SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

Proceedings of the International Conference

Date: July 30

Beijing, China 2025

上合组织国家的科学研究：协同和一体化
国际会议

参与者的英文报告

International Conference
“Scientific research of the SCO countries: synergy and integration”

2025年7月30日，中国北京
July 30, 2025. Beijing, PRC

Proceedings of the International Conference
“Scientific research of the SCO countries: synergy and integration” - Reports in English

(July 30, 2025. Beijing, PRC)

DOI 10.34660/conf.2025.49.75.088

这些会议文集结合了会议的材料 – 研究论文和科学工作者的论文报告。 它考察了职业化人格的技术和社会学问题。一些文章涉及人格职业化研究问题的理论和方法论方法和原则。
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经济新闻学的理论基础
THEORETICAL FOUNDATIONS OF ECONOMIC JOURNALISM

Gaidukova Valeria Vadimovna
Candidate of Economic Sciences
A.I. Kuindzhi Mariupol State University,
Mariupol, Russian Federation

摘要：目前，俄罗斯新闻理论领域的新研究成果层出不穷，这得益于社会的开放性以及国内理论融入世界科学话语的进程。俄罗斯研究人员高度重视媒体的经济层面，研究国内外经验，尤其关注媒体经济学、商业模式以及媒体在社会中的新功能。关于俄罗斯信息领域新兴媒体类型的研究成果层出不穷。迫切需要总结现有观点，理解新闻学在经济传播中的作用。本文探讨了“经济新闻学”的概念及其在知识体系中的地位，以及它与其他科学学科的关系。文中指出，大众传播理论是经济新闻学的基础理论，并分析了经济大众传播的特征。

关键词：经济新闻学，经济大众传播。

Abstract. *Currently, new studies in the field of journalism theory are actively published in Russia, which is facilitated by the openness of society and the integration of domestic theory into the world scientific discourse. Russian researchers pay significant attention to the economic aspects of the media, studying both foreign and domestic experience, especially in the field of media economics, business modeling and new functions of the media in society. Works are appearing on new types of media that have emerged in the Russian information space. There is a pressing need to generalize existing views and understand the role of journalism in economic communications. This paper examines the concept of “economic journalism” and its place in the system of knowledge, as well as the relationship with other scientific disciplines. It confirms that the theory of mass communications is a fundamental basis for economic journalism, and analyzes the features of economic mass communication.*

Keywords: *economic journalism, economic mass communication.*

The study of the influence of media content on the economic system of society should be based on the basic theories of communication, which form the basis of communication studies.

Communication studies is a science that studies the systems of means and humanitarian functions of mass information links formed at different stages of civilization development through various languages and discourses[1]. This area of scientific knowledge emerged in the mid-20th century in the United States and is developing in Russia taking into account domestic practice. Specialists from various fields participate in the development of communication studies: journalists, sociologists, political scientists, economists, cultural scientists, ethnographers, psychologists and philologists studying information and public relations. The theory of journalism is a part of communication studies and focuses on the media as a component of mass communication. For the theory of journalism, the theory of communications is one of the methodological foundations for studying the media [2].

Thus, the methodological basis of journalism, including economic journalism, as a practical activity, is the theory of journalism (communication studies, theory of mass communications). Mass communications are implemented through the media, which together form a media system. The media system is divided into structural elements determined by various criteria, such as technical and technological, economic, political, geographical and audience. Journalism is aimed at various audiences and satisfies a wide range of needs, including the need for information on politics, economics, the social sphere, history and culture. It forms the current agenda and provides information on various aspects of life. The complexity and specificity of forming the agenda and covering problems in these areas make it possible to distinguish different types of journalism, such as sports, social, political and economic [3].

The theoretical basis of economic journalism as a scientific field is the general theory of journalism. A distinctive feature of economic journalism from other types (for example, sports or political) both as a scientific direction and as a practical activity is its close relationship and dependence on other fundamental scientific disciplines, primarily economic theory, economic sociology and economic psychology. If we consider economic journalism as a scientific discipline, then this is a field of activity, the purpose of which is to develop and systematize objective knowledge about journalistic practice aimed at analyzing and forecasting economic development, considered as one of the forms of public consciousness. In the modern world, in the context of the transformation and development of the information society, economic journalism is acquiring the role of a driving force and an important social institution. It includes both the process of obtaining new knowledge and its totality - scientific knowledge accumulated to this point, and represents a separate branch of scientific knowledge. In a broad sense, the immediate goal of economic journalism is the theoretical reflection of reality [4]. The theory of journalism itself is the result of a complex interaction of the historical

process of differentiation (separation from other social sciences, such as history, sociology, psychology, etc.) and integration (unification of these same disciplines). Differentiation is due to the need to master new areas of reality, which leads to its division into increasingly specialized areas of knowledge. The tendency towards integration, on the contrary, arises from the need to synthesize knowledge about journalism and the convergence of various branches studying it. The development of economic journalism is associated with the problematic orientation of the theory of journalism, since this new area of knowledge arises in connection with the need to resolve issues about the relationship between the communication process and the economic activity of individuals or communities [5].

Economic journalism is a borderline scientific discipline that continues the process of differentiation of the theory of journalism, but at the same time serves as a basis for the integration of the scientific disciplines that underlie it. It integrates economic theory, economic sociology, economic psychology and other areas.

The definition of economic journalism as a theoretical scientific discipline is necessary to improve the quality of the empirical level and practice of journalism. Its formation is based on everyday experience of information and communication activities and natural language. Moving to the theoretical level, economic journalism should rely on theoretical concepts, generalize them and use scientific research methods such as observation, comparison, analysis, synthesis, induction and deduction. In addition, it should use cognitive techniques such as hypothesis, modeling, idealization, abstraction and generalization [6].

As already noted, the methodological basis of economic journalism is the general theory of journalism, which is an independent science. However, it is difficult to separate it from related disciplines. Different scientific schools can rely on different approaches when studying journalism. The communicative function of journalism is studied by communication studies, the object of which is the systems of means and humanitarian functions of mass information communications. Not only theorists of journalism participate in its development, but also sociologists, political scientists, economists, cultural scientists, ethnographers, psychologists and philologists studying information and public communications. Journalism, of course, is only one aspect of mass communication, but an extremely important one. Therefore, the theory of journalism can occupy a separate niche in the system of social sciences, closely related to other sciences. If economic journalism as a practical activity is an information and communication activity related to the economic sphere of life, then it should be considered in the context of communication theories, given that it deals with economic mass communication. To define economic mass communication, it is necessary to turn to the general definition of mass communication, which is the systematic dissemination of specially pre-

pared messages using technical means among large, anonymous and dispersed audiences. Mass communication is an important social and political subsystem of the general communication system. Thus, the definition of mass communication includes the nature of distribution, means of distribution, specifics of preparation and addressee of the message, each of which has its own specifics in economic mass communication.

Economic information can be disseminated either regularly or on a one-off basis. Regular dissemination is carried out through well-known periodicals, economic programs on television and radio, as well as specialized media, such as business publications and media holdings (for example, RBC). Personal appeals from government officials, books, and audiovisual media serve as one-off channels [7].

The means of disseminating economic information depend on the nature of the information itself and can be aimed at presenting information to the audience (oral communication) or broadcasting it through traditional media (printed publications, audiovisual resources, the Internet) and other interactive platforms.

The preparation of economic materials is determined by the specifics of the information and the characteristics of the audience. Mass communication involves working with a large and diverse audience, but their level of preparation for perceiving economic information can vary greatly. Economic specialists require professional content using terminology, while a general audience requires simpler and more understandable publications. In addition, the audience has different information needs, which requires adapting materials to specific groups. Economic information often includes statistical data and mathematical models, which requires the author to have the appropriate tools for analyzing and processing information, as well as the use of infographics.

The mass audience, being the addressee of economic information, is not a homogeneous group, but a set of segments that differ in demographic (education level), geographic and psychographic characteristics.

Given the diversity of forms of economic communication, methods of its financing and stakeholders, it is important to highlight editorial content, advertising information and materials related to public relations - all this is media content, but has its own characteristics.

Economic mass communication occupies an intermediate position between traditional mass communication and specialized marketing communication, combining elements of both.

Mass economic communication performs many functions, and information sources pursue various goals. The effectiveness of communication depends on many factors, including the specifics of the channel, the characteristics of the audience, etc. At first glance, the goal of economic mass communication is to promote the values of the market economy, discuss the ethical aspects of economic activity

and influence public opinion and people's behavior. Of particular scientific interest is the assessment of the impact of economic information on society and its individual members [8].

Materials and methods

The subjects of economic mass communication include the state, public and commercial organizations, enterprises and individual citizens. Their role in the process of disseminating information may vary depending on their attitude to specific information and the degree of interest in it. Various subjects can act as sources, consumers, owners or objects of information, as well as participants in the processes of collecting, processing and transmitting data.

Results and its discussion

The interest in collecting, disseminating and consuming economic information forms the business model of the medium, determining the sources of its financing. As a rule, the fee for disseminating information is paid by the party interested in it. Currently, the media increasingly offer content "free" to end consumers (readers, TV viewers, radio listeners, Internet users), while not forgetting that the audience's time and attention are also a valuable resource. However, most often, the media's income is formed by direct payments to investors or groups of communication subjects. This poses a potential threat to consumers, since the media are focused on satisfying the needs of sponsors who solve their own political, economic or organizational problems through the media. The interaction of the media, as representatives of large interest groups or organizations functioning on the basis of financial independence, in the sphere of economic information, as in other areas, can be described using modern communication theories.

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DOI 10.34660/INF.2025.48.21.194
UDC 338.48

欧洲组织乡村旅游的经验
EUROPEAN EXPERIENCE IN ORGANIZING RURAL TOURISM[1]

Trofimova N.V.
Candidate of Economic Sciences, Leading Researcher
Academy of Sciences of the Republic of Bashkortostan,
Ufa, Russia

摘要：近几十年来，乡村和农场旅游已成为许多欧洲国家经济的重要组成部分，促进了农村收入多元化和可持续发展。本文追溯了这一方向的演变：从游客在农场自发住宿到形成一个拥有专业营销和特色旅游产品的产业。文章特别关注了关键的成功因素，包括服务的复杂性、品牌建设、营销策略以及服务提供商之间的合作。基于对欧洲（尤其是法国）经验的分析以及消费者反馈，本文确定了影响游客满意度的关键因素：基础设施质量、服务水平和接待水平。本文强调，为了保持竞争力，并在不断变化的需求面前充分发挥乡村旅游的潜力，必须实现行业专业化。

关键词：乡村旅游、农业旅游、可持续农村发展、旅游服务营销、接待、经济多元化。

Abstract. *Rural and farm tourism has become a significant sector of the economy of many European countries in recent decades, contributing to the diversification of rural incomes and their sustainable development. The article traces the evolution of this direction: from spontaneous accommodation of tourists on farms to the formation of an industry with professional marketing and specialized tourism products. Particular attention is paid to key success factors, including the complexity of the offer, branding, marketing strategies and cooperation between service providers. Based on the analysis of European (especially French) experience, as well as consumer feedback, critical aspects affecting tourist satisfaction are identified: the quality of infrastructure, the level of service and hospitality. The article emphasizes the need for professionalization of the industry to maintain competitiveness and realize the potential of rural tourism in the face of changing demand.*

Keywords: *rural tourism, agritourism, sustainable rural development, marketing of tourism services, hospitality, economic diversification.*

[1] "Completed on the topic of the state assignment of the Academy of Sciences of the Republic of Bashkortostan"

Rural and farm tourism, as a structured and strategically planned form of activity, has been developing for about six decades in a number of European countries. During this time, the continuous adaptation of concepts and the development of specialized tourism products have created a highly competitive sector that is critical to the viability of many rural areas in Europe [1].

Initially, rural tourism was seen primarily as a mechanism to support and diversify the income of agricultural enterprises [2]. However, in recent years, there has been a marked shift in the structure of demand towards the consumption of rural resources, which has stimulated the development of a wide range of sustainable tourism initiatives based on the provision of specialized micro-services in rural areas. During the recent economic upheavals, this sector has demonstrated resilience and even growth, due to the fulfillment of a number of key conditions regarding professionalization, marketing and effective organization.

Since the first decades of the 20th century, urban dwellers who preferred to spend their holidays in the countryside found accommodation and basic services mainly on farms. This spontaneous tourism movement received its first organizational structure in 1954 in France with the creation of the "Gîtes de France" – a network of rural guest houses [FranceAgriMer. (2020). Le tourisme rural en France. Paris: FranceAgriMer]. With over 55,000 rural tourism services and a clearly defined product philosophy, it remains the largest and best-known organization in this field in Europe and the world [3].

Since 1960, the concept of agritourism, defined as the provision of tourism services as a diversification of agricultural activities [4], has regained popularity in Central and Northern Europe. It was seen as a tool to support farms, but the rapid expansion of supply with insufficient promotion and market demand led to oversupply in a number of countries.

Since the 1980s, the focus in the development of agritourism has shifted towards the provision of small-scale tourism services based on the use of local resources and the active involvement of local communities. This has led to the formation of the concept of "rural tourism" in its modern sense. Support for the development of rural tourism has been carried out mainly within the framework of the rural development policy of the European Union. The result was an increase in the supply of tourist services in the accommodation sector in the countries of Southern and Eastern Europe, which in turn led to the same problems of oversupply and crisis phenomena as in the 1960s.

At the same time, countries with developed rural tourism have focused on developing quality tourism products, raising service standards, conducting marketing research, market segmentation and professional marketing activities. The establishment of the umbrella organization EuroGites in 1991 was one example of the professionalization of the industry and cooperation at the European level.

Until the end of the 20th century, the viability of rural tourism depended to a small extent on direct or indirect government support. However, at the turn of the century, the situation changed dramatically, which was due to two key factors. Firstly, there was a marked shift in consumer preferences and values, characterized by an increased interest in the resources and assets of rural areas. Secondly, a mature market of experienced clients with high demands for authenticity of the offered experience and value for money emerged. These trends opened up new prospects and potential for further development for rural tourism. Realizing this potential requires a professional approach to ensuring the quality of tourism products, a deep understanding of market segments and the specifics of the corresponding demand, effective commercialization of individual services and the development of complex products integrating various elements.

Successful examples include the experience of France, Austria, Germany and the United Kingdom, as well as, in recent years, the Baltic countries, Poland, Romania and others.

In recent years, active research has been conducted in the field of rural tourism theory, aimed at studying its beneficial impact on the local economy, sustainable development, the activation of rural areas and ensuring gender equality. However, these positive effects are realized only if rural tourism enterprises are profitable and operationally efficient.

Based on the analysis of long-term quantitative and qualitative data, supplemented by expert assessments of professionals from various European countries, key factors determining the success or failure of rural tourism projects were identified.

Three main groups of criteria seem to be the most significant:

- a diverse and complex recreation product focused not only on short-term trips (weekends);

- a bright and recognizable image and brand, supported by an effective marketing strategy based on a thorough study of market preferences;

- a developed system of cooperation between various service providers in the region, allowing for the creation of high-quality integrated products.

To determine the criteria that are critical to meeting customer needs, a list of positive and negative aspects of rural tourism was compiled based on an analysis of reviews and criticism published on specialized websites. Negative experience is usually associated with ineffective management, unreliable information (including logistical aspects), poor quality of equipment and insufficient hospitality. Positive experience, on the contrary, is associated with modern equipment and a high level of service and hospitality. Thus, to ensure customer satisfaction, not only the material component (comfortable accommodation and modern equipment) is of decisive importance, but also the “human factor” - a friendly and attentive attitude towards guests.

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DOI 10.34660/INF.2025.91.55.195

金砖国家能源独立性趋势模型及其对外部影响的敏感性
TREND MODELS OF ENERGY INDEPENDENCE IN BRICS COUNTRIES AND THEIR SENSITIVITY TO EXTERNAL IMPACTS

Khudyakova Olga Yurievna
Candidate of Technical Sciences, Associate Professor of the Department Diplomatic Academy of the Ministry of Foreign Affairs of Russia

摘要：本文探讨了金砖国家主要成员国能源独立性问题及其在积极一体化进程中发展趋势的特点。构建了研究国家能源独立性趋势模型，并对2025年的能源独立性进行了预测。确定了模型对外部影响的敏感性。分析了金砖国家能源独立性指标之间的关联性，找出了其中最密切的联系以及中国在其中发挥的作用。运用离散度分析方法，分析了各国能源领域合作的影响。结果表明，各国能源独立性指标水平存在显著差异，并确定了时间因素和相互作用因素对指标水平的显著影响。

关键词：金砖国家，能源，能源独立性，能源安全，过程敏感性，可持续系统。

Abstract. *The article explores the issues of energy independence of the main BRICS member states and the peculiarities of trends in the context of active integration processes. Trend models of energy independence of the studied countries are constructed, and a forecast for 2025 is made. The sensitivity of the models to external influences is determined. An analysis of the interconnections of the energy independence indicators of the association countries is presented. The closest connections and the role of China in them are identified. The analysis of the impact of countries' cooperation in the energy sector using the methods of dispersion analysis is carried out. Significant differences in the level of the indicator between countries are revealed. The significant influence of the time factor and the interaction factor on the indicator level has been determined.*

Keywords: *BRICS countries, energy, energy independence, energy security, process sensitivity, and sustainable systems.*

For each country, in addition to the desire to improve the effectiveness of international cooperation, achieving a certain level of security, which serves as a guarantee of stability and protection from external threats, becomes a priority. This is influenced by many internal and external factors. Energy security is an integral part of the security of the state as a whole and serves as its foundation, since it ensures a stable and uninterrupted supply of energy resources, which is necessary for the functioning of the economy, the protection of national interests and the

maintenance of social stability. Resistance to external (exogenous) and internal (endogenous) shocks directly depends on the level of energy independence of the state, since the ability to independently meet its energy needs reduces the risks of supply disruptions and increases the protection of the economy from external and internal factors of instability.

Energy reserves analysis covers not only the quantitative measurement of physical volumes of resources, but also their ability to ensure stable production and efficient use [8]. In the context of the growing importance of sustainable development, there is a need to create quantitative indicators that allow assessing the degree of sustainability of states, regions and enterprises [7].

Such indicators include the energy independence coefficient (EIC), which serves as a measure of the level of energy self-sufficiency of a state or region. It is calculated as the ratio of the volume of domestic energy production to the total volume of its consumption. This coefficient plays a key role in assessing energy security, helps to identify the need for diversification of energy sources and serves as the basis for developing an energy strategy.

This indicator has been the subject of intense debate regarding its accuracy and ability to adequately reflect the essence of the issue [5]. However, analyzing and tracking the energy independence ratio helps governments develop and implement various measures aimed at strengthening energy security.

This study assessed changes in the level of energy independence using data provided by the portal of country and region statistics. The indicators of total electricity production and total energy consumption for the period from 2010 to 2023 were analyzed for five key BRICS countries, and data for the United States were also used for comparison (Figure 1).

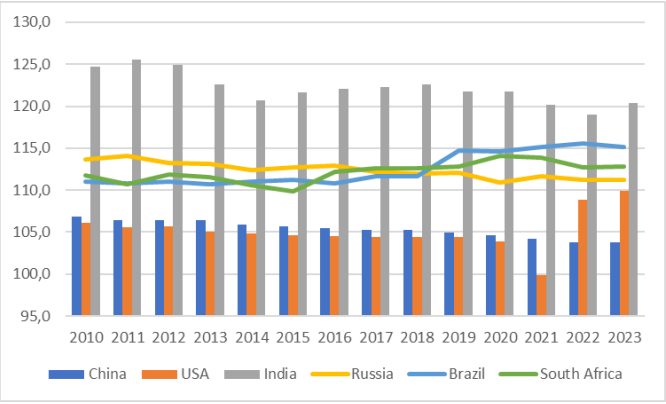

Figure 1. *Dynamics of the BRICS countries' and the USA's CEI for the period from 2010 to 2023*

The overall picture by country during the period under review is as follows: India, Russia and China show a decrease in the energy independence coefficient, while Brazil and South Africa have seen an increase. The United States has been characterized by fluctuations in this indicator, especially since the onset of the pandemic, when the country has intensified domestic energy production by developing shale gas and oil production, which has significantly increased the level of energy autonomy over the past five years.

In India, the energy independence ratio is declining due to the rapid growth of energy consumption in recent years and the limited availability of domestic resources, especially given the negative balance of energy imports. In China, domestic energy production is increasing due to the development of renewable energy sources and the expansion of coal and oil production, but the more rapid growth in consumption leads to an overall decrease in the level of energy autonomy. Russia has significant domestic hydrocarbon reserves, which ensures a relatively high level of energy independence, but the dynamics of the energy independence ratio are subject to the negative impact of global price fluctuations and sanctions.

Active use of renewable energy sources in Brazil, primarily hydropower, contributes to sustainability and increased energy independence up to 2018. At the same time, South Africa's dependence on oil and electricity imports, as well as internal difficulties in the energy sector, lead to fluctuations in the energy independence coefficient, but overall, positive dynamics are observed.

Let us define trend models of energy independence in the form of simple time series (Table 1). All constructed trend models turned out to be statistically significant according to the F-criterion at the standard significance level of 0.05 and adequate in terms of the magnitude of the determination coefficient (varies from 0.5 to 0.98).

Table 1.

Trend models of energy independence of the BRICS countries and the USA and their adequacy

Country	Trend model	Determination coefficient	Model significance by F-criterion
Brazil	$CEI_B = 0{,}4190*t - 732{,}37$	$R^2 = 0{,}7772$	$3{,}07*10^{-5}$
Russia	$CEI_R = - 0{,}2146*t+545{,}04$	$R^2 = 0{,}8724$	$1{,}03*10^{-6}$
India	$CEI_I = - 0{,}3711*t+870{,}47$	$R^2 = 0{,}6846$	$2{,}6*10^{-4}$
China	$CEI_C = - 0{,}2348*t+578{,}8$	$R^2 = 0{,}9808$	$1{,}13*10^{-11}$
South Africa	$CEI_{SA} = 0{,}2015*t - 294{,}09$	$R^2 = 0{,}4996$	$4{,}89*10^{-3}$
USA	$CEI_{USA} = - 0{,}1915*t+490{,}71$	$R^2 = 0{,}8877$	$8{,}33*10^{-5}$

Note: * - USA model calculated for the period from 2010 to 2019.

Dynamic modeling allows, using developed models, to analyze long-term trends of the process under study and predict its future state (Table 2), including the level of energy independence of countries [2].

Table 2.

Forecast of energy independence of the BRICS countries and the USA for 2025 based on the constructed models

Country	Brazil	Russia	India	China	South Africa	USA
КЭН	116,1	110,5	119,0	103,3	113,9	102,9

The sensitivity of trend models is determined by the degree of interrelation between factors, the sensitivity of the dependent variable to changes in factors (elasticity), and the value of the standard deviation. Due to its significant economic potential, China occupies a leading position among the BRICS countries, which allows it to actively interact with partners. Cooperation with China provides the participating countries with the opportunity to diversify their foreign economic relations and strengthen their positions on the world stage, which is especially important in the context of modern global economic and political challenges [1]. All the countries under consideration, except for the United States, demonstrate a high correlation with China in terms of energy independence, which is explained by the presence of an effective platform for jointly solving global economic and political problems (correlation coefficients are in the range from 0.8 to 0.9, with the exception of South Africa, which has a lower value of 0.66). The analysis of partnership relations highlights Russia and China as the most closely interacting participants in the association, since their correlation coefficients mostly exceed 0.8, while the minimum value of 0.7 is noted in the relationship between South Africa and Russia (Table 3).

Table 3.

Sensitivity of energy independence models of BRICS countries and the USA

Correlation of the country's KEN index with the KEN of China	The highest correlation of the KEN indicator with a BRICS partner	Elasticity	Standard deviation
$R_{B\text{-}C}$= -0,892	$R_{B\text{-}R}$= -0,822	E_B= 7,510	σ_B= 1,988
$R_{R\text{-}C}$= 0,911	$R_{R\text{-}C}$= 0,911	E_R= -3,850	σ_R= 0,961
$R_{I\text{-}C}$= 0,837	$R_{I\text{-}R}$= 0,822	E_I= -6,127	σ_I= 1,876
	$R_{C\text{-}R}$= 0,911	E_C= -4,494	σ_C= 0,992
$R_{S\text{-}C}$= -0,661	$R_{S\text{-}R}$=-0,699	E_S= 3,622	σ_S= 1,196
$R_{U\text{-}C}$= -0,130		E_U= -3,696	σ_U= 2,323

Technology exchange and joint implementation of innovative projects with China contribute to the modernization of the BRICS economies and strengthening their competitive positions. At the same time, such cooperation may create certain risks, including economic dependence, trade imbalances and the need to adapt national regulatory mechanisms [6,11].

Since January 2024, the BRICS countries with developing economies have been united by an important common feature that has had a significant impact on their entry into the association - the presence of extensive energy resources. New members not only increase the level of domestic energy production within the bloc, but also significantly expand its energy diversification, bringing BRICS closer to the status of a leading player in the energy sector [9]. The creation of the BRICS energy mechanism transforms the structure of the main participants in the global energy market, facilitating its transition to multipolarity [10].

Some countries are more susceptible to change due to a more dynamic or vulnerable economic and social structure exposed to external influences. Such countries require more flexible strategies aimed at rapid response and adaptation. At the same time, countries with more stable systems tend to use long-term and gradual approaches, which is reflected in their statistics and development methods. It should be noted that all the BRICS countries under consideration have a significant degree of adaptability, while the spread of indicators is relatively small (Table 2), which indicates a fairly high stability of processes in the energy sector. For a more in-depth analysis, we will conduct a two-factor analysis of variance of energy independence indicators (Table 4). As the first factor, we will consider belonging to a certain country, as the second - the time factor, dividing the study period into 3 stages (2010-2013, 2015-2018, 2020-2023).

Table 4.

Analysis of variance of the influence of factors determining differences in the KEN indicators between countries

SUMMARY	China	India	Russia	Brazil	South Africa	Total
2020-2023						
Count	4	4	4	4	4	20
Sum	416,48	481,22	445,01	460,48	453,52	2256,71
Average	104,12	120,31	111,25	115,12	113,38	112,84
Variance	0,152	1,266	0,104	0,161	0,483	29,769
2015-2018						
Count	4	4	4	4	4	20
Sum	421,60	488,54	449,71	445,27	447,25	2252,37
Average	105,40	122,14	112,43	111,32	111,81	112,62
Variance	0,039	0,135	0,185	0,142	1,716	30,888

2010-2013						
Count	4	4	4	4	4	20
Sum	426,10	497,72	454,14	443,59	445,87	2267,42
Average	106,53	124,43	113,53	110,90	111,47	113,37
Variance	0,061	1,563	0,201	0,0288	0,267	38,008
Total						
Count	12	12	12	12	12	
Sum	1264,18	1467,49	1348,86	1349,34	1346,64	
Average	105,35	122,29	112,41	112,45	112,22	
Variance	1,122	3,915	1,081	4,026	1,428	
ANOVA						
Sourse of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	6,002	2	3,001	6,921	0,002	3,204
Columns	1753,352	4	438,338	1010,944	$2{,}01*10^{-43}$	2,579
Interaction	101,773	8	12,722	29,340	$2{,}07*10^{-15}$	2,152
Within	19,512	45	0,434			
Total	1880,639	59				

The results of the analysis of variance indicate the presence of statistically significant differences between the countries in the studied indicator (KEN). This is confirmed by the high value of the F-statistics (1010.94) and the very low p-level ($2.01*10^{-43}$), which is significantly less than the established significance threshold (0.05). Thus, the differences in the average values of energy independence between the countries under consideration are significant and not random. These differences are explained by the economic and social characteristics of the countries, which is supported by a significant intergroup spread of variation. Analysis of other sources of variation, such as the time factor and their interaction, shows that the F-statistic values significantly exceed the critical thresholds (for interaction F = 29.34 with a critical value of 2.15, for the time factor F = 6.92 with a critical value of 3.20), and the corresponding p-values are very small ($2.07*10^{-15}$ and 0.002), which confirms the statistical significance of these factors. The interaction between countries and time periods is especially pronounced, indicating that differences between countries change over time. Thus, both the country and the time factor, as well as their interaction, have a significant impact on the results.

All countries of the bloc, both those already in the association and those at the integration stage, are actively expanding trade, investment and technological cooperation. This has a significant impact on the development of their energy sectors and can lead to both strengthening and weakening their energy independence. The expected formation of integrated energy markets within BRICS helps to in-

crease the sustainability of the energy system of the entire bloc, reduces the risks associated with the transit of energy resources and ensures more efficient use of available resources.

Within BRICS, energy cooperation is primarily built on bilateral relations, while the level of development of such ties varies significantly depending on the specific needs of each country for energy resources to maintain its own energy independence [4]. Despite the existing difficulties, BRICS is a unique association of large regional economies united by common priorities and complementary interests. Joint efforts to achieve common goals will allow countries to effectively provide their economies with the necessary resources and find stable markets for their products [3].

Integration processes within BRICS are capable of significantly strengthening the energy independence of its participants, but achieving this requires a well-thought-out and strategically directed approach that takes into account the individual interests of each member country of the association.

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DOI 10.34660/INF.2025.60.35.196

提高金融知识水平作为打击欺诈的机制：数字环境的挑战
IMPROVING FINANCIAL LITERACY AS A MECHANISM TO COUNTER FRAUD: CHALLENGES OF THE DIGITAL ENVIRONMENT

Isakova Anastasia Romanovna
Postgraduate
B.N. Yeltsin Ural Federal University,
Yekaterinburg, Russian Federation

摘要：在经济数字化和在线金融服务日益普及的背景下，民众面临的金融欺诈活动日益增多。尽管俄罗斯实施了相关教育计划，但公民遭受金融欺诈的脆弱性仍然很高。本文探讨了金融和数字素养水平与遭受欺诈风险之间的关系。文中提供了关于弱势群体特征的概括数据、未经客户同意的交易数据以及按金融素养水平划分的人口类别。结果表明，通用的培训形式无法满足不同类别公民的需求。最后得出结论，有必要将行为方法纳入教育政策并加强跨部门互动。本文的研究结果可用于制定旨在形成可持续和安全金融行为的目标计划。关键词：金融素养、数字素养、金融欺诈、行为经济学、金融安全。

Abstract. *In the context of digitalization of the economy and the growing popularity of online financial services, the population is increasingly faced with fraudulent activities. Despite the educational programs implemented in Russia, the level of vulnerability of citizens to financial fraud remains high. The article examines the relationship between the level of financial and digital literacy and the risk of becoming a victim of fraud. Generalized data on the characteristics of vulnerable groups, data on transactions without the consent of clients, and categories of the population by the level of financial literacy are presented. It was revealed that universal forms of training do not meet the needs of different categories of citizens. A conclusion is made about the need to integrate a behavioral approach into educational policy and strengthen intersectoral interaction. The presented results can be used to develop target programs aimed at forming sustainable and safe financial behavior. Keywords: financial literacy, digital literacy, financial fraud, behavioral economics, financial security.*

In the context of rapid digitalization of the economy, there is an increase in the availability of financial products and online services for the general population.

At the same time, the number of cases of financial fraud committed using modern digital technologies is sharply increasing. According to the Bank of Russia, in 2023 alone, the number of transactions without the consent of clients exceeded 288 thousand, and the amount of stolen funds was 3.6 billion rubles, which confirms the scale of the problem.

Despite the efforts of the state and financial organizations in the field of education and information security, including within the framework of the Strategy for Improving the Financial Literacy of the Population for 2017-2023 and the new National Strategy for 2023-2030, the level of vulnerability of the population remains high. This is especially true for categories of citizens with an insufficient level of digital financial literacy. At the same time, studies show a significant discrepancy between self-assessment and the actual level of knowledge, which creates an additional risk. Increasing the level of financial and digital literacy is considered not only as a factor in sustainable financial behavior, but also as a key tool for combating fraudulent practices in the financial sector. However, current measures in most cases do not take into account the behavioral characteristics and level of trust of different demographic groups, which limits their effectiveness.

The purpose of this article is to analyze the relationship between the level of financial and digital literacy of the population and the degree of its vulnerability to various forms of financial fraud, as well as to develop proposals for adapting educational strategies and protection mechanisms to target risk groups.

Table 19

Transactions without customer consent (OCC): the general picture[2]

	2020	**2021**	**2022**	**2023**	**2024**
Number of operations without customer consent (OWC), units	182 954	256 198	229 757	288 784	294 414
OWC volume, thousand rubles	2 716 549,83	3 206 473,23	3 973 456,54	3 591 091,15	4 263 315,94
Share of reimbursed (returned) funds (from volume), %	13,1	7,7	3,4	5,5	7,7

[2] Compiled by the author based on: [1]

Between 2020 and 2024, the number of transactions carried out without the client's consent has almost doubled. This indicates a noticeable increase in fraudulent activity, as well as an increase in the number of successful attacks on clients of banks and financial institutions. At the same time, the percentage of returned funds is increasing. This indicates that the systems for protecting and compensating for damage caused to clients have improved.

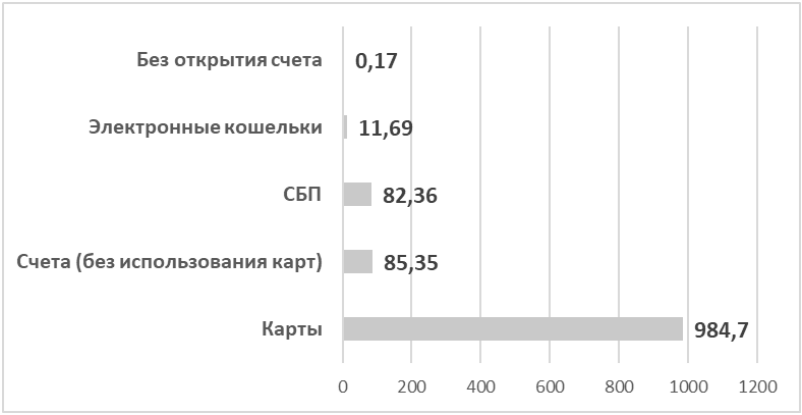

Figure 25. *Volume of transactions without customer consent made in 2023, million rubles [2]*

In 2023, the number of fraudulent transactions with payment cards amounted to 984.77 thousand, exceeding all other transaction categories. The largest share of stolen funds was accounted for by transactions with payment cards - 7,120.37 million rubles. It should be noted that, as a rule, the largest volume of funds recovered (returned to customers) occurs for transactions of the "Accounts" type - 666.77 million rubles.

Table 20

Number and volume of prevented OWC [2]

	2023	**2024**
Number of OWC, units	10 788 512	13 860 221
Volume of OWC, thousand rubles.	1 681 969 977,99	2 049 801 523,35

Credit institutions began to provide the Bank of Russia with information on prevented thefts of financial funds in 2023. Effective work to combat fraud by credit institutions made it possible to prevent 34.77 million transactions. It is worth noting that the number of restricted transactions is growing from year to

year. The 2022 figures exceed the 2021 figures by 3 times (at that time, 3,100 resources were blocked).

In the modern conditions of global digitalization of any sphere of human activity, it is necessary to pay attention to digital financial literacy, the index of which began to be calculated by NAFI in 2022.

Table 17

Digital Financial Literacy Index [2]

	2022	**2024**
Digital Financial Literacy Index	5,63	6,02

As can be seen from the table, the digital financial literacy index increased by 0.4 p. or 6%. In the context of this index, the country's population can be divided into three categories depending on their knowledge and abilities:

1. Russians with a low level of digital financial literacy are most at risk of fraud and losing money. This is 8% of the population in 2024 versus 13% in 2022. Most often, these are young people (11%).
2. The largest middle group includes 70% of the entire population, the share of which has remained unchanged since 2022. The backbone of this group is made up of working women living in large cities of the Russian Federation.
3. The highest level of digital financial literacy is possessed by men over 45 years old, who have a stable job and higher education. In general, it can be concluded that typical images in the context of division by indices coincide both in determining the level of financial literacy and in digital financial literacy.

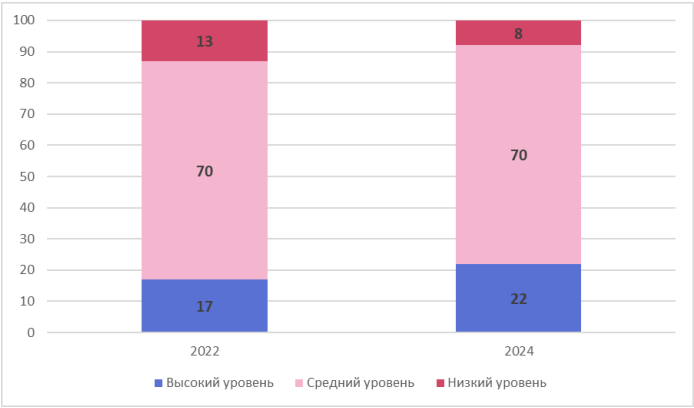

Figure 20. *Population categories by level of digital financial literacy, % [2]*

About 71% of Russians want to expand their understanding of digital financial services and how to use them safely. Twenty percent of Russians said that they have no desire to delve into this topic. At the same time, those who do not want to learn most often live alone (27%), are young (27%), live in rural areas (26%) and do not work.

However, here we should note an important conclusion: people living in our country often exaggerate or underestimate the level of their financial literacy.

This is evidenced by the discrepancy between the real picture and the proportion of people who consider their knowledge to be either extremely low or very high. As a result, the gap between different groups of the population is as follows: If we talk about a high level of financial literacy, then 22% of Russians actually have it versus 29% of those who mistakenly claim it (7 p.p. less); 42% of Russians consider their level to be average, but in reality, only 70% have it (28 p.p. more); 24% of Russians believe that they have a low level, but in reality, only 8% have it (16 p.p. less).

Such basic concepts as digital financial contracts - agreements concluded electronically through a mobile application with a bank or other financial institution, and personal data, are well known to most Russians. For example, 71% of respondents know that their data can be used for advertising, and have an idea of the concept of using personal information on the Internet. As for the legality of a digital contract, two-thirds of respondents (69%) know that it has legal force if signed digitally. However, there are many common misconceptions among Russians about cryptocurrencies. For example, according to 32% of respondents, Bitcoin can be used as an official means of circulation. When it comes to potential dangers associated with using online shopping sites, most Russians share similar views, such as: 85% of Russians believe that when making an online payment, it is important to make sure the site is secure; 61% believe it is important to read the terms and conditions. Although this figure has decreased by 10 percentage points since 2022, only 34% of Russians know that using public Wi-Fi to make online payments is risky (compared to 43% two years ago). Such statements are mostly shared by young people (40%) aged 18 to 34. Most Russians behave wisely when it comes to protecting their personal information in the digital banking space. For example, 82% of respondents claim that they never share their PIN codes or passwords online, even with close friends, and 83% - that they never exchange financial information in general. However, only 32% of respondents said that they change their passwords on online store websites, while 39% never do this. In addition, when buying a financial product online, 54% (that is, every second) of respondents never check whether the service provider is included in the official register of financial organizations.

Moving on to the conclusions of the definition of the digital financial literacy index, we can say that:

- the digital financial literacy index of Russians is based on average estimates.
- when it comes to interacting with financial products, Russians are careful online, but at the same time do not follow some Internet security rules.
- as in the case of the financial literacy index, an additional possible risk is the inflated self-esteem of respondents.
- in addition to educating the population, one of the important aspects of improving digital financial literacy is ensuring the availability of digital financial technologies for residents of small towns, villages and settlements. This is due to the fact that digital financial literacy is, first of all, a practical skill that is reinforced in the process of using the relevant services and products.

Thus, having studied and processed the information on key indicators reflecting the activities of households in the territory of the Russian Federation, we can draw several key conclusions:

- the level of income and real disposable cash income has shown a steady growth over the past years.
- statistics for 2023 show a record number of people employed in the economy along with a record low unemployment rate. By the end of 2023, the labor force increased and for the first time approached the level that existed before the pandemic.
- despite the increase in the level of financial literacy, the population of the Russian Federation continues to actively use credit products, the illiterate management of which leads to an increase in the indebtedness of the population and the level of overdue loans.
- an increasing percentage of people, mainly middle-aged, do not have liquid assets or show “symptoms” of excessive indebtedness.
- families experiencing financial instability, as a rule, live in rural areas and small towns; they consist mainly of people with children and without higher education.
- there is a tendency for the share of Russians with an average level of financial literacy to increase and the share of Russians with a low level of financial literacy to decrease. In the past two years, the socio-economic shocks associated with the coronavirus epidemic and simultaneous structural changes since February 2022 have been particularly strong.
- Russians behave more wisely when it comes to managing personal finances. Over the past four years, more and more Russians have become financially literate, have created a family budget, carefully monitor their finances and save money for specific purposes.
- with the growing adoption of digital financial services, the number of cyber frauds is also increasing. Fraudsters are rapidly adapting to new technolo-

gies, adjusting to the current agenda and creating increasingly complex fraudulent schemes.

- when it comes to financial products, Russians are cautious on the Internet, but at the same time violate certain Internet security rules. Despite comprehensive information of the population, many households still remain vulnerable to new fraudulent schemes.

These findings only highlight the need for further study and analysis of various types of fraud, since a deeper understanding of the problem contributes to the development of effective methods of combating criminals.

In the context of increasing digitalization of financial services and the continued growth of indebtedness of the population, the Central Bank of the Russian Federation and other government agencies are focusing their efforts on two key areas: increasing the general financial literacy of the population and combating cyber fraud by increasing digital financial literacy. Despite the measures being implemented and the results achieved, the problem remains, and further development and improvement of strategies is required.

Digital financial literacy is becoming increasingly relevant due to the growth of cybercrime. Modern fraudulent schemes are becoming more sophisticated every day, which requires not only fundamental awareness of financial security, but also a deep understanding of digital dangers. The state educates the population about digital threats and protective measures through government programs and information campaigns. But even despite these successes, cybercrime continues to grow, which means that these initiatives need to be improved.

In this regard, the differentiation of educational approaches depending on the vulnerable group is becoming an urgent task:

Older citizens need offline events, memos in bank branches and post offices, as well as individual consultations;

Mobile educational quests, tests and interaction via social networks are effective for young users;

Middle-aged people and entrepreneurs - courses simulating real fraud scenarios based on real-life cases.

The activities relevant for all groups of the population include:

1. Conducting classes on the basics of cybersecurity for people of all ages, including pensioners, students and schoolchildren. Providing free online training programs and courses available on government platforms and in bank applications.

2. Creating interactive simulators that teach how to effectively respond to threats and can imitate cyberattack scenarios. Virtual simulators for identifying fake websites and phishing emails.

3. Public awareness campaigns on television, social media and the media in general that talk about modern cyber fraud schemes. Creating podcasts, films and infographics that reveal complex ideas in the field of digital security.

4. Posting information about new types of fraud and protection methods on the main page of banking applications.

5. Security audits for financial institutions to check compliance with standards and technologies, as well as updating recommendations based on current data.

6. Developing a digital identity protection program, instant notification and immediate response to attempts at unauthorized use of personal data.

Thus, counteracting fraud requires an integrated approach combining educational, technological and regulatory measures. The key area is the transition from universal to targeted education, taking into account the real behavioral risks of each social group.

Financial fraud in the digital environment is one of the most acute threats to the population, especially in the context of the rapid spread of fintech services. The analysis shows that insufficient financial and digital literacy significantly increases the vulnerability of citizens, and the discrepancy between subjective self-assessment and real knowledge increases risks. Despite the existence of large-scale educational programs, the universal nature of most initiatives limits their effectiveness in working with different socio-demographic groups.

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DOI 10.34660/INF.2025.90.22.197

谋杀的特殊残酷性导致的精神障碍：刑事法律话语
MENTAL DISORDER AS A CONSEQUENCE OF THE PARTICULAR CRUELTY OF MURDER: CRIMINAL LEGAL DISCOURSE

Jurchenko Irina Aleksandrovna
Candidate of Law, Associate Professor, Department of Criminal
Kutafin Moscow State Law University (MSAL)
Moscow, Russia

摘要：本文探讨了刑法论述中关于被害人亲属因实施特别残忍的谋杀而导致精神障碍的后果的认定问题。文中探讨了该问题的理论和实践层面，并揭示了执法实践中的矛盾。作者论证了改革此类行为认定方法的必要性，并提出了其他法律评估方法。

关键词：刑法论述、谋杀、严重健康损害、特别残忍、精神障碍、犯罪总体。

Abstract. *The article is devoted to the criminal law discourse concerning the qualification of the consequence in the form of a mental disorder that arose in a person close to the victim when committing a murder with particular cruelty. The theoretical and practical aspects of this problem are considered, contradictions in law enforcement practice are revealed. The author substantiates the need to reform the approach to the qualification of such acts and proposes alternative methods of their legal assessment.*

Keywords: *criminal law discourse, murder, serious harm to health, particular cruelty, mental disorder, the totality of crimes.*

In the modern criminal law discourse, an important place is occupied by the problem of qualifying mental impact as a method of causing serious harm to health in the context of the manifestation of particular cruelty in the commission of crimes against the person. The current scientific paradigm demonstrates the lack of uniformity in understanding the mechanisms of causing harm to human health in the form of a mental disorder in the case when it is the result of criminal acts accompanied by the manifestation of particular cruelty. A retrospective analysis of doctrinal sources shows an ambiguous approach to assessing situations when a mental disorder is not a consequence of direct physical impact on the victim, but occurs as a result of the commission of a violent crime against his relative, to

which the person is an eyewitness. The judicial interpretation of the problem under consideration is also characterized by the heterogeneity of law enforcement practice, which is largely due to the evolution of the criteria for assessing the severity of harm, enshrined in regulatory legal acts adopted by health authorities in different historical periods. Given the emergence in the legal field of the Resolution of the Constitutional Court of the Russian Federation of 11.01.2024 No. 1-P «On the case of verifying the constitutionality of part 1 of article 111 and part 1 of article 112 of the Criminal Code of the Russian Federation, as well as paragraph 3 of the Rules for determining the severity of harm caused to human health, in connection with the complaint of citizen B.» and the new order of the Ministry of Health of the Russian Federation of 08.04.2025 No. 172n «On approval of the Procedure for determining the severity of harm caused to human health» [1], it is necessary to pay attention to how the epistemes (fundamental framework of thinking) underlying the criminal law discourse on the possibility of causing serious harm to health through targeted mental influence on a person in whose presence a crime was committed against his loved one have changed. In this case, not only the text of the criminal law is important, but also its context. In one scientific study, legal discourse is defined as «a set of statements on issues of legal reality, the main functions of which are prescription, persuasion, proclamation, and information» [2]. The authors reasonably come to the conclusion that the text of the law itself rarely contains all the information necessary for its correct understanding, as a result of which an appeal to discourse, to knowledge remaining beyond that expressed in the text, seems objectively necessary [2]. The following historically unchanging properties of legal language are distinguished as features of legal discourse: ambiguity and vagueness, which «allows participants in legal discourse to reasonably interpret the rules that can be applied to regulate constantly changing social relations» [3, pp. 26-27]. Accordingly, at different stages of the development of Russian criminal legislation, the same terms had different semantic content. In the context of examining the criminal law discourse, three interrelated components can be identified that form its content: 1) the text of the criminal law (normative component), 2) interpretation of the criminal law by the Constitutional Court of the Russian Federation and the Plenum of the Supreme Court of the Russian Federation (interpretative component), 3) judicial practice (enforcement component). A comprehensive analysis of the criminal law discourse on mental disorder as a consequence of particular cruelty should be based on the triad «law – interpretation of the law – judicial practice» in a certain historical period.

Classic principles of pre-revolutionary criminal law discourse on mental disorder as a consequence of particular cruelty. The Criminal Code on Criminal and Correctional Punishments of 1845 [4] included concepts of «cruelty», «mental disorder», «mental disorder», «mental faculties disorder», which are close in

name to the modern categories of particular cruelty and mental disorder, but did not disclose their content. Thus, general circumstances increasing the degree of guilt and the measure of punishment included cruelty during the preparation and commission of a crime. The circumstances influencing the appointment of punishment for specific deliberate and intentional attacks on a person included «the degree of cruelty during the commission of a crime», «the degree of malice and cruelty», «more or less cruelty shown», «the measure of suffering caused», etc. The qualifying feature of murder and causing certain types of harm to health, committed with premeditated intent or intention, were considered to be torture and more or less cruel torment. In the Code, torture and other torment together with intentional severe beatings, dangerous to life, were also provided for as an independent crime. Along with the specified concepts, the legislator used other similar terms, which created legal uncertainty. One of the commentators of the Code encountered the problem of a wide range of shades of the concept of cruelty in criminal law norms, who tried in vain to establish the meaning of the concepts of «torture» and «torment» by comparing different articles (art. 1477 – torture or other torment, art. 1489 – severe beatings, other torture or torment, part 3 art. 1526 – beatings or other torture, art. 1687 – beatings, other torture or cruelty), after which he concluded that the authors of the draft Code «did not give themselves a clear account of the meaning of torture and torment» [5, p. 361]. The judicial practice of that time began to use a formula that was later used by Soviet scientists and law enforcement officers: «Any beatings and even violence is accompanied by torture... It is necessary that the torture and torment be severe due to their particular cruelty or the duration of the suffering of the victim» [6, p. 925]. Criminal liability for causing mental disorder was provided for in independent norms, but in terms of punishability, an incurable disorder of health was equated with a serious injury, and a curable one - with a less serious one. The methods of causing mental disorder included deliberate poisoning with poison or a potent substance and deliberate disorder by other means. It is noteworthy that the law deals with causing physical harm, including mental disorder, as a result of acts directed exclusively at the victim himself. Parents, close relatives and other persons with whom the perpetrator had a special relationship were considered by criminal law only as victims of the actions of that person himself. The mechanism of causing harm to health in the form of mental disorder implied physical impact on the victim by means of physical harm or poisoning. The doctrine agreed that torment can also have the character of moral suffering (constant reproaches, insults). For example, Lokhvitsky A.V. believed that serious mental impact on a person can even lead to death, but concluded that «such facts are inaccessible to the action of the criminal law», since the Code only refers to physical suffering [7, p. 558]. Thus, at the first stage of the analyzed criminal-legal discourse, mental disorder was considered as a consequence of physical violence or poisoning applied to the victim himself.

Conceptual foundations of the Soviet criminal law discourse on mental disorder as a consequence of particular cruelty. A review of Soviet criminal legislation shows that «particular cruelty» was first enshrined as an aggravating circumstance in the appointment of a social protection measure of a judicial-correctional nature in the Criminal Code 1926 (p. «i» art. 47) [1], and as a qualifying feature of a crime – in the Criminal Code 1960 in relation to the elements of intentional murder (p. «g» art. 102) [1]. Before this, the legislator used the concepts of «cruelty» (p. «i» art. 25 of the Criminal Code 1922) [1], «a method that is especially painful for the victim» (p. «b» art. 142 of the Criminal Code 1922, p. «b» art. 136 of the Criminal Code 1926), «a method that is in the nature of torment or torture» in the case of very serious bodily harm (part 2 art. 149 of the Criminal Code 1922, part 2 art. 142 of the Criminal Code 1926). In scientific literature, the concepts of murder (culpable and unlawful causing of death to another person) and bodily harm (unlawful and culpable causing of physical suffering to another person without the intent to take his life) are formulated) [8, c. 4, 24]. On the basis of early Soviet legislation, it is concluded that a gunshot or poisoning does not constitute aggravated murder, even if «due to the characteristics of the inflicted wound or the properties of the poison, the victim died in slow agony, in terrible agony» [9, pp. 135-136]. With the adoption of the Criminal Code 1960, the concept of particular cruelty in the broadest sense began to take shape. In the early 1960s, the Presidium of the Supreme Court of the RSFSR in the case of A. repeated the postulate that was adhered to by science and judicial practice: «Any intentional murder is grave and to one degree or another cruel. However, in order to qualify intentional murder under p. «g» art. 102 of the Criminal Code requires the commission of murder with particular cruelty» [10, p. 153]. An example of a broader understanding of particular cruelty, which may consist of causing particular suffering to a close person of the victim, is the case of K. On August 6, 1974, the Penza Regional Court recognized him as an especially dangerous recidivist and sentenced him to death for the murder of his ex-wife with particular cruelty (paragraphs «b» and «g» of art. 102). The crime was committed in the presence of the victim's six-year-old daughter. K. entered the apartment through the balcony, insulted and beat his wife with a bottle and a bucket. The daughter cried and begged him not to kill her mother. When the neighbors started knocking on the door, he pushed the daughter out into the hallway and continued beating his wife, then strangled her with a tourniquet made from a pillowcase. On November 6, 1974, the Presidium of the Supreme Court of the RSFSR requalified K.'s actions as murder without aggravating circumstances (art. 103). The Chairman of the Supreme Court of the USSR filed a protest, disagreeing with the decision. The Supreme Court of the USSR confirmed the correctness of the qualification by the court of first instance. The intent to kill arose in K. long before the departure of her

daughter, as evidenced by the testimony of the kindergarten teacher that the victim's daughter was in an anxious state all the time before the incident, cried and said that her father would kill her mother. Dividing the criminal event into two periods (the beating and the subsequent murder) contradicts the factual circumstances. The fact that the daughter was not present directly when her mother was taken from her life does not eliminate the element of particular cruelty. In addition, particular cruelty was manifested in the method of taking life and K.'s desire to cause suffering to his ex-wife [11, pp. 395-396]. It is worth noting here that the court took into account the girl's anxious state before the murder, her panic fear for her mother's life, and strong emotional stress during the beating of the victim as special suffering that constitute a sign of the particular cruelty of the murder. Until recently, a new paradigm of criminal-legal assessment of such a state of a close person present at the commission of a murder has been applied in modern judicial practice, when the actions of the perpetrator are additionally qualified in relation to a close person as intentional infliction of grievous bodily harm in the form of a mental disorder. Thus, on October 24, 2024, the Judicial Collegium of the Supreme Court of the Russian Federation considered the cassation appeal of K., convicted under p. «d» part 2 art. 105 of the Criminal Code, under p. «b» part 2 art. 111 of the Criminal Code. Due to personal hostility, K., in the presence of her son M., stabbed her father G. in the vital organs. The court of first instance established that, observing how his mother stabbed her father during an argument, the minor child understood this and experienced moral suffering associated with the fear of the events taking place and compassion for his father. According to the examinations, M. showed signs of a mental disorder in the form of a mixed disorder of emotions and behavior, which is the result of a combination of a number of psychotraumatic stress factors associated with the aforementioned criminal situation. The minor's mental disorder was recognized as being in a direct causal relationship with the crime. The cassation court came to the conclusion that M. understood the external side of the actions committed by the mother against the father, therefore, K.'s actions contained such a qualifying feature of murder as particular cruelty. The sentence was left unchanged, and the cassation appeal was dismissed [1]. As can be seen from the examples, the behavior and condition of minor children present when one parent commits a crime against the other are similar in many ways (anxiety for the life of the parent, fear of what is happening, strong emotions during the murder, moral suffering), but their criminal-legal assessment is different. In particular, this is due to different approaches to the nature and duration of the mental disorder that has arisen in the person, taking into account international experience in classifying diseases and the mechanism of causing harm to health in the form of mental illness. In Soviet times, mental disorder, in relation to which the term «mental illness» was used, was classified by the legislator as seri-

ous bodily harm (art. 149 of the Criminal Code 1922, art. 142 of the Criminal Code 1926, art. 108 of the Criminal Code 1960). In the doctrine, intentional grievous bodily harm in art. 149 of the Criminal Code 1922 was understood only as mental illness, and not as a nervous disorder [12, pp. 263-264]. In art. 142 of the Criminal Code 1926, mental illness was understood as a disorder of a person's mental abilities in the form of traumatic dementia, traumatic epilepsy, and other serious mental illnesses. It was believed that mental illness could be caused by physical trauma or as a result of mental shock to the victim. For the classification of the perpetrator's actions as causing grievous bodily harm, it does not matter whether the mental illness is acute or chronic. If systematic beatings or minor bodily harm resulted in serious bodily harm, then such actions constitute a qualified offense – part 2 art. 142 of the Criminal Code 1926 [13, pp. 199-200]. In relation to art. 108 of the Criminal Code of the RSFSR, mental illness was defined as a mental disorder associated with a violation of the intellectual, emotional and volitional spheres of a person's mental activity (schizophrenia, epilepsy, feeblemindedness, etc.). For mental illness to be recognized as serious bodily harm, it was required that it be of a more or less prolonged nature. Judicial practice did not classify short-term reactive states as serious bodily harm [14, p. 72]. Specialists associated the onset of mental illness mainly with brain injuries, but did not exclude the possibility of mental illness being caused by a mental disorder. In 1975 and 1989, the particular cruelty of murder became the subject of consideration in two resolutions of the Plenum of the Supreme Court of the USSR dated 27.06.1975 No. 4 «On judicial practice in cases of intentional murder» and dated 22.09.1989 No. 10 «On the implementation by courts of the guiding explanations of the Plenum of the Supreme Court of the USSR when considering criminal cases of intentional murder» [1]. Their comparative analysis reveals a common approach (with the exception of minor stylistic differences) to the concept of particular cruelty, which may be displayed by the guilty party before or during the commission of murder and consists of three forms: a) when the murder is committed in a manner which the guilty party clearly assumes will result in causing particular suffering to the victim; b) when the victim was subjected to torture, abuse or mockery; c) committing a murder in the presence of the victim's relatives, when the perpetrator was aware that his actions were causing them particular suffering. The last circumstance caused the greatest difficulty in law enforcement practice, since this type of murder had not previously been distinguished by law. For example, the Criminal Division of the Supreme Court of the RSFSR, having considered T.'s case in cassation, recognized as justified the qualification of the actions of the convicted person by the court of first instance as an attempted murder with particular cruelty of his ex-wife's cohabitant (art. 15, p. «g» art. 102 of the Criminal Code 1960), since the crime was committed in the presence of the victim's close relatives - his moth-

er and sister [15, pp. 146-147]. In this case, a judicial error occurred, which was not corrected, since a necessary condition for imputing particular cruelty is the fact that the perpetrator must understand that he is causing particular suffering to the victim's relatives. Thus, at this stage of development of criminal-legal discourse on special cruelty shown towards the victim's relative, it is generally recognized that mental illness as serious physical injury must be of a more or less prolonged nature and be the result of physical or psychological impact on the victim. At the same time, the circumstance that by depriving the life of the victim his relative is inflicted with excruciating suffering, judicial practice considers as ruthlessness of the guilty party and associates it exclusively with the qualifying feature of murder – particular cruelty.

