results of the Vibraimage 8PRO program and improve the accuracy of determining the psychophysiological state of a person or a group of people using vibraimage technology (Minkin, 2007; Vibraimage 8PRO, 2015).

The initial data for the program are *** _ measurement.xml files, which were recorded in the Vibraimage 8PRO program. The analysis uses the mathematical expectation M, standard deviation S and variability V of the following psychophysiological parameters of a person measured in M mode by the Vibraimage 8PRO program:

T1 — parameter Aggression (P7);
T2 — parameter Stress (P6);
T3 — parameter Anxiety (F5X);
T4 — parameter Danger (P19);
T5 — the Balance parameter (P16);
T6 — parameter Charisma (Charm) (P17);
T7 — parameter Energy (P8);
T8 — parameter Self-regulation (P18);
T9 — parameter Braking (F6);
T10 — parameter Neuroticism (F9).

The results of the program forms from graphs and tables.

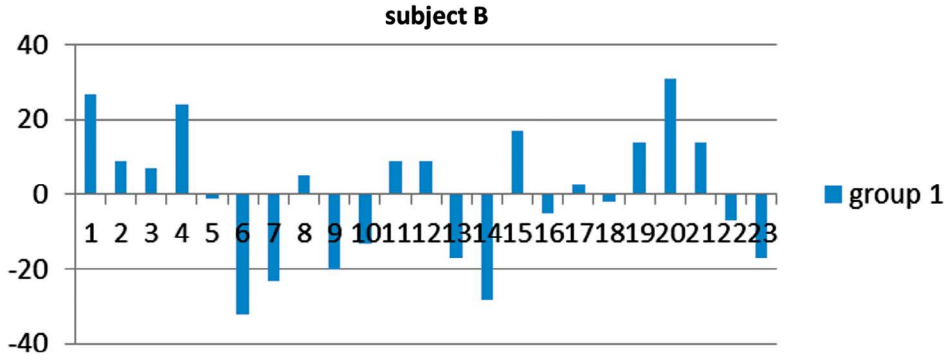

Fig. 2. Histogram of T1–T10 parameters total variability (Vs) changes of person B investigation during 23 measurements

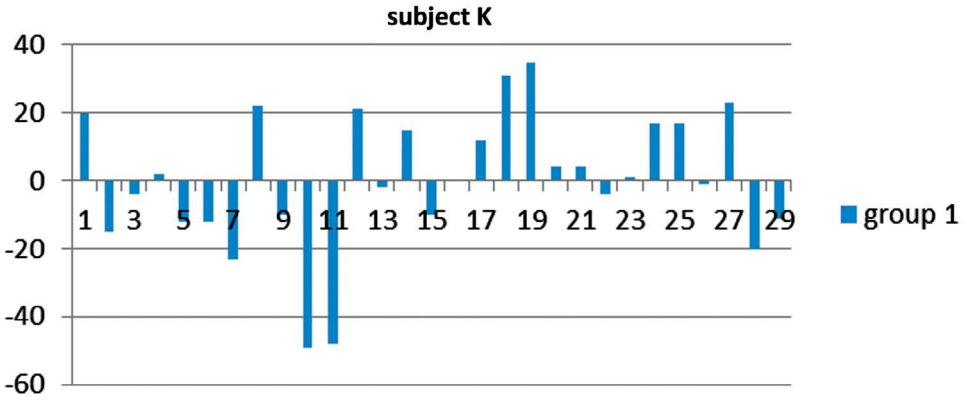

Fig. 3. Histogram of T1–T10 parameters total variability (Vs) changes of person K investigation during 29 measurements

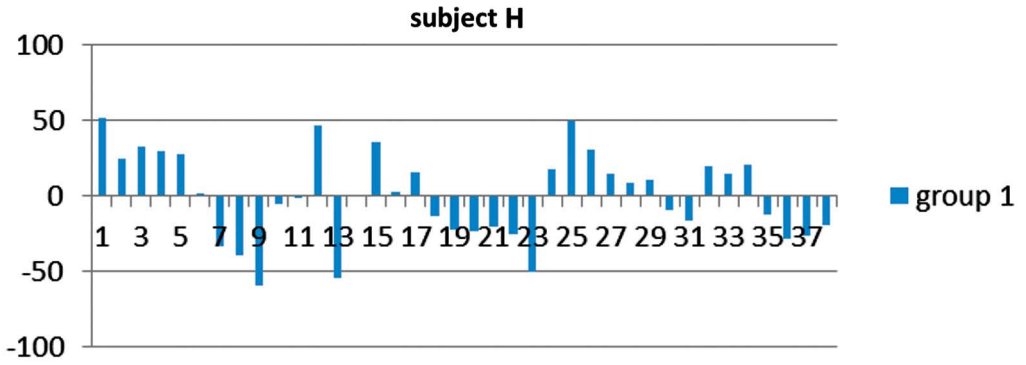

Fig. 4. Histogram of T1–T10 parameters total variability (Vs) changes of person H investigation during 38 measurements

