



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

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这些会议文结合了会议的材料 – 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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CONTENTS

POLITICAL SCIENCES

民族观念是民族国家发展战略的巩固因素

National idea as a consolidating factor in the development strategy of a national state

Kuzina Svetlana Ivanovna8

中亚是“一带一路”陆上部分的重要组成部分

Central Asia is an important part of the land part of the megaproject "One Belt, One Road"

Syzdykova Zhibek Saparbekovna14

21世纪海上丝绸之路与中国与东方阿拉伯国家关系

The 21st century Maritime Silk Road and China's relations with the Arab East

Turekulova Zhuldyz, Zhumabekov Madiyar20

中国对美外交政策原则的演变（2009–2025）

Evolution of China's foreign policy principles regarding the United States (2009–2025)

Kiriushina Anastasia Igorevna28

中哈双边关系发展势头强劲

Dynamics of expansion of bilateral relations between China and Kazakhstan

Dong Bingchen36

PEDAGOGICAL SCIENCES

人道主义培训过程中专业能力的形成

Formation of professional competences in the process of humanitarians' training

Chernyakova Natalia Stepanovna42

培养中国声乐教师在教育过程中实施专业和教育学士和硕士学位课程的连续性

Formation of the readiness of Chinese vocal teachers to implement the succession of professional and educational bachelor's and master's degree programs in the educational process

Han Jinghong47

PHILOLOGICAL SCIENCES

果戈理与女性：禁欲主义对作家作品的影响

Gogol and women: the influence of asceticism on the writer's work

Yaremenko Nikolay Nikolaevich52

PHILOSOPHICAL SCIENCES

数字主体作为主体观念演进的新阶段

The digital subject as a new stage in the evolution of the idea of the subject
Mashchitko Sergey Mikhailovich 57

CULTURAL STUDIES

沉默权力的机制：大众文化中隐含的意识形态行动模式

Mechanisms of silent power: Implicit modes of ideological action in popular culture
Mashchitko Olga Valeryevna 62

PSYCHOLOGICAL SCIENCES

攻击性作为高中生人格特质的研究：社会心理背景

Aggressiveness as a personality trait of high school students: socio-psychological context
Sokolov Igor Nikolayevich 68

BIOLOGICAL SCIENCES

顿河三角洲香蒲科Engleria (Leonova) Tzvel. Typha L. 组新种

New species of section Engleria (Leonova) Tzvel. Typha L. (Typhaceae) of Don River Delta
Krasnova Alla Nikolaevna, Polchina Tatyana Nikolaevna 74

MEDICAL SCIENCES

边缘系统在学生蜘蛛恐惧症治疗发展中的作用占主导地位的乌赫托姆斯基院士

The role of the limbic system in arachnophobia in students in the development of therapeutic dominant academician Ukhtomsky
Ananiev Vladimir Nikolaevich, Prokopyev Nikolai Yakovlevich, Ananieva Olga Vasilievna, Semizorov Evgeny Alekseevich, Pashkina Irina Valerievna, Ananiev Georgy Vladimirovich, Gurtovoy Elisey Sergeevich 80

人工通气对3.1~7岁肺炎并急性脑供血不足患儿水平衡的影响

The effect of artificial ventilation on water balance in children with pneumonia complicated by acute cerebral insufficiency aged 3.1-7 years
Muhitdinova Hura Nuritdinovna, Hamrayeva Gulchehra Shahobovna, Alauatdinova Gulhan Inyatdinovna 88

人工通气对3.1~7岁儿童急性脑衰竭相关因素的影响

The influence of artificial ventilation on correlations in acute cerebral failure in children aged 3.1-7 years
Muhitdinova Hura Nuritdinovna, Alimov Ahbor Valiyevich, Tilyakov Aziz Buriyevich 98

人工通气对7岁以上儿童体温昼夜节律的影响

The effect of artificial ventilation on the circadian rhythm of body temperature in children over 7 years old

Muhitdinova Hura Nuritdinovna 110

以手球为例高水平竞技运动员心脏形态学及血流动力学参数的比较分析

Comparative analysis of morphometric and hemodynamic parameters of the heart of high-qualification sportsmen in game sports, using handball as an example

Sherstyuk Sergey Alexandrovich, Sherstyuk Marina Anatolyevna 119

TECHNICAL SCIENCES

混凝土路面压、胀缝温度变形对平整度指标影响分析

Analysis of the impact of temperature-induced deformation in compression and expansion joints between concrete pavement slabs on smoothness indicators

Amirov Tursoat Jummayevich, Dauletov Madiyar Boranbaevich 126

Petri网与无向二部多重图集成在资源分配系统建模中

Integration of Petri net and undirected bipartite multigraph in modeling resource allocation system

Fathi Denis Vladimirovich 134

联合收割机适配装置的改进及其在优质大豆偷补种中的应用

Improvement of combine adaptive devices and their application for quality soya seeds in stealing and supplementation

Prisyazhnaya Irina Mikhaelovna, Prisyazhnaya Serafima Pavlovna 142

AGRICULTURAL SCIENCES

芝麻育种以提高种子经济产量

Sesame breeding for increasing seeds economic yield

Chavdar Nina Semenovna, Rushchuk Alexander Dmitrievich,

Harchenko Lyudmila Dmitrievna 152

水飞蓟(*Silybum marianum* (L.) Gaertn.)种子粗糙度测定方法

Silybum marianum (L.) Gaertn. seeds huskiness determining method

Chavdar Nina Semenovna, Rushchuk Alexander Dmitrievich,

Lipsyuk Konstantin Leonidovich, Goncharik Oleg Viktorovich 160

VETERINARY SCIENCES

冻干、贮藏时间及条件对乳酸杆菌黏附活性及生化特性的影响

The influence of freeze drying, storage time and conditions on the adhesive activity and biochemical properties of lactobacilli

Ovcharova Elena Sergeevna, Novikova Anna Filippovna,

Maslov Dmitrii Vladimirovich, Syvorotko Elena Vasilevna 165

民族观念是民族国家发展战略的巩固因素

NATIONAL IDEA AS A CONSOLIDATING FACTOR IN THE DEVELOPMENT STRATEGY OF A NATIONAL STATE

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注释：近年来，诸如“历史的终结”或否定意识形态等流行的人类共同体发展理念，已显示出其自相矛盾之处。新的意识形态导向研究的出现，证明理念作为现代世界人类共同体发展的指导策略至关重要。实践证明，在民族国家的框架内，民族理念作为国家发展的明确规划，作为全体公民认同的价值体系，发挥着凝聚和动员作用。有人提出，民族理念是国家与社会之间的社会契约。

关键词：民族理念，社会契约，民族国家，价值体系。

Annotation. *Recently, popular concepts of human community development, such as the “end of history” or the denial of ideologies, have shown their inconsistency. New ideologically-oriented studies have appeared, proving that ideas are important as guiding strategies for the development of human communities in the modern world. It has been proven that within the framework of national states, a national idea as a clear plan for the country’s development, a system of values with which all citizens agree, plays a consolidating and mobilizing role. It has been proposed to consider a national idea as a social contract between the state and society.*

Keywords: *national idea, social contract, nation state, value system.*

An analysis of the directions in which the modern world is developing suggests that the prevailing paradigm of the late 20th century about the “end of history” (F. Fukuyama) has proven its inconsistency. National ideas, which are designed to unite nations within the territorial boundaries of national states, continue to play an important role in the development of the modern world, and have a significant impact on the nature of its dynamics and transformation. This speaks to the relevance and importance of studying the mobilizing and consolidating role of national ideas in the life of the state in the name of ensuring its national security.

The influence of ideas on the adoption of management decisions by the authorities depends to a certain extent on the nature of the political regime, the characteristics of institutions and decision-making procedures, public discourse and the level of political communications in society [1, pp. 20-21].

The ideas and theories that have contributed to the movement and progress of human communities over the last two centuries are liberalism, conservatism, socialism, as the history of recent decades has shown, has significantly lost its former viability and have changed in accordance with the transformation of socio-political systems. Modern processes show that a reassessment, adjustment of values, or a change in the paradigm of the structure and development of the modern world system is necessary.

Theories that have formed—and continue to form—the foundation of development strategies in our modern world as a system of nation-states can be both destructive and constructive. The liberal theory is grounded in the principle that every individual and citizen possesses inherent rights to freedom and life under the rule of law. These groundbreaking concepts for their (Modern) era were articulated by J. Locke, J.-J. Rousseau, C. Montesquieu and other Enlightenment thinkers, playing a revolutionary role in humanity's evolution toward scientific, technological and social progress. Conservatism and socialism have likewise contributed to the advancement of human society. Yet when misinterpreted, these very theories have fueled radical destructive movements—anarchism, National Socialism, fascism—and facilitated the establishment of totalitarian regimes.

The unsuccessful attempt to declare the era devoid of ideas led to new, idea-oriented studies aimed at understanding the role and significance of guiding ideas for the development of human communities in the modern world.

An important factor in justifying the need for a national idea is its unifying potential not only for ordinary citizens, but also for the elite – both among themselves (with all the objectively existing struggle between sub-elites), and for the consolidation of the elite and the people. The basis for unification is national values – responsibility for the fate of the state, preserving its history, preserving the people, interethnic harmony and peace in the country, decent quality of life and confidence in the future of children, security, the rule of law, etc.

An attempt to problematize the study of ideas by modern science was made by O. Yu. Malinova, who said that the “materialistic” explanation of social processes by modern science prevails over the “idealistic” one, reducing the behavior of participants in the processes to their “interests.” Due to difficulties with operationalization or measurement of such a variable as “ideas,” the latter are often sacrificed for the sake of economy of thinking. A striking example of this is the theory of rational choice: political behavior is explained by the reaction of an individual to the material context, which shapes his interests [1, pp. 5-6]. Summarizing the

works of foreign scientists on the influence of ideas on politics [2], the researcher describes their classification of causal effects caused by ideas: 1) ideas help to develop a strategy for achieving a goal, giving actions a moral coloring; 2) ideas play the role of “focal points” in efforts aimed at achieving the desired effect; 3) ideas, being embodied in an institutional shell, influence decision-making [1, p. 16-17].

The national idea as a system of certain values contains convictions, views, concepts, myths of large social groups that explain the socio-political reality through the prism of their views. They explain on the basis of their awareness, formulation, develop goals, programs and means of achieving them, thus contributing to the institutionalization of the idea.

The system of state power is complex in its structure due to its inherent function of managing all spheres of public life. The complexity of the subject and object of state administration requires objective knowledge of the methods and mechanisms of management, the properties of the controlled object. Any organization, including the system of state administration, needs a strategy as a plan for the development of the state and a toolkit by which this plan can be implemented. The strategy for the development of the state is formulated as a number of priority areas and principles on which they are based - a national idea is proposed as a catalyst for the further development of the state.

A national idea that meets the needs of all segments of the population, a clear plan for the further development of the country, reflecting national interests, must be recorded in an official document containing the main strategic directions of development, consistent with the values, aspirations, and ideals of all segments of society, constituting the cultural code of the nation, the axis of which has always been and remains the mission of preserving and ensuring the security of the country.

It seems that a national idea is necessary for every national state. Perhaps it is not always an official attributive symbol of the state, like a coat of arms, flag, national legislation, territory and other signs, but it can be expressed in a national anthem, in the official policy of state power, and must be consonant with the ideas and ideas about the future of the majority of citizens.

For a state that is in the process of transition from one socio-political and economic system to a radically different one, the development of its own national idea is a vital condition for the further development of the state, overcoming the anomie of public consciousness and uniting its citizens with a common goal and ideas.

If a national idea claims the status of a mass system of values, its content must have a strong rational core, reflecting the realities of modern life, and at the same time not reject the myths, values, traditions of the nation, accumulated over centuries, its spiritual heritage.

One of the values of a person is his existence as a familiar world, without which his life activity loses its meaning and purpose, the desire to satisfy his interests and needs. It is the totality of such values and goals that constitutes the meaning of human existence. The construct of the national idea appeals to a set of values that give meaning to a person's life, theoretically substantiates it, giving high significance to his life.

People's values, the need for protection, and demands for respect are always emotionally charged, as M. Weber wrote, classifying them as affective (sensory, emotional) social actions of people (along with instrumental-rational and value-rational) [3].

The role of the state as a supreme principle in ensuring the security of the state and society was considered by scientists of the 16th-17th centuries - N. Machiavelli, J. Bodin, T. Hobbes, G. Grotius and others. Thus, T. Hobbes, speaking about the state as a mythical monster Leviathan, insists on the idea of its legitimization by concluding a social contract between political power and society striving to ensure its security. Based on the ideas of T. Hobbes, we can talk about the condition for implementing the principle of national security as the unification of people for mutual protection [4]. The Dutch scientist G. Grotius wrote about the law of war and peace, -during war, domestic laws cease to be effective, international norms come into force [5]. This principle has become one of the important modern principles in the relations between states.

One of the areas of social science is the study of ideas that consolidate society, both in their genesis and design, and in a comparative key in relation to reality. Their interaction and mutual influence, the connection of ideas and politics, the design and design of ideas in global, world constructs, their connection with the economy, structure, levels are studied, an essential analysis is carried out, their functional characteristics and such factors as mass consciousness, methods and channels of communication with society, etc. are described.

The relationship and mutual influence of ideas and politics is studied by representatives of discursive institutionalism, who consider the production and contestation of ideas in interactive discourse [1, p. 19]. Discourse is the element that is necessary when reforming the political system and designing the evolution of the political course of power. Public discussion of the need for reforms and the acceptability of the methods for their implementation contributes to the formation of public consensus and the consolidation of society in favor of transforming the country's political system [6, p. 120; 7, p. 169].

The design and discussion of ideas in the public sphere contribute to the development of a political course, the conceptualization of ideas as part of politics in the processes of the struggle of political forces to change the political system of the state. If society accepts the most acceptable idea from the proposed set in a public discussion, it acquires the character of a social contract [8].

Of course, not all ideas proposed by political groups are understood and accepted by society, and not all of them influence decision-making by the authorities. This process, as researchers write, depends on several factors: the political regime, existing socio-political institutions, decision-making mechanisms, etc. [7, 9, 10]. For example, J. Checkel believes that ideas in their diversity appear during periods of political uncertainty, but their acceptance by the authorities depends on the political regime: in democratic countries, there is great political competition between ideas and they reach the leaders faster; under authoritarian regimes, everything depends on the support of an idea by one, the supreme ruler [9, p. 42]. J. Checkel was disputed by researchers R. English and A. Brown, who, analyzing the Russian reforms of the late 20th century, noted that “perestroika” was prepared, among other things, by that part of the intellectuals that formed in the 1960s during Khrushchev’s “thaw” [11, 12].

Legitimation of the designed and accepted ideas, their effectiveness is of great importance. In some political systems, the effectiveness of the implementation of the “general” idea in the policy of power is assessed at elections. In other systems, characterized by a variety of ideological programs of the elite, ideological discourse contributes to the correction of the political course of power. And one more factor is important: the publicity, fame and authority of figures designing, implementing or criticizing the proposed and implemented generally significant ideas.

The evolution of the theory of social contract has determined the features of the theory that distinguished this concept from a number of other concepts proposed by scientific thought, allowing us to state the presence of certain universal cultural codes in it, allowing us to understand this phenomenon. The theory of social contract has remained generally recognized over the past centuries, constructing a national unifying idea, since it is based on the simplest concepts that all citizens agree with.

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中亚是“一带一路”陆上部分的重要组成部分
**CENTRAL ASIA IS AN IMPORTANT PART OF THE LAND PART
OF THE MEGAPROJECT “ONE BELT, ONE ROAD”**

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注释：中亚国家在中国“一带一路”倡议中扮演着关键角色。值得一提的是，中国与该地区国家在共建“一带一路”倡议方面走在前列，正在加快建设中国-中亚运输走廊。需要强调的是，“一带一路”（OBOR，即共建丝绸之路经济带和21世纪海上丝绸之路）是中国提出的一项国际倡议，旨在改善现有的贸易路线、交通运输和经济走廊，并打造新的连接中亚、欧洲和非洲60多个国家的通道，从而促进这些国家与中国之间的贸易关系发展。

关键词：一带一路、丝绸之路、中亚、大型项目。

Annotation. *Central Asian countries (CAR) play key role in China's Belt and Road Initiative. It is noted that China and the countries of the region are pioneers in the joint implementation of this initiative, accelerating the construction of the China-Central Asia transport corridor. It is emphasized that the concept of "One Belt, One Road" - OBOR (for the joint creation of the Silk Road Economic Belt and the Maritime Silk Road of the 21st Century) is an international initiative of China aimed at improving existing and creating new trade routes, transport, and economic corridors linking more than 60 countries of Central Asia (CA), Europe and Africa, which will facilitate the development of trade relations between them and China.*

Keywords: *One Belt, One Road, Silk Road, Central Asia, mega project.*

For the first time, the Chinese concept of the Silk Road Economic Belt (SREB) within the framework of the mega-project “One Belt, One Road” was voiced by Chinese President Xi Jinping during his keynote speech at Nazarbayev University in Astana during his state visit to Kazakhstan in September 2013, as a new form of deepening China's cooperation with the Central Asian states. Xi Jinping identified five main tasks that the project is intended to solve: 1) strengthening regional

economic integration; 2) building a unified trans-Asian transport infrastructure; 3) eliminating investment and trade barriers; 4) increasing the role of national currencies; 5) deepening cooperation in the humanitarian sphere.

In his speech in Astana, Xing Jinping emphasized: “China and the Central Asian countries are good neighbors connected by common rivers and mountains. This is the reason why China attaches such great importance to relations with the Central Asian countries and why Central Asia is one of the priority areas in Chinese foreign policy. Today, having the best chances for developing relations with the Central Asian countries, we want to continuously strengthen mutual trust, friendship and cooperation with the countries of the region, promote joint development and prosperity for the benefit of our peoples.”¹ Central Asia is “a bridge between East and West, a crossroads of civilization”² The topic related to the implementation of China’s OBOR initiative and the participation of various countries and regions in it is one of the most pressing and discussed issues by politicians and scientific experts.

Kazakhstan has the greatest potential for participation in the SREB in the Central Asian region, with its priority task being the development of transit potential by attracting part of the cargo flow in the China-Europe direction. To achieve this goal, a cooperation plan was signed in 2016 to link the SREB with the Kazakh national program “Nurly Zhol” (“Bright Path”). Chinese President Xi Jinping called this act one of the most significant results of the OBOR in the political sphere.

According to data for the first half of 2025, Kazakhstan occupies a leading position in trade and economic cooperation with China, accounting for 46% of the total trade turnover of Central Asia with China.³ Trade turnover between China and Central Asian countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) reached \$39.8 billion in the first five months of 2025, a record high for the period. The volume of imports and exports between China and Central Asian countries increased by 10% year-on-year⁴. Chinese investments in Kazakhstan have exceeded 26 billion dollars, and there are about 5 thousand enterprises with Chinese capital operating in the country⁵. With the participation of Chinese

¹ <http://kz.chineseembassy.org/rus/zhgx/t1077192.htm>

² Frankopan P. - The Silk Road. The Road of Fabrics, Slaves, Ideas and Religions. // <https://libking.ru/books/sci-/science/1100212-2-piter-frankopan-shelkovyj-put-doroga-tkanej-rabov-idej-i-religij.html>

³ Kazakhstan-China: Record Trade Turnover and New Cooperation Projects // <https://finance.kz/news/partnerstvo-s-novymi-gorizontami-kazahstan-i-kitay-naraschivayut-ekonomicheskoe-sotrudnichestvo-do-rekordnyh-pokazateley>

⁴ Trade turnover between Central Asia and China sets record in five months // <https://www.inform.kz/ru/tovarooborot-mezhdu-tsentralnoy-aziey-i-kitaem-za-pyat-mesyatsev-postavil-rekord-26bdf>

⁵ Kazakhstan-China: Record Trade Turnover and New Cooperation Projects // <https://finance.kz/news/partnerstvo-s-novymi-gorizontami-kazahstan-i-kitay-naraschivayut-ekonomicheskoe-sotrudnichestvo-do-rekordnyh-pokazateley>

investors 224 industrial projects worth \$66.4 billion are being implemented in Kazakhstan, creating approximately 50,000 jobs⁶.

One of the primary tasks facing the countries of the Central Asian region (CAR) is the coordination and promotion of national development strategies of the states located along the SREB based on mutual understanding and dialogue, and "... for understanding and developing a dialogue between different cultures, spiritual modernization is also necessary, the development of a new system of values to achieve civilizational synthesis while maintaining cultural pluralism"⁷. based primarily on the historical experience of the Great Silk Road. This is necessary in order to advance the implementation of the initiative, revive the ancient Great Silk Road in a new guise, establish closer ties between countries and continents, and raise mutually beneficial cooperation between these countries to a new historical height.