Reforming model of modern criminal law discourse on mental disorder as a consequence of particular cruelty. In the current Criminal Code of the Russian Federation of 1996, particular cruelty as a method of committing a crime is a qualifying characteristic of murder (p. «d» part 2 art. 105), intentional infliction of serious bodily harm (p. «b» part 2 art. 111), intentional infliction of moderate bodily harm, torture (p. «d» part 2 art. 117), rape and sexual violence (p. «b» part 2 art. 131, p. «b» part 2 art. 132), and particular cruelty is also established as a circumstance that exacerbates punishment (p. «i» part 1 art. 63). In two resolutions of the Plenary Session of the Supreme Court of the RSFSR (RF) dated 22.12.1922 No. 15 «On judicial practice in cases of premeditated murder» and dated 27.01.1999 No. 1 (as amended on 03.03.2015) «On judicial practice in cases of murder (Article 105 of the Criminal Code of the Russian Federation)» [1], the concept of particular cruelty has undergone no changes compared to similar acts of the Supreme Court of the USSR. In paragraph 6 of the resolution 1999 first formulates the concept of «persons close to the victim», which include close relatives of the victim, relatives of the spouse, and other individuals whose life, health, and well-being are dear to the victim as known to the offender. It is paradoxical that the immutability of the definition of particular cruelty in the explanations of the highest judicial bodies of the USSR, RSFSR and Russian Federation (from 1975 to 2025) did not lead to uniformity of judicial practice in cases where the result of committing the murder of the victim was particular suffering caused to his close person. At the present stage of criminal law discourse, the reasons for this are the following factors: 1) legislative classification of a mental disorder, regardless of its type, nature and duration, as serious harm to health; 2) international definition of a mental disorder as any disease accompanied by mental disorders, regardless of their types and characteristics, severity and duration (ICD-10); 3) vague description in the Criminal Code of the mechanism of causing serious harm to health, in particular, not only by inflicting physical injury, using mental violence against the victim himself, but also as a result of mental shock of a person close to

him; 4) ambiguity of the wording in the Criminal Code that a mental disorder in itself is serious harm to health; 5) misunderstanding by law enforcement agencies of the relationship between the special suffering of a loved one as a sign of special cruelty and moral harm, which is assessed in the framework of a civil claim; 6) unsuccessful terminology used in all orders of the Ministry of Health on determining the criteria for the severity of bodily injury, when grievous bodily harm itself is described by the term «qualifying features»; 7) recommendations of the Constitutional Court of the Russian Federation to assess a mental disorder under article 111 or 112 of the Criminal Code, which contradicts the order of the Ministry of Health of Russia dated 08.04.2025 No. 172n, according to which grievous bodily harm is a mental disorder of a persistent and pronounced nature, and in other cases it is proposed to assess it based on the duration of the health disorder or the degree of persistent loss of general ability to work, i.e. as moderate or mild bodily harm; 8) the difficulty of determining the form and type of guilt in the case of murder of the victim in the presence of his relative, when the consequence in the form of a mental disorder of the relative is in a remote causal relationship with the murder of the victim; 9) the absence in the resolution of the Plenum of the Supreme Court of the Russian Federation on cases of murder of any indication of the possibility of additional qualification under articles 111-115 of the Criminal Code of causing harm to health in the form of a mental disorder to a close person of the victim who was present when the crime was committed.

Based on the results of the conducted study, the following conclusions and proposals can be formulated: 1) in the order of the Ministry of Health of the Russian Federation dated April 8, 2025 No. 172n on determining the severity of harm caused to human health, the term «qualifying features of serious harm to health» should be abandoned, as it does not correspond to the understanding of such features in criminal law; 2) set out the wording of part 1 art. 111 of the Criminal Code as follows: «1. Intentional infliction of serious harm to health in the form of ... mental disorder ...», excluding the indication that serious harm to health entailed the development of a mental disorder, since it in itself is serious harm to health; 3) paragraph 8 of the Resolution of the Plenum of the Supreme Court of the Russian Federation of 27.01.1999 No. 1 shall be supplemented with a paragraph of the following content: «If as a result of the murder of the victim, harm was caused to the mental health of persons close to him, then the act may be qualified under articles 111-115 of the Criminal Code of the Russian Federation if the features specified therein are present».

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DOI 10.34660/INF.2025.82.86.198

司法自由裁量权在认定人身犯罪中被害人特殊痛苦中的作用
THE ROLE OF JUDICIAL DISCRETION IN QUALIFYING THE SPECIAL SUFFERING OF THE VICTIM IN CRIMES AGAINST THE PERSON

Jurchenko Irina Aleksandrovna
Candidate of Law, Associate Professor, Department of Criminal
Kutafin Moscow State Law University (MSAL)
Moscow, Russia

摘要：本文致力于研究人身犯罪中表明特别残忍情节的重复计算问题。分析了司法实践中的具体案例，其中将受害人遭受特别痛苦的行为视为独立犯罪，并根据关于造成健康损害的条款进行定性。最后，提出了对俄罗斯联邦刑事立法和最高法院全体会议决议的修改建议。

关键词：正义原则、司法自由裁量权、双重归责、人身犯罪、特别残忍、严重健康损害。

Abstract. *The article is devoted to a study of the problem of double counting of circumstances indicating the particular cruelty of crimes against the person. Specific examples from judicial practice are analyzed, when the infliction of particular suffering on a victim is considered as an independent crime and qualified according to the articles on causing harm to health. Finally, changes are proposed to the criminal legislation and the decisions of the Plenum of the Supreme Court of the Russian Federation.*

Keywords: *the principle of justice, judicial discretion, double imputation, crimes against the person, particular cruelty, serious harm to health.*

In law enforcement activities, there are often cases when the commission of a criminal act leads to the occurrence of a consequence in the form of causing serious harm to health, which is a derivative result of the process of a socially dangerous encroachment. Such a consequence may have various criminal-legal significance: 1) act as a qualifying or especially qualifying feature of the composition of the committed crime, 2) in accordance with the explanations of the Supreme Court of the Russian Federation, be an integral part of other serious consequences enshrined by the legislator as a especially qualifying feature; 3) go beyond the composition of this crime and require additional qualification. Particularly difficult are

situations when, as a result of the crime, the perpetrator causes special suffering to the victim or his relatives, including, expressed in the development of a mental disorder. Due to the fact that the only criminal-legal norm where the mental disorder of the victim is directly and unambiguously named as a sign of serious harm to health is the disposition of art. 111 of the Criminal Code of the Russian Federation [1], the qualification of the actions of the guilty party, when a mental disorder is a consequence of a crime committed by the person, gives rise to a number of difficulties associated with the presence or absence of a recorded set of crimes, the establishment of the form and type of guilt in relation to the ensuing consequence, the assessment of the results of forensic medical examination, etc. Generalization and analysis of materials of practice on specific criminal cases demonstrate the ambiguity of the judicial interpretation of the factual circumstances of the case due to reasons that are both objective and subjective in nature. Until recently, the classification of crimes committed with particular cruelty was carried out in accordance with the rules contained in the resolutions of the Plenum of the Supreme Court of the Russian Federation of 27.01.1999 No. 1 (as amended on 03.03.2015) «On judicial practice in cases of murder (Article 105 of the Criminal Code of the Russian Federation)» and of 04.12.2014 No. 16 «On judicial practice in cases of crimes against sexual inviolability and sexual freedom of the individual» [1]. The feature of particular cruelty is associated with: a) the method of committing the crime, b) the use of torture, torment, mockery of the victim, causing him/her particular suffering before or during the commission of the crime; c) in committing the crime in the presence of persons close to the victim. In the case of rape and violent acts of a sexual nature, the method of committing the crime is considered particularly cruel if it causes severe physical or mental suffering to the victim or other persons. With regard to murder, the Supreme Court of the Russian Federation makes a reservation that in order to recognize the murder of the victim in the presence of persons close to him/her as particularly cruel, it is necessary for the perpetrator to be aware that he/she is causing particular suffering to the latter. In accordance with the explanations of the Supreme Court of the Russian Federation, in order to impute the feature in question, it is always necessary to establish that the intent of the perpetrator included the commission of a crime with particular cruelty. However, in the science of criminal law, an ambiguous approach to determining the type of intent has developed. One group of experts associates particular cruelty exclusively with direct intent, based on the fact that the person wishes to act with particular cruelty [2, p. 23; 3, p. 76]. A more reasonable position seems to be that intent must be established in relation to the consequences, and not the characteristics of the act, therefore it can be both direct and indirect, and the awareness of the guilty party of the particular cruelty of the crime is part of the content of the intellectual intent of guilt [4, p. 138; 5, pp. 364-365]. Thus, E. was found guilty of

committing a crime with particular cruelty, having poured a flammable liquid on the victim on October 17, 1996 and set her on fire with a match. The victim died in agony and suffering from the burns she sustained. The panel of judges of the Supreme Court of the Russian Federation rejected the cassation appeal of the convicted person, since, according to the conclusion of the forensic psychiatric examination, E. committed the crime in a sane state and was able to be aware of what he had done [6, pp. 261-262]. In a similar case, E. was brought to justice on August 4, 1995 for premeditated murder committed with particular cruelty. The court of first instance excluded the element of particular cruelty, citing the lack of intent on the part of the guilty party to cause particular suffering to the victim. The Presidium of the Supreme Court of the Russian Federation overturned the sentence and sent the case for a new trial, stating that E. struck the victim K. several times with a mop, pushed her alive into the cellar, doused her with gasoline, and set the fire. K. died from burns and gasoline poisoning. At the same time, the perpetrator was aware that he was committing such actions against a living person and allowed K. to suffer special suffering [7, pp. 479-480]. In both cases, the special suffering of the victims consisted of both physical and mental suffering. In addition, there are situations when special cruelty is expressed in causing the victim only mental suffering. For example, informing the victim in advance that he would be killed, telling him about the method of murder, a cynical attitude to pleas for mercy, forcing the victim to dig his own grave, etc. constitute mockery of the victim and are regarded as other circumstances that indicate the manifestation of particular cruelty by the perpetrator [6, pp. 587-579]. A specific situation arises in the case of imputation of the qualifying feature «particular cruelty», when there is no severe physical and mental suffering of the victim against whom the crime is committed, and particular mental suffering is experienced by a person close to him who is present at the same time. Thus, in 1999, the Judicial Collegium of the Supreme Court of the Russian Federation rejected the cassation appeal of K., convicted of murder with particular cruelty. The convicted person referred to the fact that the murder of the victim D. in the presence of the latter's common-law wife B. cannot be considered as committed with particular cruelty, since she is not the spouse of the murdered man. In its decision, the higher court indicated that K., committing the murder in the presence of B., was aware that the victim D. had lived with B. for two years and intended to marry her. In this case, B. was inflicted with special suffering caused by the deprivation of life of a loved one in front of her eyes, which K. was aware of, thereby demonstrating special cruelty [7, pp. 482-483]. In this case, it is worth noting that the Judicial Collegium of the Supreme Court of the Russian Federation did not attempt to assess the severe moral suffering caused to B. by the murder of a loved one in her presence as additional consequences of the crime. In general, it can be concluded that at the turn of the

late 90s, when the Criminal Code of the RSFSR of 1960 in its latest version was still in effect, and then the Criminal Code of the Russian Federation of 1996 came into force, uniform rules for qualifying crimes against the person committed with particular cruelty were developed, which are supported in the doctrine to this day. However, a new trend has emerged in judicial practice in the criminal-legal assessment of special mental suffering caused to the victim himself or his relatives in relation to the elements of murder and serious bodily harm. In particular, in its cassation ruling of December 2, 2021, No. 45-UD21-42-A2, the Criminal Collegium of the Supreme Court of the Russian Federation upheld the first instance sentence against P., who was convicted of the murder of his wife, committed with particular cruelty, as well as for causing grievous bodily harm to his minor son Sh., which resulted in a mental disorder, committed with particular cruelty and with the use of a weapon. According to the circumstances of the case, P. killed his wife in the presence of his son, who was trying to protect his mother. At the same time, in the court's opinion, P. saw that their minor son Sh. was nearby and realized that by his actions he was causing him particular moral suffering, which ultimately led to harm to the health of minor Sh. in the form of a mental disorder, namely post-traumatic stress disorder. The court considered it justified to classify P.'s actions under p. «d» part 2 art. 105 and p. «b» part 2 art. 111 of the Criminal Code [1]. As can be seen from this and many other similar court decisions, severe mental suffering of the victim and his relatives is now additionally assessed by the courts as serious harm to health in the form of a mental disorder, which raises serious doubts about the need for such a qualification. But this practice did not arise out of nowhere. This approach became possible due to the International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) [8] in force in the territory of the Russian Federation and the Order of the Ministry of Health and Social Development of the Russian Federation dated 24.04.2008 No. 194n (as amended on 18.01.2012) «On approval of Medical criteria for determining the severity of harm caused to human health» [1], based on it. Based on the literal interpretation of the content of articles 111, 112, 115 of the Criminal Code, it follows that a mental disorder is a sign exclusively of causing serious harm to health. Due to the fact that the Order of the Ministry of Health and Social Development of the Russian Federation dated 24.04.2008 does not contain any characteristics of a mental disorder, there are different opinions in the doctrine and judicial practice regarding whether any mental illness constitutes a crime provided for in art. 111 of the Criminal Code, and if the answer is negative, then whether a mental disorder should be qualified under articles 112 and 115 of the Criminal Code. Most scientists were inclined to believe that serious harm to health is recognized as a mental disorder «regardless of its severity, duration, curability» [9, p. 167]. Some authors noted that in the context of article 111 of the Criminal Code,

only chronic or temporary mental disorders, as well as feeblemindedness, should be taken into account [3, p. 185]. A similar position was supported by specialists in the field of psychiatry, who proposed to correlate mental disorder with the elements of crimes provided for in articles 111-115 of the Criminal Code. Accordingly, mental disorders that are dangerous to human life must be classified as serious harm to health, long-term mental disorders should be taken into account as moderate harm to health, and short-term mental disorders constitute minor harm to health [10, p. 9]. This concept is also reflected in judicial practice. Thus, the Criminal Collegium of the Ninth Cassation Court of General Jurisdiction, in its ruling of June 27, 2023, in case No. 77-1073/2023, upheld the verdict of the court of first instance, by which S. was convicted under part 1 art. 112 of the Criminal Code for causing moderate harm to health. In support of the decision taken, the cassation court referred to the conclusion of the forensic psychiatric examination, according to which the victim was diagnosed with an adaptation disorder in the form of a prolonged depressive reaction of moderate severity (F 43.21). The court rejected the arguments of the victim F. that she had suffered serious harm to her health, since the expert opinion indicated that F. did not have a chronic or temporary mental disorder, and the prolonged depressive reaction was justifiably assessed by the lower court as a long-term health disorder over 21 days [1]. It is worth noting that in this case there is some silence on the part of the experts and the court about what is hidden behind the code F 43.21 in ICD-10. Here the court and the experts «simplified» the diagnosis. Firstly, the court separated «prolonged depressive reaction» (F43.21) from «mental disorder», although ICD-10 does not differentiate them, therefore the harm should have been recognized as serious only by this criterion, regardless of its duration and type, which is confirmed by the order of the Ministry of Health of the Russian Federation of 2008. Secondly, the experts and the court did not take into account the potential chronification of the victim's condition, the duration of the depressive reaction of which can be up to 2 years. Thirdly, in the expert's conclusion, the «moderate degree» of the depressive reaction characterizes the degree of limitation of the victim's life activities, and not the severity of the harm to health. In the specified case of S., the court took a formal approach to assessing the expert opinion. In another case, the same Ninth Cassation Court, in its ruling of January 15, 2025, in case No. 77-17/2025 (77-1923/2024), rejected the complaint of A., who had beaten (several blows) his wife's minor child, which did not result in any physical harm to the victim's health. However, according to the conclusion of the forensic medical examination, as a result of A.'s actions, the child developed a neurotic (mental) disorder associated with stress in the form of a mixed disorder of emotions and behavior. A.'s actions were qualified under p. «b» of part 2 of art. 111 of the Criminal Code [1]. Without justifying A.'s actions, it is nevertheless worth noting that both decisions

of the same court can serve as an illustrative example of judicial discretion. In ICD-10, the neurosis diagnosed in the child is classified as a mental disorder that is temporary and reversible, as in S.'s case. However, in the analyzed case, the court did not attempt to correlate the mental disorder that occurred in the victim with the duration of the health disorder, but clearly equated the mental disorder with serious harm to health, based on the literal meaning of the provisions of the Criminal Code. The arguments of the convicted person and his defense attorney, obtained with the help of a psychiatrist that a neurotic disorder associated with stress does not relate to persistent maladaptation of a pronounced degree, were rejected under the pretext that experts had already conducted an examination on this case. The court also did not assess the fact that the examination was conducted at a time when the child was in an orphanage, which could have affected his behavior. The court mechanically referred to the expert opinion on the presence of a causal link between A.'s actions and the mental disorder diagnosed by specialists. Although the courts of all instances in A.'s case referred to the ruling of the Constitutional Court of the Russian Federation of 11.01.2024 No. 1-P «On the case of verifying the constitutionality of part one of article 111 and part one of article 112 of the Criminal Code of the Russian Federation, as well as paragraph 3 of the Rules for determining the severity of harm caused to human health, in connection with the complaint of citizen B.» [1], indicating the need for an individual approach to assessing a mental disorder, but in this case there is a clear accusatory bias. Meanwhile, the problem of qualifying the special suffering of the victim and his relatives as an independent crime requires an urgent solution, since the new rules for determining the severity of harm to health, approved by the order of the Ministry of Health of the Russian Federation dated April 8, 2025 No. 172n, which will come into force on September 1, allow mental disorder to be qualified as serious, moderate or minor harm to health (clause 5.1.8), i.e. the criminal law is given a broad interpretation. A mental disorder that is not persistent and pronounced will be assessed in terms of the duration of the health disorder or the degree of loss of general working capacity. In this regard, it is possible to predict the continuation of the practice of independently assessing the moral suffering of the victim as causing harm to health of varying severity. In addition, the question arises about the relationship between the sign of particular cruelty and mental disorder. It seems illogical to include the element of particular cruelty, bullying and torment in articles 111 and 112 of the Criminal Code as a qualifying circumstance. Firstly, such wording seems incorrect, since bullying and torment are manifestations of particular cruelty and do not require a separate indication of them. Secondly, mental violence itself, consisting, for example, in mockery and mockery of the victim, should be considered within the framework of art. 111 of the Criminal Code as a form of a socially dangerous act that entailed consequences in

the form of serious harm to health, i.e. such actions of a person fit entirely into the main elements of the crime and cannot be assessed again as an aggravating (qualifying) circumstance. Otherwise, mental abuse of the victim will simultaneously be an act and a method of committing it. In such a situation, one can observe double counting of the same factual circumstances. One of the reasons for such an interpretation of the law is the incorrectness of the description of the elements of the crime in part 1 art. 111 of the Criminal Code: «Intentional infliction of grievous bodily harm that is dangerous to human life, or that entails...», which, according to the rules of the Russian language, implies independent actions in the form of causing grievous bodily harm, the consequence of which is the loss of sight, speech, hearing, or any organ or the loss of an organ's functions, termination of pregnancy, mental disorder, etc. One of the consequences of such an unfortunate formulation is a scientific and practical discussion about the mechanism of causing harm to human health, in particular, about the possibility of causing harm solely through mental influence on the victim. Sometimes an anecdotal situation arises when the appellate court has to exclude from the descriptive and motivating part of the verdict the judgment of the first instance judge that the ruling of the Constitutional Court of the Russian Federation of 11.01.2024 No. 1-P concerns cases of qualifying the actions of the perpetrator under art. 111 or 112 of the Criminal Code only when the mental disorder is the result of causing physical harm to the victim. At the same time, the court indicated in the verdict that no facts of physical violence were established in the case under consideration. For its part, the Cassation Court, agreeing with the position of the appellate court, in its ruling of May 23, 2024 in case No. 77-1661/2024, noted that the court of first instance misunderstood the explanations of the Constitutional Court of the Russian Federation [1]. The circumstances of the case consisted of taking possession of someone else's property by suggesting to the victim over several years that his real estate and movable property were filled with negative magical energy and needed to be disposed of by handing it over to the accused. The result of such psychological influence was a persistent change in the personality of the victim, recognized by experts as having a mental disorder. The perpetrators were convicted under articles on fraud committed by an organized group on an especially large scale, and on intentional infliction of grievous bodily harm resulting in mental disorder committed by an organized group (part 4 art. 159 and under p. «a» part 3 art. 111 of the Criminal Code). Thus, the appellate and cassation courts recognized the possibility of causing harm to the mental health of the victim by means of mental influence on him. In general, the unusualness of such a qualification is consistent with the general concept, according to which a mental disorder can be the result of harm to a person's health both by means of physical influence on him and as a consequence of the use of mental violence [3, p. 185]. A particularly difficult situation

is when special suffering is caused not to the victim himself, but to a close person present at the scene of the crime. In this case, the double qualification of one act under the articles on harm to health violates the principle of non bis in idem. Firstly, criminal legislation already takes into account the special suffering of a person close to the victim in the qualifying feature of «special suffering», which is confirmed by the long-term practice of applying Soviet criminal legislation and the current clarifications of the Plenum of the Supreme Court of the Russian Federation on certain categories of cases. Secondly, the objective side of the additionally imputed crime consists, as a rule, in the «indirect» mental impact on a close person through an attack on another person (for example, the murder of a mother in front of a child, the rape of a wife in the presence of a husband, etc.). The same indirect causal relationship is present between the main (principal) actions of the perpetrator (killing his mother, raping his wife), causing severe mental suffering in a close person (by means of «indirect» mental influence on the close person), which in turn became a «trigger» for the occurrence of mental disorders in him, which are almost always assessed as one or another mental disorder. Thus, the legal position of the judicial authorities on the need to independently qualify special suffering as a mental disorder raises great doubts about the correctness of such a decision, since the formula «special suffering of a close person = mental disorder» will always apply. Thirdly, as already noted in the doctrine, there is no single opinion on the type of intent when committing murder with particular cruelty. In law enforcement practice, courts, understanding that there is a rather distant cause-and-effect relationship between the actions of the guilty party and the mental disorder of a person close to the victim, agree with the presence of a careless form of guilt in the actions of the defendant. Of interest in the context of determining the form and type of guilt is the case of K., who killed his wife's mother in the presence of his young son, striking her multiple times. The child defended his grandmother and was cut with a knife, which resulted in a mental disorder and temporary loss of mobility in his legs. The court found that K. caused minor harm to the child's health with indirect intent, being indifferent to the consequences, and that serious harm to the child's health (mental illness) was the result of negligence, since K., reliably knowing about the unstable psyche of the minor, did not foresee, but should have and could have foreseen, the possibility of the child developing a mental disorder [1]. The qualification of K.'s actions seems unfounded, since both in it and in the decisions analyzed above, one can see the desire of law enforcement agencies to strengthen their position and impose a more severe punishment on the perpetrator by double qualification of the same factual circumstances for a combination of crimes. In addition, one should agree with the position of scientists who believe that the suffering of third parties, even if close to the victim, is beyond the scope of the corpus delicti of murder, the cruelty is directed specifically at the

victim, and therefore the qualification in such cases of the act as murder with particular cruelty is nothing more than an objective imputation [2, p. 21; 11, pp. 307-308].

Based on the results of the conducted study, the following conclusions and proposals can be formulated: 1) it is necessary to amend the wording of articles 112 and 115 of the Criminal Code as follows: «1. Intentional infliction of moderate bodily harm, expressed in a mental disorder or other long-term health disorder or significant permanent loss of general working capacity of at least one third ...», «Intentional infliction of minor bodily harm, expressed in a mental disorder or other short-term health disorder or minor permanent loss of general working capacity ...»; 2) from p. 8 and 11 of Resolutions of the Plenum of the Supreme Court of the Russian Federation No. 1 and No. 16, it is necessary to exclude the indication that particular cruelty may be expressed in the commission of the crime of murder in the presence of persons close to the victim; 3) in these same points of the resolutions, provide an explanation that the actions of a person who committed murder, rape, or violent sexual acts that resulted in a mental disorder in persons close to the victim do not in themselves indicate the particular cruelty of the crime.

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DOI 10.34660/INF.2025.59.27.199

俄罗斯普通法院解决个人民事纠纷的调解制度：理论与实践问题
THE INSTITUTE OF MEDIATION IN THE RESOLUTION OF INDIVIDUAL CIVIL LAW DISPUTES BY GENERAL JURISDICTION COURTS IN RUSSIA: ISSUES OF THEORY AND PRACTICE

Kadimova Maihalum Shamsudinovna
Candidate of Juridical Sciences, Associate Professor
Dagestan State University

Alieva Zulfizhat Zubayrievna
Candidate of Juridical Sciences, Associate Professor
Dagestan State University

摘要：本文探讨了解决冲突的途径，其中重点强调了调解制度，因为这种调解程序是2010年在俄罗斯联邦法律体系中首次在立法层面引入的程序之一。作者考察了普通管辖法院在解决民事案件时，调解程序的有效性和适用性方面存在的问题。基于对法院适用该制度的实践的分析，得出结论，在解决某些类型的民事纠纷时，有必要引入强制调解。

关键词：冲突、纠纷、民事程序、替代方法、调解程序、和平解决、调解。

Abstract. *The article discusses ways to resolve conflict situations, where the main emphasis is on the institution of mediation, since this type of conciliation procedure, which was one of the first to be introduced at the legislative level in the legal system of the Russian Federation in 2010. The authors examine the problems associated with the effectiveness and use of the mediation procedure in resolving civil cases by courts of general jurisdiction. Based on the analysis of the practice of applying this institution by courts, a conclusion is made about the need to introduce mandatory mediation in resolving certain categories of civil disputes.*

Keywords: *conflict, dispute, civil process, alternative methods, conciliation procedures, peaceful settlement, mediation.*

We live in an amazing world, where since ancient times, humanity has come a long and difficult way. People could not even dream, guess about what we have today. Modern society has advanced technologically, this is the age of digitalization, artificial intelligence is being introduced into almost all spheres of life. Despite this, as long as the world exists, there have been conflicts that require finding ways

to resolve them. At the same time, in our opinion, the standard of living of society, the ability to resolve conflicts in a civilized manner, is directly related to culture, with the need to improve it.

A revolutionary step in the development of the culture of society, according to the statement of Sigmund Freud, can be considered when an ancient man, instead of throwing a stone at an opponent, threw a word at him.

Thus, law, as a form of public consciousness, depends on the level of culture of society and it would be quite fair to agree that human behavior in a conflict depends on established stereotypes and behavior patterns formed by culture[1]. Culture includes norms, values, traditions and ways of communication that shape people's behavior in conflict situations. Undoubtedly, a person's ability to find a way to reach an agreement will depend on the level of culture.

The proverb "A bad peace is better than a good quarrel" is familiar to everyone. "Better an outrageous settlement agreement than a brilliant trial" - this phrase is attributed to Koni, a famous lawyer. In this regard, any conflict is best resolved peacefully.

Undoubtedly, reconciliation is one of the priority areas of state policy today. This is one of the main types of alternative dispute resolution.

The law enforcement function of the state, ensuring the implementation of the principle of legal protection, is expressed, along with other aspects, in the targeted use of mechanisms for peaceful conflict resolution by the judiciary. This is evidenced by the amendments and changes made to domestic legislation by the federal law of July 26, 2019 No. 197-FZ "On Amendments to Certain Legislative Acts of the Russian Federation". Taking this provision into account, Article 153.3 of the Civil Procedure Code of the Russian Federation enshrines certain types of conciliation procedures, in particular, the right of the parties to negotiations, mediation, judicial conciliation, as well as other methods of dispute resolution that are not directly prohibited by current legislation. Thus, the state emphasizes the importance of consensual resolution of civil disputes, which minimizes confrontation between the parties and increases the effectiveness of justice in general.

The explanatory note to the said law of July 26, 2019 No. 197-FZ states that the initiative to develop conciliation procedures is aimed at improving the quality of justice by reducing the judicial workload, and, first of all, reducing conflict, developing partnerships, forming a respectful attitude towards the law, as well as increasing legal awareness and social activity.

In modern Russia, the court is not a body to which people turn in exceptional cases. From year to year, the courts are forced to consider an incredibly large number of civil cases. For example, in 2024, 29,293,817 civil cases were considered, in 2023 - 27,544,981, in 2022 - 25,092,732, in 2021 - 22,619,800. Thus, there is a tendency towards a stable increase in the number of civil cases submitted to

the courts from year to year. If we study in more detail the categories of cases that were most often considered by the courts in 2023, we will note that these are disputes arising from housing (10,882,315), family (884,379) legal relations, disputes on the protection of consumer rights (199,668). Disputes related to land use are also "in the lead" (155,557 cases)[2].

A more detailed analysis of civil cases shows that in law enforcement activities, a large number of cases that are considered in courts do not always present difficulties. They arise because the majority is not ready to pay alimony, taxes, and do not fulfill other obligations assumed without coercion. Or there are categories of cases that are most often considered by the courts. Thus, the dishonesty of citizens or the unwillingness of citizens to find another form of protection of their rights is the cause of millions of civil cases and this situation cannot be called comforting. In this regard, the question of how to reduce the number of cases coming to court remains relevant. And here it seems possible to resolve them by alternative methods that can be used as an alternative to judicial dispute resolution, but in no way will become its replacement. Among the methods operating in modern Russia (arbitration, negotiations between the parties, negotiations with the participation of a neutral person, arbitration), we believe it is worth highlighting mediation, since it was the mediation procedure that was first introduced at the legislative level with the adoption of the Federal Law of 27.07.2010 N 193-FZ "On an alternative procedure for resolving disputes with the participation of a mediator (mediation procedure)" for resolving conflicts.

Please note that initially the possibility of using mediation procedures was enshrined in the Arbitration Procedure Code of the Russian Federation (Article 135), then in the Civil Procedure Code of the Russian Federation and subsequently found enshrined in the Code of Administrative Procedure of the Russian Federation, after its adoption in 2015.

It is believed that mediation in its modern form appeared only in the 20th century, but the foundations of this method of resolving conflicts are contained in the history of Ancient Babylon, African countries, China, Japan and other countries[3].

It should be noted that in the North Caucasus, in particular in Dagestan, a kind of the same mediation is performed by the long-established rule of resolving disagreements based on masliat. "Masliat as an institution of customary law of the peoples of Dagestan represents the reconciliation of conflicting parties and is one of the forms of conflict resolution in Dagestan." Through masliat, conflicts related to the murder of a person, blood feuds, and possible "resolution from land disputes and marital and family relations to defense and foreign relations issues could be resolved. At the same time, the decisions of the masliat were binding on all members of the community, which contributed to the maintenance of order and stability"[4].

People who had a dispute found a mediator, usually a man of respectable age, an elder or an imam, a dibir of a mosque, who enjoyed great respect. After explaining the essence of the dispute, the masliate member delivered a verdict, which had to be observed by the parties. Otherwise, punishment could occur, which was provided for taking into account the peculiarities of legal monuments, as well as those in force among the different nations of the peoples of Dagestan. This was how the parties were brought to reconciliation.

This method of reconciling the parties was considered the most effective from a social point of view, as well as corresponding to the mentality of the Dagestani peoples and social life. It is important to emphasize that the institution of masliate in some cases continues to be used in modern Dagestan, playing a key role in preserving cultural heritage, strengthening interethnic harmony and developing civil society.

Unlike masliate, according to Art. 2 of the Federal Law of 27.07.2010 N 193-FZ "mediation is a method of resolving disputes with the assistance of a mediator based on the voluntary consent of the parties in order to reach a mutually acceptable solution." As of 2024, at least 10,000 professional mediators are registered in Russia[5].

However, not all of them are actively practicing.

The hope that "dispute resolution through mediation can be a worthy alternative to lengthy and costly litigation"[6] unfortunately, did not come true to the extent that the legislator expected when adopting the aforementioned Federal Law of 27.07.2010 N 193-FZ, giving legal force to a mediation agreement, which is considered the result of a successful mediation procedure. Currently, a mediation agreement is certified by a notary and has the force of a legal document. The reasons for this have been and continue to be the subject of discussion [7]. It is gratifying to see that in some cases the parties to the dispute do resort to this procedure. We would like to note that there are no complete statistics on the number of mediations conducted, as many cases remain unaccounted for (especially out-of-court mediations). Among the courts that demonstrate systematic and effective implementation of conciliation practices, the Petrozavodsk City Court and the courts of the Ivanovo Region stand out[8].

A more precise analysis can be traced on the basis of consolidated statistical data, which are annually compiled by the Judicial Department of the Supreme Court of the Russian Federation[9], based on which experts[10], and scientists give comments[11].

Conducting an analysis between the number of civil cases considered and the popularity of the mediation procedure in resolving specific cases, it seems that this procedure should be provided for as mandatory for certain categories. Despite the fact that in the literature, for example, one can find the opinion that "mediation

consideration of land disputes is not popular and in demand among subjects of legal relations"[12], in our opinion, for certain categories of cases that are more common in law enforcement activities, before applying to the court, a provision should be enshrined in legislation providing for mandatory mediation by the parties before applying to the court. In particular, these may be cases on housing, family, land disputes, since they are more often considered in courts, as mentioned above. In addition, it is advisable to provide for the right of the court to refer the parties to compulsory mediation in cases where the court sees such an opportunity when resolving civil disputes based on the circumstances of the case. This right should be used for those same simple categories of cases that are encountered in courts.

However, it should be taken into account that resolving a conflict with the help of a mediator at the pre-trial stage will increase the effectiveness of protecting the violated rights of the subjects of the disputed legal relationship several times over and will relieve the courts of a larger number of civil cases. Only that part of the cases will remain for which the parties failed to reach a compromise solution. Therefore, judges at the stage of preparing a case for trial will have to, taking into account the law or based on the circumstances of the case, refer the parties to undergo the mediation procedure.

The psychological aspect of the judicial conciliator plays an important role in these matters. The parties to the conflict more easily make concessions addressed to a neutral mediator rather than directly to their procedural opponent. Such an approach helps to reduce the level of emotional tension and increases the likelihood of reaching a mutually beneficial compromise. Having analyzed the statistics and practice of applying the mediation procedure, the following arguments should be highlighted in its favor - saving time; minimal costs; maintaining relationships between the parties (personal, business); confidentiality; adaptability of the mediation agreement to the needs of the parties; reducing the burden on the judicial system. It is also noted as an advantage that "the execution of the mediation agreement is close to 100%, while court decisions on civil disputes are executed only in 20% of cases"[13].

Summarizing the above, in our opinion, it is worth noting that the protection of the rights and interests of participants in civil-legal relations should be effective, but if there is even the slightest possibility of a peaceful settlement of the dispute, it should be used. In this regard, it seems necessary to intensify educational work and information support in the legal and public media spaces, bringing to the professional community and the general public the advantages and features of the legal institution of mediation.

As additional proposals of an organizational nature, we can name the strengthening of the role of chairmen of regional courts in matters of appointing the mediation procedure by judges considering civil cases. Such measures, in our opinion,

are aimed at positioning the institution of mediation as a fast, cost-effective and reliable mechanism for ending conflicts.

Thus, mediation deserves more active implementation in legal practice. Since the parties to the conflict can apply to the mediation procedure before the court or after the initiation of a civil case, it seems advisable to establish its passage as mandatory for disputes arising from housing, family, land legal relations. For other categories of civil disputes, the mediation procedure is possible at the initiative of the court, taking into account the circumstances of the case. We believe that only such imperative rules will reduce the number of civil cases considered by the courts, as well as increase the effectiveness of legal regulation of disputes arising from civil legal relations.

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12. Vasyuchkova, O. A., Nikiforov, S. M. Alternative methods of resolving conflicts related to land rights: new approaches and prospects for the development of land legislation // Business and Law. – 2023. - N 2.

13. Experts of the RF CCI: mediation in Russia will actively develop // Novye Izvestia. November 21, 2024. - URL: https://newizv.ru/news/2024-11-21/eksperty-tpp-rf-mediatsiya-v-rossii-budet-aktivno-razvivatsya-434543 (date of access: 07/27/2025).

DOI 10.34660/INF.2025.19.64.200

刑事诉讼中的人工智能证据：上合组织成员国的比较视角
AI-GENERATED EVIDENCE IN CRIMINAL PROCEEDINGS: COMPARATIVE PERSPECTIVES FROM SCO MEMBER STATES

Alizade Vera Aleksandrovna

摘要：人工智能 （AI） 技术迅速融入执法和司法系统，引发了关于刑事诉讼中人工智能生成证据的可采性和可靠性的复杂法律问题。尽管全球关于人工智能与刑事司法的讨论正在加速，但上海合作组织 （SCO） 成员国的具体做法仍未得到充分审视。本研究对上合组织部分成员国（包括中国、俄罗斯、哈萨克斯坦和乌兹别克斯坦）在程序框架内如何处理人工智能生成或人工智能辅助证据进行了比较法律分析。

通过比较各国的做法，本文突出了监管协调方面的差距，并提出了在上合组织框架内制定通用证据协议的规范性建议。研究结果旨在支持未来在刑事诉讼中合法使用人工智能的区域合作。

关键词：人工智能生成证据、刑事诉讼、上合组织法律体系、算法问责、数字取证。

Abstract. *The rapid integration of artificial intelligence (AI) technologies into law enforcement and judicial systems has raised complex legal questions regarding the admissibility and reliability of AI-generated evidence in criminal proceedings. While global discourse on AI and criminal justice is accelerating, the specific approaches of the Shanghai Cooperation Organisation (SCO) member states remain underexamined. This research provides a comparative legal analysis of how AI-generated or AI-assisted evidence is addressed within the procedural frameworks of select SCO countries, including China, Russia, Kazakhstan, and Uzbekistan.*

By comparing national approaches, the article highlights gaps in regulatory harmonization and proposes normative recommendations for developing common evidentiary protocols within the SCO framework. The findings aim to support future regional cooperation in the lawful use of AI in criminal procedure.

Keywords: *AI-generated evidence, criminal procedure, SCO legal systems, algorithmic accountability, digital forensics.*

Artificial intelligence (AI) is rapidly transforming the landscape of criminal justice, particularly in the domains of investigation, surveillance, and forensic

analysis. One of the most legally challenging aspects of this transformation is the increasing reliance on AI-generated or AI-assisted outputs as sources of evidence in criminal proceedings. From predictive models and biometric recognition systems to generative algorithms that produce audio, video, or textual content, AI is beginning to function not merely as a tool of investigation but as a generator of evidentiary material with potential probative value in courtrooms. While international legal frameworks such as the Budapest Convention on Cybercrime (2001) and the Second Additional Protocol on enhanced cooperation (2022) have addressed aspects of digital evidence, they remain silent on the specific status of AI-generated content and the procedural requirements for its admissibility[1]. The recently adopted United Nations Convention on Countering the Use of Information and Communications Technologies for Criminal Purposes, adopted by the UN General Assembly in January 2024 (A/RES/78/261), similarly lacks specific provisions on algorithmically generated evidence, despite repeated calls during negotiations to address emerging technologies such as AI and deepfakes[2]. Meanwhile, legal systems around the world—including those of the Shanghai Cooperation Organisation (SCO) member states—face growing pressure to adapt their evidentiary rules and criminal procedure codes to the realities of autonomous and probabilistic systems.The issue is particularly salient in the SCO context, where states such as China and Russia have introduced significant regulatory measures governing AI development and deployment. China's Interim Measures for the Management of Generative Artificial Intelligence Services (2023) include provisions linking AI-generated content to public security enforcement and legal responsibility, potentially triggering criminal sanctions where harm occurs[3]. Russia has incorporated AI tools into digital forensic examinations and judicial decision support systems, though formal evidentiary guidelines for AI remain underdeveloped[4]. Other SCO states such as Kazakhstan, Uzbekistan, and Kyrgyzstan are increasingly deploying digital tools in policing and justice, but lack codified frameworks for assessing the evidentiary value of algorithmic outputs[5].

[1] Council of Europe. (2001). *Convention on Cybercrime* (ETS No. 185); Council of Europe. (2022). *Second Additional Protocol to the Convention on Cybercrime on enhanced cooperation and disclosure of electronic evidence*.

[2] United Nations General Assembly. (2024). *Resolution A/RES/78/261: United Nations Convention on Countering the Use of Information and Communications Technologies for Criminal Purposes*. Adopted on 12 January 2024.

[3] Cyberspace Administration of China. (2023). *Interim Measures for the Management of Generative Artificial Intelligence Services* (effective 15 August 2023).

[4] Russian Federation Ministry of Justice. (2022). *Development Strategy of the Digital Legal Environment of the Russian Federation until 2030*; S. M. Kazantsev. (2023). "On the Use of Artificial Intelligence in Forensic Expertise," *Journal of Russian Law*, no. 11.

[5] OECD. (2022). *Digital Government Index: Kazakhstan and Central Asia*; UNDP Uzbekistan. (2023). *Digital Transformation of the Justice Sector in Uzbekistan*.

Against this backdrop, the present article aims to explore how selected SCO member states conceptualize, regulate, and operationalize the use of AI-generated evidence in criminal proceedings. It offers a comparative analysis of doctrinal foundations, legislative gaps, and procedural safeguards—or the lack thereof—governing the admission and evaluation of AI-derived material. The study concludes with normative recommendations for harmonizing approaches within the SCO legal space, with a view to enhancing procedural fairness, regional cooperation, and responsible innovation.

Defining AI-Generated Evidence in Criminal Procedure

AI-generated evidence refers to information produced or significantly processed by artificial intelligence systems that may be submitted for evidentiary purposes in criminal proceedings. This includes:

1. Direct outputs, such as synthetic images, videos, or text generated by large language models (LLMs) or generative adversarial networks (GANs);
2. Inferential or analytical outputs, such as forensic predictions, biometric identifications, behavioral profiling, or automated decision support in investigations.

Unlike traditional digital evidence (e.g., emails, device logs), AI-generated evidence introduces unique legal challenges due to its autonomy, opacity (black-box nature), and probabilistic reasoning.

The OECD Recommendation on Artificial Intelligence (2019) emphasizes the importance of transparency, accountability, and traceability of AI systems used in high-stakes contexts, including law enforcement[6]. Similarly, the European Commission's Proposal for an Artificial Intelligence Act (2021) introduces the concept of high-risk AI systems, many of which are directly applicable to public-sector use, including criminal justice. Although the EU AI Act is not binding for SCO countries, its risk-based classification and emphasis on human oversight provide an important comparative benchmark[7].

From a technical standardization perspective, the ISO/IEC JTC 1/SC 42 committee has developed terminology and architecture frameworks (e.g., ISO/IEC 22989:2022 and ISO/IEC 23053:2022) for defining trustworthy AI, which may serve as tools for evidentiary verification and procedural reliability assessment[8].

In legal terms, AI-generated material challenges conventional classifications such as:

1. Witness testimony, which presumes human cognition and recall;
2. Documentary evidence, which presumes authenticity and provenance;

[6] OECD. (2019). *Recommendation of the Council on Artificial Intelligence*. OECD/LEGAL/0449.

[7] European Commission. (2021). *Proposal for a Regulation laying down harmonised rules on artificial intelligence (AI Act)*, COM(2021) 206 final.

[8] ISO/IEC JTC 1/SC 42. (2022). *Artificial Intelligence Concepts and Terminology (ISO/IEC 22989)*; *AI Governance and Risk Management (ISO/IEC 23053)*.

3. Expert evidence, which presumes methodological reproducibility.

This ambiguity raises critical doctrinal questions: Can algorithmic outputs be cross-examined? Who vouches for their accuracy? How should courts deal with probabilistic content?

Domestic and International Legal Approaches in the SCO Space

While there is no unified SCO treaty on digital or AI evidence, several member states have enacted domestic rules or adopted strategies affecting the treatment of AI-generated information in legal proceedings.

In China, the 2023 Interim Measures for the Management of Generative Artificial Intelligence Services require providers of generative AI to ensure accuracy, legality, and security of content. Article 21 explicitly states that where public order is harmed, criminal responsibility shall be pursued in accordance with law[9]. These Measures, along with China's Cybersecurity Law (2017) and Personal Information Protection Law (2021), form the core regulatory framework governing the production, dissemination, and evidentiary relevance of AI outputs.

Russia has advanced its Digital Justice Strategy 2030, which includes AI applications in courts and digital forensic tools. However, the Criminal Procedure Code of the Russian Federation does not yet define AI-generated materials as a distinct evidentiary category. The lack of legislative clarity has prompted calls for amendments to Articles 74 and 75 (types and admissibility of evidence), particularly to address reliability and explainability of algorithmic outputs[10].

Kazakhstan, as part of its Digital Kazakhstan initiative, has invested in legal informatization and digital case management systems. While no explicit legal provisions address AI-generated evidence, the Law on Informatization (amended in 2021) recognizes automated systems in public administration, suggesting a potential foundation for formal evidentiary treatment[11].

In Uzbekistan and Kyrgyzstan, digital justice reforms are ongoing, including biometric integration in criminal justice workflows. However, no binding norms yet distinguish AI-generated content from traditional digital evidence. Courts continue to rely on expert certification and forensic institutions to validate data origin and integrity[12].

At the international level, while the Budapest Convention (ratified by Kazakhstan and Uzbekistan) provides procedures for handling electronic evidence, it lacks provisions for autonomous or generative AI content. Likewise, the UN

[9] Cyberspace Administration of China. (2023). *Interim Measures for the Management of Generative Artificial Intelligence Services* (effective 15 August 2023).

[10] Russian Federation Ministry of Justice. (2022). *Development Strategy of the Digital Legal Environment of the Russian Federation until 2030*

[11] Republic of Kazakhstan. (2021). *Law on Informatization*, No. 418-V ZRK (with 2021 amendments).

[12] UNDP Uzbekistan. (2023). *Digital Transformation of the Justice Sector in Uzbekistan*.

Convention on Cybercrime (A/RES/78/261, 2024) remains technologically neutral and avoids reference to AI-specific forensic standards[13][14].

Evidentiary Challenges and Doctrinal Dilemmas

Across the SCO legal space, criminal procedure laws classify evidence into categories such as witness testimony, physical evidence, documents, expert conclusions, and audio-visual recordings. AI-generated outputs, however, challenge these traditional classifications due to their non-human origin, opacity, and probabilistic nature.

In Russia, the Criminal Procedure Code (Article 74) recognizes "other documents" as admissible evidence, which could in theory include AI-generated texts or images. However, in practice, courts require certification by human experts (e.g., forensic linguists or IT specialists) to validate the source and content, as there are no clear procedural standards for verifying outputs from generative models such as ChatGPT or GANs[15].

In China, the Supreme People's Court has issued Judicial Interpretation No. 9 (2020), which permits digital evidence, including data stored and processed by "automated software", provided it meets conditions of authenticity, relevance, and legality[16]. However, generative models raise new complications in proving authenticity, especially when the original data source or model weights are proprietary or inaccessible to the defense.

Other SCO jurisdictions like Kazakhstan, Uzbekistan, and Kyrgyzstan permit the use of digital and electronic evidence in criminal proceedings, but lack case law or procedural commentary on the admissibility of algorithmically generated material. This raises due process concerns where the chain of custody, method of generation, or model architecture are not disclosed to courts or defense counsel[17].

One of the most profound legal dilemmas surrounding AI-generated evidence is the problem of explainability. Many high-performing AI models (particularly deep learning architectures) are considered "black boxes" — they produce outputs without a transparent rationale or logic chain that can be meaningfully reviewed by humans. This contradicts core evidentiary principles in criminal law: the right to challenge, confront, and test the reliability of evidence.

[13] Council of Europe. (2001). *Convention on Cybercrime* (ETS No. 185); Council of Europe. (2022). *Second Additional Protocol to the Convention on Cybercrime on enhanced cooperation and disclosure of electronic evidence*.

[14] United Nations General Assembly. (2024). *Resolution A/RES/78/261: United Nations Convention on Countering the Use of Information and Communications Technologies for Criminal Purposes*. Adopted on 12 January 2024.

[15] Cyberspace Administration of China. (2023). *Interim Measures for the Management of Generative Artificial Intelligence Services* (effective 15 August 2023).

[16] Supreme People's Court of China. (2020). *Provisions on Several Issues Concerning the Trial of Cases Involving Electronic Data (Judicial Interpretation No. 9)*.

[17] UNDP Uzbekistan. (2023). *Digital Transformation of the Justice Sector in Uzbekistan*.

For example, if a suspect is identified through facial recognition or behavioral profiling conducted by a neural network, how can the defense meaningfully cross-examine the basis of that identification? Courts in the SCO region generally require human expert testimony to accompany such tools, but existing laws do not mandate disclosure of algorithmic logic, training data, or error rates.

The right to confrontation, enshrined in Article 14(3)(e) of the International Covenant on Civil and Political Rights (ICCPR) (to which all SCO members are parties), implies that the accused must be able to challenge the credibility of adverse witnesses and evidence. If AI systems function as de facto witnesses (e.g., by generating outputs presented as objective findings), procedural safeguards must evolve accordingly[18].

Furthermore, bias and false positives pose significant reliability risks. Studies have shown that generative models can be manipulated via "jailbreak" prompts or adversarial inputs, leading to the creation of false or misleading outputs[19]. Without robust mechanisms to detect such vulnerabilities, courts may admit evidence whose accuracy cannot be guaranteed.

Comparative Country Case Studies: SCO Member States

Speaking about national approaches to the legal treatment of AI-generated evidence across selected SCO countries, we need to mention that despite their divergent legal traditions, common challenges emerge regarding admissibility, authenticity, and the role of expert oversight in handling outputs generated by autonomous or semi-autonomous systems.

China is among the few jurisdictions globally to have enacted specific legislation on generative AI. The Interim Measures for the Management of Generative Artificial Intelligence Services (2023) require service providers to implement security assessments, label AI-generated content, and prevent the generation of false or harmful material. Article 21 of the Measures establishes that, where violations of public security are involved, criminal liability shall be pursued[20].

From an evidentiary perspective, China's Civil Procedure Law (amended in 2022) and the aforementioned Judicial Interpretation No. 9 (2020) accept electronic data—including content generated by software or platforms—as legally admissible evidence if it satisfies criteria of authenticity, completeness, and relevance[21]. In practice, Chinese courts increasingly rely on blockchain timestamping, trusted electronic evidence platforms, and algorithmic traceability tools, especially in

[18] United Nations. (1966). *International Covenant on Civil and Political Rights*, Art. 14(3)(e).