Figures 2, 3, 4 show histograms of the relative change in total variability Vs of T1–T10 parameters for different people. The number of measurements varied from 23 to 38. The measurements were carried out over 7–12 months. In this measurement, we are dealing with a certain PPS indicator averaged for each measurement, which includes all T1–T10 parameters. The study involved 53 people. As an example, the histograms of 3 people are given, since the rest of the histograms reflect the general trend, which shows a constant change in PPS over a long time in all research participants.

The Stat sheet, which provides generalized statistics for the parameters M, **σ**, V, allows to study the average PPS of each individual person for the studied period of time.

Table 1

Stat List

Emotion parameters	M1 avg	S1 avg	V1 avg
T1	50	6,3333	14
T2	32,667	5,6667	18,667
T3	35	9,6667	27,667
T4	39	8,3333	20,333
T5	62	7	12
T6	70,333	9	13
T7	24,667	7,3333	41
T8	65	6,3333	10,333
T9	14,333	1,6667	15,667
T10	23	4,3333	21,333

Table 2

Summary table of the parameters of the mathematical expectation (M1-M8) avg T1–T10 parameters

Emotion parameters	M1 avg	M2 avg	M3 avg	M4 avg	M5 avg	M6 avg	M7 avg	M8 avg
T1	40,556	38,154	46,533	37,417	42,417	41,5	40,553	47,875
T2	29,333	24,231	24,267	28,25	26,75	27	27,789	23,875
T3	35,889	34,577	35,533	38,917	36,583	42	34,368	34,5
T4	35,111	32,385	35,6	34,417	35,417	36,5	34,158	35,5
T5	65,944	68,962	61,867	67,417	66,667	68	63	67,375
T6	77,111	78,808	78,067	77,167	76,833	76,5	74,605	78,875
T7	26,111	29,423	28,4	23,917	29,417	30	23,368	35,5
T8	71,167	73,769	69,6	72,083	71,667	71,5	68,053	73
T9	19,333	19,769	20,733	17,75	21	17	19,421	20,125
T10	26,722	30,346	33,667	24,25	35,167	24,5	32,921	31,375

Table 3

Summary table of parameters of standard deviation (S1-S8) avg T1–T10 parameters

Emotion parameters	S1 avg	S2 avg	S3 avg	S4 avg	S5 avg	S6 avg	S7 avg	S8 avg
T1	3,9444	5,2692	3,8	4,25	4	3	6,1316	5,25
T2	3,6667	5,0769	3,2667	3,8333	3,75	4	5,8947	4,625
T3	7,2778	7,1154	5,7333	7,5	6,5	5	7,6053	7,5
T4	2,6667	3,4615	2,4	2,9167	2,75	2	4,5263	3,75
T5	6,1667	6,6538	6,4667	7,4167	4,8333	5,5	8,0789	6,125
T6	3,7222	5,4615	3,4667	5	2,75	3	9,0789	4,375
T7	3,7222	5,9615	4,2	3,6667	4	3,5	6,3421	5,625
T8	3,8889	4,9231	3,5333	5,0833	2,75	3	6,6316	4,25
T9	2,2778	2,5769	2,9333	2,0833	2,9167	2	2,8158	2,75
T10	6,1667	6,8462	8,5333	4,5833	8	5,5	7,8421	7,125

Tables 2 and 3 summarize the mean values of the mathematical expectation M, the standard deviation S of the parameters T1–T10, measured in the M mode by the Vibraimage 8 program (Vibraimage 8PRO, 2015). The tables show the results of studies of 8 different people. The studies were carried out for 6–12 months. Research data show that each person we observe their own parameters, which differ from those of other research participants. This pattern is observed when the number of research participants expands.