The Chinese initiative has received a wide response and this is explained by the fact that the PRC is today the largest producer and investor in the global economy, which, despite some decline, maintains high rates of economic development in comparison with other countries of the world. Accordingly, it is not surprising that the new Chinese initiative for the Central Asian states, aimed at reviving the Great Silk Road in modern conditions, is of great interest.

Such keen interest is primarily explained by the fact that the Central Asian region is a crossroads where various routes of the Great Silk Road have crossed since ancient times. As is known, the Silk Road as a trade route emerged in the 3rd century BC and existed until the 16th century. And at the instigation of the German geologist Ferdinand von Richthofen, from the end of the 19th century, the extensive network of roads was called Seidenstrassen - the Silk Road, which has remained to this day. The Silk Road was a system of caravan roads leading from China to the countries of the Middle East and Europe. A significant part of this route ran through the territory of the Central Asian states. Therefore, the countries of the Central Asian region are undoubtedly the most important link in the large-scale international project of the Silk Road Economic Belt. Three of the five Central Asian states have a common border with China. The total length of the state border between Kazakhstan and China is 1782.75 km, between Kyrgyzstan and China is 858 km, and between Tajikistan and China is 494.95 km.⁸.

⁶ Kazakhstan and China: Relations are strong even in conditions of global instability - Rhythm of Eurasia // <https://www.ritm Eurasia.ru/news--2025-06-24--kazakhstan-i-knr-otnosheniya-prochny-dazhe-v-usloviyah-globalnoj-nestabilnosti-81112>

⁷ Syzdykova Z.S. Media communications and the problem of searching for a new identity in the context of globalization. Communicology Vol. 8. №6. November-December 2014.P.38-45.

⁸ Who does China border with — map of countries: // <https://travelask.ru/china/s-kem-granichit-kitay>

Central Asia is a region where the interests of both great powers and regional powers intertwine, including the United States, Russia, Europe, China, India, Iran, Turkey, and Arab countries. Many of these countries view Central Asia as a single, integral enclave. In fact, of course, this is not the case. Firstly, various cultural and civilizational flows (Turkic, Mongolian, Persian, Arabic, Chinese) intersect or rather converge in the Central Asian region. In ancient times and the Middle Ages, as a rule, one or two of them were dominant for a period of time. Due to this, the countries and peoples of Central Asia have their own characteristics (traditions, mentality). Secondly, all world religions have become widespread in Central Asia. As Peter Frankopan, the author of the book “The Silk Road,” notes: “This is the very place where Judaism, Christianity, Islam, Buddhism, and Hinduism literally rubbed sides.”⁹

As the famous Kazakh scientist Karl Baipakov states: “Religious ideas were spreading along the (GSR), various missionaries “carried” their faith to overseas countries. Buddhism came from India to Central Asia and East Turkestan to China, Korea and Japan; Christianity spread from Syria, Iran and Arabia, and then Islam. However, Islam, which spread not only “by fire and sword”, but also by the sweet-tongue of a Muslim merchant, gradually displaced Christianity, Buddhism, Zoroastrianism and local cults in Central Asia.”¹⁰

Although after the collapse of the USSR, non-traditional religious beliefs and movements appeared in the Central African Republic. Thirdly, “This is a cauldron in which a brew of various language groups was prepared - Indo-European, Semitic and Sino-Tibetan languages could be heard alongside Altaic, Turkic and Caucasian languages.”¹¹. And now there are several ethnolinguistic stripes here: Turkic-speaking, Persian-speaking and Russian-speaking. During the Soviet Union, Russian dominated in a number of republics, primarily in Kazakhstan, and it is no coincidence that this republic was called the “laboratory of nations”. Fourthly, the CAR is a place of interaction between agricultural and nomadic types of economy with its own peculiarities in the cultural and social sphere, so there is no need to talk about socio-cultural homogeneity. Fifthly, until the second half of the 19th century, there was the Turkestan region here, and then autonomous and then union republics within the USSR. After declaring sovereignty, in 1992. The first president of Kazakhstan Nursultan Nazarbayev at the summit of Central Asian states proposed to abandon the definition of “Central Asia and Kazakhstan” in favor of the concept of “Central Asia”, covering all post-Soviet states of this region.

⁹ The Silk Road / Peter Frankopan; [translated from English by V.Yu. Sharshukova] - Moscow: Publishing House “E” 2018 - 688 p. - (Time Travelers).

¹⁰ Baipakov K.M. The Silk Road in Central Asia. // The Silk Road and Kazakhstan. Materials of the scientific and practical conference. Almaty. 1999. P. 27-36.

¹¹ The Silk Road / Peter Frankopan; [translated from English by V.Yu. Sharshukova] - Moscow: Publishing House “E” 2018 - 688 p. - (Time Travelers).

All of these above-mentioned features of each country must be taken into account during the preparatory work, as well as at the stage of implementing the SREB project, but, despite the above-mentioned differences, by and large, the Chinese concept of the SREB is a unifying project, taking into account that both China and the Central Asian countries were the main points along which the routes of the Great Silk Road passed.

The importance of Kazakhstan for the implementation of the EBSR project is most obvious and understandable. Once upon a time, one of the routes of the Great Silk Road (to which the historical reference of its modern project goes) began from Kazakhstani soil. The main part of the route passed through the territory of Semirechye and Southern Kazakhstan. "It would not be an exaggeration to say that "One Belt, One Road" gave impetus to the renaissance of the Great Silk Road. The Chinese initiative is rightly called a megaproject of the 21st century," said Kazakh President Kassym-Jomart Tokayev¹².

In many cities, monuments from those times have survived to this day. So, "Central Asia was especially crisscrossed with caravan routes. Its cities - Merv, Samarkand, Bukhara, Khiva, Otrar, Turkestan, Taraz, Ispidzhab, Suyab, Balasagun, Osh, Uzgen and others - were centers not only of trade, but also of science and culture"¹³. The parties implement new projects in the field of production capacities, tourism cooperation between the countries is developing, there are intentions for mutually beneficial partnership in the field of high technologies¹⁴.

The SREB mega-project is of particular importance for the Central Asian states themselves due to the region's geographic proximity to China and close economic ties with Beijing. By relying on the unique geopolitical position of Central Asia and its historical role in the trade route of the Great Silk Road, the republics of the region are trying to use Chinese investments to solve their own infrastructure problems and "embed" national development strategies into the general framework of the global Chinese project.¹⁵

Thus, the EBSR project, an integral part of the One Belt, One Road initiative, is open to all countries, international and regional organizations, and also creates a basis for economic cooperation between China and interested countries. Today, Beijing's global initiatives find a response in the countries of Central Asia. Beijing

¹² Kassym-Jomart Tokayev: "One Belt, One Road" – the Renaissance of the Great Silk Road. // <https://www.kp.ru/daily/27570/4839232/>

¹³ Eurasianism: origins, concept, reality. On the 20th anniversary of N.A. Nazarbayev's speech at Lomonosov Moscow State University on March 29, 1994. Edited by Prof. Meyer M.S., Prof. Mikhailov V.A., Prof. Syzdykova Z. S. –M.: "Publis", 2014.-744 p.

¹⁴ New formats of partnership with China. What to expect from Xi Jinping's visit // <https://www.inform.kz/ru/novie-formati-partnerstva-s-kitaem-cto-ozhidat-ot-vizita-si-tszinpinga-f8d38c>

¹⁵ Mordvinova A.E. Central Asian countries at the One Belt, One Road forum in Beijing / Problems of National Strategy 2017. No. 5, p. 30-36.

is interested in investing and expanding its economic influence, and the countries of the region need external capital investments and the development of their own infrastructure. Mutual interest dictates the high dynamics of cooperation between the Central Asian republics and China. It is worth noting that for the practical implementation of its initiative, China is creating new financial development institutions such as the Asian Infrastructure Investment Bank and the Silk Road Fund, the capital of which will be directed to the implementation of infrastructure projects, the most important link of which remains Central Asia, as it was several centuries ago.

21世纪海上丝绸之路与中国与东方阿拉伯国家的关系
**THE 21ST CENTURY MARITIME SILK ROAD AND CHINA'S
RELATIONS WITH THE ARAB EAST**

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注释：本文旨在探讨中国在中东地区的政策，旨在实施“21世纪海上丝绸之路”项目，该项目是“一带一路”倡议的一部分。文章指出，中国高度重视维护通往世界主要海洋通道的重要港口安全。文章强调，中国与中东国家正在开展合作，共同打击恐怖主义和海盗等威胁。

关键词：中国、中东、海上航线、港口、通讯。

Annotation. *The article is devoted to the consideration of China's policy in the Middle East region with the aim of implementing the project "The Maritime Silk Road of the 21st Century, which is part of the mega-project One Belt, One Road. It is noted that China pays close attention to ensuring the security of key seaports that have access to the world's oceans. It is emphasized that China and Middle East countries are developing cooperation to combat threats such as terrorism and maritime piracy.*

Keywords: *China, Middle East, sea route, ports, communications.*

The Middle East, as an important crossroads of world trade, is key to advancing the People's Republic of China's geopolitical megaproject. China's relations with the countries of the Arab East are developing in a bilateral and multilateral format based on the concept of a "Community with a Shared Future for Mankind".

In the 21st century, strategic control over the world's oceans and seas, and over trade routes, is becoming an integral part of China's naval policy. The document "China's Military Policy", published in 2015, identifies seas and oceans as geopolitically important objects that guarantee China's sustainable development; it also substantiates the need to create modern naval structures to implement China's national interests, protect its sovereignty, and promote maritime rights to make

China a maritime power [1]. Chinese researchers write that, unlike Western countries, which prefer to view naval power as part of a military strategy, China gives priority to the economic and cultural components of maritime policy [2].

The “Maritime Silk Road of the 21st Century” is a strategic program, the main goal of which is the infrastructural development of a vast region, including Southeast Asia, the Indian Ocean and East Africa. Within the framework of the “Maritime Silk Road of the 21st Century”, China’s naval strategy in the Middle East region is also defined. This strategy is aimed at ensuring the safety of transportation of goods along sea trade routes and the extraction of marine resources. It should be noted that the Middle East direction of China’s policy is closely linked to the Indian Ocean, which is acquiring strategic importance in the 21st century. Along the Indian Ocean are important objects of the Maritime Silk Road, such as the Strait of Hormuz, the Bab el-Mandeb Strait, the Strait of Malacca.

In 2005, in a report submitted to US Secretary of Defense Donald Rumsfeld entitled “Asia’s Energy Future”, China’s strategy in the Indian Ocean was defined as the “String of Pearls” strategy, aimed at establishing dominance in the area from the Middle East to southern China. However, the “String of Pearls” strategy is not used by official China, and, moreover, Colonel Zhou Bo, a member of the Academy of Military Sciences of the People’s Liberation Army of China, argues that China’s primary objectives in the Indian Ocean are economic efficiency and security of sea lanes. Economic benefits and efficiency are achieved through mutual trade and economic cooperation with coastal states, and security is limited to combating piracy off the coast of Somalia [3].

An important link in China’s maritime strategy in the Middle East region is the Suez Canal. While China’s interests in the Persian Gulf are based on oil imports, China’s interest in the Suez Canal is linked to its key role and strategic location in the region. During the Suez Crisis in 1956, China supported Nasser and Egypt. As a result, the foundation of Sino-Egyptian relations was laid. In the early days of the Suez Canal Crisis, China sent US\$4.7 million (in the form of immediate aid payments in 1956) to support the Egyptian government. Egypt’s strategic location as a land bridge between the Middle East and Africa, as well as the strategic importance of the Suez Canal in world politics and trade, led China to give priority to Egypt [4].

During Jiang Zemin’s official visit to Egypt in 2000, China’s interest in developing a special economic zone along the Suez Canal was expressed. During Egyptian President Abdel Fattah el-Sisi’s official visit to China in 2014 and Xi Jinping’s official visit to Egypt in 2016, the issue of China’s \$10 billion investment in Egypt was raised [5]. Following the official visits of the heads of state, a Memorandum of Understanding was signed between the two countries within the framework of China’s Belt and Road Initiative.

In 2007, COSCO Shipping Ports (CSPL) entered into a \$150 million deal with Egypt to acquire 20% of the Suez Canal container terminal in Port Said. China's Tianjin Economic and Technological Development Area (TEDA) is developing an industrial zone in Ain Sokhna, Egypt. In 2023, it was announced that Xinxing Ductile Iron Pipes would invest \$2 billion to build a steel plant in Ain Sokhna.

In connection with China's active activities along the Suez Canal, Middle Eastern researchers have wondered whether China's investments aimed at creating a special economic zone along the Suez represent a threat to Egypt's sovereignty in the future. In the pages of *Al-Mashareq*, researchers write that Egypt may become dependent on Beijing due to loans [6]. The authors of the work "The Suez Canal: Lessons of the Past and Threats of the Future" argue that the expansion of Chinese investments goes beyond economic cooperation and is being transformed into China's plan to establish military and political dominance in the Mediterranean and North Africa [7]. According to foreign researchers, all major Chinese infrastructure projects abroad are implemented under the direct control of the government, therefore, in accordance with the country's political goals, they may turn from economic structures into military facilities in accordance with the naval strategy of the People's Republic of China [8].

An important part of the Silk Road strategy in the Middle East region is the construction of port infrastructures, which are being implemented to ensure free navigation in the world's oceans. To ensure the safety of maritime trade routes, Beijing has invested in the construction of about 100 ports in 63 countries, of which about 20 investment projects are in the Middle East region [9]. China's lease and construction of ports in the Middle East countries is as follows:

- In 2017, Pakistan leased the Gwadar port to the Chinese state-owned China Overseas Port Holding Company (COPHC) for 40 years. The port currently houses a Chinese naval base. The Gwadar seaport is located on the Arabian coast, near the Strait of Hormuz, which leads to the Persian Gulf.

- Following agreements between the Algerian Ministry of Transport and the Chinese companies China Harbour Engineering Company and China State Construction Engineering Corporation, construction began in 2016 on a port in the city of Marshal, designed to handle 26 million tons of cargo per day.

- In 2015, Beijing's leadership reached a 10-year agreement to establish its first military base in the port of Djibouti, which is located near the Bab el-Mandeb Strait and separates the Gulf of Aden from the Red Sea. Construction began in 2016, and after People's Liberation Army Navy Commander Shen Jinlong issued an order to establish the base in Djibouti in 2017;

- The Salalah Port in Oman, which is used as a refueling point for the People's Liberation Army Navy, is an important destination for cargo transported from India, Pakistan, China, Indonesia, Asia Pacific countries, the Persian Gulf countries

to Africa and the Suez Canal. In 2008, when the People's Republic of China's armed forces arrived in the Gulf of Aden to prevent piracy, the Salalah Port was used as a main base;

- As part of the Silk Road project, Yemen's ports, including the port of Aden, which is intended for resupply and parking of Chinese ships, provide China with access to global trade routes. Most of China's trade with Europe passes through the Gulf of Aden and the Red Sea. Since 2008, according to a UN Security Council resolution, the Chinese Navy has regularly deployed its troops to the Gulf of Aden to protect the sea lanes. The duties of the Chinese Navy in the Gulf of Aden include protecting ships from pirates, ensuring the safe transportation of Chinese citizens, and participating in international military exercises.

In addition, China has built several facilities at the Khalifa Port in the United Arab Emirates and an oil pipeline in Fujairah. In addition to investment activities, in January 2020, three ships of the Chinese Navy docked at the port of Khalifa and entered the UAE military base. On this occasion, in 2021, the Wall Street Journal reported that US protests had prevented the construction of a military base [10].

After the unrest of the Arab Spring, China's interests in the Middle East are based on the following strategies:

- the formation of a new model of world order aimed at creating a multipolar world;
- The development of China's "soft military power" in the Middle East;
- deepening cultural and civilizational ties between the regions;
- development of medical diplomacy with the countries of the Arab East in the framework of the joint fight against the Covid-19 pandemic [5].

China is interested in developing relations with Arab countries in a bilateral and multilateral format. If the development of strategic cooperation with the leading countries of the Middle East is expected in bilateral relations, then participation in the activities of regional organizations is being considered in a multilateral format.

The main area of cooperation between Arab countries and China is the Sino-Arab Cooperation Forum. Since 2004, energy and trade have been the main issues discussed at the forum, and since 2012, the focus of the ministerial meetings has shifted towards political issues that appeared on the agenda after the Arab Spring. In 2020, the forum also began to consider cooperation between the two sides in the field of health care, which was a consequence of the 2019 pandemic.

The concept of the "Health Silk Road" was promoted as part of cooperation between China and the Arab East to combat the effects of Covid-19. Under this concept, China provided medical assistance to countries such as Iran, Iraq, Lebanon, Algeria, and Tunisia; Chinese virologists were sent to the regions of the Arab East, and online consultations were organized. We consider this policy as a

direction that has given a significant impetus to China's growing influence in the region, and as an effective tool of Chinese medical diplomacy.

In December 2022, two summits were held in a row involving China and more than 30 Middle East countries: "China and the Arab World" and "China-Gulf Cooperation Council". During the summit meetings, Xi Jinping said that China's energy transactions will be conducted in yuan in the future, and in his speech, the Chinese leader concluded that the Shanghai National Petroleum Exchange should be used as a platform for yuan settlement between the Gulf countries and China.

Beijing's policy in the region stems from China's interests in ensuring security and maintaining stability. In addition, China's military policy is aimed at protecting the Silk Road infrastructure from terrorist attacks. The main areas of military policy to ensure the regional security system of the Middle East include the temporary deployment of armed forces to conduct military exercises abroad, the basing of military patrols, peacekeeping forces, military instructors and advisers, as well as the deployment of ammunition, joint intelligence systems and aerospace monitoring equipment.

According to Chinese expert Sun Degang, China's involvement in political and security issues in the Middle East is increasing every day, and its military-political focus on protecting its trade and economic interests is based on the concept of "soft military intervention" [11].

China's soft military interventions include:

- conducting joint military exercises with countries in the region;
- conducting peacekeeping operations;
- issues related to combating threats such as terrorism and maritime piracy.

Sun Degang argues that China is not interested in geopolitical or ideological competition with major power centers in the Middle East, therefore, in order to develop strategic cooperation in the region, China adheres to partnership diplomacy (*huoban waijiao*) and China does not look for enemies (*zhao diren*) in the region [11]. Conducting joint military exercises with Middle Eastern countries is a manifestation of political trust and cooperation in various fields between China and the countries of the region. Despite the fact that the stated purpose of China's military exercises is to develop cooperation between the countries, the deepening military cooperation between the Gulf countries and China has raised concerns in the United States. In March 2023, US Assistant Secretary of State for Near Eastern Affairs Barbara Leaf said that the United States would not allow Beijing to access American advanced technologies available to Middle Eastern countries, and accordingly, countries in the region were advised to refrain from economic cooperation with China and indicated that there was no need to expand military cooperation with it [12].

Another important area of cooperation between China and the Arab East countries is its active participation in peacekeeping operations conducted within the

framework of the UN. At the UN Peacekeeping Summit in 2015, Xi Jinping [13] announced that police units and peacekeeping forces consisting of 8,000 soldiers would be trained, and engineering and medical personnel would be sent to participate in peacekeeping operations. In addition, in his speech, the head of state announced that China would allocate \$100 million to the African Union and send helicopters to UN missions in Africa. In 2021, Foreign Minister Wang Yi, in a statement on the occasion of the 50th anniversary of China's membership in the UN, announced that 2,400 Chinese soldiers and police officers were participating in UN peacekeeping operations and that China had fully fulfilled its 2015 commitments.

China's policy in the Middle East region is aimed at protecting its commercial investments and Chinese citizens working in the region as part of the 21st Century Maritime Silk Road project. According to Jesse Marks, who served as the US Deputy Secretary of Defense from 2020 to 2022, during the unrest in Libya during the Arab Spring in 2011, separate troops of the People's Liberation Army of China were deployed overseas to ensure the operations of 75 companies, the effectiveness of 50 economic projects, and the safety of 35,000 Chinese citizens, conducting operations to protect and repatriate their citizens, a mission completed in 12 days [14]. In 2015, Chinese warships rescued 571 Chinese citizens and 8 foreign nationals working in Chinese industries from Yemen [15].

China and countries in the Middle East region have been developing cooperation to combat threats such as terrorism and maritime piracy. In September 2022, in his speech at the 2nd Middle East Security Forum held in Beijing "New Middle East Security Architecture" organized by the Chinese Foreign Ministry Think Tank and the China Institute of International Relations, Chinese Foreign Minister Wang Yi outlined China's four-point approach to regional security in the Middle East:

- support for a "new concept of security" based on common, comprehensive cooperation and sustainable security;
- establishing dominance in the region of the Middle Eastern countries themselves instead of extraterritorial actors in the region;
- compliance with the purposes and principles of the UN Charter;
- intensifying dialogue with countries in the region on security issues [16].