[19] Carlini, N. et al. (2023). *Exploiting Model Vulnerabilities in Generative Language Models*, arXiv:2302.12173; OpenAI. (2023). *GPT-4 System Card: Risks and Evaluations*.

[20] Cyberspace Administration of China. (2023). *Interim Measures for the Management of Generative Artificial Intelligence Services* (effective 15 August 2023).

[21] Supreme People's Court of China. (2020). *Provisions on Several Issues Concerning the Trial of Cases Involving Electronic Data (Judicial Interpretation No. 9)*.

commercial and civil litigation[22]. However, in criminal cases, forensic authentication is still required, and judges are urged to evaluate the source and process of AI-generated outputs critically.

In Russia, there is no statutory definition of AI-generated evidence in the Criminal Procedure Code (CPC), but digital materials—such as computer logs, CCTV data, and digital audio/video files—are admissible under Article 84 CPC RF, provided their origin and integrity can be verified. The use of AI in forensic analysis (e.g., speaker identification, biometric clustering) has been expanding under pilot programs run by institutions such as the Russian Federal Center for Forensic Science[23].

The Digital Justice Strategy of Russia until 2030, adopted by the Ministry of Justice, outlines the integration of AI in courts, including decision support systems and automated analysis of case materials. However, it acknowledges the need for legislative reform to address risks of overreliance on opaque systems and to ensure procedural rights are maintained when AI systems participate in the production or interpretation of evidence[24].

Kazakhstan's legal system has embraced digitalization as part of the Digital Kazakhstan initiative. The Law on Informatization (amended in 2021) provides a legal basis for automated systems in state functions, including justice and law enforcement. The Code of Criminal Procedure of Kazakhstan (2014) permits electronic evidence, but—as in Russia—does not yet define AI-generated material as a separate category[25].

In criminal cases, forensic institutes play a critical role in validating digital evidence. For instance, AI-derived outputs such as image enhancement, pattern detection, or automated translation must be certified by a state-recognized expert to be admissible in court. The absence of clear standards for reviewing or challenging such outputs raises concerns about judicial dependence on technical experts without adequate AI-specific training[26].

These countries are undergoing gradual digital reforms with UNDP and international donor support. Uzbekistan's Judicial-Legal Reform Strategy includes expanding the use of automated case management, biometric integration, and digital criminal records. However, the legal framework lacks guidance on how

[22] Zhang, X. (2023). "Blockchain Evidence in Chinese Courts: A Rising Trend," *China Law Review*, 5(1), 42–57.

[23] Russian Federation Ministry of Justice. (2022). *Development Strategy of the Digital Legal Environment of the Russian Federation until 2030*; S. M. Kazantsev. (2023). "On the Use of Artificial Intelligence in Forensic Expertise," *Journal of Russian Law*, no. 11.

[24] Russian Federation Ministry of Justice. (2022). *Digital Justice Strategy until 2030*.

[25] Republic of Kazakhstan. (2021). *Law on Informatization*, No. 418-V ZRK (with 2021 amendments).

[26] OSCE Programme Office in Astana. (2023). *Workshop Report: AI and Digital Forensics in Kazakhstan's Justice System*.

AI-generated content (e.g., deepfakes or algorithmically flagged behavior) should be assessed for evidentiary purposes[27].

As artificial intelligence technologies increasingly permeate investigative and forensic practices, legal systems around the world—and particularly those of the SCO member states—face urgent questions about how to treat AI-generated evidence in criminal proceedings.

While digital transformation has brought notable efficiency to law enforcement, it has also introduced complex evidentiary dilemmas rooted in the opacity, autonomy, and probabilistic logic of algorithmic systems.

[27] UNDP Uzbekistan. (2023). *Digital Transformation of the Justice Sector in Uzbekistan*.

DOI 10.34660/INF.2025.66.99.201

远东医科大学学生“体育教育”研究结果分析
ANALYSIS OF THE RESULTS OF THE STUDY OF “SPORTS EDUCATION” OF STUDENTS OF MEDICAL UNIVERSITIES IN THE FAR EAST

Borodin Petr Vladimirovich
Candidate of Pedagogical Sciences, Associate Professor
Far Eastern State Medical University,
Khabarovsk, Russia

Tyutyukov Vyacheslav Grigorievich
Doctor of Pedagogical Sciences, Full Professor
Far Eastern State Academy of Physical Education,
Khabarovsk, Russia

Sokolova Alexandra Vladimirovna
Senior Lecturer
Far Eastern State Medical University,
Khabarovsk, Russia

Postnikova Larisa Mikhailovna
Senior Lecturer
Far Eastern State Medical University,
Khabarovsk, Russia

Moiseenko Svetlana Alexandrovna
Candidate of Pedagogical Sciences, Associate Professor
Far Eastern State Medical University,
Khabarovsk, Russia

Chaika Olga Nikolaevna
Senior Lecturer
Far Eastern State Medical University,
Khabarovsk, Russia

摘要：本文介绍了对远东联邦区医科大学学生体育节第三阶段“体育与运动——医生的第二职业”参与者的调查结果。本研究旨在了解这类受访者对远东联邦区医科大学体育教育体系中组织的体育与运动的态度，并确定其可能改进的领域，以提高他们的“体育教育”。

关键词：医科大学，医学生，调查，教育活动，教育与培训过程。

Abstract. *The article presents the results of a survey of participants in the III stage of the Sports Festival of students of medical universities of the Far Eastern Federal District "Physical Education and Sports - the Second Profession of a Doctor". The purpose of this study was to obtain information regarding the attitude of this category of respondents to physical education and sports organized in the system of physical education of medical universities of the Far Eastern Federal District, in determining the areas of its possible improvement to increase their "physical education".*

Keywords: *medical universities, medical students, survey, educational activities, educational and training process.*

Introduction

The formation of a culture of health and a healthy lifestyle in a person is a complex social and psychological-pedagogical problem. The solution to this problem is very important for any person, but it is of particular importance for student youth. Modern students are the main population and labor resource, the "quality" of which determines the prosperity of the whole society and its future [14, 23]. Students of medical and pharmaceutical universities of Russia are not left out either; they represent a highly motivated and goal-oriented group ready for complex and responsible work in the healthcare sector.

Upon graduation from a specialized university, a young doctor, starting his or her work activity, must be emotionally stable, physically and mentally resilient, have well-developed motor skills of the hands and possess sufficient static and dynamic strength of individual muscle groups, etc. Thus, in the works of V.B. Mandrikov (2002), S.A. Moiseenko (2006), E.N. Selyuzhitskaya (2008), A.V. Baklykova (2010), P.V. Borodin (2014, 2015, 2018, 2020-2022, 2025), V.O. Aristakesyan et al. (2015), R.M. Berdieva et al. (2017), A.V. Dorontseva (2017), N.N. Tsareva (2020), A.V. Sokolova et al. (2021) and A.A. Shestera (2022) noted the positive dynamics of growth of the above-mentioned qualities in this category of people due to active participation in physical education and sports. The authors believe that active participation in physical education and sports is a unique "tool" for the development of the above-mentioned components that every doctor should have, and will also help to master certain knowledge in the field of the basics of sports pedagogy and related disciplines [1-22, 23]. It should also be borne in mind that graduates of medical universities should have a good level of "physical education education", which they must implement in their future professional activities [12, 13]. In our deep conviction, future doctors should stand on "guard of health", they are obliged to promote among the general public the need for a healthy lifestyle through physical education and sports, hardening, balanced nutrition, etc. [14].

Among the students of medical universities of the country, departmental all-Russian sports and mass competitions are very popular, such as all-Russian championships in free-style wrestling, judo, swimming, skiing, kickboxing, as well as the Sports Festival "Physical Education and Sports - the second profession of a doctor" [13]. Further, we will talk about the III stage of the Sports Festival of students of medical universities of the Far Eastern Federal District "Physical Education and Sports - the second profession of a doctor" (hereinafter the Sports Festival), during which a survey was conducted among the participants of the competition on a number of issues related to the features of the educational and training process in medical universities of the Far East, determining their basic knowledge in the field of theory and methodology of physical education and sports. It should be noted that the III stage of the Sports Festival is a qualifying stage for participation in the final IV stage among students of medical and pharmaceutical universities of Russia.

We add that similar studies were conducted in Makhachkala in 2019 and in Ryazan in 2022, during the All-Russian tournaments in freestyle wrestling and judo among students of medical and pharmaceutical universities of Russia, respectively [12, 13].

Purpose, methodology and organization of the research

The survey of the selected category of respondents was conducted from March 4 to 6, 2025 in the city of Khabarovsk during the III stage of the Sports Festival. The survey involved 120 students (38 girls and 82 men) of medical universities of the Far Eastern Federal District. In particular, 56 participants in the questionnaire study were representatives of the Far Eastern State Medical University (FESMSU, Khabarovsk), and 38 respondents were students of the Pacific State Medical University (TSMU, Vladivostok). Amur State Medical Academy (ASMA, Blagoveshchensk) was represented by 16 athletes, and Chita State Medical Academy (CSMA, Chita) - by 10 students. The average age of the Sports Festival participants was 20.4 years for men and 19.6 for women.

The objective of the study was to obtain information on the attitude of medical students to the educational and training process and to determine their knowledge of the theory and methodology of physical education and sports.

The obtained data were processed using Microsoft World and Excel 2010 software.

Results of the study and their discussion

As a result of processing the questionnaire data, it was determined that 36% of respondents are representatives of basketball, 19% of the surveyed medical students play volleyball, 14% of students play chess, 12% play football, 9% play the GTO all-around, 4% play table tennis, and 3% each play darts and kettlebell lifting. The total length of sports experience of the participants in the Sports Festival was 6.7 years. Of the total number of respondents, 37% of respondents are athletes

of the third category, 23% of the surveyed students noted that they have the second category, 30% - the first category. Candidates for Master of Sports and Masters of Sports of Russia are 8 and 2% of respondents, respectively.

Figures 1 and 2 show the results of the level of development of physical qualities of the participants of the Sports Festival. Thus, the most developed physical qualities of young men are strength and endurance, and of girls - speed and endurance. The less developed physical quality, both for young men and girls, is flexibility.

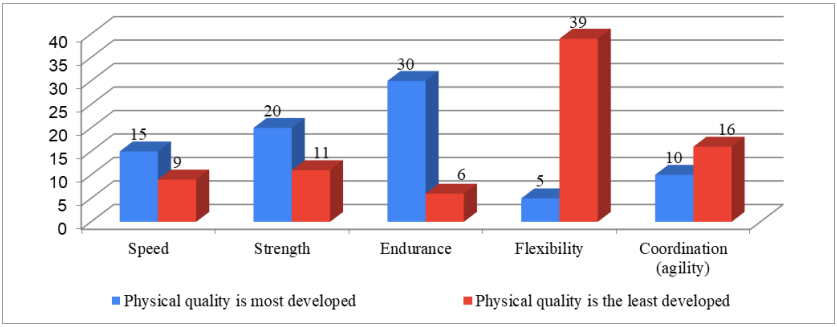

Figure 1. *Presence of developed physical qualities in medical students (young men)*

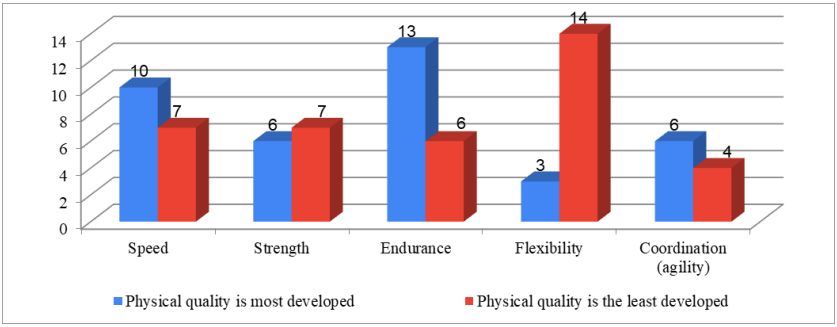

Figure 2. *Presence of developed physical qualities in medical students (girls)*

The majority of the students surveyed indicated that speed, endurance and coordination (agility) are fundamental physical qualities for the sport they practice. In this question, respondents were asked to mark no more than two values. However, students representing universities from Blagoveshchensk and Khabarovsk more often than others noted that strength is also a key physical quality for their sport (Fig. 3).

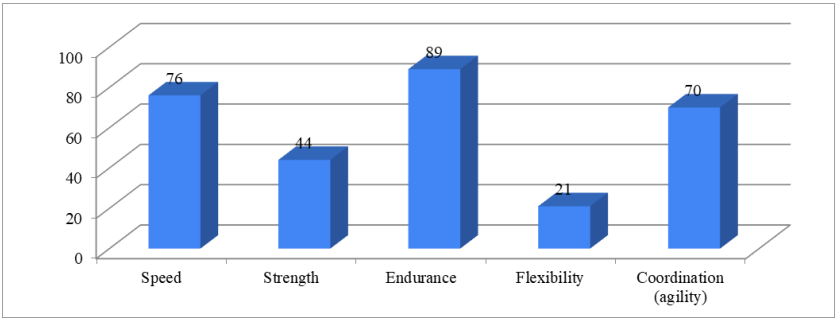

Figure 3. *What physical qualities are fundamental for medical students in their chosen sport*

77% of the Sports Festival participants can fully combine their studies at a medical university with classes in sports sections, 12% of respondents noted that this is not possible, and 11% of students found it difficult to answer.

Answering one of the questions in the questionnaire, respondents had to determine the optimal amount of weekly training load that is acceptable for medical students involved in sports. Thus, 66% of respondents believe that even in a non-specialized university, sports should be done approximately up to 3 times a week. Such a schedule of training sessions is considered acceptable by students of all medical universities of the Far Eastern Federal District, especially those studying at the Far Eastern State Medical University. At the same time, 22% of respondents indicated that it would be optimal to attend training up to 4 times a week. 8 and 4% of students, respectively, consider training 5 times a week or more. The vast majority of students (82%) believe that a training session should last from 1.5 to 2 hours.

Further, it was revealed that the participants of the Sports Festival have knowledge of the basics of sports training. Thus, 84% of respondents note that their mentors (trainers) harmoniously implement various methodological provisions of leading domestic and foreign specialists in the field of sports training at all stages of the training process. At the same time, students believe that in the preparatory and recovery periods, most time should be devoted to the development and improvement of general and special physical training. According to the participants of the Sports Festival, attention should be paid to technical and tactical training during the training of the main period (the basic training period (BTP)), and to theoretical and psychological training (TPP) - in the competitive period.

The analysis of the factors determining the process of forming needs, interests and motives in choosing a sport would be incomplete without considering the sub-

jective motivations of the individual. To the question: “Specify the advantages of your sport at the medical university that you are involved in?” 70% of respondents answered that it contributes to emotional release to the greatest extent, and 54% of students indicated that practicing their chosen sport ensures health improvement. Also, the Festival participants noted that their chosen sport ensures the formation of basic skills, abilities and knowledge in the field of physical education and sports and an increase in the level of psycho-emotional stability, this was indicated by 49% and 43% of respondents, respectively. This shows that these subjective factors are of great importance when choosing a sport. In this question, respondents were asked to mark no more than three answer options. Given the fairly large number of cases related to the disqualification of Russian athletes due to real and far-fetched violations of anti-doping rules, we were interested in the attitude of respondents to the use of prohibited drugs in sports, methods and techniques that enhance athletic performance. Thus, 67% of the study participants answered that international and all-Russian anti-doping rules must be strictly observed. However, 6% of students indicated that compliance with anti-doping rules is necessary only in professional sports, and 27% of respondents indicated that the use of prohibited drugs is possible in the system of medical and rehabilitation measures. It is well known that athletes who use prohibited drugs violate the Olympic principle of fair play (unequal conditions are created for honest athletes), in addition, doping has a side effect on the entire body. It was revealed what percentage of student subjects use biologically active supplements to improve their athletic performance. Thus, 16% of respondents use amino acids, carbohydrate-protein mixtures and isotonic drinks in their sports activities, 24% - vitamin and mineral complexes, and 5% of athletes use both at the same time. 55% of respondents do not use sports supplements.

In the final part of the questionnaire, the anonymous study participants had to assess the material and technical equipment of the sports base of the physical education department where they study. Thus, 61% of the subjects noted that they were completely satisfied with the equipment of their sports base. However, the fact that the remaining part of the respondents had a gym equipped mediocrely and insufficiently is alarming, 30 and 9% of the respondents answered this, respectively. These data indicate the presence of possible problems in the training of highly qualified athletes from among medical students.

Conclusion

The study conducted among students of medical universities of the Far Eastern Federal District involved in sports revealed a number of issues related to the organization of their educational and training process. It was found that it is rational to conduct educational and training sessions 3 times a week for a duration of no more than 2 hours. This training schedule will have a positive effect on the level of

physical health and physical fitness, as well as on the quality of educational activities of medical students. In the content of classes at different stages of the training process, it is necessary to provide a balanced but individualized load depending on the athlete's preparation and the period of the academic year. Participants in the III stage of the Sports Festival have basic knowledge in the field of the fundamentals of sports training. The majority of the students surveyed are well versed in the issues of using prohibited drugs (doping) and biologically active additives.

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DOI 10.34660/INF.2025.64.77.202

音乐素养：中俄音乐教育学中概念内涵的探讨

MUSICAL LITERACY: ON THE CONTENT OF THE CONCEPT IN THE PEDAGOGY OF MUSIC EDUCATION IN CHINA AND RUSSIA

Ma Mingzhe
Postgraduate
Institute of Fine Arts, Moscow State Pedagogical University

摘要：本文分析了当代中国教师对“音乐素养”现象理解的具体性。在比较包括俄罗斯联邦在内的不同国家学者的音乐和教育理念的背景下，作者思考了这一现象的本质，并得出结论：中国音乐教育模式对“音乐素养”的理解是具体的，是对抽象与具体的概括，旨在通过音乐艺术解决一系列关于儿童教学、培养和发展的问题。

关键词：音乐素养、音乐理论活动、音乐知识、乐谱、音乐艺术基本模式、核心素养、教师兼音乐家、音乐和教育理念、中国音乐教育模式。

Abstract. *The article analyzes the specifics of understanding the phenomenon of “musical literacy” by modern teachers in China. Having considered the essence of this phenomenon in the context of comparing the musical and pedagogical concepts of authors from different countries, including the Russian Federation, the author concludes that the understanding of “musical literacy” in the model of music education in China is specific, as a generalization of the abstract and the concrete in solving a set of problems of teaching, upbringing and developing children through musical art.*

Keywords: *musical literacy, musical and theoretical activity, musical knowledge, musical notation, basic patterns of musical art, key competence, teachers-musicians, musical and pedagogical concepts, model of music education in China.*

Introduction to the problem

Musical and theoretical activity is the most important component of music education, aimed at developing musical literacy in students. It should be noted that this problem was considered by scientists and music teachers from different countries of the world:

– Austria (K. Orff);

– Hungary (Z. Kodály);

– Switzerland (E.-J. Dalcroze);

– Sh. Suzuki (Japan).

A literature analysis on the designated problem showed that in these concepts the essential characteristic of the named phenomenon was akin to mastering musical notation, the formation of skills and abilities of creative self-realization in various types of musical activity of students.

A somewhat different vision is characteristic of the Russian model of music education. Thus, the authors of modern music and pedagogical concepts – V.V. Aleev, T.I. Baklanova, G.P. Sergeeva, L.V. Shkolyar, being followers of the theory of D.B. Kabalevsky, imply musical literacy as the development of musical and theoretical knowledge in children, which includes knowledge not only of musical notation, but also of:

● musical layers of Russian musical culture - folk, academic and spiritual;

● history of musical art and performance (based on Russian and foreign musical culture of the past and present);

● patterns of musical art (means of musical expression - intonation, harmony, tempo, timbre, register, rhythm, mode; musical image; means of development; style, genre, etc.).

In China, taking into account the current phenomena of the process of globalization of education and the ancient traditions of national culture, today it is typical to understand the term “literacy” from a philosophical perspective, which allows us to position the phenomenon in question as a synonym for the education of students.

Discussion

U Yutang [1] notes in this regard that children study music or another subject area not simply to acquire basic knowledge and skills (which constitutes subject literacy), but on their basis they study professional knowledge, skills and ideas of a more general order - of a historical and cultural nature. U Yutang supports this idea with the understanding of music in Ancient China, which interpreted this art form as a subjective expression of human self-existence. This makes it possible and natural to combine in the phenomenon of “musical literacy” a complex of subject areas, such as aesthetics, psychology, sociology and others, each of which can be separately attributed to musical literacy in a narrower context.

Thus, a certain pyramid-shaped structure is obtained (Figure No. 1):

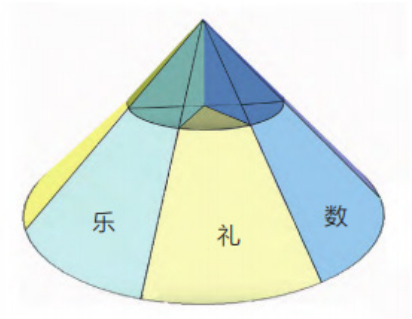

Figure 1. *Pyramid-shaped structure of the concept of "musical literacy" in the model of music education of the PRC*

In this model, two levels are clearly subordinated - basic and superstructure. The essence of the superstructure in the model of education of the PRC is close to the conceptual opinion of the German philosopher and educator K. T. Jaspers. In his book "What is Education" [3], the named scientist argued that educational activity is associated with how to maximize mobilization and realization of human potential, how to maximize the inner spirituality and capabilities of a person. In other words, according to K. T. Jaspers, education is the education of the human soul, and not the accumulation of rational knowledge and understanding.

There are other analogues in world practice. Thus, in modern Russian pedagogy, the educational model assumes the relationship between subject and meta-subject knowledge [3], which actualizes a number of concepts that go beyond the subject results of children's educational activities in music lessons (Figure №2).

Conclusion

Thus, it can be argued that the concept of "musical literacy" is a condensate of generalized, abstract, ideological and contextual content in the academic discipline "Music". This explains the understanding of this phenomenon in China, both in a broad and narrow sense:

- in a narrow sense - in the context of disciplinary literacy of the academic subject "Music";

- in a broad sense - as a key competence that appeared in 2002 in the report "Core Literacy in the Knowledge Economy Era" of the European Union research group. In this document, "literacy" was defined as: a set of transferable and multifunctional attitudes, skills and knowledge necessary for each person for self-education, competence in their work and integration into society. Being a key competence, according to Chinese music educators, basic literacy initially means a person's possession of competitiveness and the ability to successfully adapt to the modern world.

In the Russian Federation, a similar vision is close to the understanding of the need to form a set of planned results, among which equal importance, along with personal knowledge, is given to subject and meta-subject knowledge, forming in children ideas about meta-activity, meta-knowledge, meta-methods and meta-skills and abilities, as phenomena of a higher abstract order.

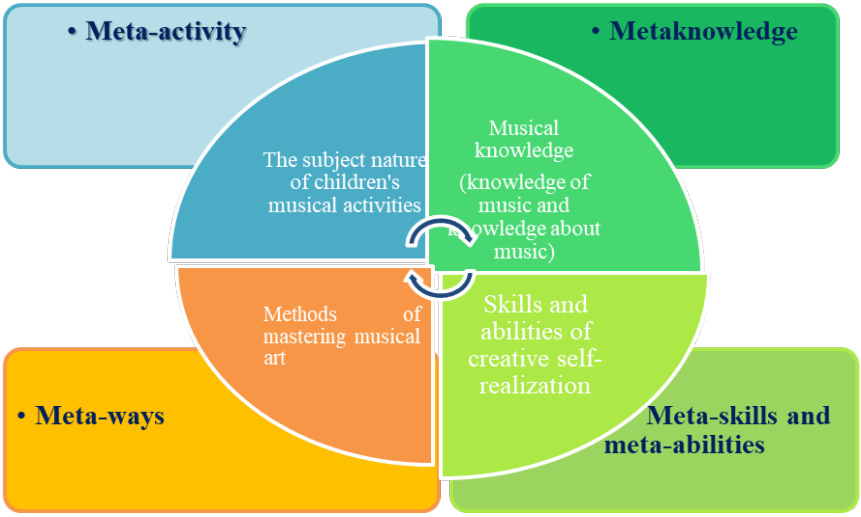

Figure 2. *The structure of the relationship between subject and meta-subject results in the model of music education in the Russian Federation*

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DOI 10.34660/INF.2025.38.33.203
UDC37

混合学习技术在师范教育体系中的区域协同与管理整合：以上合组织国家合作为例

BLENDED LEARNING TECHNOLOGIES IN THE TEACHER EDUCATION SYSTEM: REGIONAL COORDINATION AND MANAGERIAL INTEGRATION ON THE EXAMPLE OF COOPERATION AMONG THE SHANGHAI COOPERATION ORGANIZATION (SCO) COUNTRIES

Zhao Jiaheng
Postgraduate
Moscow State Pedagogical University,
Moscow, Russia

摘要：在全球高等教育体系快速变革的背景下，上海合作组织（上合组织）成员国显著加强了区域教育合作，推动资源整合、技术解决方案的共享以及教育系统的协调管理。在此背景下，混合学习技术成为推动教育数字化、个性化发展以及跨国合作的关键工具，特别是在上合组织成员国的师范教育体系中。

本文从区域协同与系统整合的视角出发，分析了混合学习技术在中国、俄罗斯、哈萨克斯坦等国师范教育系统中的实施路径，探讨了其管理机制与效能模式，揭示了在教学过程组织、师生互动结构以及教育管理模型方面的变革趋势。此外，文章还探讨了混合学习在教育融合、系统现代化及增强教育体系韧性方面的战略意义。

基于对政策文件、科研文献与实践案例的分析，本文提出了混合学习区域合作的机制建议和组织整合路径，旨在推动构建上合组织教育共同体。

关键词：　　混合学习；上合组织国家；区域协同；教育管理；师范教育；系统整合

Abstract. *In the context of the rapid transformation of the global higher education system, the Shanghai Cooperation Organization (SCO) countries are significantly strengthening regional educational cooperation, which promotes the integration of resources, the exchange of technological solutions and the coordinated management of educational systems. In this context, blended learning technologies are a key tool for digitalization, personalization and cross-border cooperation in pedagogical education of the SCO member countries. This article, from the perspective of regional synergy and system integration, analyzes the ways*

of introducing blended learning technologies in the pedagogical systems of China, Russia, Kazakhstan and other countries, considers management mechanisms and models of efficiency, identifies transformational changes in the organization of the educational process, teacher-student interaction structures and educational management models. In addition, the article explores the strategic importance of blended learning for the integration of education, the modernization of systems and increasing their sustainability. Based on the analysis of regulatory documents, scientific literature and practical examples, mechanisms of regional cooperation and ways of organizational integration of blended learning are proposed, aimed at forming the SCO educational community.

Keywords: *Blended learning; SCO countries; regional coordination; education management; teacher education; system integration.*

Introduction. The development of information technology and profound changes in the global educational paradigm are causing unprecedented structural transformations of traditional education systems. Blended learning technologies that combine digital tools with face-to-face learning are becoming a leading model in global educational practice. In this context, the SCO member states are enhancing the strategic importance of cooperation in education, focusing on joint innovations in educational technologies, training of teaching staff, and modernization of educational system management.

The SCO's geographical space covers a vast Eurasian region with diverse educational systems, but at the same time united by the common goal of digitalizing education and developing teacher education, as well as expanding cross-border cooperation in higher education. Under the influence of China and Russia, blended learning models are gradually being introduced into the pedagogical systems of Kazakhstan, Kyrgyzstan, Tajikistan, and other countries, forming effective coordination and mutual cooperation.

This study focuses on the role of blended learning technologies in pedagogical systems with an emphasis on regional coordination and integration in governance. The paper highlights three key areas: analysis of the state and differences in the implementation of blended learning in the SCO countries; study of organizational and governance mechanisms in the context of regional coordination; assessment of the strategic role of blended learning in the process of integrating educational systems. Using methods of analyzing the regulatory framework, scientific publications and practical cases, the article proposes scalable models for innovative regional education governance.

The emergence of blended learning in the region and institutional changes in the teacher education system

The trend of blended learning development has acquired a global scale: since 2010, international organizations such as the OECD and UNESCO have repeat-

edly emphasized its importance for improving the accessibility, quality and sustainability of educational systems. The COVID-19 pandemic has accelerated the transition to hybrid educational models, which has become a trigger for systemic reforms in many countries.

In the SCO countries, national educational strategies reflect this trend. China, for example, is implementing "smart education" and digital transformation programs, Russia is developing the "Digital Educational Environment" project, Kazakhstan is introducing e-learning in teacher training. All these initiatives recognize blended learning as a priority in the development of educational systems.

For teacher education, which is the basis for training future teachers, the introduction of blended technologies is not only a reform tool, but also requires changes in pedagogical approaches and organizational models. Key changes concern the transformation of course design from knowledge to competencies, the transition from linear classroom lessons to multidimensional interactive learning, and the development of quality control systems with an emphasis on monitoring the educational process.

Practical examples confirm these trends. Beijing Normal University has implemented a project to improve the digital literacy of teachers using virtual classrooms, simulation trainers and online consultations. At Kazan Federal University, blended learning is integrated with practical training of students of pedagogical specialties, increasing the level of real perception of educational activities.

The logic of building regional coordination and a blended learning management structure

Since its foundation in 2001, the SCO has been constantly developing institutional forms of cooperation in the field of education, which have evolved from academic exchange to the creation of university unions, mutual recognition of qualifications and regional research platforms. The SCO Educational Cooperation Plan, approved in 2015, highlights digital transformation and joint teacher training as priority areas. Currently, regional coordination is manifested in three main aspects: harmonization of educational policies (for example, joint certification standards for blended courses between China and Russia), joint development of educational platforms (creation of "smart classroom" resources within the SCO university unions), and teacher training (implementation of bilingual professional development projects between universities in China and Kyrgyzstan).

The success of blended learning largely depends not only on technical equipment, but also on the adaptability of management structures and the quality of cross-border cooperation. In the SCO countries, management is implemented in five areas: standardization of curricula, ensuring compatibility of platforms, exchange of teaching staff, recognition of learning outcomes, and joint quality assurance.

An example of management integration is the Russian concept of "modular management units" aimed at unifying blended courses and increasing their compatibility between universities. China is implementing a national digital education platform that provides resource sharing and supports regional teacher training systems.

Mechanisms for promoting blended learning and the future of SCO education

Real-life practices of cross-border cooperation demonstrate the high efficiency of joint educational initiatives. For example, the Blended Learning Research Center, established by Beijing Normal University and Peoples' Friendship University of Russia, has developed a comprehensive program with joint course creation, synchronous learning, and student exchange. Over two years, 32 courses have been implemented, over 120 synchronous classes have been held, and over 4,600 students have participated. This project has significantly improved the mobility of courses and their international level.

Similarly, in Kazakhstan, Al-Farabi National University has initiated a project to create blended learning laboratories, which includes educational institutions from China and Uzbekistan. A platform has been created that combines joint content development, collective management, and exchange of results, which has created a sustainable cycle of regional cooperation.

In the future, blended learning will play a key role in the formation of the SCO educational community in five areas: expanding access to quality education in remote regions; increasing the resilience of systems to crises; ensuring educational equity and reducing regional disparities; forming a common regional identity through educational content; transition to multilateral management models in the field of education.

Conclusion

Blended learning technologies not only serve as the basis for the modernization of education, but also act as a key factor in regional integration and improving the efficiency of educational system management. The SCO countries use the flexibility and innovative potential of blended learning to promote deep coordination and systemic transformation of regional educational systems.

For further successful development, it is necessary to create effective mechanisms for interaction and collaboration, improve cross-border platforms for teacher training and exchange of educational resources, and implement intellectual integration of management systems. This work offers a scientific basis and practical recommendations to support cooperation between the SCO countries in the field of digitalization of education and human capital development.

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DOI 10.34660/INF.2025.73.38.204

外语教学中跨文化影响的几个方面
ASPECTS OF CROSS-CULTURAL INFLUENCE IN TEACHING DISCIPLINES IN A FOREIGN LANGUAGE

Boychenko Olga Andreevna
Senior Lecturer
State University of Land Use Planning, Moscow, Russia

摘要：在全球化和国际教育融合的背景下，以外语教授学术学科——即内容与语言整合学习 (CLIL) 模式或“通过内容进行语言教学”——正日益普及。然而，这种方法的有效性不仅取决于语言能力，还取决于教师、学生和学术内容之间的跨文化互动。本文探讨了外语教学中跨文化影响的关键方面：教育文化差异、沟通障碍、刻板印象、文化价值观对知识感知的影响以及克服文化差异的方法。强调了培养跨文化能力作为在多元文化教育环境中成功掌握学科的必要条件的重要性。

关键词：跨文化影响、外语教学、CLIL、跨文化能力、教育文化、学术交流、文化刻板印象、全球教育。

Abstract. *In the context of globalization and international integration of education, teaching academic disciplines in a foreign language—known as the CLIL (Content and Language Integrated Learning) model or “language-through-content” teaching—is becoming increasingly widespread. However, the effectiveness of this approach depends not only on linguistic competence but also on cross-cultural interaction between instructors, students, and academic content. This article examines key aspects of cross-cultural influence in foreign language instruction: differences in educational cultures, communication barriers, stereotypes, the impact of cultural values on knowledge perception, and methods for overcoming cultural dissonance. The importance of developing intercultural competence as a necessary condition for the successful mastery of disciplines in a multicultural educational environment is emphasized.*

Keywords: *cross-cultural influence, teaching in a foreign language, CLIL, intercultural competence, educational culture, academic communication, cultural stereotypes, global education.*

Introduction

Contemporary higher education is increasingly being implemented in multilingual and multicultural environments. Many universities now offer courses in

economics, engineering, medicine, and other disciplines in English, French, German, and other foreign languages. This approach aims to enhance the international competitiveness of graduates, attract international students, and integrate into the global educational space (European Commission, 2021).

However, teaching a discipline in a foreign language is not merely a matter of changing the language of instruction; it is a complex process in which linguistic, cognitive, and cultural aspects are closely intertwined. One of the key factors for success is cross-cultural interaction, which influences knowledge perception, teaching styles, assessment formats, and students' level of engagement (Byram, 1997).

Cross-Cultural Differences in Educational Traditions

Different countries and regions have unique educational cultures that shape the expectations of both students and instructors.

- In Western universities (USA, EU), active participation, discussion, critical thinking, and independence are emphasized (Hofstede, 2011).

- In Eastern systems (China, Japan, South Korea), respect for authority, memorization, and restraint in expressing opinions are typical (Kramsch, 1998).

- In Russia and CIS countries, there is a focus on theoretical depth, lecture-based formats, and formal instructor-student distance.

When a student from a collectivist culture studies in a course that requires open expression of opinions, they may experience discomfort. In turn, instructors from Western traditions may interpret silence as a lack of understanding, although it may actually reflect respect (Byram, 1997).

Such differences can lead to misunderstandings, reduced motivation, and lower learning effectiveness.

Language as a Carrier of Culture

A foreign language is not a neutral tool for transmitting information; it carries cultural norms, thinking patterns, and communication styles.

In academic settings, English often implies:

- Direct expression of thoughts;

- Use of examples from Western reality (economics, politics, history);

- Humor, irony, and rhetorical questions (Kramsch, 1998).

For students from other cultural backgrounds, such elements may be confusing or even offensive. Moreover, terms and concepts such as *freedom*, *individualism*, or *critical thinking* may be interpreted differently depending on the cultural context (Hofstede, 2011).

The Impact of Cultural Values on Knowledge Perception

Culture influences how students perceive knowledge:

- In individualistic cultures, knowledge is seen as a tool for personal success.

- In collectivist cultures, it is part of collective wisdom passed down from elders.

- In high-context cultures (e.g., Japan, Arab countries), nonverbal cues and the speaker's status are crucial.

- In low-context cultures (e.g., Germany, USA), clarity, logic, and directness are prioritized (Hofstede, 2011).

These differences affect: willingness to ask questions; ability to work in groups; attitudes toward assessment and criticism.

For example, a student from an Arab cultural background may avoid public criticism—even if constructive—because it could disrupt social harmony (Byram, 1997).

Problems and Barriers in Cross-Cultural Interaction:

1. Communication anxiety—fear of making mistakes in a foreign language.

2. Cultural stereotypes—instructors may expect certain behaviors (e.g., "all Asians are quiet," "all Westerners are aggressive").

3. Nonverbal dissonance—differences in perception of personal space, eye contact, and gestures.

4. Contextual gaps—lack of familiarity with historical, political, or social realities mentioned in lectures.

5. Language barrier as a cultural shield—students may use limited language proficiency as an excuse for limited participation (Kramsch, 1998).

Overcoming Cross-Cultural Barriers in Teaching

To ensure effective teaching of disciplines in a foreign language, **intercultural competence** must be developed among both instructors and students:

1. Intercultural communication training—courses for instructors and students (Byram, 1997).

2. Cultural adaptation of teaching materials:

- Use international rather than local examples.

- Avoid culture-specific humor and metaphors (Coyle, Hood, & Marsh, 2010).

3. Creating an inclusive classroom environment:

- Diversify participation formats (written responses, online discussions).

- Encourage respectful dialogue.

4. Diversifying the teaching staff—involve instructors from various cultural backgrounds.

5. Culturally sensitive feedback—adapt assessment styles and comments to cultural norms.

6. Implementing the CLIL approach—integrate language and subject goals with a focus on cultural awareness (Coyle et al., 2010).

Conclusion

Teaching disciplines in a foreign language is not merely a linguistic challenge, but a deep cross-cultural process in which success depends on participants' ability to understand, respect, and adapt to differences. Cross-cultural influence significantly affects knowledge perception, communication style, and learning effectiveness. Only by developing intercultural competence, creating an inclusive educational environment, and adopting a mindful approach to cultural differences can true effectiveness in international education be achieved.

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DOI 10.34660/INF.2025.84.75.001

革命前那奈人的传统育儿体系：制度、方法与社会文化功能
TRADITIONAL CHILD-REARING SYSTEM OF THE NANAI PEOPLE IN THE PRE-REVOLUTIONARY PERIOD: INSTITUTIONS, METHODS, AND SOCIO-CULTURAL FUNCTIONS

Belaya Evgenia Grigorievna
Candidate of Historical Sciences, Associate Professor
School of Arts and Humanities
Far Eastern Federal University

摘要：本文考察了革命前时期（19 世纪至 20 世纪初）纳奈人的传统育儿制度，揭示了其主要制度、方法和社会文化功能。通过对民族教育实践的分析，本文表明纳奈人的养育方式是一个融入其经济和文化体系的综合体系。家庭和氏族社区是社会化的主要机构，儿童通过口口相传的方式获得劳动技能、行为规范和精神价值观。本文特别关注养育过程中的性别和年龄差异，以及仪式和民间传说在传承文化规范中的作用。研究强调，传统制度确保了代际延续、对自然环境的适应以及民族认同的保存。本研究依赖历史教育和人种学数据，包括来自俄罗斯远东地区纳奈村庄的田野材料。

关键词：传统教养、革命前时期、那奈人、家族制度、民族教育学、文化延续性。

Abstract. *The article examines the traditional child-rearing system of the Nanai people during the pre-revolutionary period (19th – early 20th centuries), revealing its key institutions, methods, and socio-cultural functions. Based on the analysis of ethnopedagogical practices, it is shown that Nanai upbringing represented an integrated system embedded in their economic and cultural complex. The primary institutions of socialization were the family and clan community, where children acquired labor skills, behavioral norms, and spiritual values through oral-practical methods. Special attention is paid to gender and age differentiation in upbringing, as well as the role of rituals and folklore in transmitting cultural codes. The study emphasizes that the traditional system ensured intergenerational continuity, adaptation to the natural environment, and preservation of ethnic identity. The research relies on historical-pedagogical and ethnographic data, including field materials from Nanai villages in the Russian Far East.*

Keywords: *traditional upbringing, pre-revolutionary period, Nanai people, family-clan institutions, ethnopedagogy, cultural continuity.*

The Nanai, one of the largest indigenous peoples of the Russian Far East, developed a unique child-rearing system organically integrated into their economic and cultural complex. Historically inhabiting the Amur River basin and its tributaries, the Nanai cultivated pedagogical practices aimed at transmitting knowledge, skills and spiritual values across generations. During the pre-revolutionary period (19th to early 20th century), Nanai child-rearing was implemented through family-clan institutions where oral-practical methods and early integration of children into labor activities played key roles[1].

The family served as the foundation of the educational process, where children assimilated behavioral norms, traditions and artisanal skills. Until ages 6-7, upbringing followed predominantly female lines: girls were taught domestic skills including sewing fishskin garments, food preparation, folk medicine and protective magic. Boys at this age transitioned to paternal guidance, learning hunting, fishing and toolmaking. A crucial aspect was developing children's awareness of clan belonging and understanding the value of collective labor. [2]

From age six, girls were introduced to household management and traditional aesthetic practices including protective magic techniques, folk medicine, ritual performances, amulet crafting, and sewing/embroidery skills. [3]

In traditional Nanai culture, elders performed the vital mission of preserving and transmitting ethnic heritage. Senior family and clan members served as living repositories of oral traditions, moral-ethical norms, practical wisdom and linguistic wealth. Native language acquisition was organically woven into daily family life, where direct interaction with grandparents allowed children to naturally assimilate not just vocabulary but profound layers of speech culture. Language education harmoniously combined with various folk art forms, creating an integrated system of cultural initiation.

The exceptional effectiveness of this pedagogical tradition stemmed from emotionally rich oral narratives employing vivid imagery and creating strong associative connections. The interactive learning approach, based on living intergenerational dialogue and practical orientation, fully met traditional society's needs. This natural educational environment facilitated deep assimilation of linguistic norms and cultural codes, ensuring ethnic identity continuity. Children's interactions with traditional knowledge bearers occurred in an atmosphere of trustful

[1] Fadeeva E.V. "Transmission of Ethnocultural Traditions in Families of Indigenous Peoples of the Lower Amur and Sakhalin: Traditions and Modernity." Proceedings of the Institute of History, Archaeology and Ethnography FEB RAS. – 2021. – № 32. – C. 52.

[2] Prokopenko V.I. Traditional Physical Education of the Nanai: Games and Competitions. Yekaterinburg.1992. – p. 17.

[3] Shaburova O.A. (2004) Education in Nanai Families from Mid-19th to Early 20th Century. Komsomolsk-on-Amur, 2004. – p. 114 .

communication, where every story, tale or legend became not mere entertainment but a crucial element of spiritual formation.

Shamans held a special place in the Nanai traditional knowledge system, serving according to A.N. Lipsky's[4] research as important transmitters of folklore heritage. Nanai settlements developed practices where community members - adults and children - would gather around shamans to hear various instructive narratives conveying ancestral wisdom.

The oral-poetic tradition constitutes a fundamental component of Nanai cultural space. This stratum of folk creativity performs a system-forming function as an integral element of the entire complex structure of traditional culture. Folklore works permeate all spheres of the people's life activities, serving simultaneously as a repository of historical memory, a means of educating youth, and a vehicle for transmitting worldview foundations.

As researchers note, traditional societies' folklore is characterized by blurred genre boundaries, organic interpenetration of various folk art forms, and pronounced functional orientation. These characteristic features are fully manifested in studies of Nanai oral folk traditions. [5]

Numerous ethnographers have attempted to systematize Nanai folklore heritage through field research. Among various classification approaches, the work of Yu.A. Sem[6] deserves particular attention - he developed a detailed genre typology. His system identifies these main categories: epic myths and legends (telungu), mythological and fairy tales (ningman), shamanic narratives (ningman-samani), borrowed fairy tale plots (siohor), and everyday stories (gisuren). Additionally, the scholar classified minor folklore forms including riddles (nambokan), tongue-twisters (dyarinkan), ritual laments (songon), song compositions (dyarin), humorous couplets (darinkan) and shamanic chants (yayan samani).

Of particular significance for studying Nanai educational practices are the epic tales of mergen warriors, which I.A. Lopatin identified as a distinct folklore category. These works represent a unique cultural stratum reflecting the ethnic worldview foundations.

Nanai oral folk traditions perform complex social functions extending far beyond mere entertainment. They serve as effective instruments for shaping worldviews and transmitting moral-ethical norms and practical knowledge to younger generations. The fairy tale genre ningman, traditionally oriented toward child audiences, contains pronounced didactic components. Through allegorical images

[4] Lipsky A.N. (1923) Elements of Religious-Psychological Concepts of the Goldi People. Chita, 1923. – 68 c.

[5] Bereznitsky S.V. (2003) History and Culture of the Nanai: Historical-Ethnographic Essays. Vladivostok, 2003. – p. 256 .

[6] Sem Yu.A. (1986) "Genre Classification of Nanai Folklore." Folklore and Ethnography of Northern Peoples, 1986. – p. 34.

and plot developments, these works convey concepts of world organization, social relations and traditional values in accessible forms.

The pudin archetype in Nanai folklore embodies the ideal woman, combining spiritual strength, physical beauty, loyalty, and a well-defined position within the tribal hierarchy. These fairy-tale heroines, bearing poetic names such as “Radiant” (Sinkui-dedu) or “Cloud-Born” (Dongnakay Sangnakay), serve as moral exemplars for young Nanai women.

A substantial portion of oral tradition is devoted to depictions of Far Eastern wildlife. These narratives bring to life characters from the vast taiga and river depths—from cunning foxes to mighty tigers. Each image carries specific symbolic meaning, reflecting the people’s profound observations of the natural world.

Mythological narratives known as telungu hold particular significance, distinguished from fairy tales by their claim to historical authenticity. These accounts of events believed to be true serve the vital function of preserving historical memory. Clan telungu, documenting genealogies and family histories, are especially valuable as powerful instruments for strengthening kinship ties and transmitting traditional values.

For centuries, oral tradition remained the primary medium of intergenerational communication, preserving not only factual knowledge but also emotional responses to pivotal historical events. This living heritage continues to instill patriotism, love for native land, and a sense of justice in children, while fostering the development of practical skills and physical attributes essential to traditional ways of life.

Across generations, Nanai oral folklore has fulfilled a crucial pedagogical role, shaping the moral compass and professional competencies of future hunters. Through emotionally powerful epics glorifying courage and valor, children cultivated character traits vital to their traditional lifestyle. Heroic tales of mergen warriors and brave pudin women served as particularly important role models.

As hunting and gathering formed the economic foundation, children were introduced early to specialized knowledge. Folklore transmitted not only practical skills but an entire philosophy of human-nature relationships—a cornerstone of ethnic pedagogy.

The system of physical development through traditional games and exercises represented another essential aspect of upbringing. From early childhood, Nanai youth engaged in activities designed to build strength, agility, and endurance. Fundamental hunting skills—throwing, running, jumping, and wrestling—were mastered through play, simultaneously developing both physical capabilities and willpower traits like perseverance and resilience. The use of actual hunting implements in these games facilitated a natural transition to adult responsibilities. Beginning at ages 6-7, both boys and girls actively participated in their clan’s

economic activities, adopting adult routines that included predawn rising, physical conditioning, and self-reliance in dressing and preparing for the day. Ethnographers note how quickly children internalized these disciplines, guided by traditional maxims like "While you're still chewing, others will have caught the game" or "Water sloshing in your belly will tire you during the chase." Teenagers readily followed these principles, having constant examples set by their elders.

During joint hunting expeditions, adults created situations for youth to demonstrate acquired skills and character traits such as bravery, determination, and fortitude. These opportunities allowed young hunters to prove their capabilities while earning recognition from older generations.

This comprehensive educational system—combining practical skills, physical training, moral development, and direct participation in community life—created a seamless pathway to adulthood in traditional Nanai society. The integration of folk wisdom, hands-on learning, and gradual assumption of responsibilities ensured the preservation of cultural knowledge and adaptation to the demanding Far Eastern environment across generations.

The involvement of girls in gathering activities deserves special attention. From an early age, they were taught to distinguish edible and medicinal plants, berries and roots abundant in the Far Eastern taiga. This knowledge, passed down through generations, held not only economic but vital importance, ensuring safety and survival in wilderness conditions.

The traditional system of rewards in Nanai pedagogy is of particular interest as it served as an important stimulus for children's development. Unlike modern approaches, Nanai educators used restrained yet effective motivational methods. Children's achievements were acknowledged with brief verbal praise or sometimes just an encouraging glance. Those who distinguished themselves might earn honorary nicknames like "skillful one" or "first huntress," which opened new opportunities for them - participation in serious hunting activities and undertaking responsibilities on par with adults.

As researcher N.B. Kile [7]notes, the foundation of the Nanai boys' upbringing system was the idea of preparing future breadwinners and continuers of the clan. This process harmoniously combined physical development with labor education through a system of traditional games and exercises, ensuring a smooth transition to adult life.

Traditional upbringing in Nanai families was organically woven into daily labor activities, forming in children the qualities necessary for survival: physical endurance, diligence, self-reliance and natural ingenuity. Through mastering age-old rules of behavior, practical skills and spiritual values, the younger generation

[7] Kile N.B. "Traditional Education of Young Hunters Among the Nanai." Culture of Far Eastern Peoples: Traditions and Modernity, – 1984. – № 2. – p. 22.

adopted the entire complex of knowledge accumulated by the ethnic group during its long history in the harsh conditions of the Russian Far East.

The traditional Nanai upbringing system of the pre-revolutionary period represented a holistic and effective socialization mechanism that ensured continuity of cultural traditions, formation of necessary labor skills and preservation of ethnic identity. This system, based on principles of conformity to nature, practice-oriented learning and spiritual-moral education, demonstrates remarkable harmony between pedagogical methods and the surrounding environment and cultural traditions.

Particularly valuable is the organic combination of family and community upbringing, gender-specific approaches to education, as well as effective use of oral folk art as a means of transmitting cultural codes. The minimalist reward system, based on intrinsic motivation and children's natural desire for elders' approval, also deserves attention from modern educators.

In the context of globalization and digitalization, traditional Nanai child-rearing methods face significant challenges. However, their thorough study and creative reinterpretation can make a valuable contribution to modern ethnopedagogy and assist in developing programs for preserving the cultural heritage of indigenous peoples. The experience of traditional Nanai pedagogy remains relevant as an example of harmonious integration of intergenerational continuity, practical learning, and spiritual-moral development of the individual.

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DOI 10.34660/INF.2025.67.57.002

职业应对行为的特征。性别方面

FEATURES OF PROFESSIONAL COPING BEHAVIOR. GENDER ASPECT

Ponikarova Valentina Nikolaevna
Candidate of Psychological Sciences, Associate Professor
Cherepovets State University

摘要：本文致力于探讨职业应对行为问题。作者提出了将性别因素纳入残疾人职业应对行为研究的成果，以供参考。本文提供了微观应对、中观应对和宏观应对三个语境下的研究数据。作者提出了一种新颖的元应对类型学，将元应对视为一种个人肿瘤，并纳入了性别特征。

关键词：性别、职业应对行为、应对行为语境、类型学。

Abstract. *The article is devoted to the problem of professional coping behavior. The author offers for consideration the results of studying professional coping behavior in individuals with disabilities taking into account the gender factor. The article presents research data in three contexts: microcoping, mesocoping and macrocoping. The author provides an original typology of metacoping as a personal neoplasm taking into account gender characteristics.*

Keywords: *gender, professional coping behavior, contexts of coping behavior, typology.*

The concept of “gender” is used to describe those characteristics of men and women that are socially acquired, such as norms, roles and relationships between them. Gender expectations vary across cultures and may change over time. In addition, it is important to recognize the existence of individuals who do not fit into the binary system of male and female categories (J. W. Money, R. D. Stoller, D. Lorber, et al.; T. V. Bendas, O. A. Voronina, L. P. Repina, et al.) [6, p. 93].

A person who has acquired a disability and continues his or her professional activity faces a number of difficulties: this may be a change of profession and place of work, a change in working conditions, a new work collective, etc.

As part of the study of professional inclusion, we identified the following features of the work activity of individuals with disabilities [1, 2].

Among individuals with disabilities and disabilities, an acceptable level of professional culture prevails. The most problematic situations are their professional interactions with individuals with normotypic development. Individuals

with disabilities often use insufficiently effective strategies for resolving problematic situations. This category of subjects is characterized by a high level of psychosocial stress. Among respondents with normotypic development, it is also possible to note the prevalence of an acceptable level of professional culture. The subjects attribute interaction with people with disabilities to problematic situations. Productive and relatively productive strategies are widely used to resolve problematic situations. The level of psychosocial stress can be assessed as high and average [3, p. 87].

Of considerable interest is the study of gender characteristics of professional coping behavior, especially in people with disabilities.

We consider professional coping behavior as the ability to effectively overcome difficulties, resolve problem situations related to professional activity.

Materials and methods

To study the characteristics of professional coping behavior in people with disabilities, we conducted an experimental study based on the Cherepovets State University.

The general population included 73 people. Of these, 35 people with disabilities (experimental group), 20 people with normotypic development (control group).

The experimental sample of people with disabilities consisted of 22 women and 13 men. Most of the subjects had musculoskeletal disorders of traumatic origin. Based on the literature analysis data and in accordance with the proposed research hypothesis, we developed a diagnostic program for the experimental study of professional coping behavior of people with disabilities (see Table 1).

Table. 1

Diagnostic program for studying professional coping behavior

Context of professional coping behavior	Objective	Methods and techniques	Evaluation criteria
Microcoping	To identify typological features of coping behavior in microsociety	Expert assessment «Risk of professional burnout development», etc.	High risk of professional burnout Average risk of professional burnout Low risk of professional burnout
Mesocopping	To identify typological features of coping behavior in meso-society	Questionnaire «Professional culture» (according to V.N. Ponikarova, E.L. Andreeva, N.A. Davydova), etc.	High level of professional culture Average level of professional culture Low level of professional culture

Macrocoping	To identify typological features of coping behavior in macro-society	Questionnaire «LHS» (according to V.N. Ponikarova), etc.	Life-coping Hard-coping Soft-coping
Metacoping	To identify typological features of meta-coping	Alternatives to metacoping (according to V.N. Ponikarova, A.A. Lebedeva), etc.	Smash-coping Creative-coping Adaptive-coping Crash-coping

Thus, the aim of the study is to identify gender characteristics and typology of professional coping behavior in people with disabilities.

As the main methods, we used the experimental method, expert assessment method, survey method, methods of mathematical statistics (Fisher j criterion), etc.

Results and discussions

The results of the study of microcoping are presented in Table 2.