Table 4

Sheet M-mathematical expectation for all parameters T1–T10 for 16 measurements

T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
46	38	25	36	63	72	23	66	17	28
44	32	28	35	63	72	24	68	18	32
34	28	39	34	67	80	18	74	22	44
35	29	35	33	63	79	20	71	19	24
44	22	38	34	67	77	41	72	31	67
41	25	39	35	74	76	36	75	27	35
47	20	38	36	68	81	38	75	19	50
46	15	38	34	74	80	47	78	20	38
40	28	39	36	65	76	20	69	19	29
44	30	42	38	60	74	23	67	21	28
47	29	39	39	67	76	31	71	20	29
41	25	39	35	69	79	32	74	19	18
46	30	44	40	59	76	28	68	19	43
47	21	41	36	61	80	29	71	18	31
47	20	36	35	61	82	31	71	17	46
48	29	44	40	58	73	26	65	14	23

On all the graphs and tables that we considered above, the averaged indicators of all measurements were given for all parameters T1–T10, or for each of the parameters T1–T10.

Table 4 presents Sheet M, which shows the calculation of the mathematical expectation M (MO) for all parameters T1–T10. The number of rows in the table corresponds to the number of measurements, in this case 16th. It makes possible to study each PPS parameter separately.

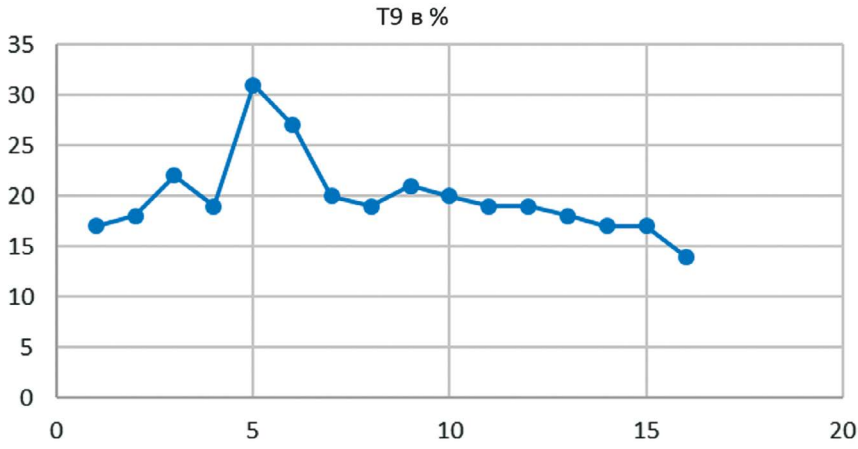

Fig. 5. Graph of parameter T9 change — Braking for 16 measurements

Figure 5 shows a diagram of the change in the parameter T9-Inhibition for 16 measurements. The measurements were carried out for 5 months. It can be clearly seen from the diagram that two indications of the Braking parameter stand out from the general row, which are equal to 27 and 31. They are higher than the rest of the indications. These readings correspond to the 5th and 6th measurements, which were carried out on day 1. From the description of the subject of his state on the day when the measurements were made, it follows that his actions were inhibited relative to the rest of the days, which almost led to several accidents. After a couple of days, signs of SARS appeared.

As you know, any reaction of excitable systems has a delay in its manifestation — a latent or latent period. It is associated with overcoming the inertia of the previous state and the formation of a system that must respond to the impact. When a person gets into a particular situation, psychophysiological conditions do not develop “right off the bat”. After the latent phase, the second phase begins — a visible (fixed) reaction to the action of this factor. That clearly captures this example. Thus, the development of states is the adaptation of the organism to new external conditions and influences.

Discussion

Studies have shown that human PPS changes depending on external conditions. The influence of the season, psychological experiences, state of health and many other factors on PPS was revealed. The body adapts to external conditions by changing these conditions. We can note the change in states daily, and the average change in states over a long time. Average changes in PPS over a long period of time are relatively constant and individual for each person.

With respect to the individual average PPS indicators (PPSS) that the PPS parameters (PPSV) can be analyzed, which are measured at each separate time interval. For deviations of the PFSP from the PFSS, it is possible to develop and carry out therapeutic measures.

Great prospects open up in the study and analysis of changes in each of the parameters T1–T10 separately. The results of such studies can be applied in the practice of various specialists working with people.

Conclusion

Vibraimage technology allows researching the individual characteristics of psychophysiological state of a person for a long time. The main advantages are friendly testing and the possibility of simultaneous study of different PPS parameters of a person.

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