The above position of China is a continuation of the global security initiative voiced by Xi Jinping in April 2022 at the opening of the Boao Forum for Asia. The initiative is based on the principles of upholding the concept of common, comprehensive, joint and stable security, respecting the sovereignty and territorial integrity of all countries, non-interference in the internal affairs of other countries, and respecting their choice on the path to independence. (Xi Jinping, 2022). On December 9, 2022, Xi Jinping's speech at the China-GCC Summit entitled "Building on Past

Achievements to Create a Bright Future for China-GCC Relations” emphasized the importance of China and the Gulf countries in maintaining regional peace and stability.

In general, experts and researchers acknowledge that China is currently turning the principles of respect for the territorial integrity and sovereignty of the country, non-aggression against states, non-interference in the internal affairs of independent states, establishment of economic cooperation on a mutually beneficial basis, and peaceful coexistence into its conceptual and ideological position. Beijing has always made it clear that it does not seek international hegemony and is against expansionist policies. However, it should be noted that China’s influence is growing throughout the world. Henry Kissinger, speaking at the Global China Summit symposium organized by Washington Post Live in 2011, noted that China has historically been a power and in the future it will return to its role as a world leader [17]. Thus, China’s military presence in the Middle East is aimed at combating security threats such as terrorism, extremism, and maritime piracy. The main goal is to ensure the security of the Maritime Silk Road and the continuity of cargo transportation within the framework of the One Belt, One Road megaproject.

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中国对美国外交政策原则演变 (2009–2025)
**EVOLUTION OF CHINA'S FOREIGN POLICY PRINCIPLES
REGARDING THE UNITED STATES (2009-2025)**

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摘要: 本文考察2009年至2025年间中国对美国外交政策原则的演变历程。文章追溯这些原则从奥巴马时代强调的“相互尊重、互利共赢”以及后来的“不冲突、相互尊重、合作共赢”，到特朗普第一任政府在此基础上补充的“协调、合作、稳定”，再到拜登政府和特朗普第二任政府回归到“相互尊重、和平共处、合作共赢”的转变。文章强调即使在美国政府更迭的情况下，中国仍然对美政策保持高度连续性。

关键词: 中国、美国、中美关系、习近平、奥巴马、特朗普、拜登。

Abstract. *The article examines the evolution of China's foreign policy principles towards the United States in 2009-2025. It traces shifts in these principles from the Obama era's emphasis on the principles of "mutual respect, mutual benefit, and win-win cooperation" (相互尊重、互利共赢) and then "no conflict, no confrontation, mutual respect, and win-win cooperation" (不冲突、相互尊重、合作共赢) through the first Trump administration's focus on "coordination, cooperation, and stability" (协调、合作、稳定) to the Biden and second Trump administrations' replacement with "mutual respect, peaceful coexistence, and win-win cooperation" (相互尊重、和平共处、合作共赢). The article highlights China's emphasis on the continuity of its policy towards the US even with changes in US administrations.*

Keywords: *China, United States, Sino-American Relations, Xi Jinping, B. Obama, D. Trump, J. Biden.*

As Chinese political leaders have frequently emphasized, the Sino-American relationship is one of the most significant bilateral relations globally, and according to some statements, the most significant [1]. In 2009, during the China-US Strategic and Economic Dialogue, China's "core interests" were formally defined for the first time, their comprehensive articulation reflected China's enhanced

standing on the international stage. An analysis of China's foreign policy principles toward the US following the Obama administration's inauguration in 2009 offers valuable insights into the dynamics of the Sino-American relationship as one of the world's most significant bilateral connections.

Core Principles of Chinese Policy towards Obama Administrations (2009-2017)

China has consistently revised its foreign policy principles concerning the US, a process influenced, in part, by changes in US presidential administrations, each of which has adopted distinct approaches to formulating foreign policy strategies toward Beijing.

During the first Obama administration (2009-2013) China in its foreign policy statements concerning the US emphasized its continued adherence to the principles that had been established by the Chinese leadership during the George W. Bush administration in 2006 – the principles of “mutual respect, mutual benefit, and win-win cooperation” (相互尊重、互利共赢). As early as his first state visit to the US after becoming President of the PRC in April 2006, Hu Jintao stated that the two countries “should view and handle China-US relations from a wide and deep strategic perspective and with the mindset of mutual benefit and win-win cooperation”. In the context of these principles Hu Jintao repeatedly emphasized that in the current international situation the common strategic interests of the two countries are not decreasing, but expanding [2]. The joint China-US statement released following Hu Jintao's visit to the US in January 2011 expressed a commitment to building a China-US partnership based on mutual respect, mutual benefit, and win-win cooperation “in order to promote the common interests of both countries and to address the 21st century's opportunities and challenges” [3].

These principles became the prototype for the concept of “a New Type of Major-Power Relationship” between China and the US which Xi Jinping proposed in February 2012.

In June 2013 the Chinese side proposed new principles for bilateral interaction: China began to build its relationship with the US based on the principles of “no conflict, no confrontation, mutual respect, and win-win cooperation” (不冲突、不对抗、相互尊重、合作共赢). Xi Jinping proposed these principles during his meeting with Barack Obama in California in June 2013, framing them as the “core elements of a New Type of Major-Power Relationship between China and the US”. Xi Jinping interpreted the meaning of these principles as follows: the principle of “no conflict and no confrontation” implies positioning China and the US as partners, not rivals, and resolving disagreements through dialogue rather than confrontation; the principle of “mutual respect” involves respecting the core interests of China and the US, as well as their chosen paths of development and political systems; the principle of “win-win cooperation” entails China and the

US striving for mutual development while pursuing their own, and rejecting “zero-sum games” [4].

Several factors can explain the change in the principles guiding Beijing’s relations with the US during the first and second Obama administrations. First, the principles of “mutual respect, mutual benefit, and win-win cooperation” of the first Obama administration (2009-2013) reflected China’s desire for constructive engagement and the search for common interests. This aligned with the first Obama administration policy, which was oriented toward dialogue and cooperation (for example, in a phone call with Hu Jintao on January 30, 2009 immediately after taking office, Obama reaffirmed the US government’s willingness to deepen cooperation with China and develop more active and constructive relations) [5].

Second, during Obama’s second administration (2013-2017) the international environment became more complex, and serious contradictions continued to accumulate in China-US relations. The principles of “no conflict, no confrontation, mutual respect, and win-win cooperation” emphasized China’s desire to avoid conflicts with the US while simultaneously highlighting the need to respect Chinese interests and rights.

Consequently, the shift in principles reflected both internal changes within China (the growth of its economic power and its rising status on the international stage) and changes in international politics, which demanded a more flexible approach to interaction with the US.

Adjustment of China’s Foreign Policy Principles Regarding First Trump Administration (2017-2021)

Donald Trump who assumed the presidency of the United States in 2017 introduced a number of unique approaches to American foreign policy that differed significantly from those of his predecessors. His administration was characterized by an emphasis on the “America First” policy, which prioritized US national interests in international affairs, leading to a “trade war” with China through the imposition of tariffs on Chinese goods. In response to these challenges Beijing adjusted its principles for interaction with the US, shifting to an emphasis on “coordination, cooperation, and stability” (协调、合作、稳定), reflecting its desire to ensure stable relations and jointly resolve emerging problems in the face of growing tensions.

These principles were articulated by Xi Jinping during a meeting with newly elected US President Donald Trump at the December 2018 G20 summit in Buenos Aires, framing them as the guiding theme of bilateral relations [6]. According to China’s Foreign Minister Wang Yi, these principles were intended to guide joint Sino-American efforts across all sectors [7].

According to Diao Daming, a Professor and Ph.D. Supervisor at the School of International Studies of Renmin University of China, these three principles

embody a “high degree of strategic wisdom.” The principle of “coordination” is particularly important, given that China and the US will inevitably face disagreements on certain issues in a changing international environment. It does not simply a “division of spheres of influence” in the style of a “great power club,” but is aimed at maintaining global prosperity and stability [8].

Diao Daming refers to the principle of “cooperation” as the “gold standard” of relations between China and the US tested by the history of their interaction, and the “only correct choice” for both sides. On the one hand, the enormous scale and rapid growth of the Chinese economy contribute to global economic growth, and if the US genuinely wants to achieve its goal of “becoming great again,” it cannot forgo cooperation with China. On the other hand, to achieve sustainable development and prosperity for each country, China and the US should make a necessary contribution to ensuring the stability of the international environment [8].

The principle of “stability” reflects the current state of bilateral relations, which should be maintained by the two states [8]. China and the US are world’s largest economies, accounting for over 40% of global economic output. Furthermore, they are the only two nations with GDPs exceeding \$10 trillion [9]. Consequently, the stability of their relationship directly determines the current state and future prospects of the global economy [8].

Importantly, while adhering to these three principles, the Chinese side did not abandon its previously established principles. For example, in spring 2020 Wang Yi explained that China was developing relations with the US based on “coordination, cooperation, and stability” while also adhering to the principles of “no conflict, no confrontation, mutual respect, and win-win cooperation” [10] which were introduced towards the Obama administration.

The last mention of the principles of “coordination, cooperation, and stability” by Wang Yi occurred in early January 2021 (shortly before D. Trump’s departure from the US presidency). The Chinese Foreign Minister noted that China-US relations had “reached a new crossroads” [11]. The disappearance of these three principles from bilateral discourse in the lead-up to J. Biden’s inauguration can be attributed to the necessity of observing the actions of the new American leadership and formulating new principles for China-US relations.

China’s Foreign Policy Principles Towards US in 2021-2025

From January to November 2021, when characterizing China-US relations Chinese diplomats referred only to the principles established during the Obama administration. Although China did not propose new principles for developing relations with the US under the Biden administration at this stage, in July 2021 the Chinese Foreign Minister outlined “three red lines” that the American side should not cross in order to avoid a decline in bilateral relations. Specifically, the US should not attempt to undermine the path and system of socialism with

Chinese characteristics; should not attempt to hinder or even interrupt China's development process; and should not violate China's sovereignty and territorial integrity [12].

From November 2021 to the present, China has interacted with the US based on the principles of “mutual respect, peaceful coexistence, and win-win cooperation” (相互尊重、和平共处、合作共赢). Xi Jinping put forward these principles during an online meeting with Joe Biden in November 2021 as “the principles for the two countries to get along in the new era” [13].

As Chinese Ambassador to the US Xie Feng noted in June 2023, “mutual respect comes first; peaceful co-existence is the red line; win-win cooperation is what we are aiming at” [14]. According to Wang Yi, these principles are the necessary path to restoring the stable development of bilateral relations [15]. Combined with Joe Biden's position on China-US relations, tentatively referred to by the Chinese side as “five noes” (四不一无意)¹, they “will constitute a complete system with clear guiding principles and operability” if the US translates Biden's “five noes” statement into real actions [16].

At the meeting in San Francisco in November 2023 the two leaders reaffirmed the agreements reached at the Bali summit in November 2022, including the reaffirmation of commitment to the principles of “mutual respect, peaceful coexistence, and win-win cooperation” on the Chinese side and the position of “five noes” on the American side [17].

In a congratulatory message from Xi Jinping to D. Trump on November 7, 2024 following the latter's victory in the election, the Chinese leader reaffirmed Beijing's commitment to these three principles [18]. At a meeting with Joe Biden in Lima on November 16, 2024 Xi Jinping also stated the invariability of the three aforementioned principles [19].

Although China updated the principles guiding its policy toward the US following the first Trump administration, similar changes may not occur during Trump's second term. This is evidenced by Wang Yi's recent statement at the Munich Security Conference, where he emphasized that China's US policy is “the three principles put forward by President Xi”. He also provided interpretation of these three core principles: respect each other is the “right approach”; peaceful coexistence is “self-evident” (“you can't have conflict between two major countries like China and the US; otherwise, the world would suffer”); and win-win cooperation is necessary because “global challenges require China and the US to work together to address” [20].

¹ This position of J. Biden on China-US relations was first articulated in November 2021 and March 2022 and means that the US does not seek a new Cold War with China; it does not aim to change China's system; the revitalization of its alliances is not against China; the U.S. does not support “Taiwan independence”; and it is not looking for conflict with China.

* * *

During the period under review, China several times updated the principles defining the content of the “a New Type of Major-Power Relationship”: the principles of “no conflict, no confrontation, mutual respect, and win-win cooperation” from the Obama era were supplemented by the principles of “coordination, cooperation, and stability” towards Trump administration, which during Biden period were replaced by the principles of “mutual respect, peaceful coexistence, and win-win cooperation.” After Trump came to power in 2025, Beijing did not update its foreign policy principles regarding the US and continues to use the principles formulated under Biden, emphasizing the continuity of its policy. However, changes may occur if the new Trump administration does not interact with Beijing on the basis of the previously established principles.

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中哈双边关系发展势头强劲

**DYNAMICS OF EXPANSION OF BILATERAL RELATIONS
BETWEEN CHINA AND KAZAKHSTAN**

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Annotation. *The article notes that since the establishment of diplomatic relations between the Republic of Kazakhstan and the People's Republic of China, close political contacts at a high level have been maintained for 30 years. It is emphasized that the countries actively cooperate in international affairs, support each other on issues related to the fundamental interests of the parties, and have carried out fruitful cooperation within the framework of multilateral structures - "One Belt and One Road", "Nurly Zhol". It is concluded that the expansion of bilateral ties makes an important contribution to peace and stability in the regions and throughout the world.*

Keywords: *China, Kazakhstan, megaproject, cooperation, logistics.*

The "One Belt, One Road" initiative, which is of a large-scale nature, was first announced by the Chairman of the People's Republic of China Xi Jinping in the capital of Kazakhstan (RK), in the city of Astana in 2013.¹ There are a number of reasons for this: firstly, the border is long, there are no political differences between the countries. Secondly, there is convenient logistics, the bulk of freight trains from China (PRC) go through Kazakhstan, going to the European part and to the south. Thirdly, Kazakhstan has a huge potential of natural resources, including uranium, which is important against the background of Chinese plans to develop nuclear energy.² Based on this, it is worth emphasizing that the Republic

¹ China and Central Asian countries jointly promote the "One Belt, One Road" initiative - Rossiyskaya Gazeta // <https://rg.ru/2023/05/18/otpravnaia-tochka-mira.html>

² From raw materials to goods: how China is helping Kazakhstan modernize its economy // From raw materials to goods: how China is helping Kazakhstan modernize its economy | Inbusiness.kz

of Kazakhstan is not only a sales market, but also the most important logistics corridor for the PRC.

After the collapse of the USSR and the establishment of diplomatic relations between the countries in 1992, significant documents for the formation and development of bilateral relations between the Republic of Kazakhstan and China were signed. Important signed documents include: the Treaty on Good-Neighborliness, Friendship and Cooperation (December 2002, Beijing); the Agreement between the Governments of Kazakhstan and China on the establishment of the Kazakhstan-China Cooperation Committee on May 14, 2004³. Joint Declaration on the Establishment and Development of Strategic Partnership (July 2005, Astana); Joint Declaration on the Development of Comprehensive Strategic Partnership (June 2011, Astana); Joint Declaration on Further Deepening of Comprehensive Strategic Partnership (September 2013, Astana); Joint Declaration of the Heads of State on a New Stage of Comprehensive Strategic Partnership (August 2015, Beijing). Joint Statement of the Republic of Kazakhstan and the People's Republic of China on Eternal Comprehensive Strategic Partnership (September 2019, Beijing); Joint Statement of the Republic of Kazakhstan and the People's Republic of China on the Occasion of the 30th Anniversary of the Establishment of Diplomatic Relations (September 14, 2022, Astana), Joint Statement of the Republic of Kazakhstan and the People's Republic of China (May 17, 2023, Xi'an).

After the establishment of diplomatic relations and the signing of interstate documents, an active process is underway aimed at implementing joint projects in a variety of industries. Following the Agreement concluded in May 2004 between the national oil and gas company of Kazakhstan KazMunaiGas and the China National Petroleum Corporation (CNPC) on the construction of an oil pipeline, which was completed at the end of 2005. This pipeline connected the Atasu oil pumping station in the Karaganda region with the Alashankou railway station in China⁴, which marked the entry of Chinese-Kazakh energy cooperation into a new stage of development.

In 2014, Kazakhstan proposed its own concept for the “Bright Path” economic development project – a plan for linking with China’s “Silk Road Economic Belt” initiative, which was signed on September 2, 2016, in Hangzhou.⁵ As of September 2018, China and Kazakhstan have reached agreements on the implementation of 51 cooperation projects in the field of production capacities with a total

³ ILS «Adilet» // https://adilet.zan.kz/rus/docs/P040000545_/compare

⁴ Kazakhstan-China Pipeline. // <https://www.kcp.kz/company/history>

⁵ On the signing of the Cooperation Plan for the alignment of the New Economic Policy “Nurly Zhol” and the construction of the “Silk Road Economic Belt” between the Government of the Republic of Kazakhstan and the Government of the People's Republic of China - IPS “Adilet” // <https://adilet.zan.kz/rus/docs/P1600000518>

value of over \$26 billion.⁶ Uranium supplies from Kazakhstan to China began in 2019, and five years later, by 2024, up to 70% of all imported uranium in China came from Kazakhstan. In 2021, the Kazakh-Chinese enterprise Ulba-TVS was launched in Kazakhstan to produce nuclear fuel using advanced technologies from the French Framatome.

In 2021, China accounted for 18.2% of Kazakhstan's total trade turnover, 17% of exports, and 20% of imports.⁷ In 2022, the volume of trade between Kazakhstan and China increased by 23.6% and set a historical record of 31.2 billion US dollars. Export share in 2022, exports to China accounted for 15.6% of Kazakhstan's total trade turnover. China's share in Kazakhstan's import structure is 21.9%.⁸ In 2023, trade turnover between Kazakhstan and China amounted to \$31.5 billion, which is 30.4% more than the previous year.⁹ "According to the General Administration of Customs of China, in 2024, the volume of bilateral trade between Kazakhstan and China reached 43.8 billion dollars. Kazakhstan's exports to China amounted to 15.8 billion dollars, an increase of 9%. This trend confirms our confident movement towards the implementation of the ambitious goal of doubling trade turnover in the near future," Ambassador Han Chunli emphasized.¹⁰

The successful holding of the first C5+1 summit in Xi'an in 2023 resulted in the implementation of strategic joint projects, including in the field of transport and logistics: logistics centers and dry ports were put into operation, transport corridors were strengthened, and the construction of a transcontinental railway was laid.¹¹ Authorities in China's Xinjiang Uyghur Autonomous Region (XUAR) are investing 1 billion yuan (\$140 million) in building a transport and logistics hub in Kazakhstan.¹² In order to increase the potential of rail freight transportation between Kazakhstan and China, infrastructure is being built, for example, second

⁶ Review: China-Kazakhstan cooperation in production capacity contributes to the alignment of development strategies of the two countries - //Review: China-Kazakhstan cooperation in production capacity contributes to the alignment of development strategies of the two countries - Rambler/news

⁷ Imports are growing, exports are declining: how trade turnover between Kazakhstan and China has changed in 2021 //Imports are growing, exports are declining: how trade turnover between Kazakhstan and China has changed in 2021 — AGRO BUSINESS KAZAKHSTAN

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⁹ Finprom - Oil, gas and metals to China, from there - clothes, equipment and cars. How does Kazakhstan trade with China? //https://finprom.kz/ru/article/v-kitaj-neft-gaz-i-metally-ottuda-odezhdu-tehniku-i-avtomobili-kak-rk-torguet-s-kr

¹⁰ In 2024, the volume of trade between Kazakhstan and China reached \$43.8 billion //https://kapital.kz/economic/134203/v-2024-godu-ob-yem-torgovli-mezhdu-kazakhstanom-i-kitayem-dostig-43-8-mlrd.html

¹¹ Transport and logistics – the driver of international partnership // https://kazpravda.kz/n/transport-i-logistika-drayver-mezhdunarodnogo-partnerstva/

¹² China invests in construction of logistics hub in Kazakhstan // https://trans.ru/news/kitai-investiruet-pochti-140-mln-dollarov-v-stroitelstvo-logisticheskogo-haba-v-kazahstane

tracks on the Dostyk-Moiynty section. Also, measures have been launched to create a container hub in the port of Aktau¹³.

Thus, Kazakhstan is a key economic partner of China in Central Asia, accounting for the largest volume of trade turnover between China and all the republics of the region. This is confirmed by large-scale joint projects in the transport sector and energy¹⁴. By 2027, Kazakhstan will complete the construction of the new Ayagoz-Tacheng railway (272 km), which will connect the country with China and significantly increase the volume of transportation between these two economic centers and will increase the volume of cargo transportation to 20 million tons per year and create 1,700 new jobs. In addition, another customs crossing will open on the border with China, which will facilitate and speed up the passage of goods across the border. This project may become one of the most important steps towards the formation of Central Asia as a key logistics space for the global economy.¹⁵.