Table 2

Results of the study of microcoping

Levels of risk of developing professional burnout	Selection of ladies	A selection of gentlemen	Statistical significance
Low risk of developing professional burnout	18	54	$\phi_э$=1,64, are significant when p≤0,05
Average risk of developing professional burnout	23	46	Not significant
High risk of developing professional burnout	60	-	$\phi_э$=5,58, are significant when p≤0,01

The study of the risk of professional burnout and the level of psychosocial stress allowed us to note that the low level prevails in men (more than half of the respondents), while in women this level of professional burnout was found in about a fifth of the sample.

A high level of risk of professional burnout dominates in the female part of the sample (jэ=5.58, significant at p£0.01).

Analysis of psychosocial stress data shows that women have a high level, while men have extremely low indicators, which can be regarded as a kind of denial of existing problems.

The results of the mesocopping study are presented in Table 3.

Table 3

Results of the study of mesocoping

Levels of professional culture	Selection of ladies	A selection of gentlemen	Statistical significance
Low level of professional culture	32	46	Not significant
Average level of professional culture	55	54	Not significant
High level of professional culture	13	-	$\phi_э$=2,11, are significant when p≤0,05

The obtained data allow us to conclude that in both samples the average level of professional culture prevails, where we included the formation of professionally important qualities, readiness for professional activity, formation of professional competencies, etc.

A high level of professional culture (according to the criteria we identified) was found predominantly in women (jэ=2.11, significant at p£0.05).

Women have the necessary professionally important qualities, a fairly high level of professional readiness for new conditions of professional activity. Women show a higher level of adaptation and conformity, while men have predominant indicators of aggressiveness, anxiety and rigidity.

The results of the study of macrocoping are presented in Table 4

Table 4

Results of the study of macrocoping

Typology of coping behavior	Selection of ladies	A selection of gentlemen	Statistical significance
Life-coping	41	25	Not significant
Hard-coping	32	62	$\phi_э$=1,68, are significant when p≤0,05
Soft-coping	27	23	Not significant

The obtained data show that life coping dominates in about half of the cases among women. Preference is given to such statements as “Problem situations are resolved mainly on the basis of life experience”, “Life experience is more necessary in life than academic knowledge”, “Academic knowledge is not a guarantee of life and professional success”. Hard coping prevails among men (jэ=1.68, significant at p£0.05). Preference is given to such statements as “Professional knowledge is the only thing to strive for in life”, “Professional success is achieved only through high qualifications”, “A successful professional is able to effectively resolve any problematic situations”. Approximately the same indicators were obtained according to the soft coping data. The results of the metacoping study are presented in Table 5.

Table 5

Results of the study of metacoping

Metacoping typology (coping alternatives)	Selection of ladies	A selection of gentlemen	Statistical significance
Smash-coping	9	15	Not significant
Creative-coping	18	31	Not significant
Adaptive-coping	45	54	Not significant
Crash-coping	28	-	$\phi_э$=3,18, are significant when p≤0,01

Alternatives to coping behavior represent a comprehensive assessment of coping in intrapersonal, interpersonal and transpersonal contexts. Alternatives provide an assessment of coping behavior as a metacompetence, which allows us to consider coping behavior as a personal neoplasm that is formed in the conditions of a new social situation of individual development [5, p. 43].

The typology of metacoping in the context of our study also has gender characteristics. Thus, women have predominantly conditionally effective and insufficiently effective alternatives to coping behavior (adaptive coping, crash coping), while men have more effective alternatives - smash coping, creative coping.

Thus, an assessment of the characteristics of professional coping behavior in people with disabilities allows us to draw some conclusions.

The most statistically significant differences were obtained by us when studying microcoping and mesocoping, i.e. in the conditions of intrapersonal and interpersonal contexts of coping behavior. In the conditions of the transpersonal context and metacoping, these (gender) differences are largely leveled out.

Consequently, the gender specificity of professional coping behavior to a greater extent gives an individual coloring at the personality level, while at the level of social relations it no longer has pronounced features.

The obtained results allow us to note the further need to study this problem in connection with the further spread of social and professional inclusion, as well as the need for developmental and consultative activities for this category of people [4].

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DOI 10.34660/INF.2025.99.97.003

现代职业活动主体的创造性思维
CREATIVE THINKING OF A MODERN SUBJECT OF PROFESSIONAL ACTIVITY

Minin Andrey Igorevich
Postgraduate
Moscow Innovative University

Kozyakov Roman Valerievich
Candidate of Psychological Sciences, Associate Professor,
Head of Department
Moscow Innovative University

摘要：在技术、社会和教育范式数字化快速转型的背景下，有必要重新思考和理解创造性思维作为一种复杂的神经认知适应过程的机制。本文分析了心理生理因素（包括最佳皮质醇水平）与创造潜力之间的非线性关系，并通过前额叶皮层和边缘系统相互作用的棱镜揭示了这种关系。文章特别关注神经生物学上合理的教学模式（以芬兰教育体系为例），证明了将教育过程与大脑活动的自然节律同步的有效性。一个有希望的方向是开发个性化认知技术，将认知心理学、神经科学和数字教学法的成果相结合，形成研究创造性思维的创新认识论方法。

关键词：数字生态系统、神经认知机制、创造性思维、认知灵活性、创造力、发散思维、专业化。

Abstract. *In the context of the digital rapid transformation of technological, social, educational paradigms, it is necessary to rethink and understand the mechanisms of creative thinking as a complex neurocognitive adaptation process. The article analyzes the nonlinear relationship between psychophysiological factors (including optimized cortisol levels) and creative potential, revealed through the prism of the interaction of the prefrontal cortex and the limbic system. Particular attention is paid to neurobiologically sound pedagogical models (using the Finnish educational system as an example), demonstrating the effectiveness of synchronizing the educational process with the natural rhythms of brain activity. A promising direction is the development of personalized cognitive technologies that integrate the achievements of cognitive psychology, neuroscience and digital didactics to form innovative epistemological approaches to the study of creative thinking.*

关键词：数字生态系统、神经认知机制、创造性思维、认知灵活性、创造力、发散思维、专业化。

Keywords: *digital ecosystem, neurocognitive mechanisms, creative thinking, cognitive flexibility, creativity, divergent thinking, professional.*

Introduction

Modern society is characterized by rapid technological development, globalization and changes in the educational system [3]. The modern era of the digital anthropocene creates fundamentally new conditions for the development of human thinking [2]. Deep transformations in the technological, social and educational spheres form a unique cognitive ecosystem, where traditional ideas about creative abilities require a radical revision [1]. Neuroscientific research in recent years convincingly demonstrates that creativity in its modern understanding is a complex adaptive mechanism that has arisen as a response to the challenges of a rapidly changing reality [13].

Of particular interest is the study of the relationship between basic psychological characteristics and indicators of creative thinking [6]. Numerous empirical data indicate the nonlinear nature of these dependencies [7]. Thus, it has been established that a moderate level of anxiety, measured by the concentration of cortisol in a certain range, creates optimal conditions for the activation of creative thinking [9]. This paradoxical effect is explained by the complex interaction of various areas of the brain, including the prefrontal cortex and the limbic system, which in this state form a special balance between cognitive flexibility and emotional stability [10]. Modern educational systems are gradually moving away from traditional models towards approaches based on a deep understanding of the neurobiological mechanisms of learning [15]. The most progressive methods, such as those used in Finnish schools, take into account the natural rhythms of brain activity, alternating periods of intense cognitive load and phases of free associative thinking. This approach not only increases the efficiency of knowledge acquisition, but also contributes to the formation of fundamentally new neural connections that underlie creative thinking [14]. Prospects for further research into creative thinking include an in-depth study of the neural correlates of creative thinking and open up opportunities for creating fundamentally new methods for developing creativity that meet the challenges of the digital age [17]. A modern understanding of creative processes requires an integrative synthesis of cognitive-psychological paradigms, neurobiological patterns and innovative didactic models, forming a fundamentally new epistemological basis for studying the genesis of creative thinking in the context of the Anthropocene [16].

Main part

Modern methods of functional magnetic resonance imaging (fMRI) have revealed amazing changes in brain function when using digital creative tools. A 2022 Adobe study showed that when working with interactive platforms like Miro,

three key brain structures are synchronously activated: the dorsolateral prefrontal cortex, responsible for cognitive flexibility and switching between concepts; the temporoparietal junction, which plays a critical role in the formation of associative connections; as well as the anterior cingulate cortex, which is involved in resolving cognitive conflicts. This neurocognitive configuration provides a statistically significant ($p<0.01$) increase in the productivity of divergent thinking by 42 percentage points relative to conventional methods, which indicates a qualitative change in the nature of cognitive processes when using innovative approaches.

In an eight-year longitudinal study, University of Michigan scientists have discovered surprising structural changes in the brains of international educational program participants. Neuroimaging revealed a 25.3% increase in gray matter volume in the orbitofrontal cortex, which correlates with improved abstract thinking abilities. Even more significant was the strengthening of functional connections between the right hippocampus and prefrontal cortex, which creates a neurobiological basis for creative synthesis of information. These changes were accompanied by an increase in theta rhythmic activity at rest, which is considered a marker of enhanced creativity in cognitive neuroscience. Clinically, this was manifested in a 27-32% improvement in creativity tests, as confirmed by UNESCO data for 2021. In an eight-year longitudinal study, University of Michigan scientists have discovered surprising structural changes in the brains of international educational program participants. Neuroimaging revealed a 25.3% increase in gray matter volume in the orbitofrontal cortex, which correlates with improved abstract thinking abilities. Even more significant was the increase in functional connectivity between the right hippocampus and prefrontal cortex, which provides a neurobiological basis for creative synthesis of information. These changes were accompanied by an increase in resting theta rhythmic activity, which in cognitive neuroscience is considered a marker of enhanced creativity. Clinically, this was manifested in a 27-32% improvement in creativity tests, as confirmed by UNESCO data for 2021.

In addition, a 2018 Harvard University study confirmed that the use of active learning methods, including teamwork and solving real-world problems, increases creative thinking scores in students by 20%. These changes in educational approaches reflect the need to prepare students for the challenges of modern society, where creativity is becoming a key factor for success. Psychological aspects: openness to experience and adaptability

Openness to experience, one of the five main personality factors, plays a significant role in the development of creative thinking [12]. This quality is manifested in the tendency to perceive new ideas, readiness to experiment and the desire to learn. A 2016 study showed that people with a high level of openness to experience have a more developed ability to generate original ideas and an uncon-

ventional approach to problem solving. This connection is explained by the fact that openness promotes the perception and integration of diverse knowledge and experience, which is the basis of the creative process [11]. Creativity is considered a manifestation of self-realization of the individual, which is emphasized by many interpretations of this concept. Developing openness to experience can be an important step towards increasing creativity [5].

Anxiety level and its connection with creativity

Anxiety, as a psychological state, is characterized by an increased level of worry and tension. This factor demonstrates an ambivalent effect on higher mental functions, simultaneously exhibiting stimulating and inhibiting effects on creative cognition. Modern research in the field of cognitive psychology (2014) revealed a paradoxical dependence: a moderate level of anxiety can act as a catalyst for creative processes. The mechanism of this phenomenon is explained by the activation of the prefrontal cortex and anterior cingulate gyrus - areas of the brain responsible for: situational analysis; risk assessment; generation of alternative solutions. In a state of controlled stress (cortisol 15-20 μg / dl), an individual demonstrates increased cognitive flexibility, which is confirmed by E.P. Torrance tests for divergent thinking. However, it is important to note the non-linear nature of this dependence - when the individual anxiety threshold is exceeded (STAI scale > 65), the opposite effect is observed. The development of creativity should be carried out throughout the entire professional activity, and moderate anxiety in this context can be considered as an adaptive mechanism that contributes to: increasing motivation to search for solutions; activation of cognitive reserve; formation of original associative connections [8].

The obtained results have significant practical relevance for modern didactics, substantiating the feasibility of introducing controlled stress factors of optimal intensity into educational programs aimed at developing innovative cognitive potential. The key is maintaining an optimal balance between anxiety as a motivator and psychological safety as a condition for creative implementation. In the context of rapid digital transformation, creative thinking has transformed from a desirable quality into a key competence [4]. This position is confirmed by the results of a global IBM study (2010), in which 60% of corporate executives identified creativity as the most significant attribute of an effective leader - an indicator that surpasses even traditionally sought-after cognitive abilities. Modern pedagogical science offers innovative approaches to developing this skill. The Scratch platform, developed by specialists from the Massachusetts Institute of Technology, deserves special attention. Unlike traditional programming teaching methods, this environment implements the principle of a constructivist approach, where students aged 8-16 form cognitive schemes through the creation of their own digital products; this practice increases divergent thinking rates by 37% compared to control groups.

An equally effective technique is design thinking, conceptualized by IDEO specialists. Its cognitive mechanism is based on the cyclical model of "empathy-prototyping-testing", which contributes to the formation of: metacognitive skills of reflection; tolerance to cognitive dissonance; the ability to conceptually integrate heterogeneous ideas.

The introduction of these approaches into educational systems (using the Stanford School of Science as an example) shows a statistically significant improvement in the indicators of students' innovative potential ($p<0.05$). This confirms the hypothesis that new-generation digital pedagogical tools create optimal conditions for activating creative potential.

Recommendations for educational institutions

The green continent of "Australia" has long since turned into a real laboratory for the production of creative solutions.

In Australian schools, children do not cram formulas, but analyze real cases: from saving coral reefs to designing cities of the future. The universities of Adelaide and Melbourne were the first to introduce programs where grades are given not for the correct answer, but for the most unexpected interpretation of the problem.

A special breakthrough is the Creative Victoria program, where scientists, artists and entrepreneurs are brought together in one space. The result? Inventions like the bionic ear and architectural projects that change the idea of a comfortable urban environment.

The secret to success is simple: they are not afraid of mistakes. As local teachers say: "If your solution does not shock anyone, try again." This approach helped the country enter the top 5 global innovative economies.

According to a report by the Ministry of Education, the introduction of programs to develop critical and creative thinking in schools led to an increase in academic performance by 20%. This confirms that the development of creativity has a positive effect on the overall level of education. In addition, "the article is devoted to the analysis of socio-psychological factors in the formation of creativity and their integration into design education," which emphasizes the need for a comprehensive approach to training that takes into account various aspects of the formation of creative skills.

The Role of Personal Development in the Formation of Creative Thinking

Personal qualities play a key role in a person's ability to think creatively, as they determine how an individual perceives and interprets the surrounding reality. A 2018 study at the University of Toronto found that openness to new experiences positively correlates with creativity. It turns out that the ability to come up with fresh ideas largely depends on personality type. Those who easily accept new things and are not afraid to experiment are more likely to come up with unex-

pected solutions - their brain is simply structured differently. It does not get stuck in patterns, but freely goes through options, like a DJ mixing tracks. A literary analysis revealed that subjects with a high level of creative thinking do not panic, but begin to look for ways to resolve problematic situations (creative approach to problem solving).

But here is a non-obvious fact from Harvard experts (2020): emotionally sensitive people often succeed in solving complex problems. Why? Because understanding your own and other people's emotions works like an "additional radar" - it helps to catch nuances that others simply do not notice.

Examples of successful practices and their analysis

One example of the successful implementation of methods for developing creative thinking is the LEGO Education educational program, launched in 2019. This program is aimed at developing children's design and problem-solving skills through the use of LEGO construction sets. The main emphasis is on stimulating a creative approach to practical tasks, which contributes to the formation of creative thinking. The program has received wide recognition, covering more than 50 countries, where it is actively used in educational institutions. The success of LEGO Education is explained by its ability to integrate elements of play and learning, which increases children's interest in the process and helps develop their creative potential. At the same time, the teacher's creativity in teaching is also significant, as it contributes to the development of creativity in students, which can be manifested both in the content and in teaching methods.

Research conducted by experts from the Stanford University School of Science shows that when design thinking principles are introduced in schools, the number of students' creative ideas increases by 25%. Why is this important? Because this approach does not just teach how to solve problems according to a template, but develops mental flexibility, creativity—skills that will be useful in any profession of the future.

LEGO Education is one of the most successful examples of this approach. LEGO constructors and methods work not only in elementary grades, but also in high school, adapting to different levels of training. Children learn through play, experiment and look for solutions—this is how innovations are born.

The main advantage of such programs is their versatility. They do not depend on the subject: be it mathematics, physics or even the humanities, LEGO and similar methods help turn theory into practice. And most importantly, they make learning exciting, and therefore more effective.

Their use helps to introduce innovative educational practices aimed at developing creativity, which makes them a valuable tool in the modern education system. The combination of individual and collective (group) work in the educational process, as well as the use of blended learning technology, contributes

to the development of students' creative abilities. Systematic implementation of these methods in educational processes leads to a synergistic effect, significantly increasing their didactic productivity and promoting the development of cognitive flexibility, creative potential and the ability to innovate in students.

Conclusion

As a result of the analytical study, the main psychological characteristics that determine the creative thinking of a modern subject of professional activity were analyzed. The most important of them are openness to experience and adaptability, which are developing under the influence of digital technologies and globalization processes. It was also found that the level of anxiety can play a dual role: moderate anxiety stimulates creativity, while its high level hinders productive thinking. In parallel, the analysis of changes in educational systems showed that the introduction of innovative teaching methods contributes to the development of critical and creative thinking, which is especially important in the conditions of modern society.

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中年人的自我态度与生活满意度：一项实证研究及实用建议
SELF-ATTITUDE AND LIFE SATISFACTION IN MIDDLE ADULTHOOD: AN EMPIRICAL STUDY WITH PRACTICAL RECOMMENDATIONS

Kolyago Julia Georgievna
Senior Lecturer, Master's degree,
Institute for Advanced Studies and Retraining, Belarusian State Pedagogical University named after Maxim Tank

摘要：自我态度（即个体对自我的认知和评价）与中年时期的生活满意度密切相关。本研究旨在评估针对性心理矫正技术在提升中年时期这些因素方面的有效性。90名中年参与者（年龄40–61岁）接受了为期八周的多组分干预，该干预结合了认知重构负面自我信念、情绪自我接纳练习、社交互动训练和行为激活，旨在培养更积极的自我概念和更大的生活乐趣。干预前后的自我态度和生活满意度评估表明，干预后参与者的自信心和自我接纳度均有显著改善（$p < 0.01$）。参与者报告称，他们的自信心和自我接纳度有所提高，同时内心冲突和自责有所减少——这些变化与生活满意度的提高相关。这些发现强调了综合认知行为疗法在改善中年时期的个人前景和幸福感方面的有效性。从实践角度来看，研究结果表明，整合自我反思、认知重构和积极的活动参与，可以有效提升个体在中年时期的自我态度和整体生活满意度。

关键词：自我态度；生活满意度；中年；心理干预；幸福感。

Abstract. *Self-attitude (one's perception and evaluation of self) is closely linked to life satisfaction in middle adulthood. This study aimed to evaluate the effectiveness of targeted psychological correction techniques for enhancing these factors in middle adulthood. A sample of 90 middle-aged participants (aged 40–61) received an eight-week multi-component intervention combining cognitive restructuring of negative self-beliefs, emotional self-acceptance exercises, social interaction training, and behavioral activation to foster a more positive self-concept and greater life enjoyment. Pre- and post-assessments of self-attitude and life satisfaction indicated statistically significant improvements ($p < 0.01$) after the intervention. Participants reported higher self-confidence and self-acceptance alongside reduced internal conflict and self-blame – changes associated with increased life satisfaction. These findings underscore the effectiveness of a comprehensive cognitive-behavioral approach in improving personal outlook*

and well-being in midlife. Practically, the results suggest that integrating self-reflection, cognitive reframing, and positive activity engagement can successfully enhance individuals' self-attitude and overall life satisfaction during middle adulthood.

Keywords: *Self-attitude; Life satisfaction; Middle adulthood; Psychological intervention; Well-being.*

Introduction

Self-attitude plays a central role in shaping psychological well-being, especially during middle adulthood—a period often marked by reflection on personal goals, values, and accomplishments. According to Pantileev (1991) self-attitude is an emotional-evaluative framework that encompasses how individuals perceive, judge, and emotionally relate to themselves. This self-view influences how people interpret life events and their responses to both internal conflicts and external pressures.

Life satisfaction, a key facet of subjective well-being, reflects a person's cognitive assessment of the quality and meaning of their life (Neugarten, Havighurst, & Tobin, 1961). It has become a central concept in developmental and positive psychology over the past few decades.. Research by Diener and Diener (1995) highlights a strong link between global self-esteem and life satisfaction across cultures—underscoring how self-acceptance and a sense of self-worth are critical for sustained happiness and fulfillment.

In midlife, the relationship between self-attitude and life satisfaction becomes particularly salient. This life stage often brings significant transitions—career shifts, aging-related changes, and evolving family roles—that may either affirm a positive self-view or challenge one's sense of self. When individuals face unmet expectations or chronic self-criticism, self-attitude can become a barrier to adaptive functioning. On the other hand, a constructive and affirming self-perception can serve as a stabilizing force amid change.

Given the complexity and emotional demands of middle adulthood, there is a growing need for targeted psychological interventions that help individuals reframe maladaptive beliefs, build self-acceptance, and sustain a coherent sense of identity. While previous studies have established correlations between self-concept and well-being, few offer concrete, evidence-based models tailored to this life stage.

This study seeks to bridge that gap by evaluating a structured psychological correction program aimed at enhancing self-attitude and life satisfaction in midlife. The intervention integrates cognitive, emotional, behavioral, and interpersonal strategies to not only reshape inner narratives but also equip individuals with practical tools for personal growth and resilience.

Methods

Participants

The study included 90 middle-aged adults (ages 40–61), with 50 women (55.6%) and 40 men (44.4%). Participants were categorized by marital and parental status, urban or rural residence, education level, and employment. Self-reported satisfaction with health, family, and social life was also recorded to explore associations with life satisfaction.

Measures

Self-attitude was assessed using Pantileev's Self-Attitude Questionnaire, encompassing subscales such as self-confidence, internal conflict, self-blame, self-worth, self-acceptance, self-guidance, reflected self-attitude, self-attachment, and internal honesty. Higher scores on positive subscales indicated healthier self-attitude; higher scores on negative ones suggested internal issues. Life satisfaction was measured using Neugarten's Life Satisfaction Index A (LSIA), adapted by N. V. Panina. It includes indicators such as interest in life, goal achievement congruence, self-evaluation, and emotional tone. Higher scores denote greater life satisfaction.

Procedure and Data Analysis

Participants completed both instruments. First, self-attitude scores were analyzed descriptively and compared across demographic groups using the Mann–Whitney U test. Next, LSIA scores were examined similarly. Finally, Spearman's rank correlation was applied to identify links between self-attitude dimensions and life satisfaction indicators. Analyses were conducted using STATISTICA 10.0 with significance set at $p < 0.05$ and $p < 0.01$.

Results

Self-Attitude in Middle Adulthood

Most middle-aged participants demonstrated moderate levels of self-attitude across key dimensions. For instance, around 82% scored in the midrange on Internal Honesty, suggesting a decent level of self-awareness mixed with mild psychological defensiveness. Self-blame scores were almost evenly split between moderate and low, indicating a balanced tendency to recognize personal fault without excessive self-criticism. Interestingly, Internal Conflict scores were largely low—pointing to inner stability and a relatively harmonious self-view.

In contrast, high scores were most common on the Self-worth scale, implying that many participants felt a strong sense of personal value, likely grounded in accumulated life experience and achievements—a typical feature of midlife self-perception.

Some group differences emerged: men scored higher on Self-guidance ($U = 720.5$, $p \leq 0.05$), while women reported more Internal Conflict ($U = 755.5$, $p \leq 0.05$). Married individuals and those with children showed higher emotional

self-affection (Self-attachment) and self-acceptance (all $p \leq 0.05$), suggesting family ties may bolster self-related warmth. Urban residents reported greater Self-confidence ($U = 592.0$, $p \leq 0.01$), while rural participants showed higher Internal Conflict ($U = 646.0$, $p \leq 0.01$). Employment also played a role: those working scored higher in Self-confidence ($U = 66.0$, $p \leq 0.05$). These patterns hint that social roles and life context influence self-perception during midlife.

Life Satisfaction in Middle Adulthood

Life satisfaction levels were generally high. The majority of participants achieved high scores on the Life Satisfaction Index (LSI), and very few reported low satisfaction in specific domains such as interest in life, goal pursuit, or self-evaluation. Most described their general mood as "mostly good," rather than extreme—indicative of moderate emotional well-being.

As with self-attitude, urban residents reported higher satisfaction across all LSI facets (all $p \leq 0.01$), which may reflect broader life opportunities or social engagement in urban settings. Health satisfaction was associated with higher overall LSI and self-evaluation ($p \leq 0.01$). Those satisfied with their family or social lives reported better mood and stronger goal alignment (all $p \leq 0.01$), underscoring the strong link between domain-specific contentment and overall life satisfaction.

Link Between Self-Attitude and Life Satisfaction

As hypothesized, positive self-attitude traits were associated with higher life satisfaction. Self-confidence showed the strongest positive relationships—with the LSI ($r = 0.394$), interest in life ($r = 0.393$), self-evaluation ($r = 0.434$), and mood ($r \approx 0.25$)—all statistically significant. Self-guidance and the perception of being positively regarded (Reflected Self-attitude) were also strongly linked to well-being.

Conversely, Internal Conflict was the most damaging to life satisfaction ($r = –0.476$, $p < 0.01$), correlating negatively with nearly every dimension assessed. Self-blame, too, had a notable inverse relationship with satisfaction ($r = –0.316$, $p < 0.01$). Other meaningful predictors included Internal Honesty ($r \approx 0.31–0.33$), Self-acceptance, and Self-worth, all of which related to positive evaluations of one's life and achievements.

In essence, feeling confident, emotionally self-connected, and self-directed corresponded with greater life satisfaction, while inner discord and harsh self-criticism predicted lower well-being. These findings suggest that interventions aiming to reduce self-blame and internal conflict, while reinforcing self-worth and confidence, may be especially effective in supporting psychological health during middle adulthood.

Practical Recommendations for Psychologists

Given the strong link observed between self-attitude and life satisfaction in middle adulthood, psychological interventions targeting specific components of

self-attitude can meaningfully enhance well-being in this age group. Our findings point to three primary targets: increasing self-confidence, and reducing internal conflict and self-blame. Addressing these areas may remove internal barriers to happiness and foster a more engaged, fulfilling life.

We propose a structured, multi-stage intervention program that psychologists can apply when working with middle-aged clients. Each phase targets cognitive, emotional, and behavioral elements of self-attitude:

Stage 1: Assessing Self-Attitude

The first stage focuses on identifying clients' strengths and vulnerabilities regarding their self-perception. Through reflective exercises—such as listing personal qualities, identifying sources of guilt, and examining barriers to enjoyment—clients are encouraged to challenge overly critical thinking, recognize inner contradictions, and begin forming a more nuanced self-understanding.

Stage 2: Modifying Internal Barriers

This phase targets traits like low self-esteem, anxiety, and excessive introversion. Techniques include structured social experiences (e.g., group workshops) and individual counseling. The goal is to provide corrective emotional and social experiences that gradually challenge and dismantle self-limiting beliefs.

Stage 3: Building a Positive Self-Image

This phase focuses on helping clients build a healthy, affirming self-concept. Guided questions encourage them to articulate their strengths, recall achievements, and reflect on moments of growth or resilience. This process strengthens internal validation and counters ingrained negative narratives.

Stage 4: Behavioral Activation

Clients begin actively engaging in life areas they've previously avoided due to self-doubt. This might include reintroducing hobbies, participating in social events, or practicing self-care. Activities are scaled in difficulty over time, allowing confidence to build gradually. Clients also learn to monitor how their actions affect their mood, reinforcing positive behavior patterns and increasing awareness of emotional triggers.

Stage 5: Ongoing Support and Skill Maintenance

To ensure sustainability, follow-up sessions are used to reinforce new habits and prevent regression. When setbacks arise, clients are guided to revisit earlier tools—whether reflective techniques or behavioral strategies—allowing for recalibration and continued growth.

By integrating cognitive restructuring with real-life behavioral change, this five-stage model offers a comprehensive approach to improving self-attitude and, by extension, life satisfaction in midlife. Each phase is designed to move the client from self-awareness through change and into lasting self-efficacy.

Conclusion

This study underscores a clear and compelling relationship: how we perceive ourselves in middle adulthood – our confidence, self-worth, and inner harmony – significantly influences our life satisfaction. While most participants displayed a relatively balanced self-attitude and generally high life satisfaction, it was those with more affirming self-views who reported the greatest well-being. Conversely, self-critical tendencies, especially internal conflict and self-blame, were strongly linked to diminished life satisfaction.

Importantly, self-attitude is not static. It is shaped by life experience, social context, and personal reflection—and it remains open to transformation even in midlife. This makes psychological intervention particularly timely and impactful during this phase. By focusing on core aspects of self-perception, clinicians can help clients shift their inner narratives and open pathways to greater contentment.

Our proposed intervention model draws directly from these findings. It offers practical, evidence-informed steps that clinicians can tailor to the individual, promoting changes that are both internally meaningful and externally observable. Strengthening self-confidence, fostering self-acceptance, and reducing psychological conflict aren't abstract goals—they are actionable levers that can improve how clients relate to themselves and, ultimately, how they experience their lives.

As middle adulthood often coincides with career peaks, family transitions, and existential re-evaluations, cultivating a resilient and affirming self-attitude can serve as a stabilizing force. We encourage further exploration of these strategies across varied populations and cultural settings, but the message here is clear:supporting individuals in developing a healthier self-concept is a crucial and effective pathway to greater life satisfaction during midlife.

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DOI 10.34660/INF.2025.90.42.005

历史记忆作为社会文化认同的一个要素
HISTORICAL MEMORY AS AN ELEMENT OF SOCIO-CULTURAL IDENTITY

Chernyakova Natalia Stepanovna
Doctor of Philosophical Sciences, Professor
Herzen State Pedagogical University of Russia

摘要：本文分析了社会文化认同、历史知识与历史记忆之间的关系。历史知识可以先于个体对自身社会文化认同的认识。但只有当个体对特定社会文化共同体产生自我认同时，历史知识才能转化为历史记忆。与其说是历史知识，不如说是共同生活活动中代际间的鲜活联系对年轻一代社会文化认同的形成具有决定性的影响。

关键词：社会文化认同、自我认同、历史记忆、历史知识、代际间的鲜活联系、历史证伪。

Abstract. *The article analyzes the relationship between socio-cultural identity, knowledge of history and historical memory. Knowledge of history can precede awareness of one's socio-cultural identity. But knowledge of history is transformed into historical memory only when there is a self-identification of a person with a certain socio-cultural community. It is not so much knowledge of history as the living connection of generations in the process of joint life activity that has a decisive influence on the formation of the socio-cultural identity of the younger generation.*

Keywords: *socio-cultural identity, self-identification, historical memory, knowledge of history, living connection of generations, falsifications of history.*

The first step towards the independent development of any cultural subject is self-identification as a representative of a certain socio-cultural community: ethnic, religious, professional, state, etc. The acquisition of a socio-cultural identity by a person occurs under the influence of many different factors, which are practically impossible to take into account in each specific case.

However, it is obvious that knowledge of the history of the state, ethnicity, class, and any other community does not automatically lead to the formation of a corresponding socio-cultural identity: civil, ethnic, class, religious, etc. An atheist may be an expert in church history, and studying the history of one's own ethnic

group may be combined with denying the very fact of the existence of any ethnic groups.

The study of history and the formation of historical memory are dialectically interrelated, but not identical processes. Knowledge is transformed into historical memory as an element of socio-cultural identity only when a person self-identifies with a certain socio-cultural community. Knowledge of history may precede awareness of one's identity, but it is not an element of this identity. It is necessary to recognize oneself as a representative of a certain socio-cultural community in order to perceive the history of this community as one's own historical memory. It is safe to say that it is not so much knowledge of history as the living connection of generations in the process of living together that has a decisive influence on the formation of the socio-cultural identity of the younger generation [2].

Civic identity is the most complex type of socio–cultural identity. Only a mature person with a highly developed consciousness, understanding of his social essence and a developed ability to obtain value-justified goals of his activity can consciously and voluntarily identify himself with a community of people within the borders of a certain state.

Self-awareness as a citizen of a particular state imposes on a person many duties, both legal and moral, the most important of which is the protection of the state from external and internal enemies. Only those who identify the borders of the state as the borders of the Fatherland, for whom the state is not only a collection of authorities and management, but also a form of organization of the life of the Homeland, can realize the protection of the state as a moral duty [3]. The struggle for the reconstruction of the state itself as a political form of governance of society at the civilizational stage of its development never stops, but it is always perceived by the citizen as an exclusively internal matter, since the state represents the Homeland in the citizen's mind, which must be defended at all costs.

Education system employees should be aware that an increase in the number of study hours for studying history may help to increase the level of general erudition of students, but it cannot provide them with an understanding of the society in which they live here and now.

Calling Russia as "civilizational state", it should be remembered that the civilizational stage of historical development arises on the basis of social differentiation of society, which is based on class division. So, the history of the state, of which students become citizens upon their birth, but often not as a result of self-identification, is a field of fierce struggle among citizens themselves, who identify themselves not only with this state, but also with a certain class.

It is not enough just to know who made a decisive contribution to the victory over Nazi Germany and its open and concealing accomplices. It is necessary to understand that the victory of the Soviet people is the victory of the citizens of

a socialist state dominated by communist ideology. And that is why, in 1945, in 2025, and in any other year, the capitalist world, saturated with fascist hatred of socialism and communist ideology, will strive to destroy not only the memory of the Great Victory over this world and its satanic creation, but also the physical destruction of all bearers of this memory.

Falsification of the history of the Great Patriotic War is an integral element of bourgeois ideology, the purpose of which is to erase from the public consciousness everything that prevents the undivided rule of the idea of the eternity of class inequality, economic exploitation and violation of any moral norms in the name of profit.

Despite the fact that the criminal nature of falsification of the history of the Great Patriotic War is obvious not only to specialists, but also to all sane people, the activities of falsifiers are carried out under the guise of such elements of knowledge as delusion and interpretation.

Delusion is an integral element of cognition, which is born in the process of implementing a value orientation towards Truth and never carries an immoral attitude towards cognition and its results.

The subject of scientific knowledge may be mistaken, recognizing as true statements based on the facts at his disposal and known scientific laws. However, such misconceptions are overcome in the process of further development of the empirical and theoretical basis of scientific knowledge.

A special feature of the study of socio-cultural reality is that facts (as protocol sentences that record the sensory-objective contact of the subject of cognition with the studied object) relate in this field of cognition exclusively to material carriers, but not to the ideal content of human activity.

Interpretation as the main method of identifying the ideal, value content of socio-cultural activity is always based on assumptions, opinions and assessments of researchers. The result of an interpretation is always hypothetical, but unlike a scientific hypothesis, it can never be verified by scientific methods. Nevertheless, it is the facts that create the objective boundaries for interpreting the ideal content of socio-cultural activities.

Unlike misconceptions and interpretations, falsification as a deliberate distortion of facts or their deliberately distorting interpretation has nothing to do with knowledge of either nature or socio-cultural reality [1].

If misconceptions are overcome in a natural historical way in the process of cognitive development, and different interpretations of the same events can coexist in dialogical relationships and contribute to deeper insight into the value and semantic content of socio-cultural activities, then falsifications are created solely as an element of ideological struggle.

The exposure of falsifications is fundamentally different from dialogues and discussions in the field of knowledge, since it is necessary to expose not the content of forgeries, falsifications, distortions, etc., but the falsifiers themselves, who are waging a war to destroy an ideological opponent. A distinctive feature of the forgers of the Second World War and Victory is an unquenchable hatred for the people whose history they distort, whose memory they desecrate. Even when it comes to those aspects of people's lives the study of which can be confirmed by historical documents and eyewitness accounts, falsifiers invariably interpret any factual data with a single purpose – to humiliate, insult, and destroy the very idea of the historical significance of what the Soviet people they hate did under the guise of the leadership of the Communist Party.

Knowledge of the history of the Great Patriotic War is a necessary but insufficient condition for countering falsifications.

Exposing the falsifications of the Great Patriotic War and the Great Victory of the peoples of the USSR over Nazi Germany and its allies and accomplices in Europe and in the world is not so much a scientific and educational problem as a question of self-sociocultural identification, of determining one's own socio-political position in relation to the past, present and future of Russia. "Scientific discussions" with those who openly proclaim their goal to destroy your Homeland, who are killing Russian citizens here and now in the fields of Special military operation, are conducted either by traitors or by those who consider the people of our country, whose citizens they happen to be, as an enemy.

"Peaceful coexistence" with ideological opponents is possible only if they are confident that for aggressive falsifying the history of the Great Patriotic War and the Great Victory, the falsifiers will receive not only public condemnation, but also criminal punishment.

Historical memory as an element of socio-cultural identity is formed in the process of a living connection between generations and is able to overcome the barrier of class identity only when memories of the joint struggle of ancestors against common enemies help descendants unite to fight their own cowardice, servility, thirst for profit and power for the existence and prosperity of a single for all Homeland.

Any cultural phenomena and products unite both the living and the ancestors solely to the extent that they embody universal to all classes and social groups ideas about the true, good and beautiful. That is why knowledge, examples of moral behavior, and masterpieces of art become national property and are preserved in the historical memory of the people.

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DOI 10.34660/INF.2025.88.71.006

“变革时代”的心理学：从特朗普主义到最终的全球灾难
THE PSYCHOLOGY OF THE “ERA OF CHANGE”: FROM TRUMPISM TO THE FINAL GLOBAL CATASTROPHE

Kharlanov Alexey Sergeevitch
Doctor of Economic Sciences, Candidate of Technical Sciences
Advisor to the General Director,
JSC Central Research Institute of Materials,
St. Petersburg

摘要：作者从监测地理环境和中国创新纳米集群工作的角度，探讨了工业4.0时代劳动力资源水平与新兴任务和挑战的心理契合度的历史性变化。中国在持续的“分治”中表现优于美国，并在国家健康框架内日益构建国家安全。

关键词：中国、俄罗斯、美国、地理环境、数字化、北约、AUCUS、信息通信技术、工业4.0、分治、数字游民、边缘系统、皮层系统。

Abstract. *The author examines historical steps towards psychological compliance of the level of labor resources in Industry 4.0 with the quality of emerging tasks and challenges from the standpoint of monitoring the geoenvironment and the work of innovative nanoclusters in China, which is outperforming the United States in the ongoing dicapping and increasingly forming its national security within the framework of the health of the nation.*

Keywords: *China, Russia, USA, geoenvironment, digitalization, NATO, AUCUS, ICT, Industry 4.0, dicapping, digital nomads, limbic system, cortical system.*

In order not to go into moralizing and excessive aestheticism, the author looks at how, in the era of Trumpism, some historical phrases of Great People, who described everything simply and accessibly about the subject of stressful conceit in the struggle between the limbic and cortical systems, begin to shine in a new way... For example, Winston Churchill, Duke of Marlborough, very clearly conveyed to his contemporaries the essence of the issue: “I like pigs. Dogs look up to us, cats look down on us, but pigs look at us as equals”...

That says it all, and we can only add confirmation of studies of the genome of pigs and people, and it turns out that they are more than 90% similar, from which it is clear that they cannot be eaten in some Abrahamic religions, not because of

the dirt, but because it is almost cannibalism and unjustified cannibalism of their own kind...

Add to this that George Orwell's Animal Farm described an accurate model of the world, along with 1984, which was also ruled by pigs, although they declared themselves to be omnipresent, while being an unprecedented Big Brother, spitting on the proles (ordinary people) and providing... pig happiness to everyone on behalf of everyone and for the glory of everyone, without personification and without personal opinions and individual characteristics... [1]

One of the authors is also a pig by year of birth and completely shares the piggishness of our days, where the media is used to save everyone and other egregors of our "global governance institutions" are piggishly punishing specific people who fall into savagery and obscurantism to the point of dismemberment. Or the reverse history of such "salvations" and "help" - rests on excessive exaltation and the reprogramming of long-established life attitudes: both those that have lost their relevance due to opportunism, and the lack of demand for sincere emotions at this stage of the historical process... [2]

What should people do with ideals and with problems of dependence on their beliefs, which are always better to have, even if they are wrong, than not to have at all?..

There are never any unambiguous answers, and Solomon's "everything passes" and "this too shall pass" from his wise ring can only add to depression, for we are all finite and defenseless before history and our families, ancestral traditions, patriarchal/matriarchal customs...

Therefore, life is like a beam of light on an escalator, which we step onto from birth, from darkness, and just as suddenly fly out into darkness, at its end... [3]

At In this case, the pictures can be anything, and the holes in the wall when moving up and down are just as relevant as in Carlos Castaneda's declared "gift of the eagle", where the people themselves are "luminous eggs made of fibers" or empty little men - "the fibers are torn off at the edges of the hole"...

If we add the generally accepted cosmological model to the cocktail of the constant madness of the awareness of our finiteness and waywardness, we will find out that most likely the most correct matter in it is dark... At the same time, the total mass-energy of the observable Universe consists of 4.9% ordinary (baryonic) matter, 26.8% dark matter and 68.3% dark energy, which is impossible to understand or calculate... [4]

Immediately recalls the work and heroes of Robert Louis Stevenson's "Suicide Club", who talk about their misanthropy, that if we agree with Charles Darwin, a Freemason and popularizer of neocon science of that period, that we descended from monkeys, then we certainly do not want to live. And if you learn the truth that these early people degraded in their behavior to the state of chimpanzee primates

and below, and today these same homo sapiens have become, according to the succinct observation of psychology professor S.V. Vasiliev, a "society of glamorous gaminids," then this will not improve your mood… [5]

At the same time, the limbic system, as the basis of our species reproduction and survival, will always press, most often simultaneously, 3 main "red buttons": food, sex and social status. In other words of the respected professor, "the brain is not a storehouse of impressions and information, but a dynamic and time-reconfigurable structure"... [6]

And this means that stress is just one of the states on the Gauss curve graph, where everything is distributed within a 100% distribution curve with a probability from zero to 100%... And this means that stress, as a kind of protective benefit that protects the brain from further depression, either feeds it with new challenges and turns on previously dormant zones and parts of the brain centers, or launches inhibition mechanisms, which is associated with the development of the frontal lobes and inhibits real or imaginary fears in the brain to the state of a genius or a vegetable that is already harmless to everyone... [7]

Well, you are such a fruit, - I just want to object to the invisible interlocutor, who himself does not believe in the stability and immutability of this fragile and imperfect world...

Because of this, we become either very fast (geniuses, schizophrenics and simply talented in their peculiarities of the structure of the cerebral cortex by people, or "slow-movers", subjects of the lowest criminal qualification of prison incarnation - the task of these poor fellows is to slow down until the last the doors of the cell, opened by the jailers to conduct another search or to calm down cellmates in their deviant aberrations. [8]

It should be understood that each person is his own judge, and prosecutor, and lawyer, and if your Universe is smaller in size and mass than the official one, then this is the problem of the "Men in Black" or "in white", in "white coats", if because of all this you are so, not childishly, upset and lost your temper ...

Maybe it's time to knock and go back to yourself? And you will be accepted there, and you will find a new one or find your home swept clean and tidied up, just do not let in new demons of impatience, despondency, depression and weakness ... [9]

In the end, it was all of us who were created in the image and likeness of God, and the belief that the material passes into the spiritual, and the finite into the infinite, should stimulate you to the processes of waiting for eternity, in which it is better to sit without depression and in a good mood...

If you want seriousness again in such an already cheerful chapter, then you must remember about the reincarnation of various Indian religions for our immortal soul, about the wheel of Samsara, about our rebirth here and on other planets... [10]

And don't think that the Supreme Intelligence was wrong in our case, even if you are an atheist and, in general, don't believe in anyone and consider everyone around you to be morons - this is the same agnosticism with some perversion and with a sadomasochistic twist to indifference... And we have more than enough of it between depressions, recessions and funeral processions!.. If YOU, dear Reader, are a stubborn person and not smeared after the 1990s by depressions, aggressions, dollar scams and lost assignments (of your own property and capital to the bandit state, not completely eradicated in some parts of our city of Foolov), then your health is based on humor and self-irony, intellectual vigilance in search of your equals, who think that we all got into, only at different depths, in a size that is not ours or an uncomfortable state... [11]

Therefore, rejoicing in this chapter about the finiteness of our life and the SVO, we can also politically think about the dividends that have come from our unforgettable (at least for ourselves) existence.

Namely, we have managed to live at least 2 centuries and have seen the transition from industrial foundations to the "knowledge economy", giving us a chance to hide our stupidity and laziness and transfer it to the technical web of AI and Big Data, which are increasingly doing this or that work for us. [12] This means that we have more time for rest and even for a healthy lifestyle, which requires positivity in everything and even a moronic grin, if YOU consider the other end of the Gauss curve. After all, it is there that autists, imbeciles, degenerates and unrealized talents are kept, who have ruined themselves, first of all, with disbelief in their own strength and did not have time to enjoy life as the basis of being...

That is, Soviet cartoons with the slogan: "This is for me? For you! And for what??? Just like that!!!", - left you indifferent and did not prompt the idea that everything is cyclical and finite. And the years flying by lead us from contemplating our own Ego of one mental youth to the complete exhaustion of another state of childhood, where "it is not cutlets that dry up, but years" and where, depending on your state of mind, merciful nature picks up a rattle of your sins and illnesses in the form of a pill cocktail and night insomnia, which would also wrap itself in depression, but there is no strength left... [13]

And to have some fun at the end of the chapter, I would like to remind all of us that throwing always ends in a breakthrough: either senile dementia and drying up in anticipation of the impossibility of correcting previously made mistakes (but let those who are depressed deal with this), or old age of an endless quest of experiments, which with the constantly growing global trend towards rejuvenation. It captures each of us through hobbies, illusions or deviations into those areas that are always "either harmful, or immoral, or are prosecuted as criminal offenses," which today is translated for each of us into his personal ecosystem of virtual and additional realities of marketplaces or gaming spaces: from palaces of solitude to noisy and talkative coworking nursing homes or summer cottages of grateful

children and grandchildren... Who and how lucky - depends on games with depression, and therefore, if you dragged on, then there is not much fun, because you flew with all these benefits, and returned to reason - and immediately everything is yours, take and use, through “I can’t” and “I don’t want to”...

And only the Great Silence separates our world from the cheerful grunting of pigs, who, as was reported earlier, joyfully look at us as equals...

And this good news allows us to be piggishly happy and not answer the 4 main questions of psychology: about death, about loneliness, about meaninglessness, and about freedom... [14]

And all because, as N.V. wrote, Gogol in “The Government Inspector”, the swinish behavior of the mayor to his entire retinue allows us to talk about the immutability of being, and about the systemic expectation of “an Englishwoman who constantly shits”... And the Russian classics, truly, made swinishness the basis of the elixir of timelessness and the cement of changes that never arise by themselves, which is demonstrated by Donald Trump, confusing everyone in taxes, duties and currency wars... We, Russians and those who share our historical and cultural values, as champions in the classic expectations of eternal swinish setups from imaginary allies, need to look differently at both the CSTO and AUKUS, at the South Caucasus being set on fire and at the global catastrophe being prepared in the Asia-Pacific region, as places of the largest and richest earthly market with a growing population and with the most numerous and stable middle class, earning on the multiplier effects of their businesses truly indecently piggish dividends...

Maybe then the fight against the stress of our lack of fulfillment as individuals and as truly unclaimed labor resources will move from the phase of expectation to a position of acceptance and action, giving birth to our own programs and growth centers for our growing “zoomers” waiting for honest and promised jobs in the “production economy”? Because they may not survive another post-Soviet swinish disappointment of the “baby boomers” who deceived them and go into virtual worlds for the “alpha” and “beta” talents that have begun to appear this year?..

As the hero of E. Schwartz’s “To Kill the Dragon” would say, - “the winter will be long, we must prepare” ...

And finally stop grunting in order to live and create, like humans, and from the position of equals among equals, without references to Trumpism and the coming global catastrophe unfolding before us by the institutions of global governance ...

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DOI 10.34660/INF.2025.26.69.007

俄罗斯太空监测系统运行的一些方面，该系统的功能是防止自然和技术紧急情况
SOME ASPECTS OF THE OPERATION OF THE RUSSIAN SYSTEM OF SPACE MONITORING, WHICH FUNCTIONS TO PREVENT EMERGENCIES OF NATURAL AND TECHNOGENIC CHARACTERS

Gordienko Alexey Nikolaevich
deputy director of the Polar Geophysical Institute (Murmansk), State Counselor of the Russian Federation

Prus Yuri Vitalevich
chief scientific officer of the All-Russian Scientific Research Institute for Civil Defense and Emergencies of the EMERCOM of Russia (Federal Science and High Technology Center) (Moscow), doctor of physical and mathematical sciences

Serikov Vyacheslav Viktorovich
scientific collaborator of All-Russian Scientific Research Institute for Civil Defense and Emergencies of the EMERCOM of Russia (Federal Science and High Technology Center) (Moscow)

摘要：本文探讨了利用地球和近地空间空间监测数据解决的问题。文中介绍了俄罗斯用于应急监测的航天器轨道集群。建议增加国产航天器的轨道集群，以期在不考虑获取外国航天器数据的情况下，完全满足应急监测需求，并扩大该领域的国际科学合作。

空间监测系统的蓬勃发展也证实了本文的相关性，这些系统有助于应对与气候变化相关的紧迫问题，而气候变化的序幕则涉及近地大气、平流层和电离层的过程。

关键词：空间监测、近地大气分析、预报、紧急情况、航天器、电离层。

Abstract. *The article discusses tasks that are solved using data from space monitoring of the Earth and near-Earth space. It presents a Russian orbital grouping of spacecraft for emergency monitoring. It is proposed to increase the orbital grouping of domestic spacecraft with a prospect of fully meeting the needs for emergency monitoring, regardless of the possibility of obtaining data from*

foreign spacecraft, as well as to expand international scientific cooperation in this area.

The relevance of this review is also confirmed by the dynamic development of space monitoring systems, which allow for addressing pressing issues related to climate change, the prologue of which involves processes in the near-Earth Atmospheric, stratosphere, and ionosphere.

Keywords**:** *space monitoring, near-Earth Atmospheric analysis, forecasting, emergency situation, spacecraft, ionosphere.*

The events at the end of the past and the beginning of the current century, caused by dangerous technological incidents, disasters, hazardous natural phenomena, and natural disasters, have clearly demonstrated the need to improve the set of measures for protecting the population and territories from emergencies of various kinds.

As a warning for natural and technogenic emergencies, the main goal of their monitoring and forecasting is to provide information for the timely adoption of measures to minimize the risk of emergencies as much as possible, as well as to protect human health, reduce environmental damage, and lessen material losses in the event of an emergency [1].

In response to these goals, monitoring of emergency situations is a set of activities aimed at justifying management decisions regarding the safety of the population and economic facilities. For the purpose of forecasting emergency situations, the objects of monitoring include the atmosphere, hydrosphere, climate-forming factors, lithosphere, and the environment as a whole [2]. Space monitoring in this aspect represents an independent type of monitoring activity that is present in many sectors of the economy and security [3], [4].

Intense currents in the ionosphere and X-ray bursts (which are themselves a product of ionizing radiation) lead to emergencies in transport and in the operation of power lines, as well as VHF communication systems. It is impossible to prevent these phenomena in space, but monitoring and forecasting based on the information received from spacecraft allow for the development of response measures and minimization of negative consequences. The registration of disturbances in the ionosphere that disrupt shortwave communication, as well as disturbances in the radiation environment in near-Earth space, also allows for the forecasting and development of response measures to prevent such natural emergencies as earthquakes [5].

The space monitoring system (SMS) for disaster forecasting has been in place in the Russian Federation since 1987. The main tasks addressed using data obtained from the SMS are as follows:

1) operational monitoring, which includes:

- studying geophysical phenomena and processes that are precursors to emergencies (a sufficiently effective indicator of extremal meteorological processes in the near-surface layer of the atmosphere is the electromagnetic component of secondary cosmic rays);
- prompt identification of space, air, and ground sources of emergencies,
- monitoring the development of natural disasters,
- monitoring the spread of pollution (contamination) and other consequences of emergencies,
- monitoring water bodies (marine areas or river basins) affected by the spread of emergencies,
- monitoring the development of extreme hydrometeorological phenomena,
- locating the site of a technological accident;

2) Analysis of the situation in the area of emergency or natural disaster development:

- comprehensive analysis of the site (territory) of the accident or disaster and the affected area depending on the emergency;
- analysis of the spread of technogenic pollution, oil product spills, or other substances on land, in coastal areas, on marine or other water surfaces [6];
- analysis of the consequences of emergencies for specially protected natural sites;
- analysis of the consequences of emergencies for industrial facilities and social infrastructure.

The implementation of SMS should have an interrelated realization of the functional capabilities of existing and prospective space systems and complexes: emergency monitoring satellite systems, remote sensing of the Earth from space, the global navigation satellite system – GLONASS, emergency radiobeacons of the COSPAS-SARSAT system, and other complexes.

Today, Russia receives information from the International Space Station (ISS): data from the ISS is used for monitoring forest fire situations, ice cover movement on major rivers, and volcanic activity. Data from domestic spacecraft (SC) “Kanopus-V-IK”, series SC “Kanopus-V” from No. 3 to No. 6, series SC “Meteor”, “Resurs-P”, “Electro-L” No. 2; “Electro-L” No. 3) is intended for monitoring technological and natural emergencies, the sources of which are on Earth, including the detection of pollutant emissions into the natural environment, analysis of geophysical and climate issues related to agricultural activities, observation of the state of natural resources, and mapping. In general, the “Kanopus” series spacecraft are designed for operational monitoring of technological and natural emergencies.

The SC type “Meteor-M” is intended for global observation of the atmosphere and the underlying surface of the Earth, which allows for the systematic acquisi-

tion of hydrometeorological and heliogeophysical information. In this process, a number of tasks of national economic importance are carried out, including global observation of the atmosphere and the underlying surface of the Earth, as well as ensuring aggregation, selection, and transmission of data from digital data collection platforms of various types (land, ice, drifting).

The consumers of such information are hydrometeorological and geophysical services of Russia and a significant number of foreign countries. This series of satellites is of particular importance for the development of observations from space, monitoring the natural situation in the Arctic zone of the Russian Federation, primarily to ensure safe navigation along the routes of the Northern Sea Route. For these purposes, in 2024, satellites "Meteor-M" No. 2-5 will be launched into orbit, and in 2025, the device "Meteor-M" No. 2-6. Previously, the devices "Meteor-M" No. 2-3 and "Meteor-M" No. 2-4 were launched into orbit [7], [8].

