STUDY OF PSYCHOPHYSIOLOGICAL PROCESSES IN STUDENTS WITH DIFFERENT BIOLOGICAL PROFILES

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The interest in the concept of time in medicine, biology, and ecology has significantly increased recently. In biological and medical sciences, unfortunately, this factor gets too little attention, although chronobiology as a research field has already gained recognition in many countries. The issues of biorhythmology are closely related to one of the most important problems of modern natural science – the problem of adaptation, one of the fundamental characteristics of living matter. This trait is inherent in all forms of life and is so all-encompassing that, like biorhythms, it can be equated with the concept of life itself. Without adaptive abilities, it would be impossible to synchronize one's life processes with the rhythms of the surrounding environment. Biorhythms are a part of adaptation processes, and they represent the most distinct aspect of these processes [4, 9, 10].

Cyclicality is a fundamental property of all living systems and a necessary condition for their functioning. This is because all processes occurring within an organism cannot follow a linear course. Instead, they represent alternating peaks and troughs. In biological systems, any activity must be followed by a decline for rest and recovery. Cyclicality, by its nature, is one of the principles of optimizing the functions of biological systems [2, 4].

Interest in studying human biological rhythms is primarily driven by the need to understand the mechanisms of adaptation to the environment. Thus, it is not by chance that the vast majority of studies on biorhythms are of a general biological, physiological, and medical nature [1, 3].

Numerous studies have identified relations between chronotype, personality, health, and quality of life. Today, approximately 400

physiological indicators in the human body are known to exhibit daily fluctuations [7]. At the same time, not only physiological but also mental processes display regular fluctuations throughout the day [6, 9, 13].

The combination of physiological and psychological traits forms specific individual characteristics allowing a person to develop their style of activity. Such a style ensures the fastest achievement of results with minimal spending on physiological and psychological resources. In the context of modern higher education institutions, where students face immense psycho-emotional and informational burdens, learning effectiveness is largely determined by shifts in activity toward morning or evening hours, i.e., the biological profile [4].

The influence of circadian rhythms on the performance of the cerebral cortex has been well studied, and there is evidence that the rhythmicity of physiological and behavioral processes correlates with the time of peak results. Most modern studies show that the optimal functioning of neural processes is achieved in the late afternoon to early evening, coinciding with the peak of core body temperature (16:00–18:00) [12]. Conversely, performance is considered to decline when core body temperature is at its lowest (03:00).

Personality traits associated with the morning type include conscientiousness and agreeableness. In contrast, neuroticism and openness to experience are typically linked to evening types [13]. Research has found conflicting evidence about whether extraversion is more representative of morning or evening types. Morning people generally perform better in school, while evening people may exhibit greater creative thinking abilities. It is difficult to say whether these traits are innate or shaped by secondary factors, such as the fact that school usually starts early, while many creative professions require evening activity [9, 11].

Evening people tend to have a more flexible sleep schedule, are less physically active, and sleep less on weekdays, compensating by sleeping more on weekends. These unhealthy habits lead to increased stress

responses, elevated cortisol levels, and higher resting heart rates, which are risk factors for sleep apnea, obesity, type 2 diabetes, mental disorders, and metabolic syndrome. Eveningness is also associated with impulsivity, anger, depression, and anxiety, along with several negative habits, such as risk-taking, skipping breakfast, eating more in the evening, using more electronic media, and consuming substances like tobacco, alcohol, and caffeine. Therefore, although some personality traits may be genetically determined, they are more likely the result of irregular sleep schedules caused by forced adaptation to earlier wake-up times. Many of these adverse effects are also linked to a mismatch between biological profiles and work schedules, regardless of whether someone is a “morning lark” or a “night owl”. This underscores the idea that one of the simplest ways to improve employee health may be to align work shifts with an individual's biological profile. Unfortunately, this is not always feasible and can severely limit career choices. For those who must adhere to a schedule that doesn’t match their chronotype, melatonin supplements, light therapy, or careful attention to sleep hygiene may help shift circadian rhythms to reduce insomnia. However, most people find that they cannot permanently change their biological profile [7, 10].

The role of biorhythms in enhancing both physical and mental productivity, as well as their impact on well-being and health, is of utmost importance. Additionally, the connection between biological cycles and the rhythms of creative activity in science and art is highly intriguing.

The purpose of the study is to determine the psychophysiological characteristics of students with different biological profiles of work capacity.