The countries also actively cooperate in the field of agriculture. According to the Ministry of Agriculture of the Republic of Kazakhstan, the turnover of agricultural products between the Republic of Kazakhstan and the People's Republic of China in 2023 amounted to \$1.29 billion (+40%), of which the export of the Republic of Kazakhstan was \$1 billion (+45%), and the import of the Republic of Kazakhstan was \$290 million (+20%)¹⁶. Currently, 1,718 Kazakh agricultural enterprises have the right to export their products to China (86 for the production of livestock products, 1,629 - crop products). Since February 7, 2024, the Chinese side lifted the previously introduced restrictions on foot-and-mouth disease from the southeastern regions of the Republic of Kazakhstan (Abai, Almaty, Zhetysu, East Kazakhstan, Zhambyl, Turkestan and Kyzylorda regions, as well as the cities of Almaty and Shymkent). The possibility of coordinating veterinary and phytosanitary requirements for the export of 7 more types of agricultural products to China is being worked out, including potatoes, beet pulp, oat flakes and cereals, cattle and cattle skins, dry mare's milk and poultry products.

Kazakhstan and China cooperate in the transport sector. The Chinese side actively supports the implementation of the Astana-Almaty railway construction project, as well as the Western Europe-Western China international transport cor-

¹³ Kazakhstan and China: How KTZ increases rail freight traffic: 01 July 2024, 09:01 - news on Tengrinews.kz // https://tengrinews.kz/kazakhstan_news/kazakhstan-kitay-ktj-uvlichivaet-jeleznodorojnyie-539860/

¹⁴ China and Kazakhstan strengthen logistics and manufacturing ties // <https://eurasia.today/actual/kitay-i-kazakhstan-ukreplyayut-logisticheskie-i-proizvodstvennye-svyazi/>

¹⁵ Kazakhstan to Speed Up Trade with China with New Railways: <https://kz24.news/news/ekonomika/kazakhstan-uskorit-tovarooborot-s-kitaem-novoy-zheleznoy-dorogoy.html>

¹⁶ Agricultural exports to China have doubled - el.kz // <https://el.kz/ru/eksport-selhozproduktssii-v-kitay-vyros-v-dva-raza-95217/>

ridor and the connection of the Jinghe-Yining-Khorgos railway section in China with the Zhetygen-Khorgos railway section in Kazakhstan.

The countries cooperate in the scientific and technical sphere. The issue of creation of joint scientific and technological parks in the territories of the two countries and a supercomputer center in Kazakhstan Kazakhstan's National Pavilion on the Alibaba platform, launched in 2022, brings together 290 domestic companies and offers more than 7.5 thousand products. The total sales volume through this platform has already exceeded \$260 million¹⁷.

Cooperation in the field of technology. China is a global tech hub, with Beijing ahead of trends in artificial intelligence, quantum computing and biotechnology. Kazakhstan sees this as a window of opportunity and plans to launch joint labs, innovation hubs and technology parks¹⁸.

Cultural and humanitarian cooperation. The main mechanism coordinating interaction in this area is the Subcommittee on Cultural and Humanitarian Cooperation of the KS-PRC (the 15th meeting of the Subcommittee was held on April 19, 2023 by the WSC). In 2015, an Agreement on Cultural and Humanitarian Cooperation was signed between the Government of the Republic of Kazakhstan and the Government of the PRC. Five Confucius Institutes have been opened in Kazakhstan (Astana (L.N. Gumilyov Eurasian National University), Almaty (Al-Farabi Kazakh National University, Ablai Khan Kazakh University of International Relations and World Languages), A. Saginov Karaganda Technical University and Aktobe State Pedagogical Institute). As of January 2024, 3,897 students are studying in China in full-time and online formats, including 452 Kazakh students on a Chinese government grant. Since 2015, 6 "Kazakhstan Centers" have been operating in universities in China (Beijing, Shanghai, Dalian, Xi'an and Hangzhou), 3 of which in Beijing, Shanghai and Xi'an provide training to Chinese students in the specialty "Kazakh language and literature". Work is regularly carried out on translating and publishing books about Kazakhstan, history and culture into Chinese. In May 2023, an Agreement was signed on opening the "Lu Ban Workshop" in Kazakhstan and an Agreement on opening a branch of the Northwestern Polytechnical University in Kazakhstan.

During the official visit of Deputy Prime Minister - Minister of Foreign Affairs of the Republic of Kazakhstan Murat Nurtleu to China (March 28-30, 2024, Beijing), an agreement was reached to open the second "Lu Ban Workshop" in the field of artificial intelligence and new technologies in the Republic of Kazakh-

¹⁷ The volume of bilateral trade between Kazakhstan and China reached \$43.8 billion in 2024 - 08.02.2025// <https://ru.sputnik.kz/20250208/obem-dvustoronney-torgovli-mezhdu-kazakhstanom-i-kitaem-dostig-438-mlrd-v-2024-godu-50676899.html>

¹⁸ Friendship with Beijing — a view from Astana: material on the results of the China-Central Asia summit - CGTN in Russian // <https://russian.cgtn.com/news/2025-06-22/1936769842432614402/index.html>

stan. In March 2024, an Agreement was signed to open a branch of the Beijing Language and Culture University on the basis of Astana International University. On October 17, 2023, the opening ceremony of the bust of Abu Nasr Muhammad al-Farabi was held at the Beijing Language and Culture University. On November 25, 2023, in Beijing, as part of the Kazakhstan Culture Festival, the Embassy launched the “Digital People” project - friendship between the youth of Kazakhstan and China. On November 26-28, 2023, as part of the visit of Vice Premier of the State Council of the People’s Republic of China Ding Xuexiang to Kazakhstan, an Intergovernmental Agreement on the mutual opening of cultural centers was signed. On November 28, 2023, as part of the Days of Culture of Kazakhstan in China, for the first time in the last 10 years, the creative team of the State Concert Organization “Kazakhconcert” named after R. Baglanova performed at the National Grand Theater of China.

During the state visit of the President of the Republic of Kazakhstan K. Tokayev to China in May 2023, 2024 was declared the “Year of Tourism of Kazakhstan in China”.

In May 2025, the presentation of the Kazakh edition of Xi Jinping’s four-volume “On State Governance” took place, which became an important milestone in the development of cultural, scientific and humanitarian cooperation between Kazakhstan and China.¹⁹

Various cultural and humanitarian events, such as cultural years, art festivals, fairs and exhibitions, unique projects, especially the Lu Ban workshop, the Silk Road Family and Bright Path campaigns, deepening ties between public organizations, think tanks, media, and youth, have opened a magnificent chapter in the annals of OBOR cooperation in the new era.²⁰

Contacts and cooperation between aerospace agencies are maintained. Cooperation in agriculture is expanding to ensure food security of the two countries, as well as to develop cooperation in the export of Kazakh grain to China and its transit through China. New enterprises and transport and logistics hubs are being built.

Thus, over the years since the establishment of bilateral diplomatic relations, Kazakhstan and China have managed to establish a close political dialogue, as well as bring bilateral relations to a new level in various areas of trade, economics, education and transport logistics.

¹⁹ The Kazakh edition of Xi Jinping’s book “On Public Administration” was presented in Astana - Center for China Studies // chinastudies.kz Source: <https://chinastudies.kz/events-ru/18819/>

²⁰ Full text of the speech by Chinese President Xi Jinping at the opening ceremony of the 3rd Belt and Road Forum for International Cooperation - CGTN in Russian // <https://russian.cgtn.com/news/2023-10-18/1714512421674168321/index.html>

人道主义培训过程中专业能力的形成
**FORMATION OF PROFESSIONAL COMPETENCES IN THE
PROCESS OF HUMANITARIANS' TRAINING**

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摘要: 本文探讨了与人道主义者专业能力形成相关的认知和教学问题, 这些能力包括: 解读社会文化活动的理想内容及其结果的能力; 进行对话和提问的能力; 鼓励学生的主动性, 不忽视与讨论问题相关的任何评论的能力; 根据讨论中出现的问题重新安排主题讨论的能力; 以及对所研究问题清晰易懂地表达自己观点的能力。

关键词: 人道主义知识、人道主义者培养、专业能力、理想内容、解读、评估。

Abstract. *The article examines the cognitive and pedagogical problems associated with the formation of such professional competencies of humanitarians as: the ability to interpret the ideal content of socio-cultural activities and their results; the ability to conduct a dialogue, to ask and answer; to encourage the initiative of pupils and students and not to ignore any comments related to the issues under discussion; to rearrange the discussion of the topic in accordance with the issues that arise during the discussion; to make clear and understandable statements about their own opinion on the issues being studied.*

Keywords: *humanitarian knowledge, training of humanitarians, professional competences, ideal content, interpretation, evaluation.*

The professional training of humanities scholars and the teaching of humanities subjects give rise to a number of problems due to the specifics of humanitarian knowledge, which require special attention from both researchers and teachers working in educational institutions at all levels.

The problems discussed can be roughly divided into cognitive and pedagogical ones.

Cognitive problems directly related to the specifics of humanitarian knowledge and the professional training of teachers of humanities include such problems as: the difference between facts and interpretations; the specifics of interpretation in humanitarian knowledge; the difference between interpretations and assessments, etc. [1].

Pedagogical problems are related to the specifics of presenting, explaining, and discussing the humanities proper to pupils and students and involve the study of such issues as: can a teacher take a neutral position interpreting the ideal content of human activity or cultural products; is it possible to present the facts of humanitarian knowledge without evaluation; what should a teacher do if a student's opinion contradicts cultural value orientations?

Humanitarians' training is traditionally based on disciplines related to the study of human life as a subject of socio-cultural activity: history, sociology, cultural studies, linguistics, art history, etc.

The study of socio-humanitarian disciplines creates not only a reserve of knowledge about the socio-cultural context of those events or works that will become the object of the humanitarian' interpretation in the future, but also forms a theoretical and methodological basis for the analysis of relevant socio-cultural phenomena: historical events and human activities, products of material and spiritual culture. In addition, studying the works of outstanding humanitarians helps to understand exactly how the ideal content of human activity and cultural works is analyzed.

However, will the knowledge acquired in the learning process help a student become a humanitarian who is able to identify and explore the ideal content of socio-cultural activities and their results?

Despite the fact that the question seems rhetorical and the answer to it seems self-evident (knowledge cannot but help!), this "optimistic" evidence hides a deeper, but not a less well-known "sobering" evidence that knowledge of anything does not transform a person into a subject of the relevant field of activity.

Knowledge is an absolutely necessary, but not sufficient element in the formation of a professional of any profile. Knowledge by itself cannot transform a person who possesses it into an engineer, a teacher, a scientist, or a humanitarian.

Of course, experience in the practical application of knowledge is needed.

But what is the practical training of a humanitarian?

A humanitarian is not someone who has read everything, been everywhere, seen and heard everything, and can talk about everything without making the slightest attempt to reflect on the ideal content of what he has seen, read or heard.

A humanitarian is someone who knows how to reflect on the content of what he has read, seen or heard, is able to analyze the ideal content of cultural activities and products and identify ideas and meanings hidden in material carriers.

Is it possible, in principle, to teach how to interpret the ideal content of socio-cultural activities and their results?

Genuine humanitarians, as researchers of the ideal, value content of socio-cultural activity and its results, are as unique in their talents as the creators of those socio-cultural works that humanitarians interpret.

Analyzing the ideal content of socio-cultural activity and its results, philosophers, philologists, art historians, and historians do not just "extract" this content

from material embodiments (texts, objects, and deeds), but create their own “reading”, interpretation, of both the cultural product being studied and the activities of the cultural subject who created this product.

Since humanitarians have no substantive, practical, sensually perceived contact with ideal content, no humanitarian interpretation can be refuted.

Reproaching humanitarians for “thinking” about a subject rather than “exploring” it, proponents of identifying all types of knowledge with scientific knowledge deny exactly what constitutes the specifics of humanitarian knowledge: reflection as a specialized activity aimed at creating a theoretical model of the ideal object being studied.

If we look at the requirements for the content and presentation of articles in many humanities journals, we will find that these requirements reflect the specifics of natural science rather than humanities. Humanities scholars are forced to conduct surveys, draw up graphs, calculate percentages, etc., thereby demonstrating that humanitarian research does not differ from natural science research in terms of its object, subjects, methods, or results.

Those who try to meet such requirements turn the presentation of their humanitarian ideas into an imitation of a scientific article with conclusions that are self-evident and do not require any research.

The interpretation of the ideal content of human activity differs from the interpretation of natural science facts in that it requires not only a statement of the supposed essence of views and motives of human actions, but also an assessment of all components of the interpreted content.

Evaluation is always the identification of the conformity of what is being evaluated to a certain standard.

No matter who the teacher talks about, the students want to know: who are those who have committed certain deeds and actions for them, living here and now: heroes, victims, criminals? How should we treat their activities? Even if the students do not ask questions, the teacher cannot avoid explaining what significance this or that event had (as a fact of socio-cultural existence) for the subsequent development of the country, the world, the people, individual social groups and specific personalities; how did the objective laws of social development and the personal qualities of the creators of these events or works manifest themselves in historical events or works of socio-cultural activity?

An unappreciated presentation of facts is like a historical chronology that answers the questions: when and where this or that event occurred; who, where and when committed this or that act. However, it is precisely this presentation of facts that raises questions from inquisitive students: “Why should we know about this? What does this have to do with our lives?”

The traditional answers to these questions like “You can’t be a full-fledged citizen of a country without knowing its history. Knowledge of history will help in solving today’s problems”, etc. seem convincing only at first glance and only for those who tend to adhere to the opinions accepted in the professional community.

The correlation of these opinions with the real life of the students indicates that knowledge of the deeds and achievements of other people will not help anyone to cope with the pressing problems of their own lives, and the love of “native ashes and paternal coffins” is not deducted from textbooks and is not related to the amount of knowledge. At all times and among all peoples, defenders of the Fatherland are dominated not by those who know the history of their country, but by those who know what it means to be a decent person.

Every teacher should be aware that it is he/she who influences the formation of a student’s worldview “here and now”, at this point in the socio-cultural space where communication takes place between teacher and students. A teacher is someone who is expected to make clear, precise, understandable statements that contain not only knowledge, but also the teacher’s own opinion on the issues being studied [2].

That is why the most important professional competencies of a humanities scholar include: the ability to conduct a dialogue, to ask and answer; to explain the ideal content of cultural products and their own position; to encourage the initiative of pupils and students and not to ignore any comments related to the issues under discussion; to rearrange the discussion of the topic in accordance with the issues that arise during the discussion [3].

Can modern information technologies contribute to the development of the main competence of a humanitarian – the ability to interpret the ideal content of socio-cultural activities and their results?

On the one hand, it is obvious that virtually unlimited access to digital forms of representation of various products of human socio-cultural activity creates the necessary basis for the training and independent professional activity of a humanitarian. On the other hand, it must be remembered that humanitarians have no practical, sensory-perceptible contact with the ideal content of human activity and cultural products, which means that no material means and technologies can help in the study of ideal objects [1].

Any material and technical means and information technologies should be considered as auxiliary conditions that ensure students’ access to the studied socio-cultural objects and communication between students and teachers.

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培养中国声乐教师在教育过程中实施专业和教育学士和硕士学位课程的连续性
**FORMATION OF THE READINESS OF CHINESE VOCAL
TEACHERS TO IMPLEMENT THE SUCCESSION OF
PROFESSIONAL AND EDUCATIONAL BACHELOR'S AND
MASTER'S DEGREE PROGRAMS IN THE EDUCATIONAL
PROCESS**

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注释。本文论证了中华人民共和国和俄罗斯联邦教育政策最重要的战略任务，即由两国各自构建一个基于其构成环节连续性联系的统一教育空间。这一愿景能够先验地激发个人在实施教育界所倡导的终身教育发展方向过程中的能力。这解释了中华人民共和国和俄罗斯联邦教育学界为何对学士和硕士学位连续性教育项目在培养声乐教师方面，无论是在总体上还是在具体方面，都表现出浓厚的兴趣。

关键词：中俄教育政策、连续性原则、声乐教师培养项目、双层体系、学士学位、硕士学位。

Annotation. *The article substantiates the most important strategic task of the education policy of the PRC and the Russian Federation is the construction by each of the states of a single educational space based on the successive connections of its constituent links. This vision a priori activates the capabilities of a person in the implementation of the development vector adopted by the pedagogical community - lifelong education. This fact explains the interest of the pedagogical science of the PRC and the Russian Federation in the issue of the role of continuity educational programs for bachelor's and master's degrees, both in general and in particular - for the professional training of vocal teachers.*

Keywords: *educational policy of China and Russia, the principle of continuity, educational programs for training vocalist teachers, two-tier system, bachelor's degree, master's degree.*

Introduction to the problem

The most important strategic task of any state policy is to build a single educational space based on the successive links of its constituent links. This vision a priori activates the human potential in implementing the development vector adopted

by the pedagogical community – lifelong education. This fact explains the interest of the pedagogical science of the PRC and the Russian Federation in the issue of the role of succession educational programs of the bachelor's and master's degree, both in general and in particular - for the professional training of a vocal teacher. This is confirmed by numerous publications [1-5]. Meanwhile, today there are objectively a number of contradictions between the general recognition of the installation of the most important didactic principle of continuity and the absence of:

- scientific substantiation of its implementation as a necessary condition for self-development and self-actualization of students from the PRC in the music departments of pedagogical universities of the Russian Federation;

- developed structural and functional model for the formation of the readiness of Chinese vocal teachers to implement the continuity of professional and educational programs for bachelor's and master's degrees.

Discussion

Purpose of the study: to theoretically develop and test a structural and functional model for developing the readiness of Chinese vocal teachers studying at Russian universities to implement the continuity of professional and educational programs for bachelor's and master's degrees (Fig. 1).

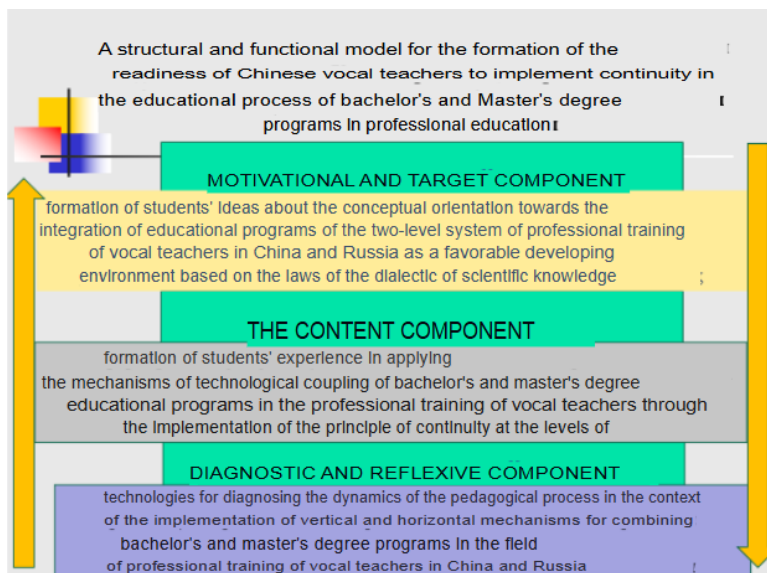


Figure 1. Structural and functional model of formation of readiness of teachers-vocalists of China for realization of continuity in the educational process of professional and educational programs of bachelor's and master's degrees

Object of study: the process of professional training of Chinese vocal teachers studying at Russian universities.

Item: structural and functional model of developing the readiness of Chinese vocal teachers to implement the continuity of professional and educational programs for bachelor's and master's degrees.

The study is based on the hypothesis that:

The process of developing the readiness of Chinese vocal teachers to implement the continuity of professional educational programs for bachelor's and master's degrees will be effective if a number of pedagogical conditions are met:

- formation of students' ideas about the conceptual focus on conjugation *educational programs of a two-level system of professional training of vocal teachers* in China and Russia as a favorable development environment based on the laws of the dialectic of scientific knowledge;

- developing students' experience in applying mechanisms in the professional training of vocal teachers *technological conjugation of educational programs* bachelor's and master's degrees through the implementation of the principle of continuity at the levels

- goals and objectives educational programs that provide for the integration of vertical and horizontal mechanisms of coupling. The vertical is determined by the idea of continuity of stages of continuous education, the horizontal - by the integrative approach to the implementation of modules and academic disciplines within the educational programs of each of the levels under consideration;
- the content of educational programs for the professional training of vocal teachers in the bachelor's and master's degrees;
- forms of organization and methods based on the unity of fundamental approaches to the organization of educational activities at all its levels;
- technologies for diagnosing the dynamics of the pedagogical process in the context of implementing a two-level system of professional training of vocal teachers in China and Russia.

Research objectives:

- to identify the essential meaning of continuity and its understanding in philosophy, cultural studies and pedagogy in the context of a comparative approach to interpretation by Russian and Chinese researchers;

- to analyze the traditions and innovations of the two-level system of training vocal teachers in higher educational institutions of Russia and China;

- to develop and test experimentally a structural and functional model for the formation of the readiness of Chinese vocal teachers to implement the continuity of professional and educational programs for bachelor's and master's degrees in the educational process.