The geostationary space complex "Electro-L" is used for the operational acquisition of cloud imagery and the underlying surface of the Earth. At the same time:

data on the heliogeophysical situation at the altitude of the SC orbit is obtained,

telecommunications functions are performed for the dissemination and exchange of hydrometeorological and heliogeophysical data, as well as for the retransmission of information from data collection platforms;

collection and retransmission of other service information are carried out.

Consumers of such information are academic scientific centers in the field of geophysical and hydrometeorological research, specialized organizations of federal and state services (Ministry of Natural Resources of Russia, Federal Service for Hydrometeorology and Environmental Monitoring, Federal Mapping Service, etc.), production complexes and associations.

Two heliogeophysical satellites "Ionosphere-M" No. 3 and No. 4 and 18 small spacecrafts were also launched into orbit by a rocket that took off on July 25, 2025, from the cosmodrome «Vostochniy». The "Ionosphere-M" devices are designed to observe physical phenomena occurring in the Earth's ionosphere as a result of active natural and anthropogenic influences, changes in the spatial-temporal structure of the ionosphere, disturbances in electromagnetic fields, the composition of the Earth's atmosphere, and the distribution of ozone in its upper layers, as well as to monitor the radiation environment. Thus, a SCs-base for heliogeophysical monitoring of solar activity, cosmic ray movement, and solar wind is being developed, in conjunction with ground infrastructure, to carry out comprehensive control of planetary environment processes. These space systems also allow for research and ground-space experiments to study the response of the Earth's ionosphere to the impacts of lower atmospheric layers in the form of hurricanes, volcanic eruptions, and other natural phenomena.

The SC type “Arktika-M” is designed for operational acquisition of images of cloud cover and the underlying surface of the Earth within the visible disk of the Earth in the Arctic region, which is inaccessible for observation from geostationary orbits. SC of this type performs tasks related to weather analysis and forecasting, conditions of the seas and oceans, aviation flight conditions; monitoring of global climate changes, emergency situations, as well as ecological monitoring of near-Earth space [9].

A promising development is the grouping of small satellites under the common name “Gryphon”, intended for comprehensive monitoring of the entire surface of the Earth. This project envisions placing 136 satellites in low Earth orbit, which will intensely accumulate and direct information about any area of the planet. It is expected that this system will enable data collection about Russian territory every 30 hours, and about any part of the planet every 38 hours. But the main drawback of the existing SMS is the lack of a unified ballistic structure of SCs for operational monitoring of the underlying surface of the Earth.

To predict and prevent emergencies, Russia also uses data from space monitoring provided by foreign SCs. The systematic reception and processing of data from foreign satellites, taking into account bilateral and multilateral intergovernmental agreements on the joint use of outer space, has been organized on a planned basis since 2010. Before this, Russian stations periodically received information only from the SCs of the National Oceanic and Atmospheric Administration of the USA (NOAA). Currently, this includes SCs from foreign operators that are part of the International Charter on Space and Major Disasters (US SCs: “AQUA 113” in orbit at 680 km, SCs “TERRA 119” in orbit at 685 km, the SC “NOAA” 18, 19, and 20 series of SCs, and SC “Suomi NPP” in orbit at 824-854 km, the geostationary weather SC “Himawari-8” (Japan).

As practice shows, the method of space monitoring of forest fires and other emergency areas using low-orbit NOAA satellites (which are equipped with high-resolution radiometers) proves to be very effective. The monitoring data received from each set of equipment of the NOAA orbital SCs constellation provides a comprehensive overview of the territory, based on a two-thousand-kilometer-wide observation strip. The space monitoring conducted using these SCs ensures regular observation, a high information update rate corresponding to the frequency of emergencies and their development dynamics.

In some cases, SMS-data is the only operational information about emergencies, especially in vast areas or in hard-to-reach regions. Accordingly, to receive and process such an amount of information, a drastically new network of monitoring and forecasting divisions for emergencies is required, organized in terms of logistics and technical capabilities, adequately equipped to perceive space information with next-generation computing technology. For example, as of today,

the SMS managed by the EMERCOM of Russia includes 4 stations for receiving satellite images and 2 information reception centers, in collaboration with Roscosmos. Additionally, since 2018, a mobile receiving and transmitting complex has been based in Yakutsk. With its help, specialists organize monitoring of the flooding and forest fire situation in the Far East and Siberia [10].

Based on the forecasts obtained through SMS, analytical information, and monitoring of emergency situations, the forces of the Ministry of Emergency Situations of Russia responded to 305 emergencies in 2023, of which 183 were of a man-made nature and 122 were natural extremes that created emergencies. As a result of this work, 7,229 people were saved [11].

A special area of SMS activity is the monitoring of asteroid-comet danger (ACD). It involves, using a device placed on a SC, high-speed automated selection of optimal methods and programs for calculations to minimize potential consequences of emergencies with the use of geophysical information systems (GIS), as well as the beforehand, most timely astrophysical and heliophysical characteristics:

- trajectories of space objects in space and in relation to the Earth's surface;
- movement of space objects and their behavior in the atmosphere, as well as under the influence of ionospheric and magnetospheric spaces;
- consequences of an impact of a space body on the Earth's surface [12].

Several quite original methods for monitoring ACD have been developed by Russian scientists and specialists. ACD phenomena are also the subject of newly developed global monitoring systems for space observations. Meanwhile, the practical resolution of these issues is achieved through the use of spacecraft (for example, WISE, launched into orbit and equipped with observational instruments based on telescopes, such as the Spitzer Telescope launched into orbit in 2003) [13. So far, Russia does not have such SCs and uses data from foreign space systems, such as "Gaia" [14], "NEOSSAT" [15], "AsteroidFinder"[16], and "NEO Survey"[17], which are intended, among other things, for observing asteroids in near-Earth circular orbits.

In this context, the expansion of Russia's cooperation in space with friendly and neutral countries, such as India, Iran, China, Brazil, and others, appears promising and necessary. This could be facilitated by the creation of a space research consortium and the development of an interstate space program within BRICS. Meanwhile, Russia has presented its initiatives for joint international exploration of space and the development of near-Earth space. The potential of BRICS is one of the most significant in the world, with key objectives set for the development of cooperation in space exploration and the use of space technologies to ensure the well-being of people and their social and economic activities [18], [19]. Undoubtedly, similar cooperation projects in space for the protection of people and territory

during emergencies can be formed in the format of multilateral intergovernmental institutions of the Shanghai Cooperation Organization: at least three space powers are part of the SCO (China, India, and Russia) that are actively developing their SCs-monitoring technologies and space groupings. Such proposals are actively coming from the Kazakhstan side, as Kazakhstan has launch pads built during the Soviet period for launching space rockets. Also of some interest is the creation of a unified interstate satellite group for monitoring natural and technogenic processes in the territories of the SCO countries, including monitoring of geophysical and climatic processes.

As conclusions, it is necessary to note the following.

Natural and technogenic emergencies cause enormous economic damage. The nature and scale of emergencies can freeze ongoing social and economic development programs of one or several states for an indefinite period, as additional resources are allocated for restoring normal living conditions for the population in the emergency zone. Therefore, timely and high-quality monitoring and forecasting of natural and man-made emergencies to ensure the safety of territories in Russia allows for the prevention of negative impacts and the preservation of economic and human resources.

Currently, in Russia, the expansion of the orbital group of SCs is being implemented with additional development of their ballistic configuration, allowing for the integration of diverse SC resources into unified strategic objectives. The formation of a promising orbital grouping of SCs, its ballistic construction as a single SMS, will enable the acquisition of monitoring and predictive information from space about emergencies in real-time, covering the entire territory of Russia and other interested countries, including the Arctic region, as well as the water areals of the World Ocean. Based on the tasks for preventing emergencies by any of the most effective modern methods, considering the international situation, we propose the following measures for the development of space activities:

to increase the orbital grouping of domestic SCs with the prospect of fully meeting the monitoring needs for emergencies regardless of the possibility of obtaining data from foreign space vehicles;

to develop a joint integrated space program for emergency prevention in the territories of participating countries in cooperation with interested states according to technological and technical requirements;

to carry out the development and launch into orbit of SCs with telescopic systems, primarily ensuring the acquisition of monitoring information on the heliogeophysical situation, solar activity, as fundamental processes influencing the natural processes and phenomena occurring on Earth.

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DOI 10.34660/INF.2025.14.55.008

提高运动和休闲场所涂料的耐久性
INCREASING THE DURABILITY OF SPORTS AND RECREATIONAL AREAS COATINGS

Mezentsev Viktor Vladimirovich
Candidate of Pedagogical Sciences, Associate Professor
Far Eastern State Academy of Physical Culture,

Shestakov Ilya Viktorovich
Candidate of Technical Sciences, Senior Lecturer
Far Eastern State Transport University,
Khabarovsk, Russia

摘要：由于生活质量的提高取决于能否拥有积极的生活方式，因此在城市发展中，专用场地的可用性是一个与分配专用场地需求相关的问题。为了确保道路和活跃休闲区表面的耐久性，建议使用能够减少材料消耗并提高表面和基层耐久性的材料，例如土工格栅。

关键词：体育活动、活跃休闲区、积极的生活方式、生活质量、运动场地覆盖物、地基、道路用土工格栅。

Abstract. *Since improving the quality of life depends on the ability to lead an active lifestyle, the availability of specialized sites in urban development is a problem associated with the need to allocate special places. To ensure the durability of the surfaces of paths and active recreation areas, it is advisable to use materials that reduce material consumption and increase the durability of surfaces and bases, such as geogrids.*

Keywords: *physical activity, active recreation areas, active lifestyle, quality of life, sports ground covering, foundation, geogrids for paths.*

Introduction

Since physical activity is a natural need of the human body, and is also a form of rest and relaxation, the need for any kind of active recreation in the fresh air becomes necessary for residents of megacities. Active recreation in open spaces allows the human body to remain active longer, improves the quality of life, increases performance, and cognitive abilities. Light and moderate physical activity in the fresh air increases the amount of oxygen in the blood, normalizes hormonal levels by normalizing the circadian rhythm. With regular physical activity, the lev-

el of stress caused by various events and phenomena in a person's life decreases. The level of socialization increases and there is a tendency towards rehabilitation of people with diseases in the complete absence of contraindications to physical activity in a mild form [4].

To achieve the above goals, city sites located in park areas are suitable, while there is a need to ensure their year-round operation, which entails certain design solutions related to the lighting of these sites. Firstly, the effectiveness of physical activity in the open air is possible in places with increased oxygen content, minimal amount of dust particles, low noise level, and the possibility of shelter from direct sunlight.

Secondly, if we formulate the requirements for sports grounds for physical activity (walking, running, cycling and scooter riding), while ensuring the above requirements, the following requirements emerge: an area of at least 0,5 square kilometers, the presence of shrubby woody vegetation, lawn, paths that allow for the above types of activity [5].

In addition, it is necessary to take into account that in regions with a moderate climate, where the change of seasons is clearly expressed, it is necessary to provide for the possibility of using sites for winter types of physical activity: skating and skiing.

Based on the recommendations for activity indicators, it is necessary to take into account that the total length of paths for physical activity should provide the possibility of passing at least 8 kilometers in 1,5 - 2 hours. Below is a diagram of the percentage ratio of element areas on a 0,5 sq. km site.

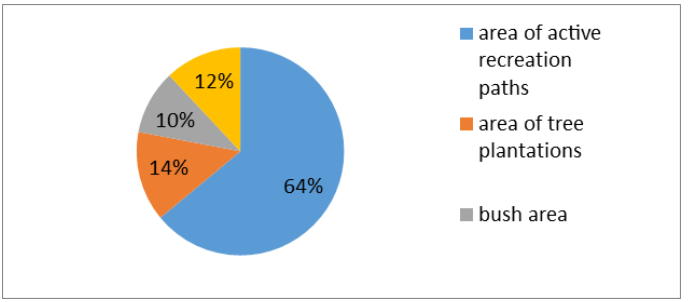

Figure 1. *Percentage distribution of the use of the area of the sports ground and green spaces with an area of 0.5 square kilometers, with a maximum site attendance of 5,000 people*

As can be seen from the diagram, the area of green spaces provides the need for at least 7 square meters of green spaces per person, taking into account active motor activity and active gas exchange, the area of green spaces is no more than

36% of the total area. Consequently, the remaining area can be fully used for active recreation, both in summer and in winter.

Below is a graph of the distribution of types of active recreation in summer and winter.

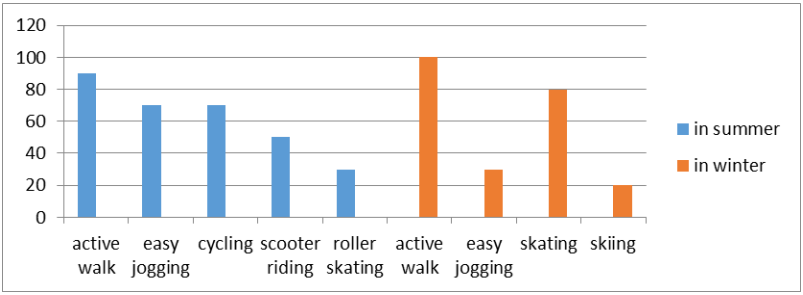

Figure 2. *Graph of distribution of types of active recreation by popularity in summer and winter*

As indicated above, in Figure 1, the surface area that can be used for active recreation is 64% of the total area of the park. This means that the surface area should be used as efficiently as possible throughout the year. It is worth noting that there are examples where park areas are used to provide year-round active recreation, such as running and walking in the summer and skating and walking in the winter.

For example, such a solution has long been implemented in Central Park in New York.

Central Park in New York is a striking example of the effective use of parkland in a large city, where residents can not only have a good time, but also engage in active recreation both in summer and winter [1].

Figure 3. *Central Park, New York in summer*

Figure 4. *Central Park, New York in winter,*

In Russia, a similar solution was used in the most densely populated city, Moscow, on the territory of Gorky Park.

Figure 5. *Gorky Park, Moscow in summer*

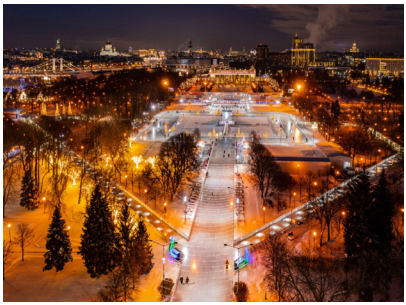

Figure 6. *Gorky Park, Moscow in winter, skating Rink*

It is worth noting the difference in the concept of the parks: if the Central Park is an example of a wild nature zone with natural ecosystems, then Gorky Park is an example of artificial improvement of the territory. However, despite the difference in concept and solutions, both parks implement the principle mentioned above - providing the opportunity to engage in active recreation throughout the year.

As already mentioned, 64% of the park area should have a hard surface to ensure active recreation. Hard surfaces of park areas can be asphalt concrete, concrete and paving stones. At the same time, there are various types of sports ground surfaces that provide effective training. For example, rubber surfaces (Figure 7).

Figure 7. *Example of a "soft" sports ground surface*

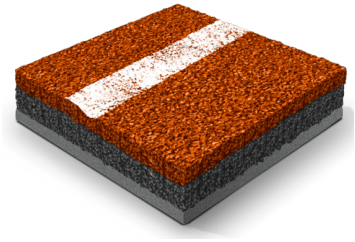

Figure 8. *Structure of the soft surface of the sports ground*

Rubber-based coatings have excellent adhesion to any hard surfaces. In addition, they are injury-safe, easy to clean, simple to use and environmentally friendly, as they reduce wear on surfaces in contact with them.

However, this type of coating has its drawbacks: high cost, wear during intensive use, and in the off-season, removing snow and any dirt that can "stick" to the surface is impossible due to possible damage. Therefore, this type of coating is more suitable for isolated areas with active sports, which are characterized by falls that can lead to injuries and bruises.

As for injuries that can be obtained during activities: running, cycling, rollerblading, skating, jogging in winter, they are shown in the graph (Figure 9).

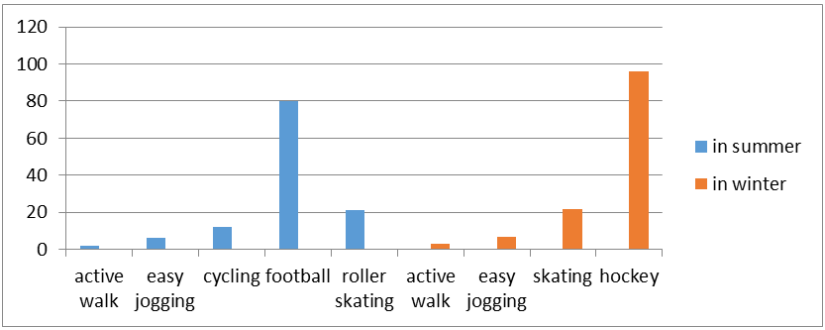

***Figure 9**. Distribution of injuries by types of active recreation in summer and winter in comparison with active sports*

As can be seen from the graph, the highest percentage of injuries occurs with cycling and rollerblading in the summer and skating in the winter.

At the same time, when cycling or rollerblading, protective equipment is used to compensate for possible injuries. Therefore, in terms of the combination of qualities to ensure year-round use and reduce operating costs, it is more advisable to use asphalt concrete or concrete.

Paving stones are not suitable as a surface for year-round outdoor activities, since after pouring and melting ice, it can become unusable and deform. In addition, when jogging or rollerblading, you can get injured due to a violation of the continuity of the surface and the presence of seams.

Thus, the surface, if the paths in the park area occupy more than 50% of the area, is an asphalt surface. It has a seamless, waterproof, wear-resistant consistency. But on top of the asphalt surface in winter, you can arrange a surface for skating. At the same time, the loads experienced by the asphalt pavement, as well as seasonal alternating stresses in the base, can lead to the formation of cracks and breaks in the pavement, which, in addition to discomfort, can lead to injuries during active recreation.

Figure 10. *Example of cracks in the asphalt concrete pavement of a park area*

Thus, we can conclude that it is advisable to use asphalt concrete pavement as a pavement for park areas with large areas of paths for active recreation. However, both the pavement itself and the asphalt concrete pavement base made of crushed stone are not environmentally friendly materials. In addition, during year-round operation, defects may occur that reduce the area of the pavement used, requiring constant repairs. In this regard, it is advisable to use materials that significantly improve the quality of the pavement, as well as reduce the volume of materials used.

The experimental part

Currently, the use of complex geogrids has become widespread in the construction, reconstruction and repair of road surfaces for various purposes. The advantage of using geogrids is the placement of the geogrid on the boundary of the base layers - at the location of the crushed stone layer, which eliminates the mutual penetration of materials, and also provides a wedging effect. The resulting pseudo-plate effect. The wedging effect ensures the stability of the base to various types of external impacts (loads), both static and dynamic, preventing the occurrence of residual deformations.

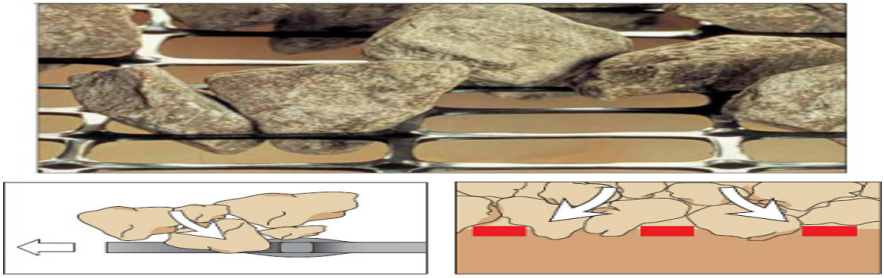

Figure 11. *Placement of rubble in the cells of the geogrid, providing the effect of the spear (pseudo-plates)*

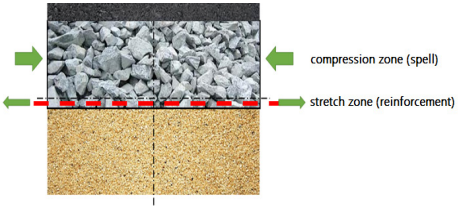

Figure 12. *The layout of the integrated geogrid*

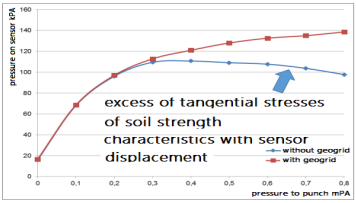

Figure 12. *Graph of voltage growth at the base, with increasing load*

Reinforced base structures, in particular, integrated gratings reduce the vertical pressure on the underlying layer by 27%, due to the partial distribution of vertical stresses in the horizontal.

The effect of the split (pseudo-plates) and, as mentioned above, the distribution of tangential forces, there is an increase in tension in the horizontal, reinforced layer.

Due to the uniform distribution of the load in the horizontal direction when reinforcing the base, the overall modulus of elasticity of the latter increases by 49% compared with non-reinforced structures.

Table 1

Change in the total modulus of elasticity of structures

№ test	total modulus of elasticity	
	without reinforcement	with reinforcement
1,5	162	254
2,6	185	261
3,7	167	271
4,8	190	266

It should be noted that the method of calculation of reinforced bases includes: 1. Selection of a layer of rubble over a geogrid, 15 cm thick; 2. Standard calculation on the elastic basis on the basis of ODN.218.046-01. Nevertheless, it is advisable to calculate the finite element method, using the methods of numerical simulation. Since the resulting increase in the elastic modulus of reinforced base structures allows using only a part of the crushed stone layer located above the geogrid, it becomes possible to reduce the thickness of the crushed-stone base layer to 15 cm. Below is the formula for calculating the required layers.

$$\{\sigma^{H}_{1,3}\} = \{\sigma^{H}_{1,3}\} + \{\Delta\ \sigma^{H}_{1,3}\} \quad (1)$$

$$\alpha_1 = (\alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_{11} X_1^2 + \alpha_{12} X_1 X_2 + \alpha_{13} X_1 X_3 + \\ + \alpha_{14} X_1 X_4 + \alpha_{15} X_1 X_5 + \alpha_{22} X_2^2 + \alpha_{23} X_2 X_4 + \alpha_{24} X_2 X_4 + \alpha_{25} X_2 X_5 + \alpha_{33} X_3^2 + \\ + \alpha_{34} X_3 X_4 + \alpha_{35} X_3 X_5 + \alpha_{44} X_4^2 + \alpha_{45} X_4 X_5 + \alpha_{55} X_5^2)^{-1} \quad (2)$$

$$\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_{11}, \alpha_{12}, \alpha_{13}, \alpha_{14}, \alpha_{15}, \\ \alpha_{22}, \alpha_{23}, \alpha_{24}, \alpha_{25}, \alpha_{33}, \alpha_{34}, \alpha_{35}, \alpha_{44}, \alpha_{45}, \alpha_{55} \quad (3)$$

In the framework of studies of the effects of various types of loads affecting the road surface, a loading installation simulating the effects of static and dynamic loads was used. These loads were applied to the traditional design of the road and for the road with the introduction of geogrid in the underlying layers. As can be seen from Figures 14 and 15, a highway with a geogrid introduced into the underlying layers shows the value of the impact of the load is half as much as without a geogrid [2].

To obtain voluminous information, numerical modeling methods were used (Figures 14 and 15).

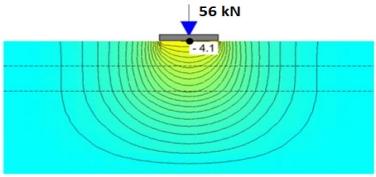

Figure 14. *Isolines of base stress without a lattice*

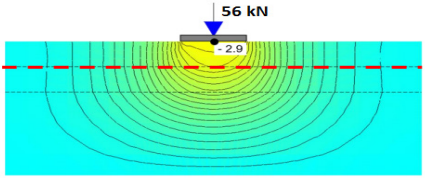

Figure 12. *Stress isolines in sonatation with geogrid*

2. Results

In the city of Khabarovsk, work was carried out to repair and reconstruct the stadium named after V.I. Lenin. In addition to reconstruction of the main sports facilities, work was carried out on the repair and reconstruction of internal roads. At the same time, a skating rink device was proposed on sections of pedestrian and bicycle paths. Bicycle and pedestrian paths were supposed to be used only in the summer. To do this, it was proposed to carry out a complete reconstruction of the pavement, with the replacement of pavement (underlying layers).

To evaluate the scope of work and make a constructive decision when replacing asphalt pavement with a universal sports pavement, seismic-acoustic and ultrasonic studies of pavement structures and geological conditions of the construction

site were carried out. Seismic-acoustic sounding made it possible to establish the physicomechanical characteristics of the soil, and ultrasonic ones to determine the actual thickness of the asphalt pavement, the thickness of the underlying layers, as well as defects that occurred during the operation of the road surface sections, for further design.

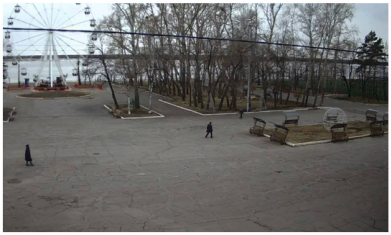

Figure 16. *Condition of coverage before repair*

Figure 17. *Condition of coverage before repair*

When designing new pavement (underlays) and the pavement itself, the Fem models application program was used. In the program, pavement and underlying layers were calculated in two stages: initially, the calculation was carried out in accordance with the requirements of regulatory documents for the construction of roads without the use of geogrids, the second action was the calculation of pavement and pavement using geogrids. Figure 18 shows the calculation scheme for calculation by numerical simulation methods.

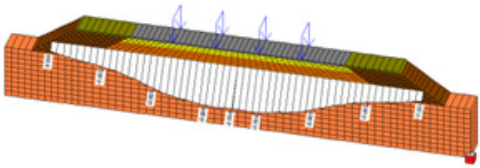

Figure 18. *Calculation scheme*

In terms of solving the problem by numerical methods, characteristics were laid down that made it possible to take into account all the negative factors affecting the road surface, as well as the underlying layers, which made it possible to select the most effective design measures.

Figure 19 shows the results of the calculation of the road surface with adjacent underlying layers and an interacting soil layer under the influence of maximum loads.

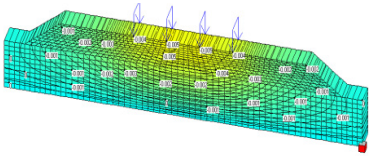

Figure 19. *Calculation results*

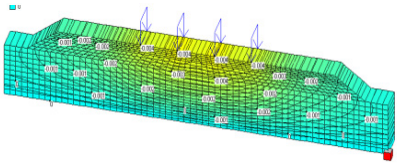

Figure 20. *Calculation results*

Figure 20 shows the results of calculating the load on the road surface, the underlying subgrade layers, and the soil mass interacting with the road surface using a geogrid.

As can be seen from the diagrams presented in Figures 19 and 20, the differences between the resulting schemes are minimal. Figures 21, 22, 23 show various points on the construction site of the road surface, paving and asphalt concrete pavement.

Figure 21. *Soilworks*

Figure 22. *Roadbed and curbstone process*

Figure 23. *Pavement process*

Figure 24. *Skating rink after repair*

Since the asphalt pavement receives the most damage when exposed to surface water, during the freezing and thawing cycle it is necessary to provide such a design of the asphalt pavement and the underlying layers in order to provide stable resistance to the loads acting periodically. This is taken into account as the load

from the work of heavy equipment during snow removal and the organization of an ice rink on a road section.

When installing asphalt pavement, asphalt concrete with a thickness of 70 mm was used, as for road paving. As for the underlying layers, their thickness of the sand cushion was 150 mm instead of 200, in the absence of a geogrid (Figures 25-26). As a geroshka we used a polymer geogrid of the Integral brand - SS30. The thickness of the underlying layer of gravel was 80 mm.

As can be seen from the above, geogrids are a structural element that allows to reduce the consumption of building materials, without reducing the strength characteristics of the designed roads for various purposes. At the same time, a significant contribution to the design process is made by the numerical modeling technique, which allows calculating with a high degree of probability for paving and underlying layers of roads for various purposes [3].

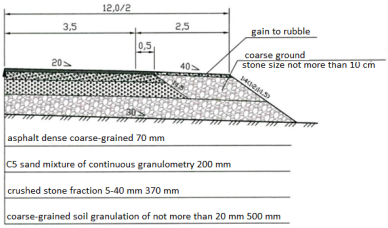

Figure 25. *Road surface sheme*

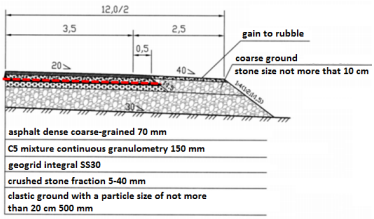

Figure 26. *Road surface sheme with geogrid*

3. Conclusion

1. As part of the extension of the control points of age groups, measures are needed to maintain a minimum level of physical fitness, implementing all forms of active recreation.

2. To maintain the quality of life and prevent diseases, residents of megacities need areas for active recreation; the article specifies the minimum area of such a structure - no less than 0.5 square kilometers, which allows for the needs of 5,000 people.

3. It is advisable to use asphalt concrete as a surface for such areas to ensure year-round active recreation.

4. To ensure the durability of the surfaces of paths and active recreation areas, it is advisable to use materials that reduce the volume of materials used and increase the durability of surfaces and bases, for example, geogrids.

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DOI 10.34660/INF.2025.37.26.009

机器学习与建筑哲学: 论建筑师职业的本质
MACHINE LEARNING AND THE PHILOSOPHY OF ARCHITECTURE: ON THE ESSENCE OF THE ARCHITECT'S PROFESSION

Kostko Oksana Iurevna
Associate Professor, Department of Architectural Space Design
Industrial University of Tyumen, Tyumen, Russia

Minulin Ilfat Gumarovich
Associate Professor, Department of Architectural Space Design
Industrial University of Tyumen, Tyumen, Russia

Turanskaia Karolina Andreevna
architectural environment designer

摘要: 本文致力于研究在机器学习的背景下，人类在建筑设计中的创造力与人工智能（AI）的比较问题。文章分析了哲学和心理学概念，强调机器学习作为人工智能的重要组成部分在建筑项目创作中的作用。最后，强调了进一步研究建筑师与计算机在创作过程中的互动的必要性，并结合技术和美学方面，创建案例和情绪板。

关键词: 建筑教育; 建筑; 人工智能; 设计; 实验; 机器学习。

Abstract. *The article is devoted to the study of the problem of comparing human creativity in architectural design and artificial intelligence (AI) in the context of machine learning. It analyses philosophical and psychological concepts that emphasize the role of machine learning as an important component of artificial intelligence in the creation of an architectural project. Finally, the need for further study of the interaction between architect and computer in the creative process is emphasized, taking into account technical and aesthetic aspects, creating cases and moodboards.*

Keywords: *architectural education; architecture; artificial intelligence; design; experimentation; machine learning.*

Back in the late 1990s, the digital method of design - the «electronic baroque» - raised a lot of philosophical and humanitarian questions: where is the wisdom of selection - what should be mechanized and what should be taboo for the machine?

Traditionally, the notion of "intelligence" was exclusively associated with human cognitive faculties. However, the introduction of the adjective "artificial" in the context of machine technologies has delineated a fundamentally distinct nature of computational reasoning. The "machine" has encroached upon a domain once considered the exclusive prerogative of human thought.

As noted by philosopher V.S. Stepin [1], bio-robots created in our "image and likeness" remain alien to scientific epistemology and philosophical conceptions of human nature. This idea is further developed in the works of G. Jonas [2], who warns of the risks of the "inventive re-making" of the inventor themselves. The issue gains particular urgency in the context of artificial intelligence, which, as A.V. Timofeev [3] observes, is modeled after the "human brain—meaning it can choose, make decisions, and act like a person."

This phenomenon transcends mere technological progress, prompting a profound reconsideration of the boundaries of human subjectivity and uniqueness.

The interplay between human and machine agency in architectural and artistic practice manifests in numerous examples: smart homes, kinetic sculptures, and interactive park complexes. However, this duality should not be regarded as an inherent quality of the object itself, but rather as an expression of the author's creative will—the architect or artist who remains the thinking, intentional creator. Consequently, contemporary architecture emerges as a complex system where the interaction of components generates emergent properties that cannot be explained through isolated analysis. These properties can only be understood holistically, through the lens of a unified, functioning structure.

The genius loci, an integral aspect of modern design, exemplifies how the whole transcends the sum of its parts. Just as algorithms analyze architectural color schemes or lighting parameters, they can identify the unique characteristics of a place that define its value—yet they remain technological tools in the architect's hands.

A comparative analysis of urban environments and neural networks reveals their resemblance to a "self-learning machine," capable of restructuring internal connections and evolving dynamically. As Nikos A. Salingaros [4] observes, "The capacity to form connections acts as the driving force of the system: they strengthen and expand, using components as nodal points within a coordinated network to create an integrated structure." Today, such connections are impossible without advanced analytics, which demand not just synchronization between human and machine efforts (as seen in machine learning) but also industry-specific adaptations. In developing self-evolving algorithms for architectural design—systems that must learn and adapt under the guidance of a "teacher"—there remain significant constraints. These limitations stem from the need to translate the nuanced, often subconscious aspects of design methodology into machine-operable logic, a task that continues to challenge the boundaries of human-machine collaboration.

1. The Anthropocentric Nature of Architectural Systems. Architecture, as an artificially constructed environment, remains fundamentally dependent on human agency, lacking the inherent qualities of self-regulation and self-replication found in natural systems. Unlike biological organisms, the built environment cannot evolve autonomously, rendering it perpetually subordinate to human intentionality.

2. The Semiotic Divide in Design Intent. When algorithmic selection pertains to formal, technical, or material parameters—tasks that can be framed as logically structured linguistic problems—machine processing proceeds seamlessly. However, attempts to encode emotional or aesthetic preferences yield diametrically opposed outcomes.

Human designers, as bearers of cultural and intellectual heritage, have demonstrated evolutionary leaps when confronting systemic challenges, accumulating what might be termed a "genetic load" of information. This repository's quantitative and qualitative dimensions have been stress-tested through prolonged cultural selection—a resilience unattainable by machines amidst exponential technological disruption. As Garfield [6] notes, "Even when parsing instructions syntactically, the system fails to correlate them with semantic meaning."

3. The Epistemological Vagueness of "Learning". The absence of a unified definition for "learning" persists not only in computer science but even in pedagogical theory (Moskovkin, L.V., Jontje Ju. [7]). While framing machine learning as a tool rather than an end—primarily for automating routine tasks—design practitioners frequently express skepticism regarding its generative capacity in creative domains. This laboratory-stage status positions ML in architectural education and practice as an experimental yet potentially transformative frontier. In the long-term paradigm articulated by Nazaretjan [8], "the escalating incursion of instrumental intelligence into the most intimate foundations of existence may precipitate the metamorphosis of Homo sapiens into a post-biological species, adapted for a human-machine civilization."

When Italo Calvino first compared computers to humanity's collective memory in 1968 while composing Invisible Cities, he conceived machine knowledge as archival "dossiers of innumerable individuals and places." Simultaneously, he distilled human aspirations into three cardinal virtues that would later title his Harvard lectures: lightness, quickness, and exactitude. These very principles now unconsciously govern our expectations of both machine learning systems and evolved architectural methodologies.

The pursuit of exactitude manifests in the transition from physical scale models and axonometric projections to digitally precise visualizations that rival traditional watercolor renderings and academic vedute in their graphic sophistication. Quickness materializes through accelerated generative design processes and streamlined

user interfaces that collapse the temporal gaps between conception and realization. Most poetically, lightness emerges in a structure's graceful integration within existing urban fabrics—where new interventions appear as inevitable rather than intrusive additions to environmental ensembles.

The integration of neural networks into architectural design finds compelling justification in the practices of leading firms like Zaha Hadid Architects. However, the experimental data available in Russian-language sources remains fragmented and insufficient to form a robust basis for generalized conclusions or industry-wide recommendations.

Recognizing that each independent experiment enhances the coherence of systems tailored to architecture's specific needs and constraints, this study incorporates projects developed under the guidance of I.G. Minulin, Associate Professor at Tyumen Industrial University's Department of Architectural Environment Design. As principal of the IST Bureau, Minulin adopted an innovative pipeline combining Stable Diffusion and ControlNet, trained on Tyumen's façades. His observation that "negotiating with a machine proves easier than with humans" underscores the operational advantages of this approach.

The project's evolution revealed new complexities: adapting the system to emulate his bureau's signature style, then repurposing it as an internal tool for generating contextual architectural imagery in client presentations. This trajectory—from urban-scale pattern recognition to firm-specific aesthetic synthesis—demonstrates neural networks' potential as customizable design assistants.

The research conducted under Igor G. Minulin's guidance demonstrated that machine learning implementation through image-generation software significantly reduced project delivery timelines, even when working with incomplete initial data, while simultaneously providing more comprehensive comparative analysis of contemporary market offerings (Figs. 1-8). What might appear as a seemingly casual approach to data collection and preparation—encompassing analysis, synthesis, assembly, rendering with post-processing, and environmental matching—proves fully justified by the system's capacity to generate multiple design alternatives efficiently.

The coordinated implementation of rapidly evolving technological innovations alongside methodological refinements in prompt formulation yields two substantial outcomes: considerable reduction in time expenditure and marked improvement in final project quality.

This approach introduces a significant new dimension to the design process—the critical task of output selection. This emerging requirement has given rise to a subsequent phase in machine learning application focused on developing effective curation models and methodologies. The experimental work clearly reveals this new challenge: the need for qualified specialists to dedicate substantial time to selecting optimal solutions from generated alternatives.

Architectural philosophy is consequently acquiring a new dimension in human existence. While stylistic movements remain transient phenomena, they leave tangible physical imprints that persist in contemporary reality. Machine learning has now transcended its former status as a speculative technological abstraction, becoming an integral component of modern architectural practice and creative processes.

Figure 1. *Materials provided by the customer to adjust model parameters at the second generation stage*

Figure 2. *Analogues specifying architectural development parameters for machine learning. Images are taken from open sources*

Figure 5. *Primary results of the generative model*

Figure 6. *Options resulting from generative design for further selection, evaluation and refinement (street space)*

Figure 7. *Options obtained as a result of generative design for further selection, evaluation and refinement (courtyard landscaping)*

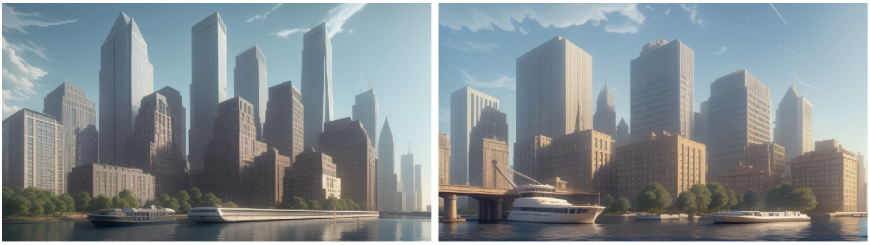

Figure 8. *Further processing of visualisations. Search and selection of optimal variants*

The aesthetic and functional domains represent two poles in design consciousness, conventionally divided along creative-routine lines: the creative remains human prerogative, while the routine is delegated to machines. By assigning repetitive tasks to computational systems – such as entourage drafting, pre-design climatic analysis, or topographic studies – architects can focus on creative ideation. However, at the project development stage, these poles become inseparable; moreover, the machine transitions from tool to dialogue partner, assuming the role of a collaborative agent.

Crucially, machine learning must be guided by the architect's conceptual vision. The primary challenge lies in translating this vision into computational terms

comprehensible to the machine's "cognition," thereby elevating design processes to new qualitative levels.

The limitations of this collaboration emerge from architectural methodology's inherent complexity: it transcends mere tool application, encompassing methodological, semantic, and psychological dimensions. Many of these layers remain partially subconscious or inarticulable even to the architect themselves, let alone reducible to machine-operable instructions. This creates translation challenges at the human-AI interface.

Figure 9. *Generated solution approximating the given criteria of architectural design*

Figure 10. *Format of finished material output to the customer*

The Ecocity project has been approved for implementation as a model of harmonious "dialogue with the landscape," seamlessly integrated into its local context. The façade designs, which carefully respond to the historical urban fabric of the Tura River embankment, have already received professional recognition and financial support.

As part of the project's ongoing development, we are compiling a methodological package containing: case studies for preliminary design stages (concept development and visual language); curated materials for architectural competitions; ready-to-use moodboard sets for client presentations.

This initiative represents a fundamentally new systemic approach to architectural form-generation, where machine learning serves multiple simultaneous roles: as a mediator between idea and materialization, as the architect's digital apprentice, as a computational design environment, and as a creative tool. Much like a chimera in mythology, this multifaceted technological nature enables the development of truly hybrid systems for architectural self-learning - systems where human intuition and algorithmic logic don't compete but rather synergistically enhance each other, establishing new developmental vectors for the profession.

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DOI 10.34660/INF.2025.56.29.010

7.1岁以上儿童急性脑供血不足严重程度脉搏动脉压昼夜节律特征
FEATURES OF THE CIRCADIAN RHYTHM OF PULSE ARTERIAL PRESSURE DEPENDING ON THE SEVERITY OF ACUTE CEREBRAL INSUFFICIENCY IN CHILDREN OVER 7.1 YEARS OLD

Muhitdinova Hura Nuritdinovna
Doctor of Medical Sciences, Full Professor
Center for the Development of Professional Qualifications of Medical Workers

Manasova Rushana Talgatovna
Resident doctor
Republican Scientific Center for Emergency Medical Care

Davlatova Nigora Uchkunovna
Resident doctor
Republican Scientific Center for Emergency Medical Care

摘要。第2组在炎症急性期前7天的PBP平均昼夜节律水平比第1组高7%。第1组在第6-8天，PBP呈现不稳定的下降趋势，提示SIR有下降趋势，而第2组仅在第16天才出现治疗有效的迹象。还发现了其他代偿反应机制——PBP 昼夜节律幅度的变化、PBP 每日变化的增加——这是能量缺乏状态发展的更敏感信号，随后出现急性心力衰竭，这是第 2 组儿童 MODS 发病机制的另一个功能性组成部分。在 PBP 昼夜节律和体温中值几乎稳定的情况下，PBP 昼夜节律和体温的相位特征结构发生了变化，表明体温降低对第 2 组的心输出量（PAD）有积极影响。

关键词：昼夜节律、血压、急性脑供血不足、儿童。

Abstract. *The average level of the average circadian rhythm of PBP during the first 7 days of the acute period of inflammation in group 2 was higher than in group 1 by 7%. On days 6-8 in group 1, the noted unstable tendency to decrease in PBP indicated a tendency to decrease in SIR, while in group 2 signs of therapy effectiveness were detected only on the 16th day. Additional mechanisms of compensatory reaction were identified - a change in the amplitude of the circadian rhythm of PBP, an increase in daily changes in PBP - as a more sensitive sign of the development of an energy-deficient state with subsequent acute heart failure, another functional component in the pathogenetic mechanism of MODS in children of group 2. With an almost stable level of mesors of circadian rhythms of*

PBP and body temperature, changes in the structure of the phase characteristics of the circadian rhythm of PBP and temperature occurred, indicating a positive effect of a decrease in body temperature on cardiac output (PAD) in group 2.

Keywords: *circadian rhythm, blood pressure, acute cerebral insufficiency, children.*

Relevance. Pulse arterial pressure (PAP) characterizes the force with which the blood presses on the vessels at the moment of maximum contraction of the heart and the lower, diastolic value, which is determined by the force of the blood impact during relaxation of the heart. Pulse pressure is normally 40-60 mm Hg. When studying the daily level of arterial pressure, it turned out that blood pressure fluctuations even in healthy individuals aged 20-60 years can be at least 20% of its average value, reaching 20-30 during the day, and 10-20 mm Hg at night, and exceeding these levels in arterial hypertension is associated with damage to target organs. A number of researchers have shown that after physical exertion, at rest, the difference will always be one, plus or minus 5 mm Hg. The authors established the presence of a correlation between age and the level of pulse pressure. Thus, in young years the difference is approximately 45 mm Hg. A low pulse pressure indicator is considered to be a level of less than 40 mm Hg. Clinically, such a condition corresponds to isolated arterial hypotension of diastolic or systolic type. The causes of this condition are always pathological [1-4]. Due to the insufficient information on the diagnostic value of PBP fluctuations, deviations in the parameters of the phase structure of the circadian rhythm of PBP, we considered it advisable to try to compensate for the lack of information by studying the features of changes in this indicator in acute cerebral insufficiency in children aged 7.1 to 18 years.

Objective of the work. To study the circadian rhythm of pulse arterial pressure in acute cerebral insufficiency in children aged 7.1 to 18 years.

Material and methods of research. The results of continuous prolonged monitoring with hourly registration of body temperature, hemodynamic parameters, and respiration were studied in children admitted to the intensive care unit of the Republican Scientific Center for Emergency Medical Care (RSCEMC) in a critical condition due to infection complicated by respiratory and acute cerebral failure at the age of 7.1-18 years. Intensive care was carried out according to the recommendations in the relevant clinical protocols. Group 1 included 8 children (mean age 13.1±3.2 years) who, upon admission to the clinic and throughout intensive care, had no indications for mechanical respiratory support, which did not exclude oxygen therapy. All patients of group 2 (8 children) aged 12.6±2.6 years were on mechanical ventilation from the moment of admission to the clinic according to indications. Of the 8 children in Group 1 over 7.1 years old, 7 were male and 1 was

female, of the 8 children in Group 2, 1 was female, i.e. male patients accounted for 88% in each group.

Results and discussion. The average value of the mesoscopic circadian rhythm of PBP did not differ from the normal values of PBP (Table 1).

Table 1.

Average values of the parameters of the phase structure of the circadian rhythm of PBP, mmHg.

Group	Mesor	In acrophase	In the bathyphase	Amplitude	Range per day
1 gr 7 days	40±2	47±2*	32±6	6±1	15±6
2 gr 7 days	43±1	49±1*	37±2*	6±1	12±3
1 gr 19 days	42±5	52±6*	30±8	11±5	22±8
2 gr 35 days	39±4	49±4*	30±6	10±5	19±6

*-deviation is reliable relative to the mesor of the circadian rhythm of the PBP.

The revealed reliable significant difference in the PBP level in the acrophase (by 17%) from the mesor of the circadian rhythm of the PBP in all subjects (in group 1 in the first 7 days by 17%, during 19 days by 24%, in group 2 in the first 7 days by 14%, during 35 days by 25%), as well as a reliably lower PBP value in the bathyphase by 10% in the first 7 days of mechanical ventilation in group 2 were confirmation of the existence of a circadian rhythm of the combined functional activity of cardiac output and vascular tone both during spontaneous breathing and during mechanical ventilation at the age of over 7 years.

Table 2.

Mesor of the circadian rhythm of the PBP, mm Hg.

Days	1 group	2 group
1	38±7	42±3
2	43±3	41±3
3	41±2	44±1
4	40±2	42±2
5	44±2	43±2
6	38±2	44±3‴
7	38±3	44±2‴
8	37±6	47±2‴
9	52±3*	42±2‴
10	42±8	45±3
11	33±7	42±2
12	34±5	41±4
13	32±5	42±4

14	51±5	39±4
15	47±7	39±3
16	46±3	34±4
17	53±3	42±4
18	42±3	40±4
19	42±5	38±5
20		39±4
21		44±3
22		34±4
23		32±5
24		33±4
25		30±5
26		29±3
27		31±5
28		34±6
29		32±4
30		35±4
31		38±3
32		37±3
33		37±6
34		32±4
35		43±6

Table 3.

Average circadian rhythm of the PBP over 7.1 years

Hours	**1 group 7 days**	**2 group 7 days**	**1 group 19 days**	**2 group 35 days**
8	36±7	45±2	39±6	40±4
9	36±9	44±1	42±6	38±5
10	38±5	46±2″	42±5	41±5
11	39±4	43±3	41±7	39±6
12	39±3	43±4	41±5	38±6
13	41±2	43±3	43±5	39±6
14	42±3	42±2	42±5	40±6
15	42±2	43±2	41±5	37±5
16	41±2	44±2	41±5	39±6
17	41±3	43±3	39±10	39±5
18	40±3	43±2	41±7	40±5
19	40±5	42±2	42±8	39±5
20	41±1	42±2	43±7	38±4

21	42±2	42±2	43±7	38±5
22	41±4	42±3	41±8	40±5
23	42±4	42±3	41±7	38±5
24	42±3	45±4	42±7	39±7
1	40±3	44±3	42±6	38±7
2	40±3	42±2	43±5	37±6
3	41±3	42±2	43±5	36±4
4	41±3	41±3	41±7	38±6
5	41±2	41±3	44±7	37±6
6	43±3	42±3	44±7	38±5
7	42±4	43±3	44±7	39±6

*- the difference is reliable relative to the indicator on day 1

‴- the difference is reliable relative to the indicator in group 1

In the dynamics of observation in group 1, the revealed reliable increase in the mesomorph of the circadian rhythm of the PBP on day 9 by 36% was due to the activity of the SVR in the patients remaining in the ICU (Table 2). It is noteworthy that on days 6–9, the value of the mesomorph of the circadian rhythm of the PBP in group 2, even with more active stress-protective therapy, was significantly higher than in group 1 by 15%, 15%, 27%, 19%, ($p<0.05$), respectively. The revealed can also be explained by the stress reaction of the cardiovascular system in conditions of insufficiently effectively relieved SVR reaction. Thus, on days 6-8 in group 1, the noted unstable tendency to decrease in PBP showed a tendency to decrease in SIR, while in group 2, signs of therapy effectiveness were detected only on the 16th day, after a repeated surge in SIR, a decrease was noted on the 26th day with a continuing tendency to exacerbation on the 35th day (Fig. 1). Thus, the dynamics of changes in the mesoscopic circadian rhythm of PBP during complex intensive care can serve as an indirect indicator of the effectiveness of stopping or exacerbating SIR in children with severe infection complicated by ACI both with spontaneous breathing and mechanical ventilation.

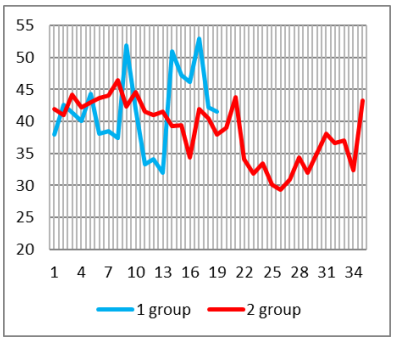

Figure 1. *Measuring the circadian rhythm of PBP, mmHg.*

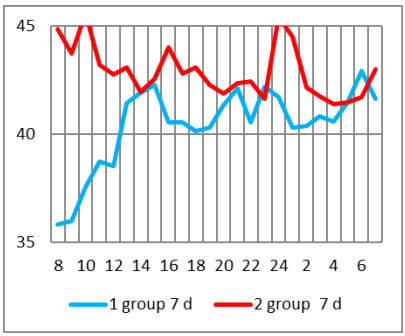

Figure 2. *Average circadian rhythm of PBP in the first 7 days, mmHg.*

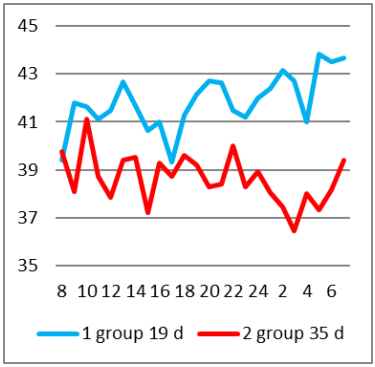

Figure 3. *Average circadian rhythm of PBP for the entire period in the ICU, mmHg*

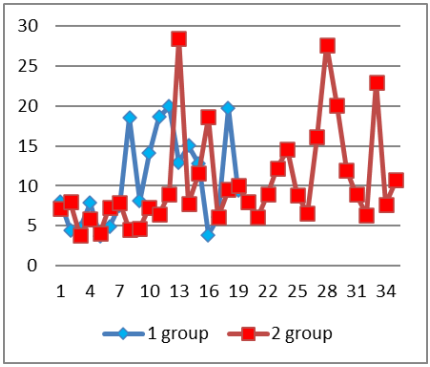

Figure 4. *Amplitude of circadian rhythm of PBP*

As shown in Fig. 2, the average level of average circadian rhythm of PBP during the first 7 days of the acute period of inflammation in group 2 (43±1 mmHg) was higher than in group 1 (40±1 mmHg), despite more active anti-inflammatory, stress-protective therapy. The level of fluctuations in the average circadian rhythm of PBP in group 2 (Fig. 3) for the entire period of treatment in the ICU (39±1 mmHg), on the contrary, was lower than in group 1 (42±1 mmHg) ($p<0.05$, respectively). Thus, in more severe SVR, accompanied by the development of decompensation of the functions of vital organs and systems (OCN, ARF), even more active complex intensive therapy gave a positive result much later than in

less severe infection complicated by OCN, ARF, approximately on the 16th day of treatment with a persistent tendency to exacerbation on the 28th, 35th day.

An increase in the amplitude of fluctuations in the circadian rhythm of PBP from the 9th day in group 1 indicated insufficiently effective sedative therapy in children with spontaneous breathing while maintaining the risk of developing central ARF. A tendency to an increase in the amplitude of the circadian rhythm of PBP on the 13th day to 28 mm Hg in group 2, a repeated surge in PBP on the 29th, 33rd day turned out to be evidence of the insufficiency of stress-protective complex therapy in a more severe condition of children against the background of mechanical ventilation (Fig. 4). The identified feature with relatively insignificant differences in the average values of the studied parameters made it possible to detect additional mechanisms of compensatory reaction - a change in the amplitude of the circadian rhythm of PBP, an increase in daily changes in PBP - as a more sensitive sign of the development of an energy-deficient state with subsequent acute heart failure, another functional component in the pathogenetic mechanism of MODS in children of group 2 (Fig. 5).