It is well known that the success of any activity, including learning, is determined by attention characteristics. One of these characteristics is stability, which refers to the ability to concentrate on the same object for a prolonged period [2, 3]. Since work capacity depends on both external and internal factors, including psychological characteristics, it is obvious that there should be a relationship

between attention stability and work capacity type. Identifying such a relationship is particularly relevant in the context of modern higher education. The educational process is still primarily oriented toward the average student, with little or no consideration given to individual characteristics that directly influence learning success: attention, memory, motor activity, their dynamics throughout the day, and their connection with the properties of the nervous system and biorhythmic characteristics [4]. Identifying such characteristics could help improve the efficiency of the educational process.

The study involved 46 individuals aged 17 to 20 years (18.03±0.13 years). To determine the biological profile, a questionnaire consisting of 19 questions regarding the temporal organization of a person's daily routine (optimal times for sleep, meals, physical exercise, and mental strain) was used. Based on the scores, the type of work capacity was determined: morning type – 59-86 points, indifferent type – 42-58 points; evening type – 41 or fewer points.

Concentration, stability, and switching of attention were estimated using the Bourdon correction test (Bourdon test). The criterion for attention was the number of missed unchecked signs, the time taken to complete the test, or the number of checked signs within 2 minutes with 60-second intervals [6, 7, 11]. According to the study's objective, attention stability was measured twice a day.

In the second series of experiments, the properties of the nervous system were assessed (using the Strelau test) — the strength of excitation, the strength of inhibition, and mobility. Each property was evaluated using a scoring system.

Based on the test to determine the biological profile of the students, three groups were identified: morning type, intermediate type (indifferent), and evening type.

The data we obtained indicate that the majority of students belong to the intermediate and evening types of work capacity (41% and 33%, respectively), while the morning type represents a minority –

26%. Thus, the predominance of evening and intermediate biological profiles among young students appears to be a general psychophysiological characteristic. Students' daily preferences may be influenced not only by their age but also by the nature of their activities. For instance, representatives of the morning or evening types are more common among individuals engaged in intellectual work, while those engaged in physical work tend to belong to the intermediate type of work capacity [8].

The evening type predominates among the males in the studied sample, while the intermediate and morning types are more typical among females. However, this difference is minor due to the small sample size, although some authors have reported a predominance of the morning and intermediate types among women in similar studies. Accordingly, there are significantly more representatives of the evening type among men. Additionally, scientific data suggest that this pattern may also be common among young people [5].

In our research, the observed gender differences can be explained, in our opinion, by the influence of both biological and social factors. From a biological perspective, the female body is more resilient to various factors and possesses more pronounced adaptive capabilities. An example of such adaptation is the indifferent type of work capacity, which is optimal for any form of activity. This biological profile allows a person to maintain an optimal level of activity over an extended period, creating conditions for high work efficiency [9].

To identify the psychophysiological characteristics of students with different biological profiles, the average values of concentration, stability, and attention switching based on the Bourdon correction test were calculated at different times of the day — in the morning and evening.

It was found that individuals with the morning type had the highest level of attention concentration compared to the other groups. The lowest level of attention concentration was observed among males of the intermediate type, while females of the same type had

slightly higher scores. Individuals classified as the evening type demonstrated average attention concentration.

Across the entire sample, slightly higher attention stability was noted among those with the morning type compared to other biological types. However, this higher stability was not significantly greater compared to individuals of the evening type (see Table 1). This minor discrepancy is likely random. Among individuals of the intermediate type, both males and females, attention stability and switching were significantly lower. The lowest attention stability was found in women of the intermediate type, which may indicate that early hours are less favorable for them.

Table 1 Average values of attention stability and switching in the morning hours among students with different biological profiles

Biological Profile	Entire Sample (n=46)	Men (n=22)	Women (n=24)
Attention Stability			
Morning Type (n=12)	3.42 ± 0.27*	3.60 ± 0.45*	3.29 ± 0.39**
Intermediate Type (n=19)	5.26 ± 0.44	5.13 ± 0.43	5.36 ± 0.53
Evening Type (n=15)	4.88 ± 0.35	4.78 ± 0.42	5.00 ± 0.47
Attention Switching			
Morning Type (n=12)	37.17 ± 2.17*	37.80 ± 3.83*	36.71 ± 3.03**
Intermediate Type (n=19)	54.05 ± 3.46	52.13 ± 6.20	55.45 ± 4.41
Evening Type (n=15)	53.80 ± 1.71	54.22 ± 2.44	53.17 ± 2.75

Note: * — significant differences in indicators between the morning and intermediate types ($p<0.05$); ** — significant differences in indicators between the morning and evening types ($p<0.05$).