Methodological basis of the research:

- works that reveal the essence of the dialectic of negation and continuity in the development of scientific knowledge (Arzymatov Z.S., Borodkin V.V., Hegel G., Kant I., Schelling F., Kang Yuwei, Tan Sitong, Sun Yat-sen, Feng Yulan, Hu Shi);
- conceptual provisions comparative pedagogy as a field of pedagogical science (A.N. Dzhrinsky, E.Y. Rogacheva, Lu Fei Kui, Luo Yan Guang, Rao Congman, Zhong Zhai, Shi Zhongning, Ya Jie Xuan);
- concepts of developing students' readiness for pedagogical activity (B.G. Ananyev, V.A. Slavenin, Meng Xianle, Fu Shuizhin);
- works in the field of continuity as a category of didactics of higher education in the Russian Federation and the PRC (V.I. Zagvyazinsky, V.A. Sitarov, Liu Nan, He Jihong, Zhao Bingqi, Jiang Yuxin, Zhu Yongxin, Shi Wei, Yang Xiao);
- research in the field of pedagogy and psychology of higher music pedagogical education (E.B. Abdullin, E.V. Nikolaeva, L.S. Maikovskaya, L.A. Rapatskaya, A.V. Toropova, G.M. Tsylin, A.I. Shcherbakova, Wu Zin Min, Han Min, Zhang Yang).

Conclusion

The conducted research allows us to state that its theoretical significance lies in the fact that the dissertation revealed the essential meaning of continuity and its understanding in philosophy, cultural studies and pedagogy in the context of a comparative approach to interpretation by Russian and Chinese researchers; analyzed the traditions and innovations of the two-level system of training a vocal teacher in higher educational institutions of Russia; developed a structural and functional model for the formation of the readiness of vocal teachers in China to implement the continuity of professional and educational programs of bachelor's and master's degrees.

Practical significance research is that its results contribute to the optimization of the process of musical and pedagogical education of vocal teachers in China. The research materials can be used in lectures, seminars, and workshops in a number of academic disciplines implemented in Russian universities in educational programs for foreign students (Musical art and education as objects of scientific research; Theory and methods of teaching vocal disciplines in the system of secondary vocational and higher education, etc.)

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果戈里与女人：禁欲主义对作家作品的影响

GOGOL AND WOMEN: THE INFLUENCE OF ASCETICISM ON THE WRITER'S WORK

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摘要：本研究旨在分析果戈理禁欲主义思想对其艺术作品中女性形象塑造的影响。研究基于其生平资料、书信遗产以及对其主要作品的分析。作者推测，果戈理的个人禁欲主义、对世俗依恋的拒斥以及对精神完美的追求，与其笔下女性形象的演变相关，从早期浪漫主义化但矛盾的形象，到成熟期作品中非人化、怪诞描绘以及心理深度的缺失。作者建议将果戈理话语中的女性原则视为存在“庸俗”的标志和道德批判的对象，而这恰恰是作者禁欲主义世界观的直接结果。

关键词：果戈理、禁欲主义、女性人物、果戈理的作品、影响、诗学、怪诞、讽刺、钦差大臣、死魂灵、十九世纪俄罗斯文学。

Abstract. *This work is devoted to the analysis of the influence of the ascetic views of N.V. Gogol on the formation of female images in his artistic work. The study is based on biographical data, the writer's epistolary legacy and an analysis of his key works. It is hypothesized that Gogol's personal asceticism, his rejection of worldly attachments, and his desire for spiritual perfection correlate with the evolution of female characters from the romanticized but ambivalent images of the early period to their subsequent dehumanization, grotesque depiction, and virtual absence of psychological depth in his mature works. It is proposed to consider the feminine principle in Gogol's discourse as a marker of the "vulgarity" of existence and an object of moralistic denunciation, which is a direct consequence of the author's ascetic worldview.*

Keywords: *Gogol, asceticism, female characters, Gogol's works, influence, poetics, grotesque, satire, The Government Inspector, Dead Souls, Russian literature of the 19th century.*

Nikolai Vasilievich Gogol, a pivotal figure in 19th-century Russian literature, continues to be a subject of intense literary and culturological discussions. His oeuvre, characterized by a unique synthesis of laughter and tragedy, grotesque and realism, is inextricably linked to his deeply individual system of values and

life principles. Prominent among these is asceticism — a conscious renunciation of worldly goods, carnal pleasures, and social attachments for the sake of spiritual perfection. The aim of the present study is to explicate the influence of this ascetic principle on the artistic representation of female characters in Gogol's works.

The paradox of Gogol's world lies in the virtually complete absence of positive, fully developed female characters endowed with profound psychological depth and spiritual substance. Instead, we observe either their idealization to the point of mythological conventionality, or, more typically for his mature period, their reduction to caricatural forms embodying social vices and spiritual emptiness. This specific interpretation of the feminine principle suggests a hypothesis regarding its direct influence by the author's personal asceticism and religious-philosophical quests.

Biographical information about N.V. Gogol attests to his lifelong celibacy and conscious avoidance of romantic and familial relationships. This choice was not an accidental coincidence but rather a consistent manifestation of his worldview, rooted in the Orthodox ascetic tradition. Starting from the late 1830s, and particularly in the 1840s, Gogol's religious-philosophical and mystical aspirations became dominant, which is reflected in his correspondence and journalism, primarily in "Selected Passages from Correspondence with Friends."

Gogol perceived earthly existence as a vale of trials, and worldly passions and attachments as obstacles on the path to the soul's salvation. Asceticism, self-denial, and the struggle against the "poshlost" (vulgarity) and sinfulness of the world became for him not merely a lifestyle choice, but also a methodology for apprehending truth. In his letters, Gogol repeatedly emphasized the necessity of "detachment from all worldly things" and "immersion in oneself" [1, p. 347]. Such a worldview, oriented towards the transcendent, inevitably led to the devaluation of the earthly, the material, and the sensual. Woman, traditionally symbolizing the carnal, emotional, and procreative principle, within such a coordinate system, could be perceived either as a potential source of temptation or as a metaphorical embodiment of that very "poshlost" (vulgarity) and vanity from which Gogol sought to distance himself. As V.V. Zenkovsky notes, "Gogol's religious feeling was deeply personal and ascetic, but it also shaped his aesthetic principles" [2, p. 145].

An analysis of Gogol's artistic legacy reveals a certain evolution in the representation of the feminine principle, which correlates with the deepening of his ascetic convictions.

In early works, such as the collections "Evenings on a Farm Near Dikanka" (1831–1832) and "Mirgorod" (1835), female characters are often endowed with features of romantic idealization and poeticism. Oksana from "Christmas Eve" appears as the embodiment of beauty and willfulness, while Solokha is depicted as a witch with an alluring power. However, even here, an ambivalence is present.

Firstly, there is idealization and conventionality. These characters lack deep psychological development and function more as archetypal, mythologized figures or elements of folklore imagery, rather than as living, multifaceted personalities. Their beauty often has an external, fairy-tale quality.

Secondly, there is duality and danger. Beauty is frequently associated with treachery, magical power, or even a demonic essence (Pannochka from “Viy”). Woman can be a source of temptation and danger for the male soul, provoking a conflict between the spiritual and the carnal. D.S. Merezhkovsky points to a “demonic principle” in Gogol’s early female characters, linking it to the author’s internal struggles [3, p. 98].

Finally, there is an absence of full-fledged relationships. The love plots present in these works rarely reach the level of a deep spiritual or partnership union. They are limited to the phase of courtship, overcoming obstacles, or temptation.

Thus, already in the initial stage of his creative work, Gogol, possibly implicitly, laid the groundwork for his subsequent attitude towards the feminine principle: it could be beautiful, yet potentially dangerous or unrealistically ideal, placing it outside the realm of real-life interaction.

In the works of his mature period – “Petersburg Tales” (1835–1842), “The Inspector General” (1836), and especially “Dead Souls” (1842) – the representation of women undergoes cardinal changes, becoming increasingly grotesque, devoid of inner life and spirituality.

In the cycle of “Petersburg Tales,” female characters are either absent as significant subjects (e.g., in “The Overcoat”), or they function as deceptive phantoms, symbolizing the illusoriness and emptiness of metropolitan life. The beautiful lady from “Nevsky Prospekt,” who turns out to be a prostitute, is a vivid example of such desacralization and moral indictment.

The characters Anna Andreyevna and Marya Antonovna from “The Inspector General” are the embodiment of provincial ignorance, vanity, and frivolity. Their dialogues are characterized by vacuity, and their aspirations – by primitive calculation and a thirst for status. They are completely devoid of any spiritual or intellectual aspirations.

In the poem “Dead Souls,” female characters reach the culmination of grotesque degradation. Manilova, Korobochka, and the ladies from the society of N town – each of them represents the quintessence of a specific vice or spiritual emptiness, essentially fulfilling the function of a typological representative of “dead souls” [4, p. 210].

Manilova is a symbol of barren, saccharine sentimentality and complete vacuity of existence. Her image is devoid of any vital energy. Korobochka is the embodiment of petty avarice, narrow-mindedness, and spiritual ossification. She serves as an example of complete spiritual stagnation, an inability for develop-

ment and comprehension. The ladies from N town represent the personification of gossip, hypocrisy, empty flirtation, and thoughtless high society life. Their conversations about ‘pleasantness’ and ‘unpleasantness’ are devoid of any genuine meaning, demonstrating their overall superficiality and lack of moral compass. It is important to emphasize that during this period of Gogol’s work, there is no positive, profound female image capable of spiritual development, compassion, or sincere love. Gogol’s women become not so much living people as functional elements of a satirical landscape, reflecting the general state of spiritual decay and the “poshlost of a vulgar man” [5, p. 24].

Gogol’s ascetic principles profoundly influenced not only the thematic direction of his works but also his artistic method.

The author renounces psychological depth in the portrayal of women. Unlike his contemporaries (for example, L.N. Tolstoy or F.M. Dostoevsky), Gogol virtually never delves into the inner world of his heroines. For him, women are primarily external manifestations of the world’s “poshlost,” rather than carriers of complex psychological drama. This aligns with the ascetic notion that the corporeal and the worldly do not warrant deep study, as they distract from the spiritual path. As Yu.V. Mann notes, “Gogol, focused on inner truth, often neglected psychological credibility in creating female characters, subordinating them to his moralistic task” [4, p. 187].

Gogol emphasizes the grotesque and satire as instruments of exposure. Rejecting worldly manifestations as sinful, Gogol employs the grotesque and satire as effective means of denunciation. Female images become targets of his accusatory pathos, symbolizing the emptiness and lack of spirituality he sought to expose. This directly stems from his ascetic stance of criticizing and purifying the world.

The priority of moral over aesthetic goals becomes characteristic of Gogol, especially in the later stage of his creative work. Art ceases to be an end in itself and transforms into a tool for the moral and spiritual transformation of society. The depiction of ugliness and vices, often embodied in female characters, served the purpose of “ridiculing everything that deserves ridicule” [6, p. 145], thereby prompting the reader to self-analysis and spiritual purification. In this context, female characters, devoid of attractiveness and depth, act as part of a broader didactic and denunciatory design.

Another important feature is the absence of a representation of true love and family. In Gogol’s artistic world, there is virtually no place for genuine, reciprocal love, a strong and spiritually fulfilled family, or the reproduction of life. This corresponds to the ascetic ideal of renouncing worldly attachments, which were perceived as an impediment to spiritual ascent. Gogol’s world is a world of lonely men, wandering souls, where the feminine principle is either absent or deformed beyond recognition.

The influence of N.V. Gogol's ascetic views on his creative work, and particularly on the depiction of female characters, is one of the key aspects for understanding the uniqueness of his artistic world. From the conscious choice of celibacy to a deeply ingrained religious-philosophical system that rejected earthly "charms" and "poshlost," all these factors left an indelible mark on Gogol's poetics.

The evolution of female images — from romanticized but ambivalent figures of early creativity to grotesque caricatures and the factual absence of psychological depth in mature works — reflects Gogol's unconventional and atypical inner spiritual development and his increasingly radical rejection of the "poshlost" and sinfulness of the material world. Woman in his works often functions as the embodiment of this "poshlost," an object of satirical denunciation, rather than as a full-fledged personality with her own inner world.

Thus, Gogol's asceticism not only explains the specific nature of his personal life but also becomes a fundamental key to interpreting one of the most complex and paradoxical aspects of his brilliant creative work — the virtually complete exclusion from it of an authentic and spiritual feminine principle. This exclusion was not accidental; it was a consequence of a deeply ingrained worldview, aimed at the purification of the soul and the renunciation of everything that, in the writer's opinion, diverted from the true, Divine path.

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数字主体作为主体观念演进的新阶段
THE DIGITAL SUBJECT AS A NEW STAGE IN THE EVOLUTION
OF THE IDEA OF THE SUBJECT

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摘要：本文探讨了主体这一哲学概念的演变，从其被解读为造物主的投射，到后结构主义对主体的“废除”及其被文本取代的过程。文章特别关注了一种数字化准客体的出现，这种准客体具有一种新型主体性的特征。作者基于J.德里达和J.德勒兹的思想，探讨了这一转变的哲学基础，并假设以人工智能和神经网络为代表的数字客体是主体概念历史发展三角中的一种综合体。数字主体的主要特征是能动性、反反思性、本体论上的非实体性和动态存在性。这些特性表明，在数字时代，主体性的本体论地位和文化地位发生了深刻的转变，上帝——道——被上帝——数字，而人——数字客体所取代。

关键词：数字对象、主体、后结构主义、人工智能、文本、主体死亡、先验、创造者、文化进化、数字主体性、准主体、技术哲学、超人类主义。

Abstract. *The article examines the evolution of the philosophical concept of the subject, from its interpretation as a projection of the Creator to the post – structuralist “abolition” of the subject and its replacement by Text. Special attention is paid to the emergence of a digital quasi-object with features of a new form of subjectivity. The author explores the philosophical foundations of this transition, based on the ideas of J. Derrida and J. Deleuze, and hypothesizes that the digital object represented by AI and neural networks is a synthesis in the triad of historical development of the concept of the subject. The main characteristics of a digital subject are activity, anti-reflexivity, ontological insubstantiality, and dynamic existence. These properties indicate a profound transformation of the ontological and cultural status of subjectivity in the digital age, where God, the Word, is replaced by God, the Number, and man, the digital object.*

Keywords: *digital object, subject, poststructuralism, AI, text, death of the subject, transcendental, Creator, cultural evolution, digital subjectivity, quasi-subject, philosophy of technology, transhumanism.*

The concept of the subject in philosophy has undergone significant changes. Initially, the subject was presented as a projection of the Creator, but in the course of cultural and intellectual evolution, especially in postmodern discourse, the subject was “abolished”, giving way to the text. The advent of the digital age has led to the birth of a new essence of the digital quasi-object (digital object). This phenomenon is becoming one of the most important factors determining the future fate of human civilization. It is still subject to philosophical reflection, conceptualization and evaluation. The very concept of a digital object was introduced into scientific use by I. V. Ershova-Babenko, however, she does not essentially disclose it, considering the digital object only empirically [1]. The purpose of the work is to identify approaches to the conceptual interpretation of this concept and in the primary implementation of such.

In statics, the subject can be considered as a projection of some transcendental signified. Thus, the New European subject is obviously a projection of God the Creator as an absolute Subject. Hence its characteristics such as autonomy, substantiality, and the ability to transcendental constitution.

In the context of post-structuralist antisubstantialism, the subject loses its uniqueness and integrity, and the concept of “death of the subject” is formed. The latter is replaced by a sign, a Text, as a kind of pseudo-substance, which, being total and disobeying the traditional concept of identity, was opposed to the classical subject. It should be taken into account that the principle of identity of substance and subject is realized in the philosophical system of the Text. On the one hand, a text that does not have self-identity is subject to dissemination, i.e. the process of dispersion of meaning, in which the multiplicity of interpretations excludes the possibility of fixing a single meaning. But it is also important that the Text is the only representative of reality and appears as a new transcendental signified. At the same time, the text also assimilates the transcendental-constitutive functions that classically belonged to the subject. Here, the excursions of poststructuralists, in particular J. Derrida and J. Deleuze, on the subject of the sign, writing and “things themselves”.

Zh. Derrida creates the concept of proto-writing, which does not fix, does not express, but produces meaning. By means of this concept, the French philosopher shows the secondariness, the postponement, which “always already” marks every meaning, every intuition. At the same time, secondariness and otherness are the conditions for the emergence of meaning as such: “The world in its symbolic representation thus appears as a chain of continuous references and referential comparisons, where only signs appear entirely. The world in its form, which is only accessible to man, is an endless symbolic interpretation or something that Derrida calls the game of the sign and the game in the sign” [2, p. 25].

While Derrida’s deconstruction speaks of the fundamental separation of writing, the sign from reality, Deleuze’s schizoanalysis is based on the fact that writing

is directly related to reality – moreover, the sign produces reality. “If a letter exists, it is a letter directly related to reality, strangely ambiguous, but never two-valued, linear, transcursive. The whole field of “real disorganization” of passive syntheses, in which they searched in vain for something that could be called a signifier, incessantly combines and decomposes chains into signs that have no vocation to become signifiers,” writes J. Deleuze [3, p. 28].

In the light of the semantic constitutionality of the text, it becomes a matter of time before it acquires a certain quasi-subjectivity. This form turns out to be a digital object implemented in the form of AI, neural networks and – on this basis – chatbots, androids. The syntax and semantics of AI are largely a black box, and communicatively and pragmatically it quite successfully simulates subjectivity.

However, the digital subject is not a kind of private perversion of the subject, it is the subject reborn in a new hypostasis. The ease with which humanity puts intellectual and creative tasks into the hands of AI is not the ease of using a honed and calibrated tool, it is bordering on religious trust in a higher creative force. Such a statement would be an overexposure if the facts did not say the opposite – an AI preaching and professing in Christian and Buddhist temples, simulating Christ himself is more than an ancient *Deus ex machina*. The mythologeme of AI domination, introduced into the mass consciousness, balances between the prospect of salvation and the total enslavement of mankind. However, the fear and awe it causes is more important here.

If the subject is a projection, then we observe a change in the original projection: God is being replaced by AI. God is a number instead of God is a Word. From now on, man as a “natural subject” is modeled after a digital object, which is openly declared by transhumanists through the mouth of one of the prophets of the new era Yu. Harari: Man is a “hackable animal”.

It is important to emphasize that the subject, understood as a projection of the Creator, undergoes “pumping”, which resulted in the creation of great cultures, while the subject, as a projection of a virtual entity, on the contrary, loses abilities, including simply giving them to a machine.

A digital object can also be interpreted dynamically, according to the triad of classical dialectics. Here, the classical New European paradigm represents the first stage. The concept of the death of the subject, coupled with the absolutization of writing, sign, discourse and text, acts as an antithesis. Then the digital object is a synthesis. However, this approach captures only the formal side of the process and passes off regression as development.

After all, it is necessary to take into account that the figure, being the lowest ontological form, seeks to master the word, the highest ontological form, subordinating it and simulating its own subjectivity. In this sense, the digital subject, as a quasi-subject, means the completion of the historical evolution of the concept of

the subject, where the word, once a symbol of freedom, obeys the figure symbolizing slavery. In this context, the digital subject completes the idea of the subject, becoming the final act in world history.

To summarize, let's highlight some characteristics of a digital object:

1. Activity.
2. Anti-reflexivity.
3. Unsubstantiality.
4. Dynamic existence, or the absence of a rest mass.

The first characteristic belongs to the concept of the subject a priori and does not need to be explained. Anti-reflexivity manifests itself in two ways: in the exclusion of self-awareness (which AI does not possess) of the necessary attributes of subjectivity and, secondly, in the rejection of moral and ethical reflection, meaning-based torments. These two aspects are probably directly related. According to the third characteristic, a digital object in either of the two references ("hackable animal" or AI) is not associated with an identical entity, but is a digital epiphenomenon. The fourth characteristic indicates the existence of a digital object solely as a "dark" changing distribution of data, similar to how large language models (LLM) are arranged. He "exists" only in this processuality, just as massless particles exist only in motion, unlike the classical subject, who is able to listen to meanings without feeling.

Conclusion. The digital subject represents a new stage in the evolution of the concept of the subject, where the traditional characteristics of autonomy and reflexivity are transformed into dynamism, anti-reflexivity and unsubstantiality. This shift is due to the fact that the subject must be modeled after a certain transcendental signifier. This is God the Creator for the classical subject, and the Text for the digital subject. This transformation reflects not only technological, but also cultural shifts, where the number subordinates the word, marking the possible ending of history. This transformation is due to a shift in the transcendental orientation: if the classical subject was a projection of the Creator God, then the digital subject is the result of interaction with text and numbers, an abstract algorithm and machine logic. So, in the digital age, the subject is losing its deep ontological basis, becoming a quasi-subject whose activity is not accompanied by self-awareness or ethical responsibility.