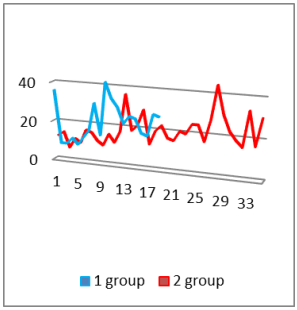

Figure 5. *Range of daily fluctuations in PBP. mmHg.*

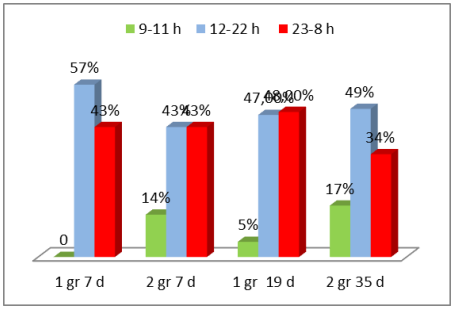

Figure 6. *Duration of inversion of the circadian rhythm of PBP*

In almost all the studied groups, the duration of the most pronounced shift of the acrophase peak to night hours prevailed, amounting to 3 days (43%) in the first 7 days in group 1, and 43% in group 2. A longer inversion of the circadian rhythm of PBP during the entire period of treatment in the ICU was 48% in group 1 and 34% in group 2 (Fig. 6). Considering that the fluctuations in PBP occurred within the permissible age values, the shift of the peak of the acrophase of the circadian rhythm of PBP did not have a clinically negative effect on the severity of the condition (Fig. 6).

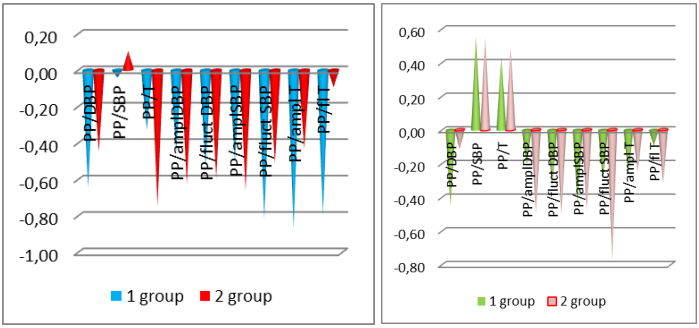

Figure 7. *Correlation relationships of PBP for 7 days.*

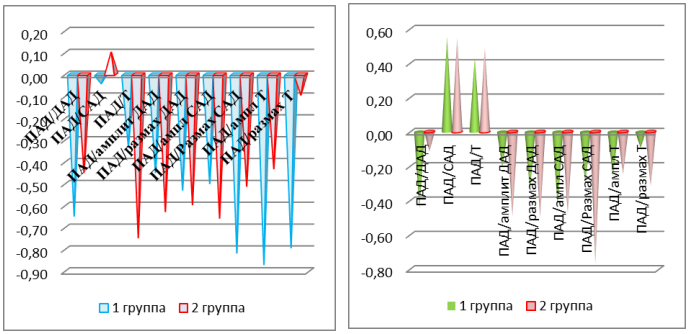

Figure 8. *Correlation relationships of PBP for 19 days*

In the first 7 days of the SVR, a tendency for an inverse relationship between PBP and DBP (-0.65) was revealed, which somewhat decreased during the MRP (-0.45). Also, the MRP reduced the negative impact of changes in the mesor of the PBP circadian rhythm on the amplitude of the SBP circadian rhythm from (-0.82) in group 1 to (-0.51) in group 2. In group 1, in the acute period (7 days), a decrease in the amplitude of the circadian rhythm T (-0.87) was accompanied by an increase in the mesor of the PBP circadian rhythm within 40±2 mm Hg. In group 2, this correlation decreased almost twofold, amounting to (-0.43). The same pattern was found in the correlation between PBP and daily fluctuations in the circadian rhythm of body temperature in the first 7 days. It was also found that the weak inverse correlation between the mesor of the circadian rhythm of PBP (-0.33) and the mesor of the circadian rhythm of body temperature significantly increased, becoming reliable against the background of artificial ventilation in the first 7 days (-0.75). That is, with an almost stable level of mesors of circadian rhythms of PBP and body temperature, changes occurred that indicate a positive effect of a

decrease in body temperature on cardiac output (PBP) in group 2 (Fig. 7). Longer monitoring of the indicators (19 days) revealed a tendency to decrease the correlation relationships in groups 1 and 2 (Fig. 8). The revealed feature can be explained by the layering of additional factors that influenced both the phase structure of the circadian rhythm of body temperature and the reaction of the components of the circadian rhythm of PBP with a more prolonged monitoring of the studied parameters. Conclusion. The average level of the average circadian rhythm of PBP during the first 7 days of the acute period of inflammation in group 2 was higher than in group 1 by 7%. On days 6-8 in group 1, the noted unstable tendency to a decrease in PBP indicated a tendency to a decrease in SIR, while in group 2 signs of therapy effectiveness were detected only on the 16th day. Additional mechanisms of compensatory reaction were revealed - a change in the amplitude of the circadian rhythm of PBP, an increase in daily changes in PBP - as a more sensitive sign of the development of an energy-deficient state with subsequent acute heart failure, another functional component in the pathogenetic mechanism of MODS in children of group 2. With an almost stable level of mesors of circadian rhythms of PBP and body temperature, changes in the structure of the phase characteristics of the circadian rhythm of PBP and temperature occurred, indicating a positive effect of a decrease in body temperature on cardiac output (PBP) in group 2.

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人工通气对7.1岁以上儿童急性脑衰竭舒张压昼夜节律的影响
THE EFFECT OF ARTIFICIAL VENTILATION ON THE CIRCADIAN RHYTHM OF DIASTOLIC PRESSURE IN ACUTE CEREBRAL FAILURE IN CHILDREN OVER 7.1 YEARS OLD

Muhitdinova Hura Nuritdinovna
Doctor of Medical Sciences, Full Professor
Center for the Development of Professional Qualifications of Medical Workers

Matyakubov Hamid Nurullayevich
Candidate of Medical Sciences, Head of Department
Republican scientific center of emergency medical care

Akbayeva Nilufar Abdibaharovna
Resident doctor
Republican Scientific Center for Emergency Medical Care

摘要。第 1 组（68±5 mm Hg）和第 2 组（69±4 mm Hg）均显示出 DBP 昼夜节律中值升高的趋势。第 2 组更积极的压力限制疗法导致重症监护前 7 天内外周血管张力波动幅度和每日范围有一定下降趋势。在 SVR 急性期，第 2 组儿童的 DBP 平均昼夜节律呈曲线状，波动幅度高于第 1 组。前 7 天的平均昼夜节律与 19 天内 DBP 的平均昼夜节律不同。发现 19 天内 DBP 平均昼夜节律出现倒置，峰值出现在 19:00，深水期出现在上午 10:00。而在最初7天内，舒张压峰值发生时间移至19小时，且第1组舒张压平均昼夜节律的振幅高于第2组，第2组的峰值和深水期峰值几乎正常（分别为8小时和23小时）。随着病情恶化，7.1岁以上急性脑梗死（ACI）患儿的舒张压昼夜节律倒置趋势加剧。每日平均舒张压越高，血管张力日变化指标出现显著波动的趋势就越大，这不仅会对外周血流产生不利影响，还会因发生心肌急性能量不足的风险增加而影响心脏功能。

关键词：人工通气，昼夜节律，舒张压，急性脑供血不足，儿童。

Abstract. *A tendency to increase the meso of the circadian rhythm of DBP was revealed both in Group 1 (68±5 mm Hg) and in Group 2 (69±4 mm Hg). More active stress-limiting therapy in Group 2 caused a certain tendency to decrease the amplitude and daily range of oscillations of peripheral vascular tone in the first 7 days of intensive care. The average circadian rhythm of DBP in children in Group 2 represented a curve with oscillations at a higher level than in Group 1 in the acute phase of SVR. The average circadian rhythm for the first 7 days*

differed from the average circadian rhythm of DBP over a period of 19 days. An inversion of the average circadian rhythm of DBP over 19 days was found with the projection of acrophase at 19:00, bathyphase at 10:00 am. While in the first 7 days the projection of the acrophase shifted to 19 hours, and the amplitude of the average circadian rhythm of the DBP in group 1 was higher than in group 2 with an almost normal projection of the acrophase and bathyphase (8 hours and 23 hours). As the condition worsened, the tendency to inversion of the circadian rhythm of the DBP increased in ACI at the age of over 7.1 years. The higher the average daily DBP, the greater the tendency to significant fluctuations in the indicator of daily changes in vascular tone, which can adversely affect not only peripheral blood flow, but also the functional activity of the heart due to an increased risk of developing acute energy deficiency of the myocardium.

Keywords: *artificial ventilation, circadian rhythm, diastolic pressure, acute cerebral insufficiency, children.*

Relevance. Acute cerebral failure (ACF) is one of the most formidable complications of acute severe pneumonia, characterized by damage and ultimately complete death of brain cells. Acute cerebral failure as a complication of cerebral encephalopathy can develop in a person of any age. In childhood, the tendency to generalization of the local process during inflammation remains and accompanies almost the entire period of childhood, but in older age, the tendency to develop sepsis decreases. The most severe complication of the systemic inflammatory response (SIR) is progressive multiple organ failure (POF). Mortality from PON remains extremely high, reaching 80% of the total mortality in intensive care units. Due to the lack of information on the specifics of managing children aged 7.1-18 years with severe pneumonia complicated by acute cerebral insufficiency, an attempt was made to present the results of the study and characterization of the effect of mechanical respiratory support on the inflammatory response complicated by acute cerebral insufficiency based on the study of circadian rhythm monitoring data of diastolic blood pressure (DBP) [1-4].

Objective. To study and evaluate the effect of artificial lung ventilation on the circadian rhythm of diastolic blood pressure in acute cerebral insufficiency in children over 7 years old.

Material and methods. The results of continuous prolonged monitoring with hourly recording of body temperature, hemodynamic parameters, and respiration were studied in children admitted to the ICU of the Republican Scientific Center for Emergency Medical Care (RSCEMC) in critical condition due to infection complicated by respiratory failure, acute cerebral insufficiency at the age of 7.1-18 years. Intensive care was performed according to the recommendations in the relevant clinical protocols. Group 1 included 8 children (mean age 13.1±3.2 years)

who had no indications for mechanical respiratory support upon admission to the clinic and throughout intensive care, which did not exclude oxygen therapy. All patients in Group 2 (8 children) aged 12.6±2.6 years were on mechanical ventilation from the moment of admission to the clinic according to indications. Of the 8 children in Group 1 over 7.1 years old, 7 were male and 1 was a girl, of the 8 children in Group 2, 1 was a girl, i.e. male patients made up 88% in each group.

Results and discussion. A tendency towards an increase in the mesoscale circadian rhythm of DBP was revealed both in Groups 1 (68±5 mmHg) and 2 (69±4 mmHg). Reliably significant differences between the DBP indicator in the acrophase and the DBP level in the bathyphase were 20 mmHg ($p<0.05$) in Group 1, 14 mmHg ($p<0.05$) in Group 2 during the first 7 days, and 27 mmHg ($p<0.05$) over 35 days, which confirmed the fluctuations in the circadian rhythm of DBP (Table 1). That is, daily fluctuations in the tone of peripheral vessels, regardless of the severity of the condition, were subject to the circadian rhythm of the activity of both the nervous and humoral centers regulating vascular tone, as well as the peripheral mechanisms involved in changing DBP. More active stress-limiting therapy in Group 2 caused a certain tendency to decrease the amplitude and daily range of oscillations of peripheral vascular tone in the first 7 days of intensive care. However, in the following days, with prolonged mechanical ventilation according to indications in more severe patients, the values of the amplitude and range of daily oscillations even exceeded the indicators in the first week of mechanical ventilation (Fig. 4, 5). The latter was a confirmation of the continuation of the stress reaction of hemodynamics at a later date in children against the background of mechanical ventilation.

Table 1

Average values of the parameters of the phase structure of the circadian rhythm of DBP over 7.1 years

Group	Mesor	In acrophase	In the bathyphase	Amplitude	Range per day
1	68±5	79±7	59±5*	11±5	20±8
2 (7 days)	72±2	79±3	65±1*	7±2	14±2
2 (35 days)	69±4	82±5	55±8*	13±5	27±11

*- reliable relative to the indicator in the acrophase.

Table 2

Mesor cir. rhythm DBP st 7.1 liters.

Days	1 group	2 group
1	66±8	74±4

Table 3

Average cir. rhythm DBP for 7 days.

Hours	1 group	2 group
8	73±7	72±4

2	61±2	71±3 ‴
3	64±2	67±2
4	71±2	73±3
5	64±2	72±3 ‴
6	72±2	71±3
7	67±3	73±4
8	62±5	70±3
9	67±4	75±3 ‴
10	69±7	70±3
11	71±8	73±4
12	80±3	62±4*
13	78±4	71±3
14	59±4	74±4
15	72±8	73±6
16	72±2	75±4
17	66±3	68±5
18	63±4	66±4
19	76±7	66±6
20		69±5
21		65±5
22		64±9
23		73±5
24		68±9
25		72±8
26		75±10
27		72±8
28		61±9
29		73±13
30		68±11
31		58±5
32		65±6
33		67±9
34		72±7
35		60±6

9	73±8	71±4
10	71±6	70±5
11	67±4	72±6
12	69±5	73±4
13	66±3	71±3
14	66±3	73±2
15	66±3	72±3
16	65±4	73±2
17	65±4	72±2
18	66±4	73±4
19	65±4	74±3 ‴
20	66±5	73±5
21	64±5	72±4
22	64±5	72±3
23	64±4	72±3 ‴
24	65±5	70±3
1	67±6	71±2
2	66±6	70±2
3	64±4	70±1
4	65±4	70±3
5	65±3	71±5
6	65±3	72±3 ‴
7	65±4	71±3

Table 4

Av. cir. r. DBP for 19 days

Hours	1 group	2 group
8	71±6	67±10
9	72±7	67±7

10	70±7	64±8
11	71±7	68±7
12	69±6	70±6
13	70±6	70±7
14	69±5	68±8
15	69±7	69±7
16	68±6	69±8
17	70±8	70±8
18	67±7	72±7
19	67±6	73±7
20	69±7	72±6
21	68±7	71±6
22	67±7	71±6
23	66±7	71±5
24	69±6	71±7
1	69±8	71±6
2	67±6	69±6
3	65±5	69±4
4	68±7	68±6
5	67±7	68±7
6	68±6	67±7
7	66±5	68±7

*- the difference is reliable relative to the indicator on day 1

‴ - the difference is reliable relative to the indicator in group 1

After day 9, group 1 (Table 2) presents the data of patient K., age 9 years, admitted on March 22, 21, discharged on April 10, 21, height 110 cm, weight 20 kg, diagnosis - progressive disease of the nervous system such as leukoencephalitis, acute respiratory asphyxia, stage 2 acute respiratory failure, stage 1 acute respiratory failure, right-sided hemiparesis, convulsive syndrome, stage 2 anemia. Group 2 presents the data of patient R., 9 years old, admitted on December 24, 24, discharged on January 28, 25, left-sided polysegmental pneumonia, focal on the right, brain tumor, ACI, respiratory support with artificial ventilation. Coma stage 2, SPO - ventriculoperitoneal shunting in June 2023, tracheostomy in November 2023. In the dynamics of significant changes in the mesoscale circadian rhythm of DBP during complex intensive care, no significant changes were observed (Table 2). In group 2, despite more active stress-limiting therapy (artificial ventilation, drug sedation), higher values of the mesoscale circadian rhythm of DBP were found compared to the indicators of group 1 on the 2nd, 5th, 9th, days by 16%, 13%, 12%, respectively (Fig. 1). A decrease in DBP in group 2 on the 12th day by

15% ($p < 0.05$) was due to the activity of complex intensive care of the remaining children on mechanical ventilation after the transfer of children with restored independent breathing to specialized departments. It is noteworthy that the average circadian rhythm of DBP (Fig. 2) in children of group 2 presented a curve with fluctuations at a higher level in the acute phase of SVR. Moreover, the average circadian rhythm for the first 7 days differed from the average circadian rhythm of DBP for a period of 19 days. Thus, reliably significant higher DBP values were revealed relative to the indicator in group 1 at 7 p.m. by 17%, at 11 p.m. by 18%, at 6 a.m. by 10% ($p < 0.05$, respectively) in the first week of treatment. The revealed differences in the subsequent days of intensive care lost their reliable significance (Table 4). However, an inversion of the average circadian rhythm of DBP was found for 19 days with the projection of acrophase at 7 p.m., bathyphase at 10 a.m. (Fig. 3). While in the first 7 days the projection of the acrophase shifted to 19 hours, and the amplitude of the average circadian rhythm of DBP in group 1 was higher than in group 2 (Fig. 2) with an almost normal projection of the acrophase and bathyphase (8 hours and 23 hours).

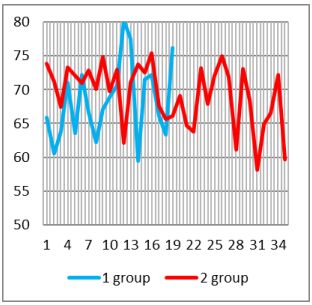

Figure 1. *Mesozoic circadian rhythm of DBP, mmHg.*

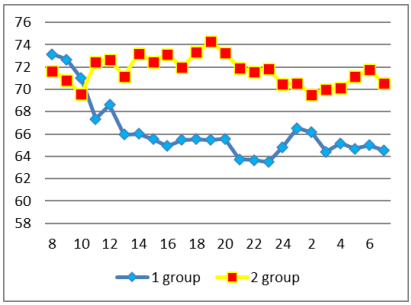

Figure 2. *Average circadian rhythm of DBP during the first 7 days.*

The tendency to increase the amplitude of the circadian rhythm after the 21st day in group 2 was due to adaptive fluctuations in the tone of peripheral vessels in the patient during the process of hemodynamic reorganization due to severe polysegmental pneumonia, against the background of a brain tumor, during mechanical ventilation (Fig. 4). The dynamics of daily fluctuations in DBP corresponded to changes in the amplitude of the circadian rhythm of DBP in both groups (Fig. 5).

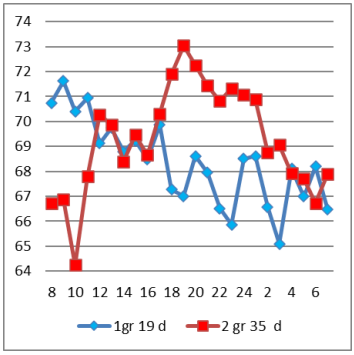

Figure 3. *Average circadian rhythm of DBP for 19 days.*

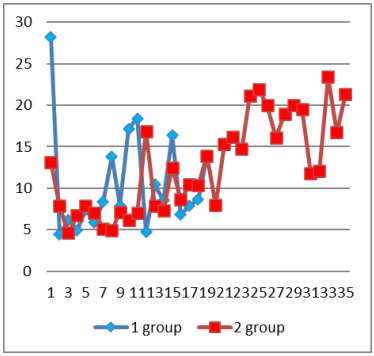

Figure 4. *Amplitude of circadian rhythm of DBP.*

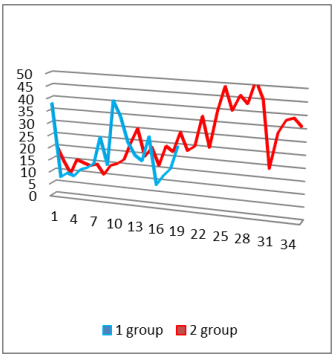

Figure 5. *Range of daily fluctuations of DBP, mmHg.*

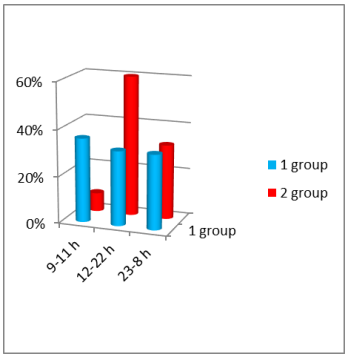

Figure 6. *Duration of inversion of the circadian rhythm of DBP.*

The inversion of the circadian rhythm of DBP in children in groups 1 (32%) and 2 (32%) was equally long, which in absolute numbers amounted to 6 days in group 1 and 12 days in group 2. It can be concluded that as the condition worsens, the tendency to inversion of the circadian rhythm of DBP increases in patients with CCI at the age of over 7.1 years.

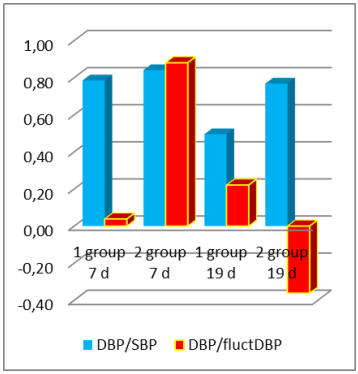

Figure 7. *Correlation links of the mesor. of circadian rhythms of DBP.*

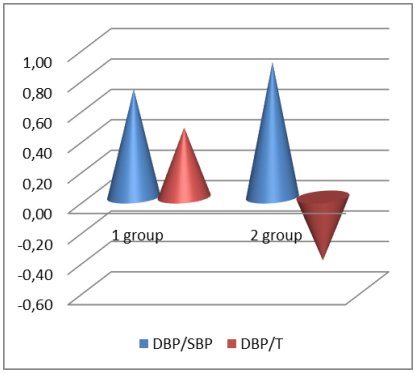

Figure 8. *Correlations of the average circadian rhythm of DBP.*

During the first 7 days, a direct strong correlation was found between DBP and SBP both in group 1 (0.78) and group 2 (0.84), which remained at the same level in group 2 (0.77) over the next 19 days, but significantly decreased (0.49) in children of group 1 (Fig. 7). That is, the direct physiological response of hemodynamics to stress in group 1 showed a tendency to decrease with spontaneous breathing and the absence of additional stress-limiting therapy. The revealed feature can be associated with the tendency to an energy-deficient state even in children with moderately expressed ARF and ACN at the age of over 7.1 years. It is noteworthy that in group 2 during the first 7 days of observation, a strong direct correlation between daily changes in DBP and the level of the mesorum of the circadian rhythm of DBP appeared. That is, the higher the average daily DBP, the greater the tendency to significant fluctuations in the indicator of daily changes in vascular tone, which can adversely affect not only the peripheral blood flow, but also the functional activity of the heart due to an increased risk of energy-deficient myocardial state. The detected strong direct correlation between the average circadian rhythm of DBP and SBP was 0.71 in group 1 and 0.89 in group 2. That is, despite the difference in the severity of the condition, the volume of complex intensive therapy in both groups of children over 7.1 years old, a direct dependence of changes in cardiac output with an increase in peripheral vascular tone was observed, indicating a stress response to SVR. However, the revealed tendency to increase DBP in hyperthermic reaction (0.46), in connection with more active stress-protective therapy, revealed a tendency to decrease the average circadian rhythm of DBP (-0.42) in group 2 (Fig. 8). Thus, more active stress-protective therapy can reduce the severity of the negative impact of the vasopressor effect with a tendency to increase SVR. Conclusion. A tendency to increase the mesoral circadian rhythm of

DBP was revealed both in group 1 (68±5 mm Hg) and in group 2 (69±4 mm Hg). More active stress-limiting therapy in group 2 caused a certain tendency to decrease the amplitude and daily range of oscillations of peripheral vascular tone in the first 7 days of intensive care. The average circadian rhythm of DBP in children of group 2 represented a curve with oscillations at a higher level than in group 1 in the acute phase of SVR. The average circadian rhythm for the first 7 days differed from the average circadian rhythm of DBP for a period of 19 days. An inversion of the average circadian rhythm of DBP for 19 days was found with the projection of acrophase at 19:00, bathyphase at 10:00 a.m. While in the first 7 days the projection of acrophase shifted to 19:00, and the amplitude of the average circadian rhythm of DBP in group 1 was higher than in group 2 with an almost normal projection of acrophase and bathyphase (8:00 and 23:00). As the condition worsened, the tendency to inversion of the circadian rhythm of DBP increased in ACI at the age of over 7.1 years. The higher the average daily DBP, the greater the tendency to significant fluctuations in the indicator of daily changes in vascular tone, which can adversely affect not only peripheral blood flow, but also the functional activity of the heart due to an increased risk of developing an acute energy-deficient state of the myocardium.

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DOI 10.34660/INF.2025.11.56.012

7.1岁以上儿童急性脑供血不足平均动脉压昼夜节律的动态特征
FEATURES OF THE DYNAMICS OF THE CIRCADIAN RHYTHM OF MEAN ARTERIAL PRESSURE IN ACUTE CEREBRAL INSUFFICIENCY IN CHILDREN OVER 7.1 YEARS OLD

Muhitdinova Hura Nuritdinovna
Doctor of Medical Sciences, Full Professor
Center for the Development of Professional Qualifications of Medical Workers

Yuldasheva Saida Anvarovna
Candidate of Medical Sciences, Head of Department
City Clinical Children's Hospital No. 1 of Tashkent

Abdusaliyeva Tursunoi Mutanovna
Candidate of Medical Sciences, Doctor of Functional Diagnostics
City Clinical Children's Hospital No. 1 of Tashkent

摘要。在急性脑梗死急性期的前 7 天，第 2 组（机械通气）患儿的病情相对第 1 组（自主呼吸）更为严重，在更强的压力保护性综合重症监护的背景下，平均动脉压中位值平均显著升高 16%。平均动脉压昼夜节律幅度的变化几乎与所研究指标的每日波动动态同步发生，这与病情的严重程度和相对无效的传统综合镇静疗法相对应。第 2 组平均动脉压昼夜节律倒置的最长时间为重症监护病房治疗时间的 26%。在两组中，第 1 组（0.71）和第 2 组（0.98）的平均动脉压昼夜节律中位值与舒张压之间存在直接的强相关性。外周血管张力、心输出量与平均动脉压之间存在直接密切的关系，是反映7.1岁以上儿童压力限制疗法有效性的血流动力学参数应激反应的功能性指标。

关键词：昼夜节律、平均动脉压、急性脑供血不足、儿童。

Abstract. *In the first 7 days of the acute period of ACI, the comparatively more severe condition of children in Group 2 (mechanical ventilation) relative to Group 1 (spontaneous breathing) was accompanied by a reliably significant increase in the mesor of the mean arterial pressure by an average of 16%, against the background of more powerful stress-protective complex intensive care. Changes in the amplitude of the circadian rhythm of the mean arterial pressure occurred almost synchronously with the dynamics of daily fluctuations of the studied indicator, corresponding to the severity of the condition and relatively less effective traditional complex sedative therapy. The longest inversion of the*

circadian rhythm of the mean arterial pressure in Group 2 amounted to 26% of the duration of treatment in the intensive care unit. In both groups, there was a direct strong correlation between the mesor of the circadian rhythm of the mean arterial pressure and the diastolic arterial pressure in Group 1 (0.71), in Group 2 (0.98). Direct close relationship between peripheral vascular tone, cardiac output and mean arterial pressure is a functional indicator of stress response of hemodynamic parameters reflecting the effectiveness/inefficiency of stress-limiting therapy in children over 7.1 years old.

Keywords: *circadian rhythm, mean arterial pressure, acute cerebral insufficiency, children.*

Relevance. Primary brain damage is caused by various factors, including a systemic inflammatory response to infection, which determines the formation of conditions for secondary brain damage factors that act on the primarily damaged brain, leading to the development of its additional functional and structural insufficiency. Extracranial factors of secondary brain damage, such as repeated episodes of hypoxia, arterial hypo-, hypertension, hyperthermia, hypo-, hypernatremia, hypo-, hyperglycemia, hypocapnia often significantly reduce the effectiveness of intensive care, worsen the prognosis. Modern provisions in the basis of intensive care provide, first of all, an organoprotective (function-preserving) strategy! According to numerous studies, the physiological level of mean arterial pressure in children aged 3 to 7 years fluctuates within 70-94 mm Hg, over 7.1 years 80-102 mm Hg. Due to the lack of information on the specifics of managing children aged 7.1 to 18 years with severe acute pneumonia complicated by acute cerebral insufficiency, an attempt was made to assess the effect of mechanical respiratory support on hemodynamics based on a study of the data from monitoring the circadian rhythms of mean arterial pressure (MAP) in systemic inflammatory response (SIR) complicated by acute cerebral insufficiency [1-3].

Objective of the work. To study and assess the specifics of the dynamics of the circadian rhythm of mean arterial pressure in acute cerebral insufficiency in children over 7.1 years old

Material and methods of the study. The results of continuous prolonged monitoring with hourly registration of body temperature, hemodynamic parameters, and respiration were studied in children admitted to the ICU of the RRCEM in a critical condition due to infection complicated by respiratory and acute cerebral failure at the age of 7.1-18 years. Intensive care was carried out according to the recommendations in the relevant clinical protocols. Group 1 included 8 children (mean age 13±3 years) who had no indications for mechanical respiratory support upon admission to the clinic and throughout intensive care. All patients of group 2 (8 children) aged 12.6±2.6 years were on mechanical ventilation from the moment of admission to the clinic according to indications. The aggravating

factors of the general condition of patients in group 1 were severe pneumonia, observed in 88% (7), acute respiratory failure 1-2A degree 50% (4), acute respiratory failure 1-2 degree in 75% (6) of children. While in group 2 the severity of the condition and the need for external respiration prosthetics in children was due to the severity of pneumonia in 100% (8), secondary encephalopathy in 100% (8), acute respiratory failure 2-3 degree 87% (7), acute respiratory failure 2 AB stage in 75% (6), convulsive syndrome 37% (3). In general, the most severe pathological conditions that were complications of the underlying disease were observed in group 2. These are severe complicated pneumonias, which accounted for 50% of the total cohort of patients studied, secondary encephalopathy complicated by grade 1-2 coma (50%), convulsive syndrome (36%), acute respiratory failure 42%, and acute heart failure – 36%. Cerebral dysfunction upon admission to the clinic was assessed using the Glasgow scale and was 9.1±0.4 in group 1 and 6.5±1.0 points in group 2, which corresponded to a reliably significant depression of brain function by 29% in group 2, which determined the duration of MCI and the duration of intensive care in the ICU. After awakening, restoration of adequate breathing, reflexes, and consciousness within one to two days, the children were transferred to a specialized department. The research data were processed by the variation statistics method using the Excel program by calculating the arithmetic mean values (M) and errors of the mean (m). To assess the reliability of differences between two values, the parametric Student's criterion (t) was used. The relationship between the dynamics of the studied parameters was determined using the paired correlation method. The critical significance level was taken to be 0.05.

Results and discussion. An attempt to differentiate the severity of the condition in the acute period during the first 7 days of intensive care allowed us to identify a reliably significant, more pronounced hemodynamic stress reaction, despite more extensive stress-limiting therapy (sedatives, hypnotics, muscle relaxants, artificial ventilation) in children of group 2, which was expressed by a higher value of the mesocircadian rhythm MAP (by 16%, $p < 0.05$), the level of the indicator in the acrophase (by 13%, $p < 0.05$) and bathyphase (by 16%, $p < 0.05$) (Table 1).

Table 1.

Average level of mean arterial pressure in patients with cerebral insufficiency over 7.1 years, mm Hg.

Groups	Mesor	In acrophase	In the bathyphase	Amplitude	Daily range
1 (7 days)	74±3	82±6	69±3	8±5	13±6
1 (19 days)	80±6	89±7	72±6	9±3	17±7
2 (7 days)	86±2‴	93±2*‴	80±1*‴	7±2	13±2
2 (35 days)	82±4	94±4*	69±8	12±5	24±10

*-difference is reliable relative to the mesor indicator

‴-reliable relative to group 1 (7 days)

Table 2.

Mesozoic circadian rhythm MAP

Days	1 group 19 days	2 group 35 days
1	74±6	88±4
2	71±2	85±2
3	71±3	82±2
4	77±2	87±3
5	71±2	86±3
6	76±1	86±2
7	79±3	88±3
8	75±3	86±2
9	84±3	89±3
10	83±6	85±3
11	82±7	87±4
12	92±3	76±4*
13	88±5	85±3
14	76±3	87±3
15	87±6	86±5
16	88±2	87±4
17	84±2	82±4
18	77±4	79±3
19	90±6	79±5
20		82±4
21		79±5
22		75±8
23		84±5
24		79±8
25		82±8
26		85±9
27		82±7
28		73±8
29		84±13
30		80±10
31		71±4
32		77±6
33		77±8
34		83±7
35		74±6

Table 3.

Average circadian rhythm MAP, mm Hg

Hours	1 group 7 days	2 group 7 days	1 group 19 days	2 group 35 days days
8	79±6	86±3‴	82±6	80±9
9	80±7	85±4	84±7	80±7
10	79±5	85±5	83±7	78±8
11	74±4	87±6‴	82±7	81±7
12	75±4	87±4	80±7	83±6
13	74±3	86±2‴	82±8	83±6
14	73±4	87±1‴	80±7	82±8
15	74±2	87±3‴	81±7	82±7
16	73±2	88±2‴	80±7	82±7
17	74±4	86±2‴	81±7	83±7
18	74±4	88±4‴	79±7	85±6
19	74±3	88±3‴	79±6	86±6
20	73±5	87±4‴	80±7	85±5
21	72±5	86±4‴	80±8	84±6
22	71±4	86±3‴	78±7	83±5
23	72±4	86±2‴	78±7	84±4
24	73±4	86±2‴	81±7	84±5
1	73±3	85±2‴	80±8	84±5
2	73±5	84±2‴	79±6	81±6
3	73±4	84±1‴	77±6	81±4
4	73±4	84±3‴	80±6	81±5
5	73±3	85±4‴	80±7	80±7
6	75±2	86±2‴	81±6	79±7
7	75±2	85±3‴	80±5	81±7

*- the difference is reliable relative to the indicator in

‴- the difference is reliable relative to the indicator in group 1

On the first day, the mesomorph of the circadian rhythm MAP in both groups did not differ from the physiologically acceptable age standards given in the literature (80-102 mm Hg) (Table 2). In the dynamics, no significant changes in the indicator in group 1 were revealed. In group 2, only on the 12th day was a decrease in the mesomorph of the circadian rhythm MAP by 13% noted, within the acceptable values. More interesting were the average data of the average circadian rhythm MAP for the first 7 days in children of group 1 (74.1 ± 1.4 mm Hg) and group 2 (85.9 ± 1 mm Hg), when a statistically significant increase in the indicator was noted both during the day and at night by an average of 15% ($p < 0.05$) (Fig. 2). While for the entire period of stay in the intensive care unit (Fig. 3), the differ-

ence in average indicators in groups 1 and 2 amounted to only 2 mm Hg between the studied indicators (Table 3).

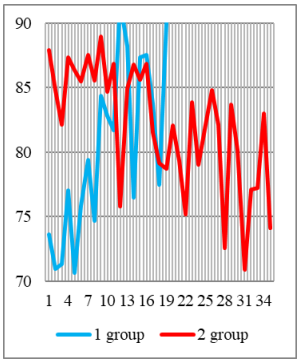

Figure 1. *Dynamics of the mesocircadian rhythm MAP, mmHg.*

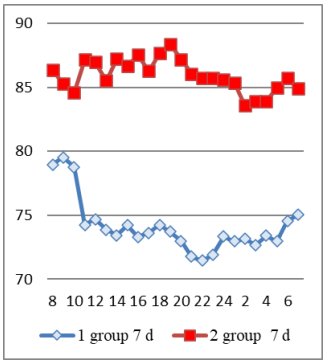

Figure 2. *Average circadian rhythm of mean arterial pressure in the first 7 days, mm Hg.*

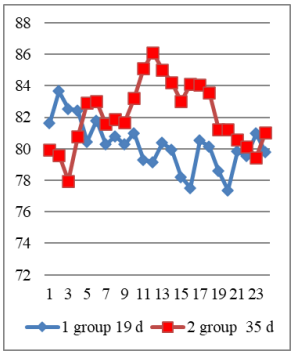

Figure 3. *Average circadian rhythm of MAP in the intensive care unit, mm Hg*

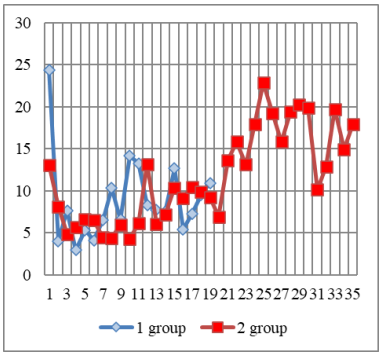

Figure 4. *Amplitude of circadian rhythm of MAP, mm Hg*

A tendency to increase in the amplitude of the circadian rhythm in group 1 was noted starting from the 8th day, in group 2 from the 12th day and corresponded to a more severe condition of children (Fig. 4). Changes in the amplitude of the circadian rhythm of MAP occurred almost synchronously with the dynamics of daily fluctuations of the studied indicator, corresponding to the severity of the condition and comparatively less effective traditional complex intensive therapy.

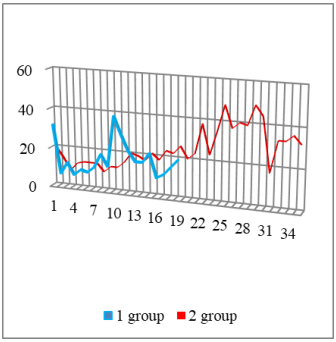

Figure 5. *Daily fluctuations of mean arterial pressure, mmHg.*

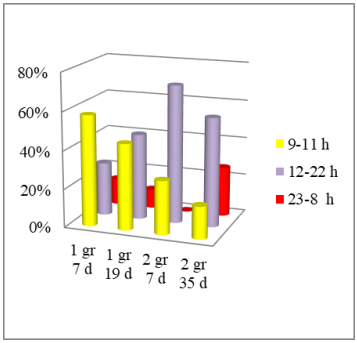

Figure 6. *Inversion of mean arterial pressure circadian rhythm, in %.*

The longest inversion of mean arterial pressure circadian rhythm was observed in group 2, amounting to 26% of the duration of treatment in the intensive care unit (35 days) (Fig. 6).

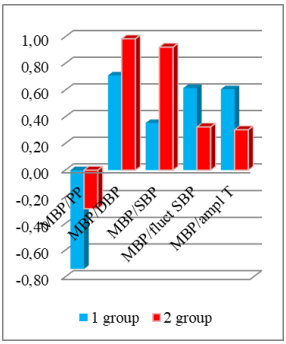

Figure 5. *Correlation relationships in the first 7 days.*

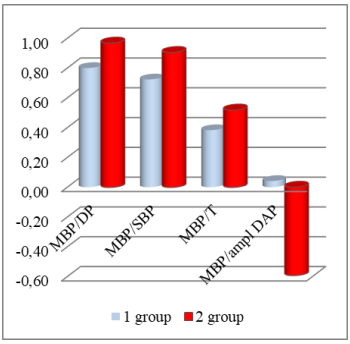

Figure 6. *Correlation relationships for 19 days.*

A direct strong correlation between the mesor of the circadian rhythm of mean BP and DBP was common to both groups in group 1 (0.71), in group 2 (0.98), which is quite consistent with the literature data on the direct dependence of mean pressure on the tone of peripheral vessels, which increases with aggravation of the condition. In more severe patients, the inverse dependence of mean BP on DBP decreased from (-0.74) to (-0.28) and increased from the mesor of SBP from (0.35) in group 1 to (0.92) in group 2, which indicated the predominant influence of the

increase in the mesor of the circadian rhythm of SBP (cardiac output) as the condition worsened on the level of mean BP (Fig. 7, 8).

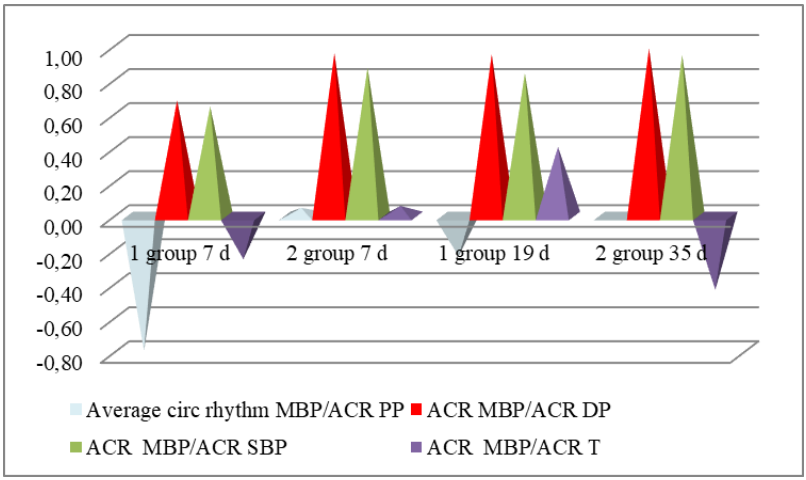

Figure 9. *Correlation relationships of average circadian rhythms of MAP*

An inverse correlation relationship was found between the average circadian rhythm of MAP and PBP (-0.79) in the first 7 days in group 1, which disappeared in patients of group 2 (0.05). The moderate slope of the direct correlation relationship found in group 1 in the first 7 days between the CC of MAP and the CC of DAP (0.68), as well as with the CC of SAP (0.64) became strong and reliably significant in the first 7 days in group 2 (0.96; 0.87; respectively), the identified pattern remained in the following days of treatment in both groups (Fig. 9). The findings characterize a direct close relationship between the tone of peripheral vessels, cardiac output and the mean arterial pressure as a functional indicator of the stress response of the studied hemodynamic parameters, reflecting the effectiveness/inefficiency of stress-limiting therapy in children over 7.1 years old.

Conclusion. In the first 7 days of the acute period of ACI, the comparatively more severe condition of children in group 2 is expressed in a reliably significant increase in the mesoral mean arterial pressure by an average of 16%, despite more powerful stress-protective complex therapy. Changes in the amplitude of the circadian rhythm of mean arterial pressure occurred almost synchronously with the dynamics of daily fluctuations of the studied indicator, corresponding to the severity of the condition and comparatively less effective routine complex intensive care. The longest inversion of the circadian rhythm of mean arterial pressure was noted in group 2, amounting to 26% of the duration of treatment in the intensive

care unit (35 days). In both groups, a direct strong correlation was found between the mesocircadian rhythm of mean arterial pressure and diastolic arterial pressure in group 1 (0.71), in group 2 (0.98). A direct close relationship between the tone of peripheral vessels, cardiac output and mean arterial pressure is a functional indicator of the stress response of hemodynamic parameters, reflecting the effectiveness/inefficiency of stress-limiting therapy in children over 7.1 years old.

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DOI 10.34660/INF.2025.75.52.013

社会数字化对健康带来新的挑战和威胁
DIGITALIZATION OF SOCIETY POSES NEW CHALLENGES AND THREATS TO HEALTH

Savicheva Natalia Mikhailovna
Candidate of Medical Sciences, Associate Professor
Academy of Postgraduate Education of the Federal State Budgetary Institution Federal Scientific and Clinical Center of the Federal Medical and Biological Agency of Russia

Fedorovich Aleksandr Vladimirovich
Candidate of Culturology, Associate Professor
Academy of Postgraduate Education of the Federal State Budgetary Institution Federal Scientific and Clinical Center of the Federal Medical and Biological Agency of Russia

摘要：本文探讨了21世纪全人类，特别是我国人口身心健康面临的新威胁，这些威胁源于数字化社会的形成、普遍的计算机化、基于电磁波辐射的电子产品的广泛普及以及基于互联网和其他信息和数字网络集团的通信能力。本文阐述了俄罗斯保障信息安全的监管框架，并分析了在信息保护制度建立的同时出现的威胁。

关键词：数字化社会、数字化、信息安全、暗网、健康威胁、Z世代、网络世代、后工业社会、社会通信安全。

Abstract. *The article examines the prerequisites for the emergence of new threats to the physical and mental health of the human population of the 21st century as a whole, and the population of our country in particular, in connection with the formation of a digital society, universal computerization, widespread and all-age use of electronic gadgets based on wave radiation and communication capabilities based on the Internet and other information and digital network conglomerates. The regulatory framework for ensuring information security in Russia is provided, the threats that appeared simultaneously with the creation of information protection are considered.*

Keywords: *digital society, digitalization, information security, darknet, health threats, generation Z, network generation, post-industrial society, communicative security of society.*

Programs for ensuring chemical, biological, radiation safety have arisen since the implementation of work in these areas. The concepts of "threats", "risks", "challenges" associated with the use of chemicals, biological agents, sources of ionizing radiation, etc. remain relevant due to man-made disasters in the form of fires, floods, oil spills and, as a result, the death of flora and fauna. In addition, 2020 has become a year of trials and resistance to the new coronavirus infection for all of humanity, and since 2022, due to the difficult geopolitical situation.

The course towards digitalization and the introduction of artificial intelligence into public and economic life in the 21st century, filled with and provided by the widespread use of computer technologies, electronic wave gadgets, remote forms of interaction between an individual and the world (transfer of documents and other transactions certified by a digital signature, training, communication, entertainment and implementation of functional tasks) leads to the emergence of another cluster of threats to the population and, accordingly, to the form of caring for a person - information security.

The trend towards the creation of an information society in the Russian Federation has existed for quite a long time. It was first discussed back in 2002 with an attempt to implement the federal target program "Electronic Russia" [1]. Further, in 2010, a state program entitled "Information Society (2011-2020)" was approved [2]. And now, at a more modern stage, in 2017, the Presidential Decree introduced the strategy for the development of the information society [3] and in 2024 - the Presidential Decree "On the national development goals of the Russian Federation for the period up to 2030 and for the future up to 2036" [4], where one of the goals is "Digital transformation of state and municipal administration, economy and social sphere", which provides for "increasing by 2030 to 99 percent the share of provision of mass socially significant state and municipal services in electronic form, including the introduction of a decision-making support system in the framework of the provision of at least 100 mass socially significant state services in electronic form in a proactive mode or upon direct application of the applicant, due to the introduction of a single digital platform in the activities of government bodies", as well as "the creation of a system for effectively countering crimes committed using information and telecommunications technologies and reducing the damage from their commission and "ensuring network sovereignty and information security in the information and telecommunications networks "Internet".

The intensification of the trend towards digitalization of the economy and society as a whole requires consideration of not only the positive and rational aspects of development in this direction, but also attention to issues of potential threats and population safety.

The situation with development along the path of digitalization of society can be viewed in two ways: on the one hand, this is the activity of the state on the

active formation of a “post-industrial society”, “information society”, “digital society”, “network society”, on the other hand, the emergence, for example, of the term and phenomenon of “generation Z”.

This term refers to young people born in the late 90s and after 2000, who grew up in an environment created, formed and supported by the results of digital globalization, and for whom the natural and necessary communicative and knowledge field is the Internet with social networks, messages in which everything is connected with everything. According to the Federal State Information Service for 2023, there are just over 22 million people aged 15-29 in Russia. As studies show, the time spent on the Internet and gadgets in this age group is not comparable to reading books (not electronic ones), visiting theaters, playing sports and going for walks.

In addition, mobile cellular communication is very popular among users of different ages. At the same time, children exceed the adult population in terms of duration of conversation on a cellular phone [18]. In this regard, there is a daily irradiation of the brain of these children with electromagnetic fields of the radio frequency range (EMF RF). In addition, all children are constantly exposed to EMF RF from base stations and relay devices around the clock.

It should be noted that the problem of preserving the health of children in the conditions of the development of wireless communications is classified by the World Health Organization as a priority.

With a duration of daily use of a cellular phone of about an hour, the total energy load can be comparable with the permissible energy load for conditions of professional irradiation with EMF [4]. Children (age 0-14 years) are the most vulnerable group to this kind of impact, because children have imperfect endocrine and immune systems, while the sensitivity and reactivity of the child’s body is higher than that of an adult, and, as a result, they are more sensitive to any environmental influences.

Regular interaction of children with the technical achievements of the modern post-industrial technological era leads to a decrease in visual acuity, the formation of spinal curvatures, the development of fatigue due to lack of sleep and a sedentary lifestyle [5, 6].

All this creates the prerequisites for identifying, understanding, studying and organizing activities to stop or eliminate threats to the physical health of children and society as a whole, formed during the implementation of innovations in life. At the same time, in the year of the pandemic of the new coronavirus infection - 2020, when most of the population had to switch to remote work and education, it led to almost round-the-clock, unregulated and uncontrolled communication using mobile devices. According to the Federal State Statistics Service, there has been a positive increase in some nosological forms of neurological, ophthalmological,

and endocrinological pathology in various age groups in the "post-pandemic" period.

The second side of the problem of using computer technologies and receiving information via the Internet is that some information posted on the Internet is of a criminal nature.

Thus, we are faced with another problem of the modern Internet - a specific phenomenon called "Darknet" (from the English "Darknet" - literally "black Internet"). Traditionally, the emergence of this term is associated with the 21st century [19], in contrast to the emergence of the mechanism for building such a connection, which occurred along with the Internet itself in the usual sense. Initially, it was an ordinary, private Internet connection, but as the main, non-anonymous segment of the World Wide Web developed, the "Darknet" became a public platform, but still, with specific, limited access. The amount of content posted and the audience also increased. Publicly available anonymizer programs, redesigned for non-professionals in the field of cyberspace, began to appear, which actually provide the opportunity to visit sites that are blocked by the jurisdiction of a particular state.

Thus, we are faced with the problem of criminalization of secure connections. Created for the purpose of ensuring state secrets or protecting corporate interests, private Internet connections are becoming a haven for various criminal communities.

In Russia, the "Darknet" is most often used for the sale (purchase, sale) of narcotics [14]. The share of crimes in this area using information and telecommunications networks has grown significantly in recent years and only continues to increase, creating a large-scale problem for law enforcement agencies [15], but, unfortunately, is not the only one.

In other words, summing up all of the above, the integration of the information society in the Russian Federation is a truly necessary and important process of development of our state. The newly created infrastructure will have to ensure the safety of both each individual and society as a whole. However, similar metamorphoses in modernization and informatization are also taking place in the criminal community. Already now, such categories as "Darknet" and "cybercrime" are gradually entering the everyday life of law enforcement officers. This process is natural and is observed throughout the development of the entire society. Therefore, it is so important to predict the upcoming threats to the security of the newly created social order. Such a threat, in our opinion, is the "Darknet". Representing the abode of everything prohibited and illegal, it is a fairly popular anonymous platform with a fairly simple penetration algorithm and a system of the device that is difficult to interfere with and regulate. Methods and ways of counteraction are ineffective and do not work with the entire problem of the "dark Internet", but

with its specific manifestations, therefore, today, a legal mechanism for regulating this segment of the Internet should be developed. It is necessary to develop legal literacy of both law enforcement officers and other citizens, which forms a complex of social and cultural tasks. By working in this direction consistently and systematically, such a threat as the "Darknet" can be prevented and thereby stop the introduction of crime into the information society. An additional problem in the conditions of work, study in the "on-line" mode at a distance (distance format) leads to the constant impact of electromagnetic fields on the human body. Protection by "time" and "distance" is no longer possible.

Thus, all this creates the prerequisites for isolating, understanding, studying and organizing activities to stop or eliminate threats to the physical health of children and society as a whole, formed in the course of introducing innovations into life.

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DOI 10.34660/INF.2025.48.32.014

医学教育中的游戏化：一种新方法
GAMIFICATION IN MEDICAL EDUCATION: A NEW APPROACH

Generalova Elena Vladimirovna
Candidate of Medical Sciences, Associate Professor
Head of Pediatrics and Child Health (St Joseph College of Health and Allied Sciences, St Joseph University in Tanzania), Tanzania, Dar es Salaam
Associate Professor of the Department of Introduction of Childhood Diseases and Faculty Pediatrics of Kazan State Medical University, Russia, Kazan

摘要：游戏化已成为一种有效提升学生参与度、学习动机和学习成果的方法。本综述的主要目的是分析医学教育中游戏化的现有文献。系统检索了2010年至2025年间发表的同行评审文章和学术出版物，并选取28篇文章进行详细分析。综述揭示了医学教育中不同背景、方法和学科中几个反复出现的主题和实证研究结果。总体而言，游戏化已被证明能够显著提高学习者的学习动机、知识保留、临床推理能力和情绪健康。未来的研究应侧重于评估游戏化对临床能力和专业行为影响的纵向研究。

关键词：医学教育、学生、游戏化、知识、学习成果、模拟、教学方法。

Abstract. *Gamification has emerged as a promising approach for enhancing student engagement, motivation, and learning outcomes. The primary objective of this review is to analyze existing literature on gamification in medical education. A systematic search of peer-reviewed articles and academic publications published between 2010 and 2025 was conducted. 28 articles were selected for detailed analysis. The review revealed several recurring themes and empirical findings across different contexts, methodologies, and disciplines in medical education. Overall, gamification has been shown to significantly enhance motivation, knowledge retention, clinical reasoning, and emotional well-being among learners. Future research should focus on longitudinal studies assessing the impact of gamification on clinical competencies and professional behavior.*

Keywords: *medical education, students, gamification, knowledge, learning outcomes, simulation, teaching methods.*

Introduction

The rapid evolution of educational technologies has brought significant changes to traditional teaching strategies in medical education. Among these, gamification—defined as the use of game design elements in non-game contexts—has emerged as a promising approach for enhancing student engagement, motivation, and learning outcomes [20, 27]. Medical education, often regarded as rigorous and content-heavy, can benefit greatly from techniques that foster active learning and increased retention. The adoption of gamification in medical training reflects a broader paradigm shift toward student-centered learning, interactive environments, and adaptive instruction [17].

Numerous studies have explored how digital tools, game-based platforms, and simulated clinical environments can replicate the dynamics of real-life medical decision-making. This transformation is particularly relevant in the post-COVID era, where online and hybrid learning have become the norm 22]. Gamification serves not only as a motivational booster but also as a structural tool to develop critical thinking, communication skills, and teamwork among medical students.

Objective

The primary objective of this review is to analyze existing literature on gamification in medical education, with an emphasis on evaluating its effectiveness, identifying best practices, and recognizing challenges in implementation.

Materials and Methods

We conducted a systematic search of peer-reviewed articles and academic publications published between 2010 and 2025 using databases such as PubMed, Scopus, Web of Science, ERIC, eLibrary.ru, and Google Scholar. Keywords used included “gamification,” “medical education,” “game-based learning,” “simulation,” “serious games,” and “educational technology.” A total of 286 articles were initially identified, and after applying inclusion criteria (English or Russian language, empirical or review-based, relevance to medical education), 28 articles were selected for detailed analysis. Data were extracted concerning educational context, gamification design, learner outcomes, evaluation methods, and identified barriers.

Results

The review revealed several recurring themes and empirical findings across different contexts, methodologies, and disciplines in medical education. Overall, gamification has been shown to significantly enhance motivation, knowledge retention, clinical reasoning, and emotional well-being among learners. Simulations and serious games promote experiential learning, while adaptive feedback and personalization foster deeper engagement. Despite notable challenges—including high implementation costs and cultural barriers—the literature underscores the value of well-integrated gamification as a powerful supplement to traditional in-

struction. methodologies, and disciplines in medical education. This section provides a detailed synthesis and elaboration of those findings, grouped by thematic focus.