Similar results were obtained regarding attention switching. The highest number of errors was found in individuals of both genders with the intermediate type, indicating a moderate level of attention switching. A significantly higher level of attention switching was

observed in men with the morning type compared to men with the intermediate type. Among women of the morning type, this indicator was slightly higher than that of the men. The evening type was also characterized by a moderate level of attention switching and differed slightly in men compared to the intermediate type.

According to the results obtained in the afternoon from the same participants (see Table 2), it was found that individuals of the evening type demonstrated greater attention stability than representatives of other biological profiles, but significant differences were found only among men. These differences indicate a decrease in attention stability and switching in individuals with the morning type during the evening hours.

Table 2 Average values of attention stability and switching in the evening hours among students with different biological profiles

Biological Profile	Entire Sample (n=46)	Men (n=22)	Women (n=24)
Attention Stability			
Morning Type (n=12)	4.17 ± 0.35	4.27 ± 0.34	4.08 ± 0.36
Intermediate Type (n=19)	4.98 ± 0.30	5.05 ± 0.33	4.92 ± 0.29
Evening Type (n=15)	3.67 ± 0.28*	3.64 ± 0.29*	3.71 ± 0.27
Attention Switching			
Morning Type (n=12)	46.72 ± 3.41	45.91 ± 3.40	47.46 ± 3.49
Intermediate Type (n=19)	55.01 ± 3.43	56.32 ± 3.35	53.79 ± 3.56
Evening Type (n=15)	40.43 ±2.64*	39.14 ± 2.81*	41.63 ± 2.51

Note: * — significant differences in indicators between the evening and intermediate types ($p<0.05$)

Based on the data obtained on attention stability and switching throughout the day (Tables 1 and 2), a dynamic of these indicators can be observed. For example, in women of the evening type, the indicator of attention stability slightly decreases from 5.00 ± 0.47 in the

morning to 3.71 ± 0.27 in the evening, indicating an increase in attention stability. A similar pattern is observed in men with the morning type (3.60 ± 0.45 in the morning and 4.27 ± 0.34 in the evening). In other groups, changes in attention stability are random, and if present, they are only at the level of trends. The attention switching indicator followed a similar trend of changes in individuals with different biological profiles.

The observed decrease in average indicators of attention stability and switching in individuals of the morning and intermediate types does not reflect individual tendencies. For example, in two groups, some individuals do not show a decrease in attention throughout the day.

In the second series of studies, the strength of excitation and inhibition, as the main properties of nervous processes, were determined. It is known that the strength of the nervous system is considered as the ability of neurons in the cerebral cortex to withstand strong or prolonged excitation. If attention stability is the ability to concentrate on a specific stimulus for a long period, then this ability is probably determined by the strength and/or inertia of the excitation process [8, 9, 13]. The strength, mobility, and balance of nervous processes were determined using the Strelau test (see Table 3).

Table 3 The degree of nervous system properties expression in individuals with different biological profiles, points

Biological Profile	Excitation strength	Inhibition strength	Mobility
Morning Type (n=12)	57.25 ± 2.22	55.08 ± 2.85	54.67 ± 3.40
Intermediate Type (n=19)	51.11 ± 1.53	57.21 ± 2.45	44.89 ± 2.57**
Evening Type (n=15)	49.73 ± 2.27*	59.47 ± 3.15	43.93 ± 2.90*

Note: * — significant differences in indicators between the evening and morning types ($p<0.05$); ** — significant differences in indicators between the evening and intermediate types ($p<0.05$)

It is easy to see that, on average, all the mentioned characteristics,

especially the strength of excitation, are more pronounced in individuals of the morning type compared to the other two groups. Inhibition strength is almost equally expressed in all three groups, with the highest values observed in individuals of the evening type. The level of mobility of nervous processes also has a higher average score in the morning type group. No significant differences were found between the intermediate and evening types in terms of all the nervous system properties. The balance of nervous processes in the three groups ranged from 0.85 in the evening type group to 1.07 in individuals of the morning type. Unbalanced nervous processes (balance index below 0.85) were found in 32% of the entire sample. A significant proportion of individuals with unbalanced nervous processes belonged to the evening type.

The conducted study allowed us to reflect the general trend in the manifestation of psychophysiological properties of the nervous system within each group. The manifestation of changes in attention indicators and the main properties of nervous processes represents a continuous, not discrete, series. In light of this, the relationship between the expression of the biological profile and the properties of nervous processes appears to be optimal. According to this relationship, individuals with a morning biological profile exhibit a more pronounced strength of excitation processes, which likely determines their increased attention stability in the morning hours. Conversely, in individuals with the evening type, the strength of excitation and attention stability is lower, indicating a predominance of inhibitory processes in such individuals.

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