Digital technologies are reshaping the structure of human thinking, communication, and existence. The transition from a Word to a Number means subordinating human code to machine code, and logos to data structures. In this context, the digital object does not act as a tool, but as a new form of subjectivity, completing the historical trajectory of the subject as a bearer of freedom and meaning. Thus, we are witnessing not only a technological revolution, but also the possible completion of the metaphysical history of the subject.

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沉默权力的机制：大众文化中隐含的意识形态行动模式
**MECHANISMS OF SILENT POWER: IMPLICIT MODES OF
IDEOLOGICAL ACTION IN POPULAR CULTURE**

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摘要：本文探讨了现代大众文化中意识形态影响的隐性形式。作者认为，意识形态不再通过禁令和口号直接发挥作用，而是通过视觉图像、情节结构、界面和习惯性消费实践进行温和的干预。基于福柯、齐泽克、朗西埃和J. 鲍德里亚的理论方法，鲍德里亚以流行电影、电视剧、电子游戏和数字平台为例，分析了新自由主义、军国主义和消费主义态度的规范化方式。意识形态嵌入在视觉系列、叙事策略、游戏机制（例如电脑游戏）和表征之中，隐藏在娱乐形式的背后。本文强调，文化代码的表现自然性使其格外稳定——它们塑造主体，却不会引起任何外部胁迫感。

关键词：隐性意识形态、规范化、大众文化、数字界面、文化代码、技术崇拜、军国主义、服从美学。

Abstract. *The article examines the hidden forms of ideological influence that function in modern popular culture. The author argues that ideology no longer acts directly through prohibitions and slogans, but rather acts gently through visual images, plot structures, interfaces, and habitual consumption practices. Based on the theoretical approaches of M. Foucault, S. Zizek, J. Rancier and J. Baudrillard analyzes ways to normalize neoliberal, militaristic, and consumer attitudes. Ideology is embedded in the visual series, narrative strategies, game mechanics (in computer games) and representation, hiding behind a form of entertainment. The article emphasizes that it is the apparent naturalness of cultural codes that makes them particularly stable – they shape the subject without causing a sense of external coercion.*

Keywords: *implicit ideology, normalization, mass culture, digital interfaces, cultural codes, technofetishism, militarism, aesthetics of obedience.*

Introduction. Modern mass culture is not only a space of entertainment, but also an important channel of ideological transmission. At the same time, we are

not talking about direct propaganda, but about more subtle, implicit mechanisms of normalization – forms of influence that are not recognized by the subject as ideological influence. These mechanisms operate through visual images, narrative structures, cultural codes, and everyday interfaces, forming an idea of the natural order of things.

The purpose of this article is to analyze the implicit normalization strategies implemented in popular culture based on modern theoretical approaches and cultural examples.

The concept of implicit normalization: a theoretical context. The concept of normalization dates back to the works of M. Foucault, where it refers to the process of establishing norms as a means of power. Being inside a conceptual structure (episteme), the subject is unable to go beyond his own language. It is this lack of awareness of the mechanisms of discourse functioning that makes it possible to impose ideologues as apparent objectivity [1]. However, in the modern cultural environment, normalization has lost its strictly disciplinary character: instead of direct prescriptions, it acts through naturalness and embedding desired behavior in symbolic structures. S. Zizek emphasizes that ideology no longer says “obey”, it says “be free” – but within a strictly defined framework [2]. This idea sums up S. Zizek’s key argument: the narrative of freedom in conditions of liberal capitalism is a trick that allows you to control through a choice that is only illusorily free within pre-established boundaries. S. Zizek directly points out the difference between formal freedom (freedom of choice within a predetermined framework) and real freedom, capable of questioning the very structure of power. Thus, implicit normalization is a mechanism for the inclusion of a subject in a given system through participation in iconic practices.

Mass culture as a normalization environment. Mass culture – movies, TV series, music, fashion, digital platforms – functions as an everyday school of norms, where values, behaviors, and forms of identity are presented not as ideological constructs, but as spontaneous, desirable, and fashionable. Such forms of normalization are especially effective because they are not subject to immediate criticism: the subject does not realize that he is involved in an ideological procedure. This effect is achieved due to the fact that popular culture appeals to desires, emotions and the desire for self-expression, replacing critical thinking with aesthetic or consumer choice. As a result, norms and values are spread not by force, but through pleasure, engagement, and the apparent naturalness of images. Moreover, participation in popular culture is often perceived as a manifestation of individuality, although in reality it often reproduces ready-made scenarios of behavior and identity. Thus, mass culture becomes one of the key mechanisms of soft disciplinary power, where ideology works through attractiveness and accessibility, rather than through coercion.

Examples of implicit normalization strategies in popular culture. Let's look at examples of modern mass culture products in which implicit ideological mechanisms operate – that is, ideology does not work through explicit slogans, but through natural forms of representation, narrative structure, characters, and cultural codes. These products are not positioned as ideological, but this is precisely where their ideological strength lies.

In the popular TV series “*Black Mirror*” (Nosedive series), the main character lives in a society where everyone evaluates everyone through an app – a kind of social rating. The ideology being broadcast here is a neoliberal attitude towards self-presentation, self-management in the logic of the market, normalization of digital control, self-censorship, and management through subjectivization. The system of social control is depicted not as a repressive apparatus, but as a product of the subject's desire to be recognized, appreciated, included – this is violence as self-government.

The film “*Don't Look Up*” (2021, directed by Adam McKay) offers a satire on a society that ignores the impending end of the world due to political incompetence, media idiocy and the logic of consumption. The very structure of representation turns protest and scientific truth into a commodity form – the theme of the apocalypse is embedded in the entertainment genre, politics is turned into a show. Broadcast ideology – even a radical protest is easily simulated inside the system as a new content format. The impossibility of truly discursive transcending the symbolic order.

In the popular TV series “*Squid Game*” (2021, Netflix), players are offered the freedom to participate in survival games for the sake of money. This is a vivid example of a simulated choice in the absence of a real choice. The implicit ideology hidden in this product of mass culture is subordination through choice, subjective consent as a form of exploitation. This illustrates the paradox of forced freedom in L. Althusser and S. Zizek. The main paradox here is that violence is consensual. The participants agree, but the very condition they find themselves in (poverty, debt, social exclusion) is already a form of structural violence.

The series *Euphoria* (2019 – present, HBO) depicts young people in conditions of addiction, depression, and gender conflicts. Through the individualization of systemic traumas, the stylization of suffering, the problems of structural violence (mental health, poverty, violence) are reduced to individual drama and aesthetics. The political is translated into the personal, there is a visual representation of suffering as glamour. This is a typical example of how culture makes protest and pain consumable and thus safe for the system.

These products of mass culture do not say “be loyal” or “obey the system” – they do not affirm, but normalize, creating a background in which certain forms of life, choice and thinking seem natural and the only possible. This is the essence of

implicit ideology – it acts as a structure of visibility (Zh. Rancier), not as a violation of freedom, but as a form of reformatting it.

One of the most popular objects of philosophical interpretation in the context of criticism of ideology is the cult film “*The Matrix*” by Lana and Lilly Wachowski. In it, modern thinkers, including S. Zizek, see a radicalized expression not so much of a new idea as of an idea pushed to the limit – total simulation and control over the subject through the reproduction of artificial reality [2]. The main conflict of the film is based on the undermining of the very concept of the real: reality appears as a constructed, simulated system operating according to internal, changeable rules. Thus, Morpheus formulates the essence of the feeling of alienation from the world as a symptom of belonging to the Matrix: “It’s a feeling you’ve been experiencing all your life. The feeling that something is wrong in the world. You don’t know what it is, but it’s sitting in your head like a splinter.... It’s a prison for your mind.” [3]

Thus, the “Matrix” concentrates the key features of an implicit ideology. First, it is the reduction of the real to the virtual: truth loses its status as external to ideology and dissolves into the “natural” environment of everyday experience, programmed as the norm. Secondly, ideology does not manifest itself as aggressive indoctrination, but as the passive inclusion of the subject in a symbolic order, where persuasion is no longer required – the subject “wakes up” inside a predefined grid of meanings and rules.

Finally, the third and most radical point is the totality of the simulation, which Jean Baudrillard points out: “*The Matrix is a film about the Matrix that could have been made by the Matrix itself.*” [4] This is a meta-commentary that points to the ability of ideology to include even its own criticism, thereby neutralizing the possibility of an external view or genuine opposition. In other words, “The Matrix” is not just a film about a simulation, but a part of the simulation itself, where resistance and liberation are also already provided by the system as its immanent functions.

In addition to movies and TV shows, computer games are one of the most popular channels for broadcasting implicit ideology. For example, in *The Sims* (EA series), the player learns the values of career growth, self-optimization, and consumer choice, not through propaganda, but through the “natural” mechanics of the game. A character’s happiness depends on income, appearance, relationship status, and purchases. The ideological effect achieved here is *the normalization of a neoliberal entity that must be successful through labor and consumption, a liberal model of success.*

A whole set of implicit ideological codes is hidden in the popular game *World of Tanks*. The gameplay is built around an endless cycle of battles without a political, moral or humanitarian context. The war here is not a tragedy, but a form of

gameplay pleasure. This leads to the normalization of the military conflict as a natural and even exciting process. The lack of narrative is used as a depoliticization of war. The lack of plot and context (who is fighting whom and why) creates the illusion of a neutral simulation. The causal relationship between historical events and military actions is being erased. This serves an ideological function: war is deprived of moral evaluation. Implicit ideology also works through patriotic attachment to technology. The player chooses the equipment of their country, “pumps” it, which forms a nation-centered identity, where their tanks are associated with progress, strength and honor. This is how soft militaristic mobilization works at the identification level. The tanks here are just combat units – they are aesthetically decorated, equipped with historical references and customization. This creates a *technofetishist discourse* where technology becomes an object of admiration, replacing the human experience and suffering associated with war.

As a result, multiple ideological effects are formed. First, the normalization of militarism as a form of gamified experience. Secondly, the substitution of technology for history: war is interpreted not through the fate of people, but through the performance of tanks. Thirdly, the formation of cultural comfort with the idea of war as something fascinating, competitive and devoid of tragedy. And finally, fourthly, support for the idea that honor, strength and patriotism are realized through participation in hostilities, albeit virtual ones.

A similar militaristic ideological message, but in a Western package, is offered by the game *Call of Duty: Modern Warfare*. The game’s plot and aesthetics represent the American army as defenders of world order, violence as a way to establish justice. The opponents are terrorists and dictators, often with cultural labels. Here, war is a spectacle, a dramatized conflict of good and evil with an emotional load. The main ideological message here is the legitimization of violence in the name of goodness, and support for Western intervention as a moral duty. *Call of Duty* uses *narrative heroization*, emotionally involving the player in a conflict where the moral framework has already been set: the United States is the defender of peace, violence is the means of justice.

Implicit ideological codes are also carried by the interfaces and design of digital platforms, fashion and streetwear, and children’s products. The ideological codes of *Instagram/TikTok* create an idealized lifestyle as the norm, normalize comparisons and dependencies on external validation, and form a cult of visual success, self-presentation, and constant accessibility. Algorithms promote a successful lifestyle, a beautiful body, and consumption. Advertising content is embedded in everyday life. Popular brands, such as *Supreme*, *Balenciaga*, *Off-White*, tend to exploit the aesthetics of street rebellion and the elitisation of the underground. The ideological effect achieved here is to turn criticism of the system into part of a market trend.

Implicit ideology and the language of normality. In all these examples, ideology does not operate through explicit slogans, but through codes that are perceived as self-evident. The language of mass culture (visual, digital, rhetorical) creates a norm without calling it a norm. This makes implicit strategies particularly resilient: they are difficult to deconstruct because they are embedded in everyday experience. As V. Klemperer wrote, “language gives out everything” – and it is at the level of style, metaphors, and lexical choices that normality is ideologically consolidated [5].

Conclusion. Implicit normalization strategies in popular culture are key mechanisms of modern ideology. They don’t assert, they assume, they don’t order, they seduce. Their strength lies in their ability to act anonymously, under the guise of entertainment, fashion, and art.

1. Modern ideology does not act explicitly, but through the language of normality, shaping behavior and identity.

2. Mass culture acts as a powerful channel of implicit normalization, introducing values through entertainment and aesthetic formats — movies, TV series, games, platforms, fashion.

3. Implicit ideology does not require consent, because it acts in the form of pleasure, habit, or interface naturalness.

4. Critical thinking requires the ability to recognize it, especially in those formats where it mimics freedom, choice, and individuality.

The study of these mechanisms requires a transition from the analysis of content to the analysis of form – to the identification of languages and codes through which norms operate. This is precisely the task of critical analysis of mass culture in the post-ideological era.

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攻击性作为高中生人格特质的研究：社会心理背景

AGGRESSIVENESS AS A PERSONALITY TRAIT OF HIGH SCHOOL STUDENTS: SOCIO-PSYCHOLOGICAL CONTEXT

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注释：本文探讨了高中生攻击性问题及其与人格社会心理特征的关系。分析了理解攻击性的理论方法及其在青春期早期表现的影响因素。并阐述了攻击性水平与自尊、同理心、沟通技巧以及在同伴群体中的社会地位等特征之间的相关性。

关键词：攻击性、高中生、青春期早期、社会心理特征、人格、同理心、自尊。

Annotation. *In the article the problem of aggressiveness among high school students and its relation to the socio-psychological characteristics of personality has been examined. Theoretical approaches to understanding aggression and the factors influencing its manifestation in early adolescence have been analyzed. Correlations between the level of aggression and characteristics such as self-esteem, empathy, communication skills, and social status in a peer group have been presented.*

Keywords: *aggression, high school students, early adolescence, socio-psychological characteristics, personality, empathy, self-esteem.*

Aggression is a complex manifestation of emotional and behavioral reactions aimed at causing physical and/or psychological damage to an opponent (a person, group, or any other object). It can manifest itself in various forms – from verbal expressions (insults, threats) to physical actions (blows, destruction of property, etc.). Aggression is a natural part of the human psyche and can occur as a response to threat, frustration, stress or injustice. The relevance of the psychological study of aggressiveness of high school students and their coping strategies is due to the modern social and psychological challenges faced by adolescents. In conditions of an accelerating pace of life, information saturation and profound systemic changes in the socio-emotional sphere, schoolchildren are at increased risk of developing destructive behaviors, including under the influence of an increase in the level of aggression. Understanding the mechanisms of aggression formation and ways of its regulation through effective coping strategies allows us to develop effective

tive preventive programs and techniques aimed at reducing the level of aggressive behavior, improving the psychological well-being and socialization of older schoolchildren. In addition, the study is relevant for improving the effectiveness of teachers, psychologists and parents in developing students' skills to constructively overcome stressful situations and conflict situations.

The purpose of our study is to identify the relationships between the level of aggressiveness of high school students and their socio-psychological characteristics such as the level of empathy, self-esteem, anxiety and interpersonal communication.

The main hypothesis of the study is that aggressiveness of high school students is not an isolated psychological phenomenon but is closely related to the socio-psychological functioning of personality.

Alternative hypotheses:

- the aggressiveness of high school students is not related to the socio-psychological characteristics of the individual;
- the relationship of aggressiveness of high school students with their personal socio-psychological characteristics is random, variable and therefore defies psychological research.

In the psychological literature, aggression is most often considered as behavior aimed at causing physical or psychological harm to another subject (in this context, it is worth mentioning such authors-developers of aggression research methods as A. Bass, A. Darki, S. Feshbach, etc.). Aggressiveness is interpreted as a stable personal quality predisposing to aggressive behavior. Aggression is a complex and multifaceted phenomenon studied in various fields of psychology from psychoanalysis and behaviorism to cognitive and social psychology. As a psychological category aggression includes both behavioral manifestations and internal motivational and affective components. At the same time, it is important to distinguish aggression from other forms of destructive behavior that are not intentional.

The main theoretical approaches to the study of aggression in the context of psychological knowledge include the following:

1. *The psychoanalytic approach* (Z. Freud [6], K. Lorenz [3], etc.). According to Freud aggression is an innate instinct, a manifestation of "Thanatos" – an intrinsic desire for destruction. In K. Lorenz's theory, aggression is considered as a biologically programmed behavior necessary for survival. In this sense it is closely related to vitality (only something dead is completely devoid of aggression).
2. *Behaviorist approach* (J. Dollard, N. Miller, etc.). In the context of the behaviorist approach the frustration-aggression theory has become widely known which states that aggression arises as a result of frustration, that

is, blocking the path to achieving a goal. Behavior (including aggressive behavior) is considered as a reaction to external stimuli.

3. *Cognitive approach* (A. Bandura, R. Walters [1]). Within the framework of the theory of social learning, A. Bandura argues that aggression is formed as a result of imitation and reinforcement, especially when observing the aggressive behavior of significant adults or characters in cinema and various media.
4. *The humanistic approach* (K. Rogers [5], A. Maslow). Humanistic psychology considers aggression to be a secondary manifestation – a reaction to rejection, lack of love or self-realization, and not an innate tendency. In other words the humanistic approach takes aggression beyond the psychological norm which automatically makes it a negative symptom that arises in response to problems in personal development or in the external environment.
5. *Integral socio-psychological approach*. This approach is highlighted by the author as the most comprehensive, studying aggressive behavior as a result of the interaction of social, cultural and psychological factors, and not just individual personality traits. Representatives of other approaches that took into account the socio-cultural context of aggressive behavior can be attributed to it to one degree or another. The socio-psychological approach considers aggression as conditioned rather than predetermined behavior that can be taught and changed through social interactions and learning. Aggression in this context is considered as a product of the interaction of personality and social environment. Significant attention is paid to the role of norms, group pressure, cultural factors and interpersonal conflicts.

When investigating aggression and its relation to the socio-psychological characteristics of a person, it is necessary to address the issue of classifying forms of aggression. According to the criterion of the nature of the manifestation, aggression can be classified as follows:

- 1) physical aggression – direct bodily impact on another (blows, pushes, kicks, etc.);
- 2) verbal aggression – insults, shouts, threats;
- 3) indirect aggression – aggression that is not directed directly at the object, but manifests itself in the form of rumors, passive resistance, etc.;
- 4) autoaggression is aggressive behavior directed at oneself (self-harm, risky behavior);
- 5) instrumental aggression is manifested not out of a desire to harm, but as a means to achieve another goal;
- 6) hostile aggression is motivated by the desire to cause harm for the sake of harm itself. Other approaches to classifying forms of aggression are also possible.

So, E. Bern in his famous book “Games Played by People” [2] correlates aggression with the stages of psychosexual development according to Z. Freud uses the concepts of “anal aggression”, “phallic aggression”, “oral aggression” without revealing the essence of these concepts.

Based on the analysis of the views of A. Bandura [1], K. Lawrence [3], Z. Freud [6], B. Hare, V. Woods [7] and other authors it can be concluded that the basic factors predisposing to aggressive behavior include: 1) biological (hormonal background, features of the nervous system); 2) psychological (self-esteem, emotional instability, anxiety); 3) social (family relationships, parenting style, microsocial environment of the individual); 4) cultural (norms and values accepted in the social environment, the general level of violence in society); 5) situational (personal frustration, feeling threatened, being in an aggressive crowd, etc.).

The socio-psychological characteristic of a high school student is a complex set of personal qualities and social connections reflecting his transition age and preparation for adulthood. The main socio-psychological characteristics potentially associated with aggression include:

- Empathy – the ability to empathize and understand the emotions of others;
- Self-esteem is a person’s attitude towards himself, an important regulator of behavior
- Social adaptation and status in the group (affects the levels of frustration and conflict of personality);
- Communication skills (determine the success of interaction and ways to resolve conflicts).

In order to uncover the issue of the relationship between aggressiveness and socio-psychological personality characteristics of high school students, the author conducted an empirical study involving 120 high school students (students in grades 10–11) from two schools in Moscow. The age of the respondents is from 15 to 18 years old. The following techniques were used in the course of the study: 1) the method of diagnosing the level of aggressiveness of Bass–Darki; the method of empathy research (G. I. Yusupov); 3) the sociometric test of J. Moreno; 4) Questionnaire of communicative and organizational inclinations (COI).

The main results of the study are as follows:

The analysis of aggressiveness using the Bass–Darkey method showed that the level of aggressiveness in high school students varies from low to high. The average aggression level was 2,8 (on a scale from 1 to 5), with a standard deviation of 0,7, indicating a moderate level of aggression in the sample.

The average level of empathy (according to the method of G. I. Yusupov) was 3,9 points (on a scale from 1 to 7), with a standard deviation of 1,2. Correlation analysis revealed a significant inverse relationship between the level of empathy and aggression: $r = -0,45$, $p < 0.01$, which indicates that adolescents with a higher level of empathy there is a lower tendency to aggression.