1. Increased Motivation and Engagement

One of the most consistently reported effects of gamification is its capacity to increase student motivation and participation. In studies by Landers et al. [12], the introduction of points, levels, and leaderboards in anatomy classes led to significantly higher attendance and completion rates. Other studies corroborated these findings, demonstrating that medical students were more likely to engage in voluntary learning activities when game elements were present [2, 16]. Motivation was both intrinsic and extrinsic: students reported feeling a greater sense of achievement and enjoyment, especially when rewarded with digital badges or ranked in competitive environments [10].

Furthermore, qualitative data indicated that the presence of game mechanics helped establish a more dynamic classroom culture, encouraging active participation and competition in a positive spirit. Students consistently preferred environments that rewarded incremental progress, as seen in badge systems and level-up structures. This preference also aligned with the findings of J. Hamari et al., who emphasized the importance of continuous feedback in maintaining user engagement 8].

2. Improved Learning Outcomes and Knowledge Retention

Empirical evidence indicates that gamification can lead to improved academic performance. A meta-analysis by P. Wouters et al. [26] showed that serious games increased both declarative and procedural knowledge in health professions education. M. Boeker et al. [1] conducted a randomized controlled trial that demonstrated a 20% improvement in assessment scores for students who used a gamified e-learning module versus those who used standard materials.

In the study by I. Hege et al. [9], virtual patient platforms embedded with game mechanics (e.g., time-limited diagnostics, scoring based on accuracy) led to significantly improved diagnostic reasoning skills among final-year medical students. Importantly, these outcomes were retained over time, with follow-up tests showing less knowledge decay.

Knowledge retention was especially evident in clinical scenarios requiring procedural memory. For example, students who trained using VR or serious games for laparoscopic surgery were able to replicate learned skills months later with minimal performance decline. These findings suggest that gamified environments may support the formation of durable cognitive schemas essential for clinical decision-making.

3. Simulation and Serious Games

Simulations and serious games, including VR and AR applications, have become integral to clinical training. P. Piromchai P. et al. [19] reported that VR sim-

ulations for surgical skills training resulted in higher psychomotor performance scores than traditional mannequins or static videos. These tools also improved learner confidence in performing real-life procedures.

Similarly, M.K. Khalil and M.M. Mansour [11] examined gamified anatomy applications and noted a substantial increase in both spatial understanding and test scores. Students also self-reported greater confidence in applying anatomical knowledge during clinical placements.

In addition, serious games such as digital escape rooms and virtual hospital rounds have proven effective in teaching emergency medicine and triage skills. These platforms provide immersive problem-solving experiences under time constraints, which mirror real clinical environments. Several studies noted enhanced critical thinking, adaptability, and decision-making under pressure [21].

4. Peer Collaboration and Real-Time Feedback

Platforms such as Kahoot have shown that incorporating competitive quizzes and collaborative problem-solving tasks improves knowledge acquisition and peer-to-peer interaction [3, 18].

In a study by Domínguez et al. [5], students working in gamified groups outperformed control groups in both formative and summative assessments. Additionally, they displayed better communication skills and stronger team cohesion.

Feedback loops in gamified systems (e.g., instant correction of wrong answers, adaptive question difficulty) were shown to reinforce learning and reduce errors over time [4, 7]. These features also contributed to a sense of mastery and progress, which are critical components of self-regulated learning.

Moreover, gamified systems with adaptive algorithms tailored content difficulty based on student performance. This form of personalization increased learner confidence and prevented discouragement due to overly difficult material.

5. Emotional and Psychological Benefits

Beyond cognitive outcomes, gamification positively influenced emotional and psychological states. Some authors highlighted the positive emotional response to gamification among medical students, emphasizing its role in alleviating stress associated with high-stakes learning environments. Gamification tools such as badges for achievements can help an overwhelmed student take a task that feels too big and break it up into smaller parts. This way, the student can keep their focus on each smaller step until they reach their overall goal at their own pace. Moreover, a gamified curriculum can help to ease the stress of ‘serious’ high-stakes schoolwork and make learning fun. A group-based or collaborative lesson can also help anxious students in that they can now share the work and responsibility with their classmates, easing their burden and lowering the stakes [28].

According to M. Sailer and L. Homner [23], students experienced decreased anxiety and increased self-efficacy, especially when gameplay incorporated elements of choice and autonomy.

Gamification was also associated with resilience and perseverance, particularly in challenging modules such as pharmacology and biochemistry. Students reported being more likely to persist in difficult tasks when guided through game-based scaffolding [14, 25].

6. Contextual Challenges and Limitations

Despite its benefits, gamification is not without limitations. Studies by A.M. Toda et al. [24] and E.D. Mekler et al. [15] pointed out the potential for over-reliance on extrinsic rewards, which can diminish intrinsic motivation if not properly designed. In some cases, students disengaged once rewards were removed.

Other constraints include high development costs, technical limitations in lower-resource settings, and resistance from faculty members unfamiliar with digital tools [6, 13].

A further concern is content quality. Poorly designed gamification can lead to superficial engagement without meaningful learning. This highlights the importance of integrating instructional design principles and involving subject matter experts in game development.

Conclusion

Gamification represents a transformative tool in medical education, with evidence supporting its potential to improve motivation, engagement, and learning outcomes. While challenges remain—particularly in scalability, and faculty readiness—the reviewed literature suggests that well-designed gamified experiences can complement traditional teaching methods and address some of the persistent gaps in medical training.

Future research should focus on longitudinal studies assessing the impact of gamification on clinical competencies and professional behavior. Moreover, developing standardized frameworks for gamification design in medical education, based on evidence and pedagogical theory, will help educators create effective and sustainable implementations.

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DOI 10.34660/INF.2025.75.12.015

口腔黏膜外伤治疗中黏附剂保留时间的评估

ASSESSMENT OF THE DURATION OF ADHESIVE RETENTION IN THE TREATMENT OF TRAUMATIC LESIONS OF THE ORAL MUCOSA

Grigoryan Milena Zhirayrovna
Assistant of the Department of Therapeutic Dentistry
RUDN University, Moscow, Russia

引言

口腔黏膜每天都会受到各种物理、化学和生物因素的影响。尽管其具有显著的屏障特性，但它仍易受损伤，尤其是由锋利的牙齿边缘、缺陷的假体结构、咬颊或错颌畸形造成的慢性机械性创伤。黏膜损伤会导致愈合延迟和感染风险。在这种情况下，局部使用屏障剂至关重要，因为它们不仅可以保护患处，还能促进其再生。这类屏障剂的要求之一是，即使口腔内环境复杂，例如潮湿的环境、组织活动性、唾液分泌以及进食和说话时的机械冲击，它仍能与黏膜充分粘附。

目的

评估不同粘合剂在口腔黏膜创伤性损伤治疗中的固定持续时间。

材料与方法

本研究纳入了20例口腔黏膜机械性创伤患者。受试者被分为两组：

第一组——应用含Solcoseryl的角膜塑形膜；

第 2 组 - 使用含维生素 E 的愈合贴片。

根据药物在黏膜上的滞留时间评估药物的固定效果，患者自行记录并报告给研究人员。采用学生 t 检验进行统计学处理。

结果

第一组平均滞留时间为 48.4 ± 9.19 分钟，第二组为 127.7 ± 49.07 分钟。两组间差异具有统计学意义 (p = 0.000180)。维生素 E 贴片在黏膜上的滞留时间明显更长。

结论

两种药物在固定期间均能提供足够的保护。然而，在需要更长时间屏障效果的临床病例中，最好使用含维生素 E 的愈合贴片。

关键词：机械性创伤、口腔黏膜、粘合剂、索高塞利、维生素 E、愈合贴片、固定。

Introduction

The oral mucosa is subjected daily to various physical, chemical, and biological factors. Despite its pronounced barrier properties, it is susceptible to

damage, especially from chronic mechanical trauma caused by sharp tooth edges, defective prosthetic constructions, cheek biting, or malocclusion. Damage to the mucous membrane creates conditions for delayed healing and risk of infection. Under these circumstances, the use of local barrier agents is of great importance, as they not only protect the affected area but also promote its regeneration. One of the requirements for such agents is sufficient adhesion to the mucosa despite the challenging conditions in the mouth: a moist environment, tissue mobility, salivation, and mechanical impact during eating and talking.

Objective

To assess the duration of fixation of various adhesive agents in the treatment of traumatic lesions of the oral mucosa.

Materials and Methods

The study involved 20 patients with mechanical trauma of the oral mucosa. The participants were divided into two groups:

Group 1 — application of keratoplastic film with Solcoseryl;

Group 2 — application of healing patch with vitamin E.

The fixation of the agents was evaluated based on the duration of their retention on the mucosa, which the patients self-recorded and reported to the researchers. Statistical processing was performed using Student's t-test.

Results

The average fixation duration in the first group was 48.4 ± 9.19 minutes, while in the second group it was 127.7 ± 49.07 minutes. The differences were statistically significant ($p = 0.000180$). The vitamin E patch showed a significantly longer retention time on the mucosa.

Conclusions

Both agents provided adequate protection during the fixation period. However, in clinical cases requiring a longer barrier effect, it is preferable to use the healing patch with vitamin E.

Keywords: *mechanical trauma, oral mucosa, adhesive agents, Solcoseryl, vitamin E, healing patch, fixation.*

DOI 10.34660/INF.2025.90.38.016

光动力疗法——牙科的现代视角和创新
PHOTODYNAMIC THERAPY – MODERN PERSPECTIVES AND INNOVATIONS IN DENTISTRY

Andreasyan Tatev Shotaevna
Kuban State Medical University
Russia, Krasnodar

引言

近年来，光动力疗法 (PDT) 因其抗菌、抗炎甚至抗肿瘤特性，在牙科实践中日益受到重视。该方法基于光敏剂（其特异性地聚集在病理组织中）与特定波长的光源相互作用，从而产生活性氧和其他活性自由基。这些分子对病原微生物和变异细胞产生细胞毒性作用，同时最大限度地减少对健康组织的损害。

在过去的几十年中，PDT 在临床牙科中的应用得到了显著扩展。首先，全球范围内的抗生素耐药性问题使得寻找替代的抗菌策略成为必要；其次，需要提高治疗方法的生物相容性，尤其是对于具有复杂病史的患者；第三，技术进步推动了新一代光敏剂和光照射设备的开发。PDT 在口腔炎症、感染性、破坏性和肿瘤性疾病的综合治疗中尤为重要。

目的

本研究旨在对当代关于光动力疗法在牙科领域应用的科学文献进行全面分析，重点关注该方法的致病原理、技术发展、在各种临床情况下的有效性以及进一步发展的前景。

材料与方法

本研究回顾了近期的科学文献，包括关于光动力疗法 (PDT) 在牙科领域应用的论文、荟萃分析和系统综述。分析涵盖了国内外作者发表的论文，描述了实验研究和临床实践结果。研究考虑了各种光敏剂、光照参数、应用方案及其与其他治疗方法的联合应用。

结果

分析结果表明，PDT 在多种牙科疾病的治疗中均具有较高的临床疗效：

牙周病学。PDT 有助于显著减少牙周袋内的微生物负荷，改善临床参数（袋深、出血、附着水平），尤其在与机械治疗和臭氧疗法联合使用时效果更佳。PDT 疗法在慢性全身性牙周炎中具有持续缓解的疗效。

牙髓病学。PDT已被证明可有效对抗根管内顽固菌群，包括对传统抗菌剂耐药的粪肠球菌菌株。PDT与超声激活冲洗液和含钙药物相结合使用，可提高根管灭菌率。

种植学。该方法已成功应用于治疗种植体周围炎。PDT可确保安全有效地净化种植体表面，且不影响骨整合。纳米光敏剂和专用涂药器的使用可提高药物的生物利用度和组织渗透性。

肿瘤牙科。PDT被认为是治疗早期口腔黏膜恶性肿瘤的手术和放射治疗的替代或辅助手段。研究表明，PDT具有明显的选择性、低毒性和良好的美容效果。其在治疗白斑、红斑和耐药性肿瘤方面效果显著。

联合疗法。 PDT 与激光疗法、免疫调节剂、生物再生技术和抗菌肽相结合，可实现协同效应。这拓展了该方法的治疗潜力，并实现了治疗方案的个体化。

技术方面。PDT 设备的创新包括便携式 LED 设备、荧光导航系统、光纤探头以及可根据患者生物反应实时调整治疗参数的智能模块。

结论

光动力疗法是一种多功能、安全、有效的治疗方法，可用于治疗多种牙科疾病。将其整合到综合治疗方案中，可实现良好的临床疗效，同时将风险降至最低。技术创新和个性化方法扩展了 PDT 的能力。然而，仍然需要制定标准化的治疗方案、开展多中心随机研究以及长期治疗结果研究。未来，PDT 可能成为牙科预防、治疗和康复领域不可或缺的一部分。

关键词：光动力疗法、牙科、光敏剂、牙周病学、牙髓病学、种植体周围炎、口腔癌、抗菌疗法。

Introduction

In recent years, photodynamic therapy (PDT) has gained increasing prominence in dental practice due to its antimicrobial, anti-inflammatory, and even antitumor properties. The method is based on the interaction of a photosensitizing agent, which specifically accumulates in pathological tissues, with a light source of a certain wavelength, resulting in the generation of reactive oxygen species and other reactive radicals. These molecules cause cytotoxic effects on pathogenic microorganisms and altered cells while minimizing damage to healthy tissues.

Over the past decades, there has been a significant expansion in the application of PDT in clinical dentistry. This is due, firstly, to the global problem of antibiotic resistance, which necessitates the search for alternative antimicrobial strategies; secondly, to the need to enhance the biocompatibility of therapeutic methods, especially in patients with complicated somatic histories; and thirdly, to technological progress enabling the development of new generations of photosensitizers and light exposure devices. PDT is particularly relevant in the complex therapy of inflammatory, infectious, destructive, and neoplastic diseases of the oral cavity.

Objective

The objective of this study is a comprehensive analysis of contemporary scientific literature dedicated to the application of photodynamic therapy in dentistry, with an emphasis on the pathogenetic rationale of the method, the evolution of technologies, effectiveness in various clinical situations, and prospects for further development.

Materials and Methods

A review of recent scientific literature was conducted, including articles, meta-analyses, and systematic reviews concerning the use of PDT in dentistry. The analysis included publications by both domestic and international authors, describing experimental studies as well as clinical practice results. Various photosensitizers, light exposure parameters, application protocols, and their combination with other treatment methods were considered.

Results

The analysis results demonstrate high clinical efficacy of PDT in the treatment of a wide range of dental diseases:

Periodontology. *PDT contributes to a significant reduction of microbial load in periodontal pockets, improves clinical parameters (pocket depth, bleeding, attachment levels), especially when combined with mechanical treatment and ozone therapy. Sustained remission in chronic generalized periodontitis is noted.*

Endodontics. *PDT has proven effective against persistent root canal microflora, including Enterococcus faecalis strains resistant to traditional antiseptics. Combined use of PDT with ultrasonic activation of irrigants and calcium-containing drugs increases root canal sterilization rates.*

Implantology. *The method is successfully applied in treating peri-implantitis. PDT ensures safe and effective decontamination of implant surfaces without disrupting osseointegration. The use of nano-photosensitizers and specialized applicators improves drug bioavailability and tissue penetration.*

Oncological Dentistry. *PDT is considered an alternative or adjunct to surgery and radiotherapy for early-stage malignant tumors of the oral mucosa. Studies show PDT has pronounced selective effects, low toxicity, and favorable cosmetic outcomes. Its effectiveness is noted in treating leukoplakia, erythroplakia, and resistant tumors.*

Combined Approaches. *Synergistic effects are achieved by combining PDT with laser therapy, immunomodulators, bioregenerative technologies, and antimicrobial peptides. This expands the therapeutic potential of the method and allows individualization of treatment protocols.*

Technological Aspects. *Innovations in PDT equipment include the development of portable LED devices, fluorescent navigation systems, fiber-optic applicators, and intelligent modules that adapt therapy parameters to the patient's biological response in real-time.*

Conclusions

Photodynamic therapy is a versatile, safe, and effective method for treating a broad spectrum of dental diseases. Its integration into comprehensive treatment protocols enables high clinical outcomes with minimal risks. Technological innovations and personalized approaches expand PDT capabilities. However,

there remains a need for protocol standardization, multicenter randomized studies, and research on long-term treatment outcomes. In the future, PDT may become an integral part of prevention, therapy, and rehabilitation in dentistry.

Keywords: *photodynamic therapy, dentistry, photosensitizers, periodontology, endodontics, peri-implantitis, oral cancer, antimicrobial therapy.*

DOI 10.34660/INF.2025.82.53.017

混合装置圆柱形腔体中混合物在旋转过程中的动力学（横截面视图）

DYNAMICS OF A MIXTURE IN A CYLINDRICAL CHAMBER OF A MIXING APPARATUS WITH CHANGING GEOMETRY DURING ROTATION IN A CROSS-SECTIONAL VIEW

Lozovoy Nikolai Mikhailovich
Candidate of Technical Sciences, Associate Professor
Belgorod State Technological University named after V.G. Shukhov

Kapranova Anna Borisovna
Doctor of Technical Sciences, Professor
Yaroslavl State Technical University

摘要：本文论证了使用可变几何形状混合室的混合装置的可行性，该装置能够定性混合不同粒径（微米至3毫米）和密度（0.1克/立方厘米至4.0克/立方厘米）的初始组分粉末。该装置可在横截面积可变的旋转混合室中实现，并控制混合过程。本文提出了一种通过移动夹具模拟旋转对混合室的影响的方案。并给出了用于确定混合材料颗粒对滚轮力的反作用力总和的表达式，从而避免了上述混合装置的旋转效应。

关键词：可变几何形状混合室，混合过程控制，旋转效应模拟。

Abstract. *The article substantiates the relevance of using a mixer apparatus with a variable geometry chamber capable of qualitatively mixing powders from initial components differing from each other in particle size (from micron to 3 mm) and density (from 0.1 g/cm³ to 4.0 g/cm³), which can be implemented in chambers with variable geometry in the cross-section by rotation, in which the mixing process can be controlled. The scheme of the organization of the simulation of the rotational effect on the chamber by moving the clamps is presented. Presented are expressions for determining the total force of the reaction of the mixed material particles to the force of the rollers, which prevents this effect of the named mixing apparatus.*

Keywords: *mixing apparatus with a variable geometry chamber, control of the mixing process, simulation of rotational effects.*

Today, the production of bulk material mixtures is impossible without the use of mixing equipment that can ensure the required level of mixture homogeneity. Many dry mixtures use a system of “rheological” additives to regulate their tech-

nological properties, and a number of components are added in small amounts (0.05-1%), but their impact on the properties of mixtures and solutions is extremely significant. Therefore, a mixing apparatus capable of qualitatively mixing powders from initial components that differ from each other in particle size (from a micron to 3 mm) and density (from 0.1 g/cm^3 to 4.0 g/cm^3) is the main unit of the technological cycle for the production of mixtures and their components, which can be implemented in chambers with variable geometry in mixing apparatuses that allow for the control of the mixing process.

The working chamber with variable geometry [1] in the cross-section by rotation in the mixing apparatus is made of an elastic material, for example, of corded rubber, metal and/or plastic plates, flakes, rods, etc. It is filled with the mixed components after changing its geometry from cylindrical to elliptical, and then its geometry is changed during operation by rotating rollers around it or by simulating the rotational movement of the rollers using other types of impact (Fig. 1) [1].

For example, between the DC poles 1, 2, 3, 4 (Fig. 1) and 13, 14, 15, 16, there is a fixed working chamber with variable geometry and fixed ferromagnetic plates 5, 6, 7, 8 and 9, 10, 11, 12, respectively. A stepper switch is located in the control unit for attracting the plates to the poles. To control the mixing process, plates 5 and 7 are attracted to poles 1 and 3, then 9 and 11 are attracted to 13 and 15, 6 and 8 are attracted to 2 and 4, 7 and 5 are attracted to 3 and 1, and so on, which simulates the rotational effect of rollers on the camera (rolling).

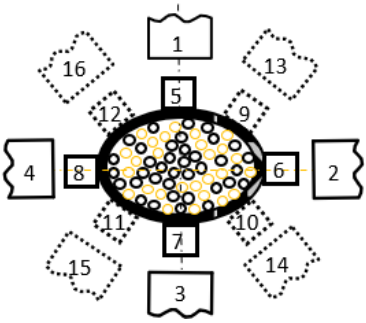


Figure 1. *Scheme of the organization of the simulation of the rotational effect on the camera (rolling) by moving the clamps*

To quantify the position of the mixed material particles in the working chamber at the current time, the movement of which is carried out under the action of rollers or other elements (Fig. 1), the linear velocity of which ϑr (Fig. 2, a) will be determined as:

$$\vartheta_r = \omega R, \quad (1)$$

where ω - is the angular rotational speed of the drive; for n=100…300 min^{-1}, ω=10.5…34.5 s^{-1} (Fig. 2, a);

n - is the number of rotations of the roller drive, min^{-1}.

An analysis of the graphs of the dependence of the linear speed of the rollers on the angular speed of the drive ω=10.5…34.5 s^{-1} (Fig. 2, a) shows that when the drive speed is increased by a factor of 3, the linear speed of the rollers for the cameras of the sizes under consideration increases by a factor of 4: 1 - L=1 m, R=0,2 m, D=0,4 m, 2h=0,064 m, V=0,11 m^3, M=157 kg (fig. 2, the black line);

2 - L=0,035 m, R=0,07 m, D=0,02 m, h=0,013 m, V=0,0048 m^3, M=6,7 kg (fig. 2, the red line).

When the geometry of the chamber changes, a force F_0 is formed in it - the reaction of the material particles to the force of the rollers, which prevents this effect, H [3]. To determine it, it is necessary to determine the angular frequency of rotation of the particles during operation of the device under study. This force is balanced by the spacer force F_r, which is related to the angular rotation frequency of the material particles by the ratio [4]:

$$F_r = K\rho La^3\omega_0^2 = \rho La\vartheta\omega_0, \quad (2)$$

$$\omega_0 = \sqrt{\pi}(K_n^2 + K_\tau^2)^{\frac{1}{4}}\omega, \quad (3)$$

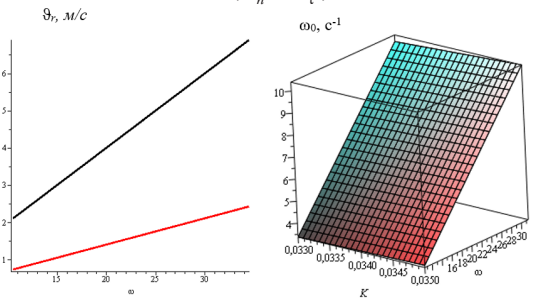
where ω_0 - angular frequency of rotation of material particles, s-1,

then, taking into account (2) and (3),

$$K_n = \frac{f_n}{3}(1 - f_n)\left(1 - \frac{3}{4}\varepsilon^2\right); \quad (4)$$

$$K_\tau = \frac{1}{8}f_\tau\frac{(2R-d)d^3}{La^3}\left[\frac{\pi(2R-d)}{d}\right]\left[\frac{L}{d}\right]; \quad (5)$$

$$K=(K_n^{\,2}+K_\tau^{\,2})^{1/2}. \quad (6)$$



a) *b)*

Figure 2. *Graphs of the linear dependence of the clamping speed ϑ_r (a) and the dependence of the angular rotation speed of the particles ω0 on the angular rotation speed of the drive ω and the total coefficient K (b)*

A graph (Fig. 2, b) was obtained showing the dependence of the angular velocity of the particles ω_0 on the angular velocity of the drive ω and the total coefficient *K*, which depends on the geometric parameters of the mixing chamber and the coefficients of friction between the particles and the walls of the chamber. It has been determined using formulas (4-6) that the total coefficient for the studied range of camera sizes is K_1=0.033 and K_2=0.035, with ω_{01}=3.4 s^{-1}, 10 s^{-1}, and ω_{02}=3.5 s^{-1}, 10.5 s^{-1}, respectively, for ω=10.5 s^{-1}, 31.5 s^{-1}. To simplify the calculations, we assume that ω=10.5 s^{-1} and 31.5 s^{-1} are equal to ω_0=3.5 s^{-1} and 10 s^{-1}, respectively.

The maximum force that prevents external influences from affecting the components is determined by:

$$F_0=F_n+F_\tau, \tag{7}$$

then the friction force F_n (Fig. 3, a) arises during the relative shear of adjacent loading layers and is caused by the action of the spacer force (2) throughout the entire volume of the chamber [4]:

$$F_n \approx \pi \frac{f_n}{3}(1-f_n)\rho a^3 \omega_0^2 L\left(1-\frac{3}{4}\varepsilon^2\right), \tag{8}$$

where $f_n = 0{,}15 - 0{,}45$ - coefficient of friction of sliding sand on sand, on cement, etc.;

ρ - bulk density of the material, ρ=1300-1700 kg / m^3 (for quartz sand, technical ceramics, cement, etc., accepted, for a mixture of sand and cement ρ_ =1500, kg / m^3;

a - the greater semi-axis of the elliptical part of the variable geometry chamber, m;

$\varepsilon^2 = 1-\frac{b^2}{a^2}$ - eccentricity of the section of the elliptical part of the body [5];

L - length of the variable-geometry working chamber, m.

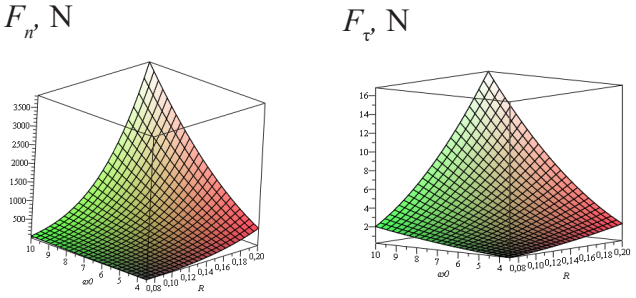
$$F_\tau = \frac{1}{8} f_\tau \pi \omega_0^2 \rho (2R-d) d^3 \left[\frac{\pi(2R-d)}{d}\right]\left[\frac{L}{d}\right]. \tag{9}$$

where F_τ - force occurs as a result of interaction of loading with the walls of the working chamber;

f_τ=0,08 - coefficient of friction of sliding of sand on rubber walls of the chamber.

The analysis of the friction forces Fn and F_τ (Fig. 3), depending on the technological and geometric parameters of the working chamber, shows that the force F_n is many times greater than the force F_τ. This is due to the fact that the coefficient of sliding friction of the mixed particles with the chamber material is less than the coefficient of friction of the mixed particles with each other by more than two times, as well as the fact that the contact area of the particles with the inner surface of the variable geometry chamber is much smaller than the contact area of the particles with each other.

Therefore, in further theoretical studies, the force F_τ can be neglected. It should be noted here that when the rollers slide along the axis *OY* of the control unit, all particles move vertically downward under the influence of gravity until they meet the loading level of the chamber, and at this stage there is no reaction force preventing the loading of the rollers. That is, the maximum reaction forces preventing the loading of the rollers at the angular velocity of their ω =10.5; 31.4 s^{-1}, which corresponds to *n*=100, 300 min^{-1} are equal to 470 N and 3818 N, respectively (the difference between them is 6.4 times).



a) *b)*

Figure 3. *Graphs of the change in friction forces (reactions) $F_n=F_0$ (a) and (b) for the range of camera radii R=0.07-0.2 m, ω_0=3.5 s^{-1}-10 s^{-1} at ω=10.5, 31.4 s^{-1}*

Conclusions

1. In mixers with working chambers with variable geometry, the working chamber is made of an elastic material, for example, corded rubber, metal and/or plastic plates, flakes, rods, etc. It is filled with the mixed components, and then its geometry is changed during the operation, by rotating rollers around it or by imitating a rotational effect on it (rolling) by moving the clamps. By adjusting the angular velocity of the rolling rollers, the mixing process can be controlled to match the physical and mechanical properties of the materials being mixed, resulting in a mixture of the desired quality.

2. Analysis of the graphs of the dependence of the linear velocity of the rollers on the angular rotational speed of the drive ω=10,5…34,5 s^{-1} shows that when the rotational speed of the drive is increased by 3 times, the linear velocity of the rollers for the chambers of the considered sizes increases by 4 times.

3. Equations of the friction forces are obtained: F_n, which occurs during the relative shear of adjacent layers of the mixture, which is caused by the action of the spacer force in the entire volume of the chamber; F_τ, which occurs as a result of the interaction of the mixture with the walls of the working chamber. At the same time, it is established that:

-the force F_n is several times greater than the force $F\tau$, this is due to the fact that the coefficient of sliding friction of the mixed particles with the material of the chamber is less than the coefficient of friction of the mixed particles with each other by more than 2 times, as well as the fact that the contact area of the particles with the inner surface of the variable geometry chamber is several times smaller than the contact area of the particles with each other;

-in further theoretical studies, the force $F\tau$ can be neglected;

- the maximum values of the reaction force that prevents the load from being affected by the rollers at an angular speed of their drive of ω=10.5; 31.4 c^{-1}, which corresponds to n=100, 300 min^{-1}, are 470 N and 3818 N, respectively (the difference between them is 6.4 times).

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DOI 10.34660/INF.2025.96.29.018

具有纵向变化腔体几何形状的混合研磨装置的负载动力学

LOADING DYNAMICS OF A MIXING AND GRINDING DEVICE WITH A LONGITUDINALLY VARYING CHAMBER GEOMETRY

Lozovoy Nikolai Mikhailovich
Candidate of Technical Sciences, Associate Professor
Belgorod State Technological University named after V.G. Shukhov

Kapranova Anna Borisovna
Doctor of Technical Sciences, Professor
Yaroslavl State Technical University

摘要：本文论证了使用带有纵向可变几何形状腔体的混合研磨设备的可行性，并绘制了其运行特点图。文中给出了用于确定混合和/或研磨物料颗粒对推杆力（防止其冲击）的总反作用力的表达式。

关键词：混合研磨设备，可变几何形状纵向往复腔体，推力，总反作用力。

Abstract. *The article substantiates the relevance of using a mixing and grinding apparatus with a longitudinal variable geometry chamber, presents a diagram with the features of its operation. Expressions are obtained for determining the total reaction force of the mixed and/or ground material particles to the force of the pusher, which prevents its impact.*

Keywords: *mixing and grinding apparatus, variable geometry longitudinal reciprocating chamber, thrust force, total reaction force.*

Due to the development of small businesses, there has been an increasing demand for devices that combine multiple functions. One widely used device for mixing and grinding powder mixtures is apparatus with a variable geometry chamber. Depending on the properties of the material being processed, the design of the machine allows for the selection of optimal grinding and/or mixing modes to achieve the desired quality of the product without fundamentally altering the machine's design [1, 2].

It is known (Fig. 1) a batch mixing and grinding device [2], which contains a horizontal elastic barrel-shaped body 1 with variable geometry, made of corded rubber, metal and/or plastic plates, rods, etc., which can move back and forth along its longitudinal axis. The body 1 has a loading and unloading opening 2 with a shutter 3. The body 1 is fixed on the frame 4. On the other hand, the housing 1 is

connected to a pusher 5 that is coaxial with the housing 1. The pusher 5 is rigidly connected to a horizontal working element 6 located inside the housing 1, which can reciprocate along the longitudinal axis of the housing 1 together with the pusher 5. The working element 6 is made in the form of a rod 7, along which there are evenly spaced plates 8 in the form of circles with holes.

The apparatus operates as a mixer. Mixing of components (two or more), such as lime, sand, and pigment, occurs when they are fed into the barrel-shaped body 1 and when the pusher 5 reciprocally impacts the movable side of the body 1, changing its geometry and shifting the plates 8 with holes by the amount of its stroke, causing the material particles to move evenly along the entire length of the body 1, which improves the quality of the mixture.

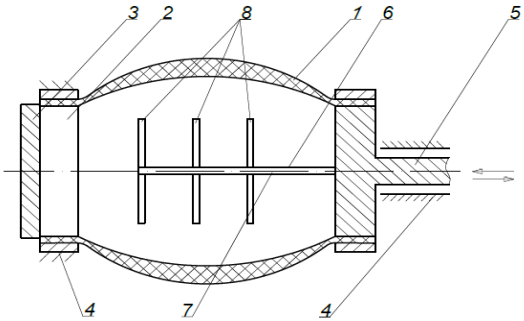


Figure 1. *Mixing and grinding device of a periodic type*

The apparatus works as a mixer-grinder. Components (two or more), such as sand and cement, are fed into the apparatus, and they need to be further ground during the mixing process. To achieve this, grinding bodies (up to 30% of the volume of the apparatus) are added to the body. The pusher 5 moves the plates 8 evenly along the entire length of the chamber, and the grinding bodies and the components being mixed are located between the plates. At the same time, the entire mixed material or its individual components are mixed and further ground by the contact surfaces of the working body 6 and the grinding bodies, depending on the recipe and/or their physical and mechanical properties, resulting in a high-quality finished product.

When the geometry of the chamber changes, a force F_0 is generated in it - the reaction of the material particles to the force of the pusher's impact, which opposes this impact [3, 4]. The magnitude of the force F0 is balanced by the thrust force F_r, which is related to the angular velocity of the material particles ω_0 by the following equation [4]:

$$F_r = K\rho L R_g^3 \omega_0^2, \quad (1)$$

$$\omega_0 = \sqrt{\pi}(K_n^2 + K_\tau^2)^{\frac{1}{4}}\omega, \quad (2)$$

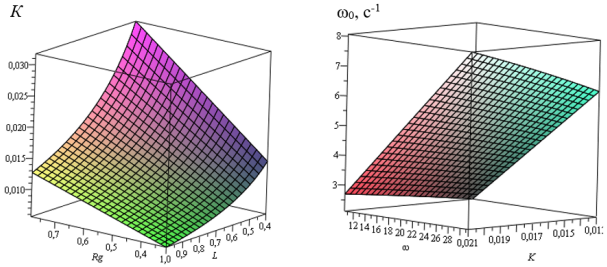
then, taking into account (3) and (4),

$$K_n = f_n(1 - f_n)R_g / L; \quad (3)$$

$$K_\tau = 4f_\tau \frac{d_ч}{LR_g^2}\left(d_ч - R_g\right)^2; \quad (4)$$

$$K = K_n + K_\tau. \quad (5)$$

Three-dimensional graphs (Fig. 2) have been obtained showing the dependence of the angular velocity of the particles on the angular velocity of the drive ω and the total coefficient *K*, which depends on the geometric parameters of the mixing chamber and the coefficients of friction between the particles and the walls of the chamber.



a) *b)*

Figure 3. *Graphs of the dependence of the total coefficient K on the geometric parameters of the mixing chamber (a); dependence of the angular velocity of particles ω_0 on the angular velocity of the drive ω and the total coefficient K (b)*

Graph analysis showed that for the studied range of camera sizes:1 – L_1=1 m, D_1=0,5 m, $d_{ц1}$=0,23 m, R_{g1}=0,783 m, h_1=0,25 m; 2 – L_2=0,4 m, D_2=0,15 m, $d_{ц2}$=0,09 m, R_{g1}=0,313 m, h_1=0,04 m); K_1=0,013, K_2=0,025), at the same time ω_{01}=2 s^{-1}, 7,2 s^{-1}, и ω_{02}= 2.8 s^{-1}, 8 s^{-1} by *n*=100 $mines^{-1}$, 300 $mines^{-1}$ or ω=10,5 s^{-1}, 20,9 s^{-1}, respectively. To simplify the calculations, the average values of the angular velocities of the particles are taken ω_0=2.4 s^{-1}, 5 s^{-1}, by ω=10,5 s^{-1}, 20,9 s^{-1}, respectively.

Each time the pusher exerts force on the chamber body, a force F_0 is generated to counteract this force [4].

$$F_0 = F_n + F_\tau. \quad (6)$$

where F_0 is the maximum force that prevents external forces from affecting the load, *N*.

The friction force (Fig. 3, a) occurs during the relative shift of adjacent sectorial layers of the load and is caused by the action of the spacer force throughout the chamber [4]:

$$F_n = \pi f_n (1 - f_n) \rho \omega_0^2 R_g^4, \quad (7)$$

where f_n - is the coefficient of friction of sand on sand/cement;

ρ - is the bulk density of the material, ρ=1300-1700 kg/m^3 (for quartz sand, technical ceramics, cement, etc., it is assumed for a mixture of sand and cement ρ =1500 kg/m^3;

ω_0 - angular velocity of material particles, ω_0=2,4; 7,5 s^{-1} at ω=10.5, 31.4 s^{-1};

ω - angular velocity of the pusher drive; ω=10.5, 31.4 s^{-1}, which corresponds to n=100, 300 min^{-1};

R_g – average radius of curvature of the surface of the chamber before and after deformation, m.

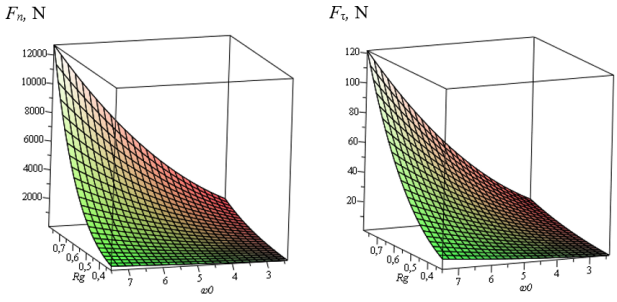
The friction force F_τ (Fig. 3, b), which occurs during the relative shift of the load along the inner surface of the working chamber and is caused by the tangential force acting on the entire inner surface of the chamber [4]:

$$F_\tau = 4\pi f_\tau \rho \omega_0^2 R_g d_{sh} \left(R_g - \frac{d_q}{2}\right)^2, \quad (9)$$

where f_τ - the coefficient of friction of sand on rubber;

d_{sh} – the average size of the component particles, m.

The graphs of the friction forces F_n and F_τ (Fig. 3), depending on the technological and geometric parameters of the working chamber, show that the force F_n is many times greater than the force F_τ. This is due to the fact that the coefficient of friction of the mixed particles with the chamber material is almost two times lower than the coefficient of friction of the mixed particles with each other, as well as the fact that the contact area of the particles with the inner surface of the variable geometry chamber is much smaller than the contact area of the particles with each other.



a) *b)*

Figure 4. *Graphs of changes in friction forces F_n(a) and F_τ(b) depending on the geometric and technological parameters of the mixer during R_g=0,313-0,783 m, and ω_0=2.4 s^{-1}- 7.5 s^{-1}*

Conclusions

1. Recently, there has been an increasing demand for devices that combine several functions. One of the widely used devices for mixing and grinding powder mixtures is a device with a variable geometry chamber. Depending on the properties of the material being processed, the design of the device allows for the selection of optimal grinding and/or mixing modes to achieve the desired quality of the product, without fundamentally changing the design of the device.

2. Three-dimensional graphs have been obtained showing the dependence of the angular velocity of the particles on the angular velocity of the drive ω and the total coefficient *K*, which depends on the geometric parameters of the mixing chamber and the coefficients of friction between the particles and the walls of the chamber. Installed, graph analysis showed that for the studied range of camera sizes:1 – L_1=1 m, D_1=0,5 m, $d_{ц1}$=0,23 m, R_{g1}=0,783 m, h_1=0,25 m; 2 – L_2=0,4 m, D_2=0,15 m, $d_{ц2}$=0,09 m, R_{g1}=0,313 m, h_1=0,04 m); K_1=0,013, K_2=0,025), at the same time ω_{01}=2 s^{-1}, 7,2 s^{-1}, и ω_{02}= 2.8 s^{-1}, 8 s^{-1} by *n*=100 $mines^{-1}$, 300 $mines^{-1}$ or ω=10,5 s^{-1}, 20,9 s^{-1}, respectively. To simplify the calculations, the average values of the angular velocities of the particles are taken ω_0=2.4 s^{-1}, 5 s^{-1}, by ω=10,5 s^{-1}, 20,9 s^{-1}, respectively.

3. The equations of friction forces have been obtained: Fn, which occurs during the relative shear of adjacent layers of the mixture, and is caused by the action of the распорной force throughout the entire volume of the chamber; Fτ, which occurs as a result of the interaction of the mixture with the walls of the working chamber. The graphs of the friction forces F_n and F_τ (Fig. 3), depending on the technological and geometric parameters of the working chamber, show that the force F_n is many times greater than the force F_τ. This is due to the fact that the coefficient of friction of the mixed particles with the chamber material is almost two times lower than the coefficient of friction of the mixed particles with each other, as well as the fact that the contact area of the particles with the inner surface of the variable geometry chamber is much smaller than the contact area of the particles with each other.

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DOI 10.34660/INF.2025.18.97.019

信号衰落条件下具有擦除的信道的数学模型
MATHEMATICAL MODELS OF A CHANNEL WITH ERASURES UNDER CONDITIONS OF SIGNAL FADING

Panov Sergei Anatolevich
Candidate of Technical Sciences, Associate Professor

Minzhesarova Sabina Aleksandrovna
Bachelor's degree in additional education
Federal State Budget Educational Institution of Higher Education «K.G. Razumovsky Moscow State University of technologies and management (the First Cossack University)», Moscow, Russia

注释：以体积为单位测量，信息发送量已达到惊人的数值，且呈持续增长趋势。所使用的信息传输信道性质各异，会在传输信息中产生错误流。目前已有相当多的研究致力于开发信息传输信道错误流的模型描述，但构建考虑传输信道参数的适当模型仍然具有现实意义。本文提出了具有信号衰落的信道数学模型，其中应用了不可靠字符的擦除。所开发的模型考虑了信道衰落的参数以及由此产生的错误流和擦除之间的相关性。

关键词：离散消息；错误；错误概率；错误向量；信号衰落；信噪比；符号擦除。

Annotation. *The amount of information sent, measured in volume units, reaches enormous values, while its increase is a constant trend. The information transmission channels used are of different nature and create error streams in the transmitted information. Quite a lot of research has been devoted to the development of model descriptions of error flows of information transmission channels, but the construction of adequate models that take into account the parameters of transmission channels remains relevant. The paper presents mathematical models of channels with signal fading in which the erasure of unreliable characters is applied. The developed models take into account the parameters of channel fading and the correlation of the resulting error streams and erasures.*

Keywords: *Discrete message; error; error probability; error vector; signal fading; signal-to-noise ratio; symbol erasure.*

Introduction

Indicators of the quality of information transmission in discrete message transmission networks are usually the reliability of information transmission and the time of message delivery. Many studies have been devoted to increasing the reliability, in particular, the noise immunity of information reception. The main provisions for taking into account the parameters of real data transmission channels when calculating probable characteristics are laid down in [1,2], in [3] a mathematical apparatus of characteristic functions was developed that allows taking into account various parameters of signal fading. In [4,5,6,7], various issues of constructing models for calculating noise immunity for different types of channels with a common feature of error flow formation are considered.

One of the methods of increasing noise immunity in channels with a stream of errors is the method of reception with the erasure of unreliable characters and the use of codes that correct the streams of erasure. In this paper, we consider a discrete channel model with variable parameters that allow us to calculate the probabilistic characteristics of erasure and error flows. The channels that can be described by this model include heterogeneous channels of the decameter range of radio waves and other types of channels [4,5,6,7]. A special feature of such channels is the presence of memory in the condition of signal fading.

Mathematical modeling

The model of a discrete channel with a variable parameter without erasure is introduced in [2] and is defined by the expression:

$$P(e_{I_m}^{[n]}) = \int \dots \int \prod_{i \in I_m} p(\mu_i) \prod_{i \notin I_m} (1 - p(\mu_i)\, W(\mu_1, \mu_2 \dots, \mu_n) d\mu_i .. d\mu_n \quad (1)$$

Here n is the length of the sequence of transmitted characters, $e_{I_m}^{[n]}$ defines the error vector, $e_{I_m}^{[n]} = (e_1, e_2, .. e_n), e_i = 1,$ если $i \in I_m, e_i = 0,$ если $i \notin I_m,$ $e_i = 1$ indicates an error in this character., $p(\mu_i)$ - the probability of erroneous reception of the symbol at the ith position, $W(\mu_1, \mu_2 \dots, \mu_n)$ multidimensional probability density of a variable parameter μ_i.

The model of a discrete erasing channel with a variable parameter μ, similarly to (1) может can be defined as:

$$P(e_{I_{m,m_1}}^{[n]}) = \int \dots \int \prod_{i \in I_{m,m_1}} p(\mu_i) \prod_{j \in I_{m,m_1}} s(\mu_j) \prod_{k \in I_{m,m_1}} q(\mu_k) W(\mu_1, \mu_2 \dots, \mu_n) d\mu_i .. d\mu_n \quad (2)$$

Where $e_{I_{m,m_1}}^{[n]}$ is a vector with m errors, m_1 erasure, $s(\mu_j)$ - is the probability of erasing the jth character, $q(\mu_k)$ – is the probability of correctly accepting a character in the kth position.

At the same time:

$$p(\mu) + s(\mu) + q(\mu) = 1 \quad (3)$$

Let's express $q(\mu)$ from (3), $q(\mu) = 1 - p(\mu) - s(\mu)$ and we expand the product in (2) as:

$$\prod_{k\in I_{m,m_1}}(1-p(\mu_k)-s(\mu_k)=\sum_{r_1+r_2+r_3=d}(-1)^{r_2+r_3}\sum_{l=1}^{C_d(r_1,r_2,r_3)}\prod_{j\in I_{r_2}^{[l]}}p(\mu_j)\prod_{b\in I_{r_3}^{[l]}}s(\mu_b) \quad (4)$$

where $d=n-m-m_1$, $C_d(r_1,r_2,r_3)=\frac{d!}{r_1!r_2!r_3!}$.

Vectors $I_{r_2}^{[l]}$ и $I_{r_3}^{[l]}$ denote the lth combination, respectively, of r_2 multipliers of $p(\mu)$ and r_3 multipliers of $s(\mu)$ in the free spaces defined by the vector $e_{I_{m,m_1}}^{[n]}$.

Taking into account (4), expression (2) is written as:

$$P(e_{I_{m,m_1}}^{[n]})= \quad (5)$$

$$\int\dots\int\sum_{r_1+r_2+r_3=d}(-1)^{r_2+r_3}\sum_{l=1}^{C_d(r_1,r_2,r_3)}\prod_{j\in I_{m+r_2}^{[l]}}p(\mu_j)\prod_{k\in I_{r_3+m_1}}s(\mu_j)\,W(\mu_1,\mu_2\dots,\mu_n)d\mu_i..d$$

Let's determine the probability of an incoherent reception in an orthogonal system with an active pause [1]. It is known that for a channel without erasure, the error probability is [8].

$$p_{\text{ош}}=P(U_{\text{П}}>U_{\text{СП}})$$

where $U_{\text{П}}$ - is the amplitude of interference in the path without a signal, and $U_{\text{П}}$ - is the amplitude of the signal and interference in the path with a signal.

For the erasing channel, assume that the probability of error is:

$$p_{\text{ош}}=P(U_{\text{П}}>U_{\text{СП}}(1+\alpha))$$

where $0\le\alpha\le 1$ defines the erase zone.

Then following [8]:

$$p_{\text{ош}}=e^{-h^2}\int_0^{\infty}xe^{-\frac{x^2}{2}}I_0(x\sqrt{2}h)\left[\int_{x(1+\alpha)}^{\infty}ye^{-y^2/2}dy\right]dx=\frac{1}{1+(1+\alpha)}e^{-\frac{h^2(1+\alpha)^2}{1+(1+\alpha)^2}}=\beta e^{-h^2(1-\beta)} \quad (8)$$

where $I_0(x)$ – the Bessel function, h^2- signal-to-noise ratio.

After a number of transformations, we finally have:

$$P\left(e_{I_{m,m_1}}^{[n]}\right)$$

$$=\sum_{r_1+r_2+r_3=d}(-1)^{r_2+r_3}\sum_{l=1}^{C_d(r_1,r_2,r_3)}\sum_{k=0}^{m_1+r_3}(-1)^k\sum_{g=1}^{C_{m_1+r_3}^{k}}e^{\ln\beta(m+r_2)+\ln\beta'(m_1+r_3)+k(\ln\beta-\ln\beta')}$$

$$\int..\int e^{[(1-\beta)\sum_{j\in I_{m+r_2}^{[l]}}\mu_j^2+(1-\beta')\sum_{k\in I_{m_1+r_3}^{[l]}}\mu_k^2+(\beta-\beta')\sum_{c\in I_k^{[g]}}\mu_c^2}W(\mu_1,\mu_2\dots,\mu_n)d\mu_i..d\mu_n \quad (9)$$

where $\beta=\frac{1}{1+(1+\alpha)}$, $\beta'=\frac{1}{1-(1-\alpha)}$

Applying the Laplace characteristic function method for a channel with Nakagami-Rice fades [3] from (9), we obtain:

$$P\left(e_{I_{m,m_1}}^{[n]}\right) = \sum_{r_1+r_2+r_3=d}(-1)^{r_2+r_3}\sum_{l=1}^{C_d(r_1,r_2,r_3)}\sum_{k=0}^{m_1+r_3}(-1)^k\sum_{g=1}^{C_{m_1+r_3}^k} e^{ln\beta(m+r_2)+ln\beta'(m_1+r_3)+k(ln\beta-ln\beta')}\theta(V_{rl}T_{kg}) \quad (10)$$

where $\theta(\cdot)$ - the characteristic function of the Laplace square transformation of a variable parameter, $\tau = m + r_2, V_{rl} = diag(v_1, v_2, .. v_n), v_j = ih^2(1-\beta), i = \sqrt{-1}, v_k = \begin{cases}\tau_j, k = 1, \tau \\ 0, \ k = \tau, k\end{cases}$

$T_{kg} = diag(t_1, t_2, \dots t_n), t_j = ih^2(\beta - \beta')$

Calculating the probability of a vector of errors and erasures for large values of n, the number of characters transmitted, is computationally difficult even for modern high-speed computers [9].

The boundary cases of expression (10) are the case of a channel with independent fades and a channel with constant correlation.

For a channel with independent signal fades, we have:

$$P_{\text{нз}}\left(e_{I_{m,m_1}}^{[n]}\right) = \sum_{r_1+r_2+r_3=d}(-1)^{r_2+r_3}C_d(r_1,r_2,r_3)\sum_{i=0}^{m_1+r_3}(-1)^i C_{m_1+r_3}^i e^{ln\beta(m+r_2+i)}\theta^{m+r_2+i}((1-\beta)v)\cdot\cdot e^{ln\beta'(m_1+r_3-i)}\theta^{m_1+r_3-i}((1-\beta')v) \quad (11)$$

where $\theta((1-\beta)v) = \frac{1}{((1-\beta)v+1)^{m_g}} exp(-\frac{m_g q^2(1-\beta)v}{(1-\beta)v+1}), v = \frac{h^2}{m_g(1+q^2)}, m_g, q^2$ – Nakagami-Rice distribution parameters.

For a channel with constant correlation, or as it is called in [2], a composite channel, we have:

$$P_{\text{ск}}\left(e_{I_{m,m_1}}^{[n]}\right) = \sum_{r_1+r_2+r_3=d}(-1)^{r_2+r_3}C_d(r_1,r_2,r_3)\sum_{k=0}^{m_1+r_3}(-1)^k C_{m_1+r_3}^k \cdot e^{ln\beta(m+r_2)+ln\beta'(m_1+r_3)+k(ln\beta-ln\beta')}\theta^{m+r_2+i}(\varepsilon v) \quad (12)$$

where $\varepsilon = (1-\beta)(m+r_2) + (1-\beta')(m_1+r_3) + (\beta'-\beta)k$

From (10) we obtain the probability of occurrence of the vector of erasures at m=0, m_1=n:

$$P\left(e_{I_{o,n}}^{[n]}\right) = \sum_{k=0}^{n}(-1)^k\sum_{g=1}^{C_n^k} e^{nln\beta'+k(ln\beta-ln\beta')}\theta(T_{kg})$$

where $C_n^k = \frac{k!}{n!(n-k)!}$ the number of combinations.

The probability of error-free reception of a block of symbols is obtained from (10) when $m_1 = 0, m = 0$:

$$P\left(e_{I_{o,o}}^{[n]}\right) = \sum_{r_1+r_2+r_3=n}(-1)^{r_2+r_3}\sum_{l=1}^{C_n(r_1,r_2,r_3)}\sum_{k=0}^{r_3}(-1)^k\sum_{g=1}^{C_{r_3}^k} e^{ln\beta r_2+ln\beta' r_2+k(ln\beta-ln\beta')}\theta(V_{lr_2}T_{kg})$$

Integral indicators are more informative, which can be obtained using expression (10), for example, the indicator - is the probability of exactly m errors and m_1 erasures in a block of n characters:

$$P(m, m_1, n) = \sum_{I_{m,m_1}} P(e^{[n]}_{I_{m,m_1}}) \quad (13)$$

where in (13), the summation is performed over all vectors with m errors and m_1 erasures.

For channels with independent signal fades and a channel with constant correlation, the probability (13) will take the form:

$$P(m, m_1, n) = \frac{n!}{(n-m-m_1)!m!m_1!} P(e^{[n]}_{I_{m,m_1}}) \quad (14)$$

where in (14) $P(e^{[n]}_{I_{m,m_1}})$ it is calculated by formulas (11) and (12), respectively.

To select the type of noise-resistant encoding, the important characteristics are the probability of a multiplicity error greater than the specified one for a given number of erasures, it can be calculated using the following expression:

$$P(\geq m, m_1, n) = \sum_{i=m}^{n} \sum_{I_{i,m_1}} P(e^{[n]}_{I_{i,m_1}}) \quad (15)$$

For channels with independent signal fades and a channel with constant correlation, the probability (15) will take the form:

$$P(\geq m, m_1, n) = \sum_{i=m}^{n} \frac{n!}{(n-i-m_1)!i!m_1!} P(e^{[n]}_{I_{i,m_1}}) \quad (16)$$

Conclusion

Calculating the probability of message delivery is especially relevant in cases where messages are transmitted over several heterogeneous channels, of different frequency ranges, and virtually error-free message delivery is required. In this case, before transmitting a message, it is necessary to evaluate the probability of error-free reception in real time.

For the mathematical models presented in this paper, software has been developed in the Scilab system, which allows calculating the probabilistic characteristics of a channel with the erasure of unreliable simulations.

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DOI 10.34660/INF.2025.44.11.020
UDC 622.777.4

银矿的电分离
ELECTROSEPARATION OF SILVINITE ORES

Chernykh Oleg Lvovich
Candidate of Technical Sciences, Deputy Chief Designer for Science
OOO NPF TeploEnergoProm, Perm

摘要：本文致力于钾盐矿石的选矿和干法富集技术与设备的研发。矿石研磨阶段在旋转电磁场中带有涡流层的设备工作室内进行，同时对矿石进行真空干燥。文中给出了硬件和工艺流程图（设备链）。文中还介绍了格列米亚钦斯基采矿和加工厂钾盐矿石静电分选的结果。

关键词：干法研磨，电感器，微弧处理，铁磁针，真空干燥，矿石除尘，重力气动分级机，摩擦起电，旋转电磁场，机械矿石粒度分级，自由落体电选机，带式电选机。

Abstract. *The article is devoted to the development of technology and equipment for ore preparation and dry enrichment of sylvinite ores. The stage of ore grinding is supposed to be carried out in the working chamber of the apparatus with a vortex layer in a rotating electromagnetic field with simultaneous vacuum drying of the ore. The hardware and process flow chart (chain of apparatuses) is presented. The results of electrostatic separation of sylvinite ore of the Gremyachinsky Mining and Processing Plant are presented.*

Keywords: *Dry grinding, inductor, microarc processing, ferromagnetic needles, vacuum drying, ore dust removal, gravity pneumatic classifiers, tribocharging, rotating electromagnetic field, machine ore size classes, free-fall electric separator, belt electric separator.*

The existing regulatory documents, for example: [1,2], indicate to us the prospects of dry methods of ore enrichment. Analysis of the existing problems of industrial implementation of the electric separation method suggests that this is a complex, multi-link technology.

Previously conducted, mainly laboratory tests with the separation of sylvinite ores on electric separators, showed that the technology (developed 50 years ago) includes the following main stages: crushing; dry grinding; dust removal; thermal drying; heating; separation of ore into machine sizes, charging of particles of insoluble residue (IR) and anhydrite (CaSO4), or obtaining IR (and anhydrite)

particles with surface conductivity properties, separation of IR (and anhydrite) particles on a drum corona-electrostatic separator; treatment with reagents; tribocharging; electrostatic separation of sylvinite and halite. The main disadvantages of the technologies and electric separators previously used in the USSR were: the inability to separate finely dispersed materials; the presence of a thermal drying stage blocked the way to install dry enrichment units in mines; very low productivity (up to 2 t/h) of electric separators produced in the USSR and subsequently in Russia. Thus, the fundamental possibility of dry pre-enrichment of sylvinite ores with the removal of insoluble residue and separation of the main minerals: sylvinite and halite was experimentally proven. The resulting concentrate contained up to 90-92% KCl. A significant amount of research work has previously been carried out on sylvinite ores, starting from a dissertation - [3], and ending with a book - [4]. However, enrichment of sylvinite ore of the Gremyachinsky potash deposit performed for the first time in laboratory, test trials on electric separators, in particular the issue of removing CaSO4 by a dry method was not described in the scientific and technical literature. The ore differs from other potash deposits (Verkhnekamskoe, Starobinskoe, Tyubegatanskoe) by the presence of a significant amount of anhydrite CaSO4 in its composition (up to 10%). Therefore, when processing ores of the Gremyachinsky GOK by the flotation method, EuroChem-VolgaKaliy LLC obtains a flotation concentrate with a content of the main substance of 92%. Subsequently, NaCl is leached with water and the KCl content is brought to 95%. However, this is not always possible, since CaSO4 is poorly soluble and often the final product has a KCl content of less than 95% and the manufacturer is forced to ship the finished product to the consumer as grade 2. The initial ore sample with the initial size of +0-10 mm in the amount of 10.45 kg was subjected to dry grinding in a centrifugal-reflective mill TsOM-250 with a 250 mm accelerating disk diameter. The ore was sifted on a 1.0 mm sieve, the large fraction was sent for re-grinding. The fraction less than 1 mm was divided into machine classes +0-40 μm; +40-500 μm; +0.5-1.0 mm using a set of appropriate sieves. The dust fraction was weighed and discarded, not used in the experiments. The yield of this fraction was 7.2%. If necessary, the dust fraction can be processed by the dry method on belt electric separators, or other, mainly wet methods. The large fraction +0.5-1.0 mm was also discarded, because on this type of free-fall electric separator at an electric field strength of 3 kV/cm it cannot be separated due to insufficient electric charges on ore particles and insufficient electric field strength, which should be 4-5 kV/cm. At the same time, it is known that large class is enriched better. It should be noted that the separation of ore on a 40 μm sieve was not carried out effectively enough and the presence of a dust fraction in the machine class +40-500 μm was also visually observed, with which further tests were carried out.

Thermal drying of ore samples of machine class +0.040-0.5 mm was carried out in a laboratory drying cabinet at a temperature of 120 °C. Drying was carried out for 20-25 minutes until a constant sample weight of 2-2.5 kg and a residual moisture content of less than 0.1%.

Reagent treatment was carried out by adding a powder reagent (salicylic or benzoic acid) to the dried ore sample, thoroughly mixing it and re-heating it in a drying cabinet for 5-10 minutes at a temperature of 120 °C. The reagent weight was selected based on no more than 200 g / t of ore.

Tribocharging was carried out on a mesh vibrating tray when pouring ore from a hopper into an electric separator. The vibrating tray was set in reciprocating motion using an electromagnetic device. Electromagnetic separation

The removal of insoluble residue was carried out on a laboratory electromagnetic separator with a magnetic field strength of 1.5 T. In this case, clay particles were separated both from the +0.5-1.0 mm ore fraction and from the +0.04-0.5 mm ore fraction. It should be noted that the yield of this I.O. was extremely small, due to the low content in the original ore - less than 1%.

It is known that the KCl content in the ore of the Gremyachinskoye deposit reaches up to 40%. At the same time, the I.O. contains less than 1% iron oxides and no more than 0.1% nickel. But even such tiny amounts of ferromagnetic particles are sufficient to separate them and, together with them, the I.O., using a dry method (see Fig. 1). Similar results were obtained with sylvinite ores of other potash deposits [5].

Electrical separation in a free-fall electrical separator

In 2024, a research study was conducted on a laboratory electrical separator with a flat electrode height of 1.45 m designed by Russkaya Korona LLC with a 30 kV voltage source.

It should be noted that not only single tests of sylvinite ore separation were carried out, but also repeated ones, i.e. re-cleaning of separation products.

Earlier, in 2022, similar tests were carried out on the enrichment of sylvinite ore of the Talitsky section of the Verkhnekamskoye potassium salt deposit. Encouraging results were obtained.

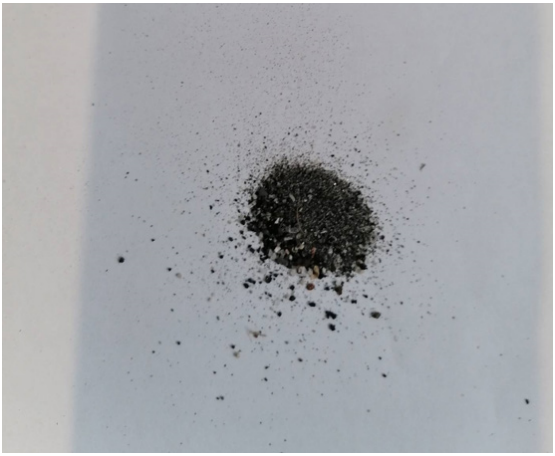


Figure 1. *Insoluble residue particles separated from the ore fraction +0.04-0.5 mm, by electromagnetic method*

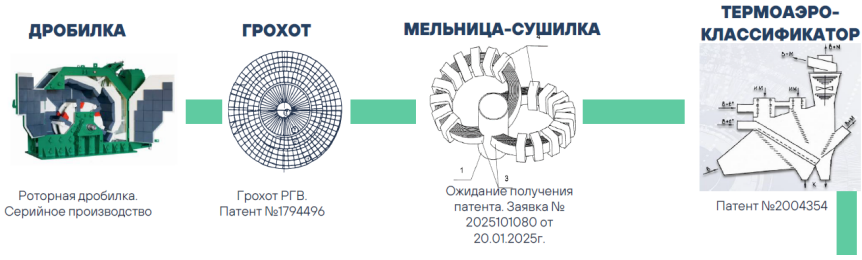
Main results of laboratory tests of sylvinite ore electrical separation at Gremyachinsky Mining and Processing Plant in 2024

1. With electrical separation using a reagent (salicylic acid), the possibility of obtaining first-stage halite tailings with a KCl content of ~10÷8% was demonstrated. In the cleaning operation (tailings), the KCl content in the tailings was further reduced to 2.18÷2.7%. At the completed stage of the experiments, there is reason to believe that the yield of halite tailings (see Fig. 2) with a KCl content of ~2.7÷2.8% can amount to a total of ~44-45% with a loss of sylvinite extraction of ~3÷4%.
2. In this case, the yield of the enriched product (with a KCl content of ~77%) can be ~50% with the extraction of sylvite of ~90%.
3. The second stage of laboratory tests demonstrated the fundamental possibility of obtaining concentrates with a KCl content of 85% to 89.0÷90.5% with a CaSO4 content of 3.26÷4.4% from the enriched product with KCl of ~70÷75% using an additional electrical separation operation.

Figure 2. *Beneficiation tailings – NaCl*

It is obvious that with such contamination of the concentrate with anhydrite (3.26÷4.4%), the quality of the finished product is not satisfactory, at least the proportion of the remaining anhydrite in the concentrate is the same as in flotation beneficiation at the existing flotation plant. Here, we can talk about pre-beneficiation of the ore, or achieve a decrease in the anhydrite content in the concentrate by additional physical effects, for example, ultrasonic treatment. At least, obtaining tailings with KCl extraction losses of 3-4% can be considered a satisfactory result at this stage of R&D.

Further development of the hardware design of dry beneficiation technology using electrical separation of sylvinite ore can be represented by a chain of devices (Figure 3).



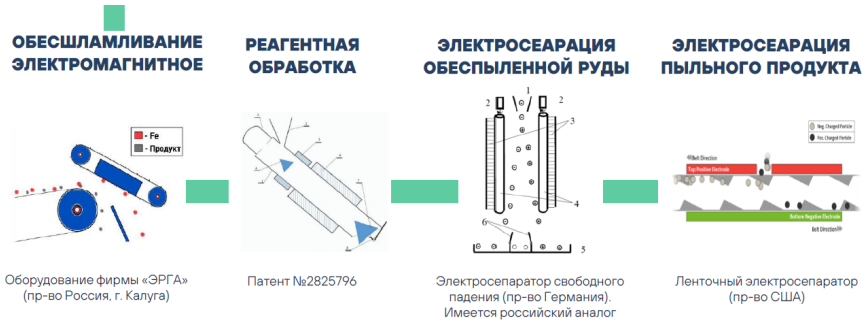


Figure 3. *Chain of devices of dry enrichment technology of sylvinite ore*

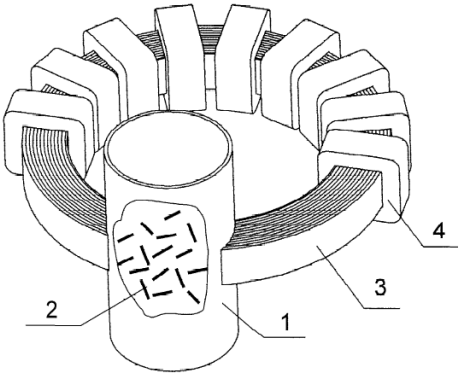
PNEUMOCLASSIFICATION

Based on the results of the tests, it was noted that after dry grinding of the ore, anhydrite during classification (division into machine classes) was concentrated in dust (less than 40 μm) and large fractions (+0.5-1 mm). The fraction of ore +0.04-0.5 mm contains about 1% of anhydrite. Based on this fact, as well as the need to distinguish machine classes of ore before its electrical separation on various types of electrical separators, the expediency of the ore classification stage in the dry enrichment technology is substantiated. The problem is aggravated by the presence of finely dispersed clay particles in the sylvinite ore, as well as the presence of moisture in it. A mass fraction of moisture in the ore of more than 0.5% makes it significantly less free-flowing and the pneumatic transport properties of the ore are sharply reduced. It agglomerates and demonstrates a tendency to arching, which complicates its pouring into chutes and bunkers of dust-collecting equipment. Despite the above, the technical problems of ore pneumatic classification were solved more than 30 years ago [6]. Gravity pneumatic classifiers of various designs, including those with a combined drying process, were developed and tested, including on sylvinite ores. The main advantages of pneumatic classification are high separation efficiency (especially for materials with a high content of dust fraction), a wide range of separation boundaries with smooth adjustment from 5 to 5000 μm with the ability to change the separation boundaries of the original product during operation. The productivity of pneumatic separators is from several kilograms to hundreds of tons per hour, while energy costs do not exceed 2 kW h / t. Pneumatic classifiers operate under vacuum, so they do not produce dust, can operate in a closed air cycle and meet environmental requirements.

If we take modern gravity pneumatic classifiers, their specific load reaches 20 t/h·m2 when separating by a boundary grain of 0.1 mm, while for screens the latter will be 0.2 t/h·m2.

Grinding in vortex layer devices

In recent years, interest in devices with a vortex layer in a rotating electromagnetic field has revived in Russia [7]. The development and improvement of the specified devices is directed towards: increasing their unit capacity, developing built-in devices to improve the efficiency of bulk material processing, regulating the temperature in the working chamber, ensuring explosion-proof conditions, using abrasion-resistant and corrosion-resistant coatings of working elements and the working chamber, combining various processes in one device, as well as improving the automatic control system for the grinding process of granular materials. Publications have appeared [8] that it is possible to create grinding devices based on the specified principles with a capacity of up to several hundred tons per hour. The devices under consideration are finding ever greater areas of application. They are very compact and demonstrate energy consumption 20-40% lower than traditional ball drum mills, which have been known to the world for over 130 years. The device with a vortex layer of ferromagnetic elements (AVS) is a working chamber (pipeline) with a diameter of 60–330 mm, located in the inductor of a rotating electromagnetic field (EMF). The working area of the pipeline contains cylindrical ferromagnetic elements with a diameter of 0.5–5 mm and a length of 5–60 mm in quantities ranging from several tens to several thousand pieces (0.05–20 kg), depending on the working area of the apparatus (Figure 4) [9].



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Tribocharging, reagent treatment

The most important stage of electrostatic enrichment technology is the preparation of ore before the main separation stage, by applying electric charges to the particles of sylvinite ore minerals. We have proposed two technical solutions: charging ore particles by treating them with jets of finely dispersed NaCl or KCl powder [12]; charging ore particles by treating them with cold plasma and ions in a rotating electromagnetic field [13]. It is also proposed to carry out reagent treatment of ore in this device.

Conclusions

Technologies that involve the use of discharge-pulse treatment of mineral raw materials at the stages of ore preparation are increasingly penetrating into the practice of processing mineral raw materials during enrichment. It is these innovative methods that provide a significant leap in reducing energy costs for ore disintegration.

Sylvinite ores are enriched by dry methods and, in the future, we can hope to place enrichment plants in mines. Continuation of R & D on the development of dry enrichment technology for sylvinite ores using electric separators seems to be an extremely promising direction.

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DOI 10.34660/INF.2025.55.81.021

关于水在相变过程中的结构和性质
ABOUT THE STRUCTURE AND PROPERTIES OF WATER DURING PHASE TRANSITIONS

Khalidov Gamid Yusupovich
Advisor
Dagestan Scientific Center of the Russian Academy of Sciences

摘要：本文探讨了水分子在“冰-水”和“水-冰”相变过程中，在核、分子内和分子间层面上发生的过程。文中提出的理解原子核形成过程中质子和中子相互作用过程的方法，也有助于解释“魔核”强度增强的原因、元素周期表中放射性元素原子核的不稳定性以及“Mhebe”效应等。

关键词：核层、相变、中子、水分子、电子、质子、氧原子核。

Abstract. *The article examines the processes occurring at the nuclear, intramolecular and intermolecular levels of water molecules during the phase transitions “ice - water” and “water - ice”. The approach to understanding the processes of interaction of protons and neutrons during the formation of atomic nuclei, presented in the article, also allows us to explain the reason for the increased strength of “magic” nuclei, the instability of nuclei of radioactive elements of the periodic table, the “Mhebe” effect, etc.*

Keywords: *nuclear sphere, phase transitions, neutron, water molecule, electron, proton, oxygen nucleus.*

According to the hypothesis, with a sufficient number of protons (taking into account the number of neutrons and the volume they occupy), nuclei tend to take the most stable spherical shape to external pressure. In such nuclei, the sphere consists of protons. And between the protons, below their level, as well as deep in the nucleus, neutrons are located, forming a “rigid” framework for the proton sphere and generally enhancing the stability of the nucleus.

As stated in the article by American physicists, experimental data with a reliability of 99.997% refute the currently accepted model, according to which the movement of nucleons in the nucleus is chaotic and is described by the mathematical theory of random matrices.

It follows from this that we will have to abandon both the old - “planetary” models of the atom, and the prevailing idea in physics today about the electrons of

the atom - as an electron cloud freely floating in the volume of the atom, and place each electron strictly opposite each proton of the nucleus.

Let us accept this assumption as a working hypothesis and check its applicability to understanding the structure of the water molecule H2O and the processes occurring in it during the phase transitions “ice-water” and “water-ice”.

According to the hypothesis, the sphere of the nucleus of the oxygen atom should consist of eight protons (p1-p8), located at the eight vertices of a conditional cube (as the most stable volumetric geometric body inscribed in a sphere) (Fig. 1). The neutrons of the nucleus of the oxygen atom should form inside this “proton” cube - a “neutron” cube (n1-n8), the edge length of which and the distance from each of its vertices to the two nearest vertices of the “proton” cube are the same*:* $p_1n_1=n_1p_2$; $p_2n_2=n_2p_3$; $p_3n_3=n_3p_4$; $p_4n_4=n_4p_1$; $p_5n_5=n_5p_6$; $p_6n_6=n_6p_7$; $p_7n_7=n_7p_8$; $p_8n_8=n_8p_5$.

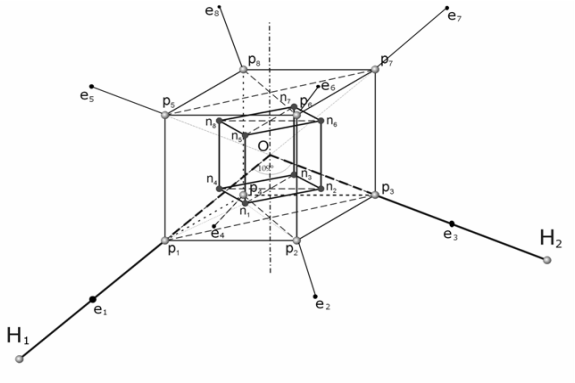

Figure 1.

This arrangement of neutrons in the nucleus of the oxygen atom provides maximum stability of the protons of the nucleus sphere, since each vertex of the “neutron” cube is stabilized by the maximum (five) possible number of bonds. So for vertex n1 it is $n_1p_1=n_1p_2$, $n_1n_2=n_1n_4=n_1n_5$.

The considered design of the oxygen nucleus and its proton sphere allows us to calculate the angle p_1-O-p_3 formed by the segments connecting the center of the cube O with the protons p1 and p_3 located at opposite vertices of one face of the cube. It turned out to be equal to 109°. But according to experimental data in the water molecule (in the ice state) the angle H_1-O-H_2 between the nuclei of the hydrogen and oxygen atoms is also equal to 1090.

This allows us to assume that in the water molecule two nuclei (protons) of the hydrogen atoms H1 and H2 are located opposite two protons of the nucleus

of the oxygen atom located at the vertices of the cube p1 and p3. According to the hypothesis, only one common electron located between them on the line of action of their forces can bind two protons of different atomic nuclei into a stable compound. For a water molecule, this is e1 on the segment of the side of the angle H_1p_1, and e3 on – H_2p_3. This follows from the logic of reasoning and is consistent with the sizes of hydrogen and oxygen atoms in a water molecule. And it is clear that in this design of a water molecule, the location of two electrons on each of the segments of the sides of the angle H_1p_1 and H_2p_3 opposite H_1 and p_1, and H_2 and p_3, due to the sameness of their charges, does not allow for the creation of even a low-stable compound.

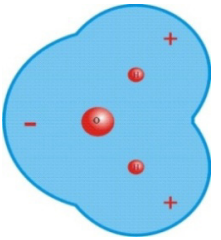

Figure 2.

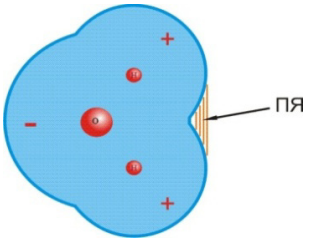

Figure 3.

When the temperature (energy) of the water molecule (in the ice state) (Fig. 1 and Fig. 2) increases to the values of the phase transition, a rapid one-time convergence of the nuclei of the H_1 and H_2 hydrogen atoms occurs, which entails a decrease in the angle H_1-O-H_2 to 104.50 and a compression of the segments H_1p_1 and H_2p_3 of the sides of the angle H_1-O-H_2 (Fig. 3 and Fig. 4)

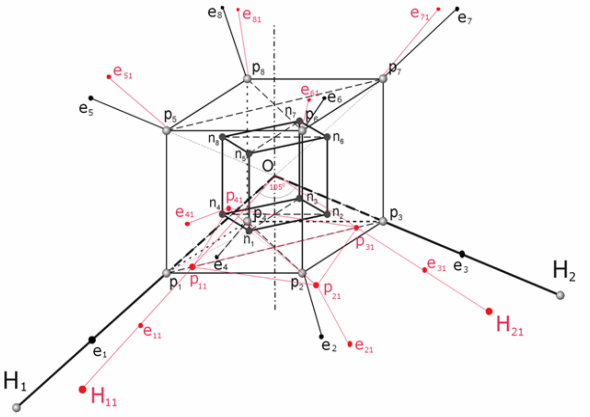

Figure 4.

The reason for this phenomenon, according to the hypothesis, is that at the moment of the phase transition, due to the greater amount of intramolecular energy in the H_1-O-H_2 part of the molecule's volume than in the H_1 - H_2 part of the molecule's volume, the pressure force aimed at bringing H_1 and H_2 closer together exceeded the pressure force aimed at pushing them apart.

For a better understanding of the reasons for this phenomenon, it would be appropriate to compare it with the phenomenon of two boats approaching each other in calm water, located close to and parallel to each other, which occurs due to the excess of the water pressure force on the sides of the boats from the free, larger space of water over the pressure force on the sides of the boats from the small space of water between the boats.

According to the hypothesis, it is the decrease-increase of the H_1 - H_2 distance, which subsequently causes a change in the arrangement of all protons and electrons in the molecule, including the common electrons e_1 and e_3 in the H_1-p_1 and H_2-p_3 bonds, the decrease-increase of the H_1-O-H_2 angle and the H_1-p_1, H_2-p_3 distances, the very shape of the water molecule with its design feature - the "potential well" (PW), - that are the causes of the unique physical and chemical properties of water in all its three aggregate states. To verify the above, we will study the processes occurring during phase transitions in water molecules and between them, and try to understand the reasons for the anomalous behavior of water density in the temperature range from 0 ° C to 3.98 ° C. During the ice-water phase transition, when there is no thermal motion, the decisive influence on the sudden increase in water density, according to the hypothesis, is exerted by the new intramolecular arrangement of the nuclei and electrons of the water molecules, which makes it possible for intermolecular bonds to arise between neighboring molecules and which appear simultaneously with the phase transition and arise between the two positive poles H_1 and H_2 of the hydrogen nuclei of one water molecule and the two negative poles of the pair of electrons e^1_5 and e^1_7 of the oxygen nucleus of another molecule.

At new locations H_1 - H_{11}, H_2- H_{21}, e^1_5 - e^1_{51} and e^1_7 - e^1_{71} the distances between H_{11} and e^1_{51} are less than the distance between H_{11} and e^1_{51}, and accordingly $H_2{}^1$ and e^1_{71} are less than $H_2{}^1$ and e^1_{71}, which allows the forces of attraction to be realized and bring the molecules closer together along the lines $H_1{}^1$ - e^1_{51} и $H_2{}^1$ - e^1_{71} of the direction of the forces of action of the 2 positive poles of the hydrogen nuclei $H_1{}^1$ and $H_2{}^1$ of one molecule and the 2 negative poles e151 and e^1_{71} of the oxygen nucleus O of another molecule (Fig. 5). The appearance of these forces is caused by an abrupt change in the location of both nuclei of hydrogen atoms in the volume of the molecule from position H_1 to position $H_1{}^1$, and H2 to position $H_2{}^1$, and the electrons of the nucleus of the oxygen atom from position e^1_5 to position e^1_{51}, and e17 to position e^1_{71}, i.e. an abrupt change in the location and direction of the forces

of action of the positive and negative poles, which gives an abrupt increase in the forces of attraction between molecules, causes their mutual convergence and, as a consequence of this convergence, the density of water increases.

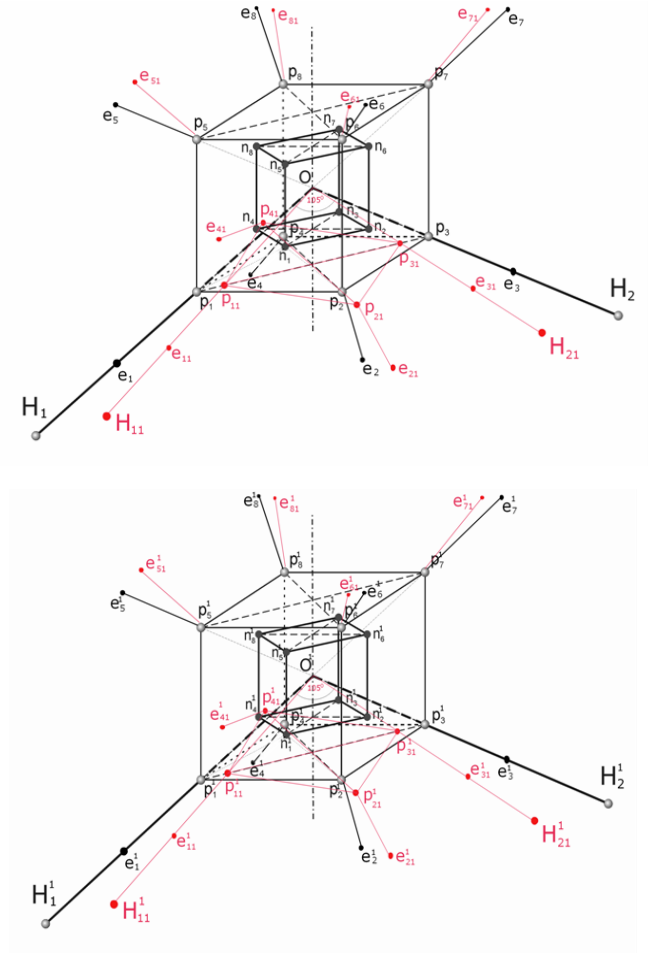

Figure 5.

Having come closer and thereby increasing the density of water by 9%, the molecules stop due to the resulting equilibrium between the forces of attraction and repulsion (Fig. 6).

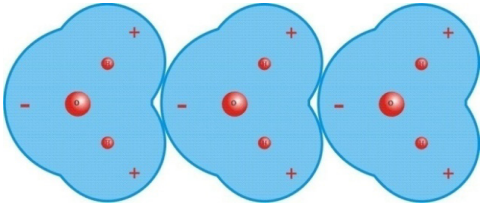

Figure 6.

That is, the attractive force of the bonds acting between the nuclei of the hydrogen atoms H_{11} and H_{21} of one molecule and two electrons e^1_{51} and e^1_{71} of the nucleus of the oxygen atom of another molecule is balanced by the repulsive force created by two electrons e_{21} and e_{41} located opposite the protons p_{21} and p_{41} of the nucleus of the oxygen atom of one molecule and two electrons, e^1_{61} and e^1_{81}, located opposite the protons p^1_6 и p^1_8 of the nucleus of the oxygen atom of another molecule.

With this convergence and compaction, the boundaries of the "potential wells" of the molecules intersect and the molecules are placed in a part of each other's "potential wells". The following reasoning leads to this assumption. During the water-ice phase transition, along with the phenomena already described, there is a sharp increase in the level of negative energy in the "potential wells" of water molecules, when the electrons of the oxygen atom nucleus of one molecule come closer to each other when returning to their original positions e2 and e4 from positions e21 and e41 and are repelled by the electrons of the oxygen atom nucleus of another molecule, which have returned to positions e^1_6 and e^1_8 from positions e^1_{61} and e^1_{81}. This mutual repulsion "pushes" the molecules out of each other's potential wells, which causes a sudden increase in the volume of water (ice) by 9%. If the molecules were not in each other's potential wells, then during the water-ice phase transition there would be neither their rapid expulsion nor a rapid increase in the volume of water (ice). And we consider the transformation of water into ice as a consequence of an abrupt increase, and therefore rapid cooling, of the intermolecular and intramolecular space of water molecules (Fig. 7).

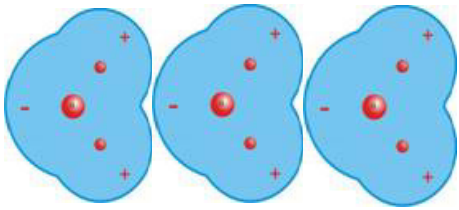

Figure 7.

With further cooling, changes in intermolecular and intramolecular energy levels and distances will repeatedly occur, which will produce many varieties of ice.

The hypothesis suggests that a change in the location of H1 and H2 causes a subsequent shift in the location of the p1 and p3 protons of the oxygen atom nucleus. This causes a deformation of the "neutron cube", which, in turn, deforms the proton sphere of the oxygen atom nucleus in such a way that all its protons and their electrons change their location and the "proton" cubic shape of the oxygen atom nucleus is transformed into a parallelepiped, where the "lower" and "upper" squares of the cube become rhombuses.

Until experiments and calculations are carried out, it is too early to talk about all the changes that take place during phase transitions, in the parameters of the oxygen nucleus of the water molecule, and in the water molecule as a whole.

In the first approximation, we can talk about the following changes:

- *the angle H_1–O–H_2 is transformed into the angle H_{11}–O–H_{21} and decreases to 104.50.*
- *the protons p_1 u p_3 come closer together, occupy the positions p_{11} u p_{31} and are somewhat "sunk" into the nucleus, which results in a decrease in H_1p_1 when it moves to the position $H_{11}p_{11}$and a decrease in H_2p_3 when it moves to the position H_{21} p_{31}.*
- *the convergence of the protons p_5 and p_7 causes the electrons e5 and e7 located opposite them to converge and occupy the positions e_5 and e_7. For similar reasons, the electrons e_2 and e_6 come closer and occupy the positions e_{21} and e_{61}, and the electrons e4 and e8 come closer and occupy the positions e_{41} and e_{81}.*
- ***as a result of these convergences in the water molecule between the electrons $e_{51} – e_{71}$, $e_{21} – e_{61}$ and $e_{41} – e_{81}$, areas of increased concentration of negative energy are formed, capable of breaking the chemical bonds of most substances, which gives water such high dissolving abilities.***
- *the structure of molecules is a direct consequence of the structure of the nuclei of atoms of chemical elements, or more precisely their proton spheres. That is, atoms, forming molecules, connect with each other precisely through the common electrons of the protons of the nuclei of atoms, or in other words - "proton regions".*
- ***the region between the electrons e_2 and e4 in the positions e_{21} and e_{41}, due to the increased distance between them, becomes a region with a reduced level of negative energy, i.e. a "potential well" (PW), which, as will be shown below, is the cause of the anomalous behavior of the density of water in the range from 0°C to 3.98°C.***

As is known, with an increase in temperature from 0°C to 3.98°C and the onset of thermal motion of molecules, an anomalous behavior of water density is observed - its increase.

According to the hypothesis, the increase in water density in the temperature range under consideration is caused by the continuation (after the phase transition) of the process of convergence of water molecules, which occurs due to further interpenetration and placement of molecules in the remaining free volume of the potential wells of molecules.

The reason for this interpenetration is the increasing thermal motion of molecules, the pressure force of which begins to exceed the resistance forces of the energy levels of the "potential wells".

That is, the force of increasing thermal motion of molecules tends to overcome the forces of mutual repulsion acting between the regions of negative energy located opposite each other, formed by the electrons e_{21} - e_{41} of one molecule and the electrons e^{1}_{61}–e^{1}_{81} of another molecule. But, since in the central part of the region e_{21} - e_{41} there is a PY, and opposite to it, in the central part of the region e^{1}_{61}–e^{1}_{81}, on the contrary, there is a concentration of energy, it becomes possible to "push" one molecule into another and bring them closer.

As a result, at a temperature of 3.98 ° C (most likely, having reached the bottom of the PY molecule along the front, and its boundaries along the edges), the "penetrating" molecule stops. A balance is established between the forces of "pushing" and the forces of resistance of the energy levels of the PY, which tend to restore their original position. And since these processes occur in parallel throughout the volume of water, at this moment the maximum density of water is recorded.

With an increase in temperature from 3.98 ° C to 8 ° C, the increasing energy of the PY molecules, the increasing thermal motion of the joined molecules themselves and the molecules surrounding them, push the molecules out of each other's PY. The density of water gradually decreases.

When the water temperature decreases from 3.98°C to 0°C, the density of the water decreases due to the fact that the forces of mutual repulsion of the regions e_{21}–e_{41} и e^{1}_{61}–e^{1}_{81} begin to exceed the pressure forces of the decreasing thermal motion of the molecules and ultimately squeeze the molecules out of part of the volume of the PY. When the water temperature drops to the values of the "water-ice" phase transition, the hydrogen nuclei H_{11} and H_{21} abruptly return to their original locations H_1 and H_2, and, thereby, return the protons, neutrons and electrons, the segments H_1p_1 и H_2p_3 of the sides of the angle H_1-O-H_2 to their original positions and restore the angle H_1-O-H_2 to 109028". The phase transition is complete, the water turns into ice, increases in volume by 9% and acquires new physical properties.

It becomes obvious that the described approach to understanding the processes of interaction of protons and neutrons during the formation of atomic nuclei also allows us to explain the reasons for: the increased strength of "magic" nuclei, arising due to the possibility of the formation by neutrons of the

"magic" nucleus of a chemical element of a more rigid volumetric geometric figure than in the nuclei of neighboring chemical elements; instability of nuclei of radioactive elements of the periodic table, where the neutrons of these nuclei do not form stable volumetric geometric figures, and different degrees of instability explain different periods of their half-life; the "Mgebe" effect, etc. It is no coincidence that the nucleus of the oxygen atom, having twice the "magic" number, has a sufficiently high stability to ensure the stable existence of our water-air world.

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DOI 10.34660/INF.2025.35.19.022

向量三角形的不变量
INVARIANTS OF A VECTOR TRIANGLE

Apartsev Oleg Rolenovich

摘要：本文描述了一种关于抽象对象稳定属性形成的非传统观点，即“不变量”。这种新方法并非基于对象外向的全局坐标系，而是基于描述局部对象内部属性的内向坐标系——矢量三角形。本文使用一个等效的代数模型——“矢量三角形的柱头表示”来考虑矢量三角形的非稳态（奇异态）。本文提出了矢量三角形的四种持久属性——“矢量三角形不变量”。本文揭示了此类不变量的用途：它们不仅可以用作分析连续变化的矢量结构，还可以用作将矢量结构描述为易于发生离散变化的量子对象的工具。

关键词：矢量三角形、不变量、柱头表示、奇异性、量子变量、柱头代数、属性、非稳态、矢量结构。

Abstract. *The article describes an unconventional view of the formation of stable attributes for abstract objects called “invariants”. The new approach is based not on global coordinate systems that are extraverted for the object, but on introverted ones that describe the internal properties of local objects - vector triangles. The nonstationary (singular) states of vector triangles are considered using an equivalent algebraic model called the “stigmatic representation of a vector triangle”. The study presents four types of persisting attributes of a vector triangle – “vector triangle invariants”. The article reveals the purpose of such invariants: their use as a means of analyzing not only continuously changing vector structures, but also as a tool for describing vector structures as quantum objects prone to discrete changes.*

Keywords: *Vector triangle, invariant, stigmatic representation, singularity, quantum variables, algebra of stigmata, attribute, unsteady state, vector structures.*

1. Introduction

In the articles devoted to the study of the properties of vector triangles [1…8], the basis of the theory is built on the following principles:

- Only compensated objects are considered – vector triangles **(1)** with a vector sum of zero are considered.

$$\bar{a} + \bar{b} + \bar{c} = 0. \qquad (1)$$

- Our research is based on local coordinate systems, which are called introverted coordinates. The essence of such coordinates is that they are inextricably linked to the vector triangles in question.
- Continuous internal variables defining the parameters of vector triangles, such as mutual angles and vector amplitudes, determine the interval zones of stable solutions for arbitrary triangles. Stability is also determined by the sign, or otherwise quantum, variables identified in previous studies [3,4]. The existence has been called the "stationarity of a vector triangle".

From these positions, it became possible to justify the equivalent replacement of the vector triangle **(1)** an algebraic equation **(2)**, the so-called "stigmatic representation of a vector triangle" [3,4]:

$$\begin{cases} [r_a][cos\alpha]P_a + [r_b][cos\beta]P_b + [r_c][cos\,\gamma] = 0, \\ [r_a][sin\,\alpha] + [r_b][sin\,\beta] = 0. \end{cases} \quad (2)$$

Where:

- Expressions in square brackets: $[\mathbf{x}] \in \{+i, 0, -i\}$ – is a general designation of symbolic (quantum) variables.
- $\mathbf{P_a} = \mathbf{a}\,|\cos\alpha|$, $P_b = b\,|cos\,\beta|$, $\mathbf{a}, b \in Re$ – projections of vectors $\bar{a}$ и $\bar{b}$ onto a vector $\bar{c}$ – are continuous variables.
- $[r_a], [r_b], [r_c] \in \{+i, 0, -i\}$ – are "rotational" sign variables, the basic components of the so-called "rota-vectors" $\bar{R}(\bar{r}) = \bar{R}(r_a, r_b, r_c)$, (from Latin. rota – wheel), indicating
- the direction of the vectors $\bar{a}, \bar{b}, \bar{c}$ relative to any interior point a vector triangle, according to the rule of the "right screw" in the direction of contemplation of the plane of a triangle by a Virtual External Observer.
- $[cos\alpha], [cos\beta], [sin\,\alpha], [sin\,\beta] \in \{+i,\ 0, -i\}$ – signed (quantum) variables called "angle" variables, which are assigned signs in accordance with the sign of the corresponding trigonometric angular functions of the vectors relative to the direction of the vector $\bar{c}$, are considered in pairs: $\bar{a} \leftrightarrow \alpha$; $\bar{b} \leftrightarrow \beta$.
- A special interpretation has been given to the signed (quantum) variable $[cos\,\gamma] \in \{+i, 0, -i\}$, the value of which is set by the rule of the "right screw" of the rotational direction set by a vector $\bar{c}$, relative to the perpendicular projection of the location of the External Observer on the plane of a vector triangle. The sign $[cos\,\gamma]$ defines the "upper" or "lower" position of the vectors $\bar{a}$ и $\bar{b}$ relative to the vector $\bar{c}$ in the plane of their

location. Or, equivalently, the value $[cos\,\gamma]$ can be considered an indication of the half-space of the location Observer relative to the plane of the triangle ("in front of" or "behind" the plane of the triangle).

2. Introverted coordinates in terms of vector algebra

To demonstrate a generalized analytical approach, in comparison with the more trivial way proposed earlier [1, 2], it is proposed to consider a system of two equations (3), where in the first scalar multiplication by a vector $\bar{c}$ is performed , and in the second , vector multiplication is performed by that the same vector [9].

This system is essentially an analytical description of a vector triangle in an introverted coordinate system defined by a vector $\bar{c}$ in the plane of the triangle as a polarization vector.

$$\begin{cases} \bar{a}+\bar{b}+\bar{c}=0,| * \bar{c} \\ \bar{a}+\bar{b}+\bar{c}=0.| \times \bar{c} \end{cases}$$

$$\begin{cases} \bar{a}*\bar{c}+\bar{b}*\bar{c}+\bar{c}*\bar{c}=0, \\ \bar{a}\times\bar{c}+\bar{b}\times\bar{c}+\bar{c}\times\bar{c}=0. \end{cases} \quad (3)$$

As before [1, 2], taking $|\boldsymbol{c}|$ =1, and using the rules of vector and scalar multiplication, we obtain:

$$\begin{cases} \bar{a}*\bar{c}+\bar{b}*\bar{c}+1=0, \\ \bar{a}\times\bar{c}+\bar{b}\times\bar{c}+0=0. \end{cases} \quad (4)$$

And then we come to the already known [3, 4] system:

$$\begin{cases} \pm a\cos\alpha \pm b\cos\beta \pm 1=0, \\ \pm a\sin\alpha \pm b\sin\beta = 0. \end{cases}$$

Similarly to what was described in [3, 4], the system of equations **(4)** turns into a system **(2)**, using the position of an abstract Virtual External Observer, which generates a basis for continuous and signed local coordinates in the stigmatic representation of vector triangles. From a mathematical point of view, the approach proposed by the **(3)** system seems to be a more aesthetic technique corresponding to the modern fundamentals of vector analysis.

Thus, all three expressions are identical. **(1)**, **(2)** and **(3)**.

3. Unsteady states of vector structures

Let us ask ourselves the question of finding a suitable methodology when considering the system of equations (2) for nonstationary cases [3, 4]. We will use generalizing substitutions for real variables in order to separate them from signed variables and formally hide their dependence on trigonometric functions:

$$\begin{aligned} P_a &= a\,|\cos\alpha|, \\ P_b &= b\,|\cos\beta|, \quad (6) \\ S_a &= 1\backslash 2 * c * a * |\sin\alpha|, \\ S_b &= 1\backslash 2 * c * b * |\sin\beta|, \end{aligned}$$

with $c = 1$.

At the same time, we leave visible the influence of trigonometric functions when they signally accompany the terms in the equations **(2)**.

The variables in the stigmatic of the triangle are divided into two types:

- **4** continuous variables – S_a, S_b, P_a, P_b.
- **8** quantum variables –$[r_a], [r_b], [r_c], [cos\alpha], [cos\beta], [sin\ \alpha], [sin\ \beta], [cos\ \gamma]$.

The introverted "universe" of a vector triangle is a space of **12** (dependent) variables, these are two interrelated groups continuous and quantum variables.

Note that continuous variables can satisfy the stigmatic representation not only by being real positive numbers, but also based on the algebraic forms of expressions, they can be any real numbers, and moreover complex numbers. This possibility of expanding the scope of definition significantly increases the applicability of the stigmatic representation of vector triangles in modeling processes of various nature resulting in a vector concept, including wave and oscillation processes.

Obviously, the amplitudes of continuous variables can vary in a certain range of values without crossing the range of acceptable values of the stigmatic system of equations.

However, when zeroing one of the real variables, one term, or the sum of two terms in the first equation of the system **(2)**, as well as when changing the quantum variables (considering that these changes are also a switch through **"0"**, which occurs when changing the directions of the vectors $\overline{a}, \overline{b}. \overline{c}$ in the triangle, as well as when the angles α, β pass through the values $\alpha, \beta \in \{0; \pm\frac{1}{2}\pi; \pm\pi\}$, in the system of equations **(2)**, catastrophic metamorphoses occur(in the mathematical sense), which are accompanied by changes in various parameters of the vector triangle.

According to the logic of mathematical formalism, at the moments when the terms of the system of equations take zero values **(2)**, singular states arise, which coincides with the destruction or significant changes in the structure of the vector triangle under consideration, leading to changes in quantum variables, and in some cases, in continuous ones.

The transition through singular states can be resolved in three ways:

- By converting a three-vector object into a two-vector compensated object – this object is mentioned in [5,6].
- Transformation of the original triangle into a compensated triangle with a modified list of labels and possibly continuous variables perhaps.
- Going back to the vector triangle that took place.

In singular states, it is of interest that it is possible to specify a number of attributes of a vector triangle set by variables that do not undergo zeroing, which is why attributes can be preserved "by inertia" when the system loses stationarity. (2). These phenomena will be discussed further.

4. Invariants of vector triangles

Let us discuss the remaining attributes of vector triangles, which are proposed to be called "introverted invariants of a vector triangle". It is assumed that the invariants are determined by the internal variables of the triangle and their interre-

lationships due to the stigmatization when there is no external influence on them. That is, only those invariants that retain algebraic meaning under the actual type of singularity are subject to consideration.

- ***Conservation of momentum***

Let's imagine, as some hidden entity, that the first of the equalities in **(2)** can be formally considered as an analog of the law of conservation of momentum with respect to a local vector object. This means ensuring a constant total value of the projections of the amplitudes $\boldsymbol{P_a}, \boldsymbol{P_b}$ on the vector. Let's give this a formal name**:"Momentum invariance"**and let's denote this as **Ii**.

$$\textbf{Ii}: (\boldsymbol{P_a} + \boldsymbol{P_b}) = -\mathbf{c} = \mathbf{const} \qquad \textbf{(7)}$$

Figuratively speaking, this entity fixes the amplitude and sets the stability of the vector orientation of the object in the direction of $\overline{\boldsymbol{c}}$.

- ***Energy conservation***

The second equation and the second type of invariance, which can be represented by the conditional law of conservation of energy – **"Energy invariance"**, are denoted as **Ei**. Invariance appears in a somewhat unusual interpretation – through ensuring stable compensated **equality of the areas of triangles** $\boldsymbol{S_a}, \boldsymbol{S_b}$. Energy invariance can be considered as a measure of the stability of the object's coverage of its location.

This invariant can be considered the basic essence for modeling dynamics under conditions of nonstationarity of the first equation. **(2)**.

Despite the actual absence of area measures in the second equation, the analysis turns out to be possible, since it is easy to return to area measures based on the formulas for the area of a vector triangle, or rely on the values of the amplitudes of vector products $(\overline{\boldsymbol{a}} \times \overline{\boldsymbol{c}})$ и $(\overline{\boldsymbol{b}} \times \overline{\boldsymbol{c}})$ **(4)**.

$$\textbf{Ei}: \ \boldsymbol{S_a} = -\boldsymbol{S_b} = \boldsymbol{const}. \qquad \textbf{(8)}$$

- ***Ap-spin conservation***

The source of another type of invariance is the stability of the integral value of the rota-vector [7,8], a rotational attribute of a vector triangle called "up-spin". The variables involved in the organization of "**Ap-spin invariance**", **Ai**, are orthogonal, quantum, with a range of acceptable values specified in the notes to **(2)**.

$$\textbf{Ai}: \boldsymbol{As} = [\boldsymbol{r_a} + \boldsymbol{r_b} + \boldsymbol{r_c}] = \boldsymbol{const}. \qquad \textbf{(9)}$$

Properties arising from "**Ap-spin invariance**" – preservation of the magnitude and directivity of the rotational attribute of the vector triangle. The significance of this invariance may be more significant: it returns the equivalent values vector triangles after singular transformations when the amplitudes (or angles) of all three or at least two vectors are equal.

- ***Conservation under reflection – symmetric transformations***

The fourth type of invariance is "**Symmetric invariance**", **Si**, concerning angle variables, implying the conversion of vector triangles through the formation of

their reflections while preserving their configurations, which are manifestations of three types of symmetry**:**

- **central – Si.1,**

and two mirrored:

- **«vertical»– Si.2**.
- **«horizontal» – Si.3**.

These types of invariance are, in their essence, an expression of the trigonometric rule hidden in the stigmatic representation, which defines this type of invariance in the system **(2)** through the trigonometric law [9]**:**

$$\boldsymbol{cos^2\theta + sin^2\theta = 1,}$$

This invariance preserves the amplitude variables and the modular values of the trigonometric functions, only the signed parts of the trigonometric variables can change.

On Fig.1 the results of transformations under the influence of symmetric invariants are presented.

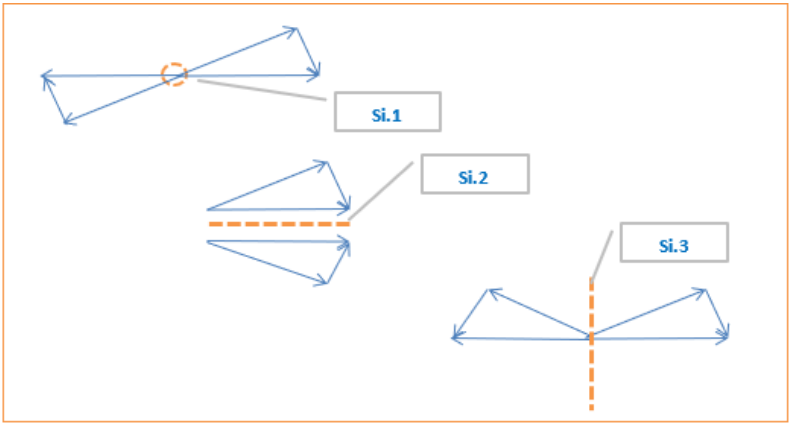

Figure 1

A common property of the symmetric invariant is the immutability of the amplitudes of the vectors $\boldsymbol{a, b}$ and the two signed angular variables $\boldsymbol{[cos\alpha], [cos\beta]}$ during the passage of the points of the singular transformation:

$$\mathbf{Si:}\begin{cases}(\overline{a},\overline{b},\overline{c})_{t-} = (\overline{a},\overline{b},\overline{c})_{t+}\\ [cos\alpha]_{t-} = [cos\alpha]_{t+},\\ [cos\beta]_{t-} = [cos\beta]_{t+}.\end{cases} \qquad \mathbf{(10)}$$

Additional characteristics of variable transformation for each type of symmetry:

Central symmetry:

$$\mathbf{Si.1}:\begin{cases}[sin\,\alpha]_{t-}=[sin\,\alpha]_{t+},\\ [sin\,\beta]_{t-}=[sin\,\beta]_{t+},\\ [cos\gamma]_{t-}=-[cos\gamma]_{t+}.\end{cases} \quad \textbf{(11)}$$

Mirror "vertical" symmetry:

$$\mathbf{Si.2}:\begin{cases}[sin\,\alpha]_{t-}=-[sin\,\alpha]_{t+},\\ [sin\,\beta]_{t-}=-[sin\,\beta]_{t+},\\ [cos\gamma]_{t-}=[cos\gamma]_{t+}.\end{cases} \quad \textbf{(12)}$$

Mirror "horizontal" symmetry:

$$\mathbf{Si.3}:\begin{cases}[sin\,\alpha]_{t-}=-[sin\,\alpha]_{t+},\\ [sin\,\beta]_{t-}=-[sin\,\beta]_{t+},\\ [cos\gamma]_{t-}=-[cos\gamma]_{t+}.\end{cases} \quad \textbf{(13)}$$

This invariance defines three types of reflection transformations that preserve the geometric properties of the original object.

- Obviously, for each of the properties related to the listed three types of symmetric transformations, a different number of singular conversions is required, equal to the number of invertible variables, in additional characteristics **(11)**, **(12)**, **(13)**, This number is also intentionally fixed in the name of the invariant.
- It can be seen that the symmetric invariance defined in **(10)**, it is a special case of momentum invariance due to the fulfillment of the condition **(7)**.

For $\mathbf{Si.2}$ – condition **(7)** is satisfied.

But, for types $\mathbf{Si.1}$ and $\mathbf{Si.3}$ that's fair enough only taking into account the following assumption:

It is necessary to allow for **(7)** the opposite direction of the vector $\overline{c}$, i.e. accept the condition of the possibility for its reversal by $\mathbf{180^0}$:

$$\mathbf{Ii}: (P_a + P_b) = |\mathbf{c}| = \mathbf{const} \quad \textbf{(7)}$$

- We also note: $\mathbf{Si.1}$ that it obeys the condition **the ap-spin invariance (Ai)**, since from **(9)** should be:

$$\mathbf{Si.1}:$$
$$As_{t-} = [r_a + r_b + r_c] = +1 + 1 - 1 = +1, \gg$$
$$As_{t+} = [r_a + r_b + r_c] = +1 + 1 - 1 = +1.$$

At the same time, $\mathbf{Si.2}$ and $\mathbf{Si.3}$ do not comply with the requirements

$$\mathbf{Si.2}: As_{t-} = 1 \gg As_{t+} = -1;$$
$$\mathbf{Si.3}: As_{t-} = 1 \gg As_{t+} = -1.$$

The above examples of the interrelationships of various invariants demonstrate the existence of a complex system of dependencies of vector variables during transformations of a vector triangle.

Further work is expected to be devoted to the study of this diversity.

5. Conclusion

The paper takes additional steps towards the universalization of the methodology of stigmatization of vector structures by referring to the formalized procedures of the abstract apparatus of vector algebra.

In addition, it is argued that in a stigmatized view, the amplitudes of vectors can be expressed in complex numbers, and this significantly expands the range of possible applications, including for simulating oscillatory and wave processes.

It is shown that changes in the variables defining the configuration of the triangle, in which the terms of the equations in the stigmatic representation pass through the value **"0"**, transfer the vector triangle to non-stationary states, mathematically described as a singularity and bifurcation, and some of the quantum variables, in non-stationary conditions, fall into an intermediate zero state, which is indefinite.

However, for another part of quantum variables, the outcomes of bifurcation changes in vector systems, due to the inertial conservation of their initial states, can have quite predictable consequences while preserving the values of some attributes of vector structures, which will play the role of invariants when the vector structure returns to a stationary state.

In this paper, **4** examples were demonstrated an attribute of vector triangles that, under certain conditions, can participate as invariants in the construction of modified vector structures after returning to stationary states.

The number of singular transformation trajectories for such an "elementary" object as a vector triangle turns out to be quite large. Based on the above, it is concluded that the variety of outcomes can be described within the framework of a certain "algebra of stigmata" based on quantum and continuous variables defining a vector triangle.

In fact, the proposed invariant approach opens up the possibility for analyzing vector objects not only as structures prone to continuous changes, but also as quantum objects subject to discrete configuration changes.

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科学出版物

上合组织国家的科学研究：协同和一体化

国际科学大会的材料

2025年7月30日，中国北京

编辑A.A.Siliverstova
校正A.I.尼古拉耶夫

2025年7月30日，中国北京
USL。沸点：98.7。 订单253.流通500份。

在编辑和出版中心印制
无限出版社