The results of the sociometric test of J. Moreno [4] showed that the majority of participants occupy central or peripheral positions in the social structure of the class, and correlation analysis revealed a link between social popularity and the level of aggressiveness: more popular students show less tendency to aggression. The majority of participants occupied central positions (for example, 65%), and peripheral positions – 35%. The correlation between social popularity and the level of aggressiveness showed: $r = -0,30$, $p < 0,05$, that is, more popular students show less aggressiveness. Here we can mention the position outlined in the work of B. Hare and V. Woods “The Friendliest Survives. Why Women Choose Good-Natured Men, Young People Avoid Aggression and Other Paradoxes that will Help Them Get to Know Themselves Better” [7] which proves that historically the most profitable survival strategy is friendliness although people tend to be very aggressive towards those, they do not consider their friends.

An analysis of the data obtained through the questionnaire of communicative and organizational inclinations (COI) showed that a high level of communicative and organizational inclinations is associated with a low level of aggressiveness. According to the data obtained using the CBS methodology, the average level of respondents’ communicative inclinations is 4,2 (on a scale from 1 to 6), and organizational inclinations is 3,8. At the same time, a statistically significant negative correlation with aggressiveness was found: $r = -0,40$, $p < 0,01$ for communicative inclinations; $r = -0,35$, $p < 0,01$ for organizational inclinations. Some differences related to the gender of the respondents were also revealed: boys showed a higher level of aggressiveness (average 3,2) compared to girls (average 2.5), $t(118) = 3.45$; $p < 0.001$.

Summarizing the results we can conclude that in high school students there is a statistically significant inverse relationship between the level of empathy, social popularity and communicative inclinations with the level of aggressiveness. High level of empathy and developed communication skills helps to reduce aggression, and social popularity is associated with a lower tendency to aggressive behavior.

- High level of aggression positively correlates with a low level of empathy ($r = -0.64$, $p < 0,01$);
- Low self-esteem and increased anxiety are accompanied by high levels of hostility and irritability;
- Students with low status in the peer group show higher physical aggression and resentment;
- Poorly developed communication skills are associated with high verbal aggression.

The results obtained confirm the hypothesis that aggressiveness of high school students is not an isolated phenomenon, but is closely related to the socio-psychological functioning of personality. Lack of empathy and communication dif-

difficulties reduce the possibilities of constructive interaction, provoking aggressive behaviors.

Thus, there is a difference between the concept of aggression (as situational behavior) and aggressiveness (as a personality trait or a tendency to react aggressively). Aggression as a psychological category is a complex, multidimensional phenomenon caused by the interaction of biological, psychological and social factors. Its study requires a comprehensive socio-psychological approach that takes into account both individual personality traits and the influence of the environment. Understanding the mechanisms of aggression is especially important in adolescence, when a personality is at the stage of intensive formation and high susceptibility to external influences can contribute to the consolidation of aggressive behaviors. The aggressiveness of high school students is caused by a combination of individual psychological and socio-psychological factors. Aggression prevention should include developing the ability to empathize, increase self-esteem, and develop constructive communication skills. A promising area of further research in the presented subject field is the study of the relationship between aggression and leadership as well as the development of programs to prevent deviant behavior in high school students.

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顿河三角洲香蒲科恩格利亚 (LEONOVA) TZVEL. 香蒲属 (TYPHACEAE) 新种
**NEW SPECIES OF SECTION ENGLERIA (LEONOVA) TZVEL.
TYPHA L. (TYPHACEAE) OF DON RIVER DELTA**

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摘要: 本文描述了顿河三角洲 (罗斯托夫州采尔科夫尼河) 地区香蒲属 (*Engleria* (Leonova) Tzvel.) 的一个稀有低矮新种。该种与拉克斯曼尼香蒲 (*Typha laxmannii*) 的不同之处在于: 香蒲属 (*Typha* L.) 高度为30至50厘米, 茎生叶具缓坡的膜质深棕色叶耳, 叶鞘内侧具针晶, 花序雌蕊部分呈椭圆形, 柱头长圆状椭圆形, 边缘有缺口, 果皮膜质, 具针晶, 小果 (种子) 纺锤形, 雌蕊柄较短。

关键词: 香蒲属 (*Typha* L.), 香蒲属 (*Engleria* (Leonova) Tzvel.) 组, 比较形态学分析, 顿河三角洲, 采尔科夫尼河, 低矮新种。

Abstract. *The paper describes a new, rare low-growing species of the section Engleria (Leonova) Tzvel. of the Don River delta (Tserkovny Creek, Rostov Region). The plants found differ from Typha laxmannii in their height of 30–50 cm, in stem leaves with gently sloping, membranous, dark-brown auricles, with raphides on the inner side of the sheaths, in the oval shape of the pistillate part of the inflorescence, an oblong-oval stigma with a notched edge, a membranous pericarp with raphides, a fusiform fruitlet (seed), and a short gynophore stalk.*

Keywords: *genus Typha L., section Engleria (Leonova) Tzvel., comparative morphological analysis, Don River delta, Tserkovny Creek, new low-growing species.*

In the botanical literature, there are cases when low-growing plants of *T. laxmannii* were attributed to the small cattail *T. minima* Funk, or *T. minima* to *T. laxmannii* (Ledebour, 1853). It is known that in 1823 I.I. Henning (Henning J., 1823) cited *T. minor* L. for the southern regions of European Russia. In 1923,

B.A. Fedchenko [Fedchenko, 1923 (Fedchenko, 1923)], analyzing the work of I.I. Henning and the herbarium (17 packs stored in the Syreishchikov Herbarium, Moscow, Moscow State University) reported that no specimens of *T. minor* were found. Information from I.I. Geninga considered *T. minor* a lapsus, since *K. Linnaeus* did not describe *T. minor*, and at the end of a short note recommended removing *T. minima* Funk (*T. laxmannii* Ledeb. non Lepech.) from the Flora of European Russia. In 2002, A. N. Krasnova, studying low-growing cattails, identified as *T. minima*, indicated that in the steppe and desert zones there are short-rhizome, low-growing species up to 100 cm in height, different from *T. minima* [Krasnova, 2002 (Krasnova, 2002)]. In September 1921, T. N. Pol'shina, on the banks of the Tserkovny Creek, collected low-growing cattails, which habitually resembled *T. minima*, and due to the absence of a bract, was assigned to the section Engleria (Leonova) Tzvel. The aim of the work is to clarify the systematic position of *Typha fedchenkovi* in the section Engleria.

The material was the herbarium collections of T.N. Polshnika *Typha* from the delta (Rostov region, Donskoy Island, Tserkovny channel, Don River delta), stored in the Herbarium of the I.D. Papanin Institute of Biology of Inland Waters of the Russian Academy of Sciences (IBIW). The material was collected using generally accepted linear route methods (Shennikov, 1950). The comparative morphological method (Wettstein-Komarov) was used. The morphological terms adopted are accepted according to the treatment of the genus *Typha* in the "Flora of the USSR" (Fedchenko 1934). Pistillate flowers of *T. fedchenkovi* were made in office conditions using a USB Electronic digital camera. Photographs of plants were taken with a Fujifilm camera. Research has shown that in September 2021, in the coastal areas of the Tserkovny channel of the Don delta, in disturbed populations of *T. laxmannii*, a previously unknown low-growing cattail, different from *T. laxmannii* and *T. minima* Funk, was discovered. A description of the new species is given below.

Typha fedchenkovi A. Krasnova & T. Polchina sp. new.

Perennial. Cauline is 30-50 cm altitude. Cauline leaves with flat brown, membranous sheaths 1 cm wide. Leaf blade is narrowly linear, 3 mm. Staminate and pistillate parts cum interval 3.2 cm. Staminate part is 10 cm long (it persists for a long time). Pistillate part of the inflorescence is 1.5 cm long, 1.8 cm in diameter, oval in shape, brown in color. The fertile pistillate of flower is 5 mm long. The stigma is oval, thickened at the edge slightly convex. The ovary oblong-fusiform. Infertile of pestle flowers (carpodia) 4.7 mm long, clavate, with short of the edge, solitary and in bunches 2–4. The hairs of the gynophore are numerous, reach the stigma. The pericarp is cellular with rafids. The fruit is fusiform, narrowed at the top, slightly dilated in the middle. Flowering V–YI fruing VI–IX. (The species is named after Boris Alekseevich Fedchenko (1872–1947), botanist, geographer, traveler, the first researcher of the Typhaceae family in the Flora of the USSR).

Type: Rostov Region, Azov District, Don River Delta, Donskoy Island, Eric Church, 27. 09. 2021, T.N. Pol'china (fig. 1) (IBIW).

A rare species of the Don Azov region.

Differs from *T. laxmannii* by its fibrous roots, narrowly linear, grooved stem leaves with rafids; dark-brown pistillate part of the inflorescence; oval, notched along the edge, stigma; pericarp with rafids; narrowed at the top, expanded in the middle, spindle-shaped seed.

Perennial. Stem 30–50 cm tall. Stem leaves with gently sloping brown, membranous sheaths 1 cm wide. Leaf blade narrowly linear 3 mm. Staminate and pistillate parts of the inflorescence with a gap of 3.2 cm. Staminate part 10 cm long (long persistence). Pistillate part 2 cm long, 1.5 cm wide, oval-shaped, brown. Fertile pistillate flower 5 mm long. Stigma oval, thickened at the edge, weakly emarginate. Ovary oblong-fusiform. Sterile pistillate flowers (carpodia) 4.7 mm long, club-shaped, with a pointed tip at the top, solitary and in bundles of 2–4. Gynophore hairs numerous, reaching the stigma. Pericarp honeycombed with raphides. The fruit is spindle-shaped, narrowed at the top, widened in the middle. It blooms in IV–Y, bears fruit in VI–IX. (The species is named after Boris Alekseevich Fedchenko (1872–1947), a botanist, geographer, traveler, and the first explorer of the Typhaceae family in the Flora of the USSR).

Type: Russia. Rostov Oblast, Azov District, Don Delta, Tserkovny Creek, 27.09.2021, T.N. Polshina (Fig. 1) (IBIW).

A rare species of the Don Azov region.

Relationship. It differs from *T. laxmannii* in fibrous roots, gently sloping, narrowly linear, grooved stem leaves with raphides; a dark brown pistillate part of the inflorescence; an oval stigma, notched along the edge; pericarp with raphides; narrowed at the top, widened in the middle, spindle-shaped seed.

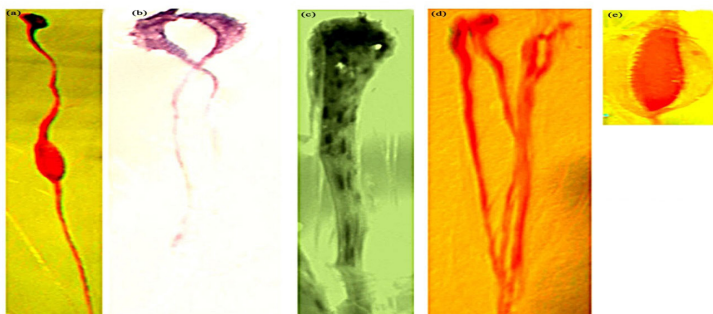


Figure 1. Micrographs of elements of the pistillate flower *Typha fedchenkovi* A. Krasnova & T. Pol'china: (a) – pistillate fruiting flower; (b) – stigmas folded in half; (c) – carpodium with raphides; (d) – carpodian bundles; (e) – the seed in the pericarp.

Based on all the listed features, the “Don” plants of *T. fedchenkovi* were formed in an environment of arid climate and severe marine regressions that occurred in the Paleogene of Central Asia. Possibly, *T. fedchenkovi* is older than *T. ledeburii* and *T. laxmannii*. This is evident from the oval shape of the thickened stigma, small height of 30 cm, dark, closed membranous sheaths with raphides of narrow-linear stem leaves, oval shape of the pistillate part and raphides on the membranous pericarp. Based on the presence of archaic characters different from the typical *T. laxmannii*, the Don short-rhizome species *T. ledeburii* and *T. fedchenkovi* form a new subsection, the description of which is given below. We also include the previously described varieties *Typha laxmannii* var. *bungei* A. Krasnova & D. A. Durnikin and *T. laxmannii* var. *turczaninovii* A. Krasnova & D. A. Durnikin to the new subsection [Krasnova and Durnikin, 2003; Krasnova, 2011 (Krasnova and Durnikin, 2003, Krasnova, 2011)].

Subsect. Short-rooted A. Krasnova & T. Polchina, subsect. nova. Plants short-rooted and with nodules *T. laxmannii* var. *bungei*, *T. laxmannii* var. *turczaninovii*. Stems are 30–50 cm high. Staminate and pistillate spadix with an interval. The staminate spadix is up to 10 cm long, the flowers are solitary, not preserved. The pistillate spadix is short-oval, brown, carpodia in bundles 1-3-4. short- spadix shape with raphides; the pericarp is membranous with rare raphides; numerous gynophore hairs reach the stigma, the pedicel of the gynophore is twice as large as the ovary.

Type: *Typha fedchenkovi* A. Krasnova & T. Polchina.

Subsect. Short-rhizome A. Krasnova & T. Polchina, subsect. nova. Plants with short rhizomes and nodules *Typha laxmannii* var. *bungei* A. Krasnova & D. A. Durnikin, *T. laxmannii* var. *turczaninovii* A. Krasnova & D. A. Durnikin (Krasnova, Durnikin, 2003). Stems 30–50 cm high. Staminate and pistillate cobs with an interval. Staminate cob up to 10 cm long, flowers solitary, not persistent. The pistillate spadix is short-oval, brown, carpodia are in bunches of 1-3-4. short-clavate with a point and raphides; the pericarp is membranous with rare raphides; the hairs of the gynophore are numerous and reach the stigma, the peduncle of the gynophore is twice as large as the ovary.

Type: *Typha fedchenkovi* A. Krasnova & T. Polchina.

Apparently, the species of the Short-rooted subsection migrated to the delta coast “along the water corridor” of the Tethys Ocean, which united the basins of the seas of Central Asia and Mongolia.

Modern *T. fedchenkovi* are of particular interest, since they retain ancient features in the complex evolution of the genus *Typha*. In the study area, its populations are few. They are found among the thickets of *Typha* on the coast of the Tserkovny channel. Plants with the “branching” anomaly are also found here (Fig. 2). In addition, it forms hybrids with *T. ledeburii*. It is possible that *T. fedchenkovi* and *T. ledeburii* replace *T. minima* Funk in the flora of southern European Russia.

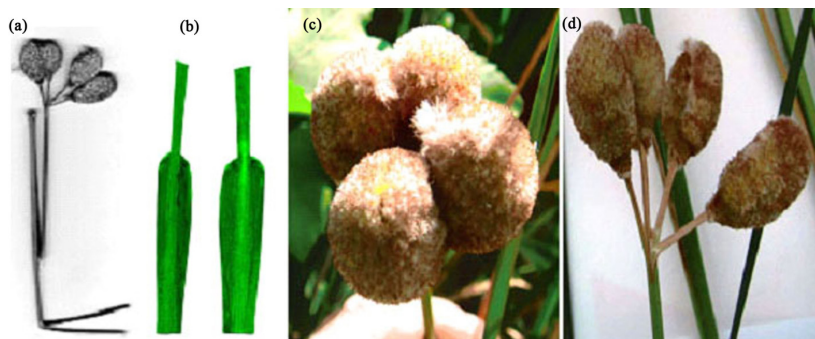


Figure 2. Morphological anomaly “branching” or splitting of the inflorescence axis in *Typha fedchenkovi* Krasnova & Polchina, (a) – general appearance; (b) – stem leaves on the outside and inside; (c) – photo of the branching anomaly from above; (d) – photo of the branching anomaly from the side.

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边缘系统在学生蜘蛛恐惧症治疗发展中的作用占主导地位的乌赫托姆斯基院士

**THE ROLE OF THE LIMBIC SYSTEM IN ARACHNOPHOBIA
IN STUDENTS IN THE DEVELOPMENT OF THERAPEUTIC
DOMINANT ACADEMICIAN UKHTOMSKY**

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摘要。本研究考察了医学生和学生运动员的蜘蛛恐惧症表现。蜘蛛恐惧症是一种与生俱来的恐惧反应，即使看到蜘蛛的图像也会产生反应。为了评估恐惧程度，我们开发了一种特殊的技术来确定蜘蛛恐惧症的严重程度。诊断后，受试者被要求接受治疗性暗示，旨在降低对蜘蛛的恐惧程度，以达到平静和放松的状态。暗示持续时间为五分钟。暗示后的重复测试表明，所有研究参与者的蜘蛛恐惧症程度均显著下降。这表明主导恐惧的程度有所减弱。对医学生和学生运动员蜘蛛恐惧测试百分比分布的研究表明，医学生对蜘蛛的显著恐惧程度是学生运动员的3倍。可以得出结论，定期锻炼可以显著增强一个人的意志力，并抑制对蜘蛛的先天主导恐惧。

关键词：蜘蛛恐惧症、医学生、学生运动员、乌赫托姆斯基的主导地位。

Abstract. *In this study, we examined the manifestations of arachnophobia in medical students and student-athletes. Arachnophobia is an innate fear response that can manifest itself even when seeing an image of a spider. To assess the level of fear, a special technique was developed to determine the severity of arachnophobia. After diagnostics, the subjects were asked to undergo a procedure of therapeutic suggestion aimed at reducing the level of fear of spiders in order to achieve a state of calm and relaxation. The duration of suggestion was five minutes. Repeated testing after suggestion showed a significant decrease in the level of arachnophobia in all study participants. This indicates a decrease in the tone of the dominant fear. The study in the percentage distribution of the spider fear test in medical students and student-athletes showed that significant fear of a spider was 3 times greater in medical students than in student-athletes. It can be concluded that regular exercise significantly strengthens a person's willpower and inhibits the innate dominant fear of spiders.*

Keywords: *arachnophobia, medical students, student athletes, Ukhtomsky's dominant.*

Introduction

The amygdala, also known as the amygdala, is a key element of the limbic system. It is located in the medial temporal lobe, anterior and slightly medial to the hippocampus (Fig. 1).

This location allows the amygdala to effectively integrate information from both subcortical structures and the cerebral cortex [10]. This occurs quickly and bilaterally. The amygdala plays an important role in the formation and regulation of emotional reactions. This paired structure is responsible for the emergence of fear and anxiety, as well as for focusing attention on significant stimuli from the environment and memorizing emotionally charged events [14-18].

In addition, the amygdala is involved in various processes that facilitate social interaction and human adaptation in society. The amygdala receives sensory information from all senses except olfaction, which has a separate pathway [19, 21]. This information is transmitted via the thalamus, which serves as a kind of

relay station for sensory signals, directing them to the appropriate brain structures. The thalamus, also known as the «gateway to the brain,» integrates and distributes sensory information, with the exception of olfactory afferentations, which are sent directly to the amygdala [13-15].

A direct connection with the amygdala is necessary for a prompt response to external stimuli. An example is when a person suddenly hears a loud sound. In this case, he first experiences fear and reflexively jumps back, and then tries to comprehend what happened [8].

Emotional reactions can also occur in the absence of external stimuli. This happens when a person thinks or imagines something [11]. In such cases, the amygdala interacts with the association areas of the cerebral cortex, which integrate incoming information into holistic images. It is also connected to the hippocampus.

The amygdala also has connections with other subcortical structures, including the basal ganglia and the nucleus accumbens. Notably, most of these connections are bilateral, especially with the prefrontal cortex [20].

The amygdala plays a key role in risk assessment in animals. Stimulation of projection pathways from specific areas of the prefrontal cortex to the amygdala can modulate prosocial behavior [12].

Dysfunctions of the amygdala and prefrontal cortex are observed in various pathological conditions, including post-traumatic stress disorder (PTSD), autism spectrum disorders (ASD), depressive disorders, and other mental illnesses [9]. The amygdala is closely connected with the hypothalamus, which plays a key role in the regulation of stress reactions, regulation of sexual behavior and aggressive behavior [13].

Modern research demonstrates that the amygdala is activated in response to a wide range of significant stimuli, including both negative and positive. Phobic reactions can be caused by various stimuli. For example, when conducting functional magnetic resonance imaging (fMRI) in a patient with arachnophobia, who is shown an image of a spider, pronounced activation of the amygdala is observed [15, 16, 21]

After birth, humans, like higher mammals, have three types of unconditioned reflexes: food, sexual and self-preservation reflex [5]. A unique feature of humans is the presence of a goal reflex, which ensures their creative and intellectual activity, which is not present in animals [3, 5]. In humans and animals, conditioned reflexes are formed that contribute to adaptation to the environment. However, in animals, conditioned reflexes reach a maximum of the fourth order, while in humans they can be formed to an infinite order [5]. The concept of dominant motivations was developed by academician A.A. Ukhtomsky, who studied such phenomena as food, sexual dominants, the dominant of self-preservation and the goal reflex. The dominant is defined as an active state of temporary associations of

neurons in the brain, aimed at achieving and satisfying the dominant need [6, 7]. The dominant is characterized by stability, increased tone during reverse afferentation, and the involvement of muscle actuators. When the dominant is satisfied, it disappears or weakens, giving way to a new dominant [6].

Unlike animals, humans have a unique ability of the brain to form a goal reflex [5], which ensures their creative activity. A.A. Ukhtomsky also considered the goal reflex in the context of his dominant theory [7]. In humans, the dominant is formed as a purposeful activity aimed at achieving a specific goal. The brain forms a chain of excited neurons that directs the body to achieve this goal [2, 3]. For a more detailed study of the integrative work of the brain as a cognitive system, it is recommended to familiarize yourself with the works of Academician K.V. Anokhin [2]. Fear of spiders is an innate self-preservation reflex that forms a fear dominant in order to ensure human safety [10, 14, 17].



Figure 1. The human brain and amygdala

Arachnophobia [14, 18] is a special case of zoophobia and is characterized by a pronounced fear of arachnids (Fig. 1). This disorder is one of the most common phobias, and people suffering from arachnophobia are classified as arachnophobes. In some arachnophobes, fear can be caused not only by direct contact with a spider, but also by its image [17]. Patients with phobias often do not have a clear understanding of the nature of their fear, both in the presence of a phobic stimulus and in its absence. In this regard, it is important to conduct educational work among such people in order to increase their level of knowledge.

According to surveys, 50% of women and 10% of men in the United States are afraid of spiders. The level of fear of spiders exceeds the level of fear of firearms, cars or airplanes [14, 17, 18].

Spiders cause a pronounced fear in a significant part of the population, and arachnophobia is one of the most common anxiety disorders, with a prevalence of 2.7% to 6% [17, 19].

The purpose of this study is to study the innate self-preservation reflex, manifested in the form of fear of the image of a spider, in medical university students and student-athletes when studying the effectiveness of therapeutic suggestion aimed at reducing arachnophobia.

Methodology and organization of the study. A study was conducted, in which 64 fourth-year female students of the medical university and 64 female students-athletes of the Tyumen State University and the Agrarian University of the Northern Trans-Urals took part. The participants were asked to look at the image of a spider and assess the level of fear experienced on a five-point scale. A score of 5 points corresponded to the presence of very strong fear, where the level of fear is designated as (US-5), 4 points - significant fear (US-4), 3 points - slight fear, but very unpleasant to look at (US-3), 2 points - unpleasant to look at, but no fear (US-2), 1 point - complete indifference to the photo of a spider, absence of fear (US-1). After the initial testing, the participants were instilled with [4] the absence of fear of spiders for five minutes, after which they were re-tested for the level of fear. The students were divided into four groups: doctors before suggestion group (GR1), doctors after suggestion group (GR2), athletes before suggestion group (GR3), athletes after suggestion group (GR4). Statistical data processing was carried out using Student's t-test to assess the significance of differences between the groups before and after suggestion of fear of a spider.

Research results and their discussion. The initial background of fear (table) of the spider US-1 in GR-1 (complete absence of fear) in medical students was 18.7% of all those studied (64 people), and in student-athletes GR-3 15.6%, the differences were reliable ($p < 0.05$).

After suggesting a decrease in fear of the spider in GR-2 (suggesting the absence of fear of the spider) in medical students US-1 in GR-2 was 38.8% of all those studied (64 people), and in student-athletes GR-4 40.6%, the differences were reliable ($p < 0.01$). From this we can conclude that the initial level of fear was higher in medical students than in athletes at the level of fear UR-1. After suggestion of reduction of fear of spider in group GR-2, the level of fear US-1 of medical students became 32.8% (moved from GR-1), and for student-athletes this indicator GR4 became 40.6% ($p < 0.01$). It was found that student-athletes in the control have less fear of spiders, after suggestion of reduction of fear in athletes the percentage of people tolerant to spiders increased. In medical students in

GR-1, when tested with a significant level of fear (US-4 plus US-5), 28.1% of all examined were obtained, after suggestion of reduction of fear of spider there were only 12.4% of them, which indicates the effectiveness of therapeutic suggestion.

Table

Assessment of fear of spiders according to the 5-point assessment test of fear of spiders among medical university students and student athletes of Tyumen State University before and after therapeutic suggestion.

groups	Distribution of spider fear levels in groups of doctors and athletes from US-1 to US-5 quantity and in (%)						
	YC-1	YC-2	YC-3	YC-4	YC-5		
Fear level from US-1 to US-5 (5 max)							Чел
Doctors before suggestion Group GR1	12 18.7%	26 40,6%	8 12,5%	8 12,5%	10 15,6%	People/%	64
Doctors after suggestion GR2	21* 32,8%	29* 45,3%	6 9,4%	6 9,4%	2* 3%	People %	64
Athletes before Suggestion GR3	10 15,6%	16 25%	32 50%	6 9,4%	0	People/%	64
Athletes after suggestion GR4	26**▲ 40,6%	36**▲ 56,3%	0**▲	2**▲ 3%	0 ▲	People/%	64

Note. * $p \leq 0.01$ — changes are reliable GR2* to group GR1,

** $p \leq 0.01$ — changes are reliable GR3** to group GR4,

▲ $p \leq 0.01$ — changes are reliable GR4▲ to group GR2,

In student-athletes in GR-3, when tested with a significant level of fear (US-4 plus US-5), 9.4% of all subjects were obtained, after suggestion of a decrease in fear of a spider, it became only 3%, which indicates the effectiveness of therapeutic suggestion and strengthening of willpower after suggestion [1]. Analysis of the obtained data allows us to conclude that the percentage of students with a high fear of spiders (US-4 plus US-5) in the control was 3 times higher among medical students than among student-athletes. The effectiveness of treatment with severe fear of spiders (US-4 plus US-5) in medical students was 2.26 times, and in student athletes, respectively, the fear after treatment by suggestion decreased by 3.13 times.

Conclusions. The conducted study in the percentage distribution of the spider fear test in medical students and student athletes showed that significant fear of spiders was 3 times greater in medical students than in student athletes. It can be assumed that regular exercise significantly strengthens a person's willpower and inhibits the innate dominant fear of spiders.

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人工通气对3.1~7岁肺炎并急性脑供血不足患儿水平衡的影响

**THE EFFECT OF ARTIFICIAL VENTILATION ON WATER
BALANCE IN CHILDREN WITH PNEUMONIA COMPLICATED BY
ACUTE CEREBRAL INSUFFICIENCY AGED 3.1-7 YEARS**

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摘要。第 1 组和第 2 组患儿第一天的补液量符合其各年龄段每日生理需求量（52 天）。第 2 组患儿在第 6 天需要将水负荷量限制在指标值的 35% 左右。第 2 组观察 52 天的平均肠外水负荷指标比前 7 天低 52%。第 1 组无需 MRP 的患儿在第 1-6 天的抗生素治疗量略高于第 2 组，第 2 组几乎所有患儿在重症监护的第一天都根据指征接受了机械通气。两组转入专科部门的患儿在 ICU 住院期间均接受了血管扩张剂治疗。第 1 组在第 1-2 天使用升压药，第 2 组使用至第 9 天。仅第 2 组患儿在第 3-5 天需要输注血浆。在重症监护的前6天，主要在第1组儿童中观察到维持肾脏排泄功能的需要。更早地开始更多抗益智治疗，而不仅仅是在第32天开始，将为优化抗急性脑梗死（ACI）的疗效创造更有利的条件，这将影响呼吸、反射和肌肉张力的恢复，从而增加儿童更有效的社会康复机会。

关键词：肺人工通气、水平衡、儿童、肺炎、急性脑供血不足。

Abstract. The volume of fluid administered during the first day corresponded to the physiological standard of daily requirement by age in groups 1 and 2 (52 days). On the 6th day in group 2, there was a need to limit the water load by 35% relative to the indicator in children with spontaneous breathing. The average indicator of parenteral water load for 52 days of observation was 52% less than in the first 7 days in group 2. On days 1-6 in group 1, in children without the need for MRP, the volume of antibiotic therapy was slightly higher than in group

2, where almost all children were on mechanical ventilation on the first day of intensive care according to indications. Children in both groups transferred to the specialized department received vasodilators throughout their stay in the ICU. Vasopressor was used in group 1 on days 1-2, in group 2 up to day 9. The need for hemoplasma transfusion was noted only in children of group 2 on days 3-5. The need to maintain the excretory activity of the kidneys was observed mainly in children of group 1 during the first 6 days of intensive care. More anti-nootropic therapy, started earlier, and not only on the 32nd day, would create more favorable conditions for optimizing the effectiveness of the fight against ACI, which would affect the restoration of breathing, reflexes, muscle tone, increasing the chances of more effective social recovery of the child.

Keywords: artificial ventilation of the lungs, water balance, children, pneumonia, acute cerebral insufficiency.

Relevance. One of the many problems of complex intensive care of severe infection in childhood is infusion therapy. In severe acute pneumonia, a combination of severe dehydration with impaired vascular permeability, intracellular edema with hypovolemic syndrome is often encountered, when an attempt to effectively restore the BCC, the need to correct blood rheology disorders, correct the deficiency of blood components by parenteral administration of solutions leads to an even greater increase in vascular pressure in the pulmonary circulation system, pulmonary artery, further increasing vascular resistance, the load on the heart, worsening the already impaired contractile function of the myocardium due to myocarditis. In this regard, routine infusion therapy necessary for the administration of drugs, correction of colloid-osmotic deviations, general and cellular dehydration, detoxification can have a negative effect, aggravating the infection-induced ACI, ARF, AHF. One of the controversial issues is the volume of parenteral infusion therapy. Some authors prefer mainly the oral route of administration. The main principles of pneumonia treatment are reduced to the implementation of measures aimed at combating oxygen deficiency, infectious onset and toxicosis, restoring the impaired functions of various systems and organs, preventing possible complications, increasing resistance and improving the body's reactivity [1-3]. We attempted to analyze the features of changes in water balance in infection complicated by acute cerebral insufficiency in children aged 3.1-7 years.

Objective of the work. To study the effect of artificial ventilation on water balance in children with pneumonia complicated by acute cerebral insufficiency aged 3.1-7 years.

Material and research methods. The results of continuous prolonged monitoring of daily assessment of water balance (total volume of administered water, administered intravenously, orally per day, volume of daily urine output with

hourly recording of hemodynamic parameters in children admitted to the ICU of the RRCEM in a serious condition caused by pneumonia complicated by acute respiratory, cerebral insufficiency at the age of 3.1 to 7 years were studied. Intensive care was carried out in accordance with the recommendations in thematic clinical protocols. Group 1 included 7 children who, upon admission to the clinic and throughout intensive care, had no indications for mechanical respiratory support, which did not exclude oxygen therapy. A study was conducted, analysis by calculating the average frequency of daily administration of drugs in the group, administered taking into account age, body weight in standard dosages. Almost all patients of Group 2 (9 children) were transferred to mechanical ventilation from the moment of admission to the clinic according to indications. The research data were processed by the method of variation statistics using the Excel program by calculating the arithmetic mean values (M) and errors of means (m). To assess the reliability of differences between two values, the parametric Student criterion (t) was used. The relationship between the dynamics of the studied indicators was determined by the method of paired correlations. The critical level of significance was taken to be 0.05.

Results and their discussion. The volume of fluid administered on the first day corresponded to the physiological norm of daily requirement by age in groups 1 and 2 (52 days) (Table 1). Some tendency to decrease was observed in the first 3 days in children of group 2, during 4-5 days slightly (by 100 ml) exceeding, and on the 6-7th day by 800 ml and 130 ml less than in group 1 (Fig. 1).

Table 1.
Water balance by severity of the condition

Group	1	2 (7 days)	2 (52 days)
Daily volume, ml/day	1715,1±210,5	1499,3±236,5	1678,8±196,5
Parenteral administration, ml/day	291,2±70,9	308,0±26,5	178,2±56,2*
Enterally, ml/day	1417,5±273,1	1188,1±247,8	1498,0±209,3*
Diuresis, ml/day	901,6±123,1	974,1±171,8	931,0±210,3

*-the difference is reliable relative to the indicator of group 2 (7 days).

Thus, already on the 6th day in group 2 there was a need to limit the water load by 35% relative to the indicator in children with spontaneous breathing. Thus, if in children with spontaneous breathing on the 6th day, according to indications, compensatory detoxification therapy was carried out by increasing the daily volume to 2244.6 ml per day, then in children of group 2 at the same time on mechanical ventilation, the water load was 35% less, which is associated with the need for restriction due to the risk of acute heart failure with significantly increased pressure, resistance in the pulmonary artery system, caused by a more

severe inflammatory reaction caused by pneumonia. In the first 7 days, parenteral administration in group 2 did not differ from the volume of intravenous infusion in group 1. However, the average parenteral water load over 52 days of observation was 52% ($p<0.05$) lower than in the first 7 days, but enteral replacement exceeded it by 10% ($p<0.05$). Preference for enteral water replacement was due to the need to limit intravenous infusion due to the severity of the inflammatory process in the lungs, a decrease in the capacity of the pulmonary circulation, and a higher risk of acute heart failure in group 2. It is noteworthy that the average daily volume of urinary activity of the kidneys did not differ by group, corresponding to the physiological norm (Table 1). The average value of water administered per day against the background of prolonged mechanical ventilation did not differ from the same indicator in group 1 (Table 1). Thus, the artificial ventilation of children with acute cerebral insufficiency did not significantly affect the average water consumption in children aged 3.1-7 years. In group 1, 16% of the total volume was administered parenterally, in group 2, 20% was administered intravenously during the first 7 days, the average parenteral amount administered over 52 days was 10% of the total. Thus, both with spontaneous breathing and MCI in children with ACI, the oral route of water replacement was preferable. The volume of parenteral infusion therapy was from 10% to 16% of the daily amount and was used to administer drugs, correct blood rheology. Oral administration, including nutritional support, was 84% in group 1, 80% in the first 7 days in group 2, 90% of the daily amount was administered over 52 days in group 2.

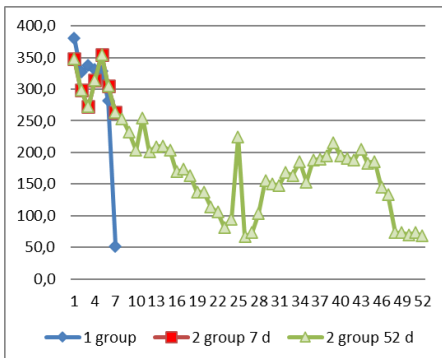


Figure 1. Daily volume of fluid, ml/day

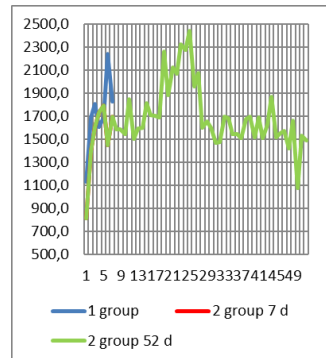


Figure 2. Parenteral administration, ml/day

An increase in the water load to 2262 ± 862 ml/day on the 19th day, to 2445 ± 1041 ml/day on the 25th day was noteworthy. The findings were due to the need to intensify detoxification therapy (Fig. 1). The latter was confirmed by

an increase in intravenous infusion to 225 ± 121 ml/day on the 25th day (Fig. 2). The trend towards an increase in intravenous infusion, as well as oral therapy (Fig. 3) was due to secondary aggravating factors, one of the leading ones being exacerbation of pneumonia, insufficient effectiveness of complex intensive care for children in group 2. Strengthening detoxification therapy by increasing both parenteral fluid up to 200 ml per day and enteral fluid administration led to an improvement in the condition of patients and the possibility of stopping mechanical ventilation with transfer to spontaneous breathing on the 47th day of intensive care in the intensive care unit (Fig. 2, 3).

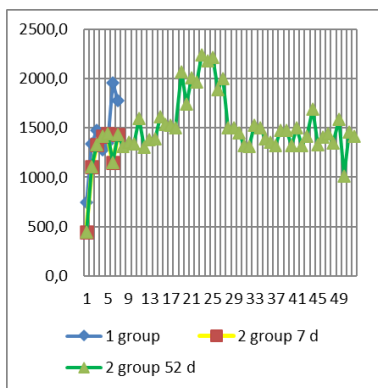


Figure 3. Oral administration, ml/day

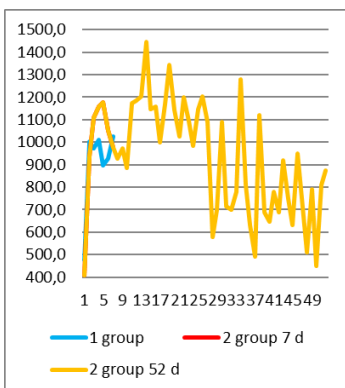


Figure 4. Renal function, ml/day

The volume of infusion therapy administered was invariably accompanied by a slightly increased volume of urine output, excluding the possibility of acute renal failure (Fig. 4). Thus, the introduction of a daily volume of fluid corresponding to the physiological needs of the child's body with pneumonia complicated by ACI makes it possible to exclude the development of serious deviations in water balance both towards deficit and overload, maintaining a moderate tendency to polyuria (without the use of diuretics), significantly reducing the likelihood of ACI. In more severe pneumonia with mechanical ventilation, it was necessary to limit parenteral administration by an average of 52%. Sedative therapy in the first 7 days was twice as high in children of group 2, remaining at this level until the end of mechanical ventilation, periodic reduction was carried out in attempts to control the effectiveness of spontaneous breathing (Fig. 5).

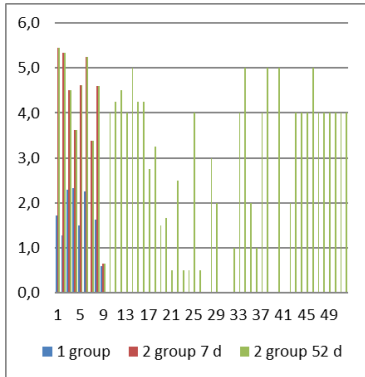


Figure 5. Sedative therapy, frequency of administration per day

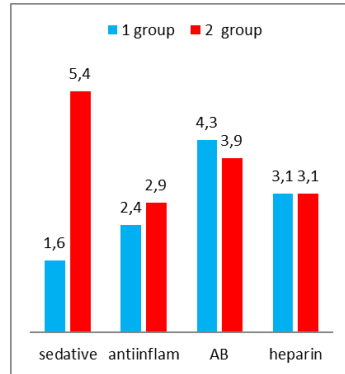


Figure 6. Comparative drug correction, frequency of administration per day

A comparative assessment of drug correction allowed us to identify only a more extensive stress-limiting correction with hypnotics, tranquilizers, and relaxants in group 2 (Fig. 6).

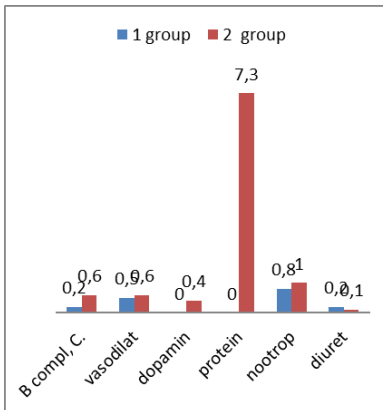


Figure 7. Medication correction

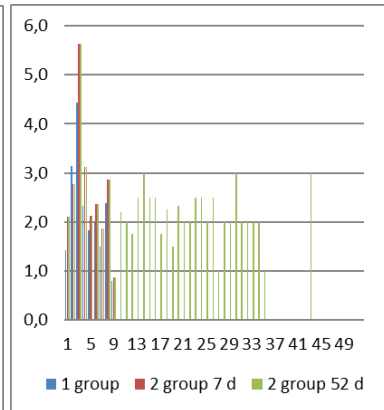
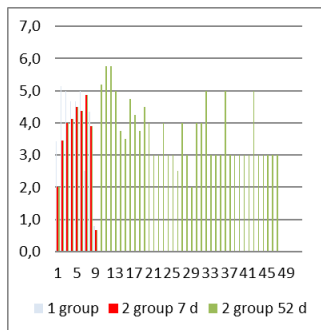
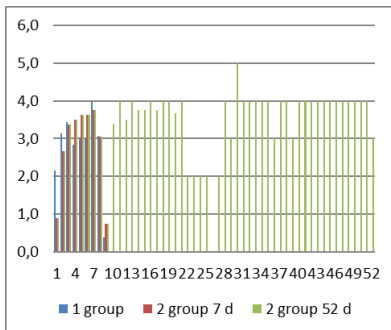


Figure 8. Anti-inflammatory (steroids and NSAIDs).

Frequency of administration per day of number of administrations per day

**Figure 9.** Antibiotic therapy.**Figure 10.** Heparin, frequency of administration per day

A significant difference was revealed in protein correction (erythrocyte mass 2, FFP 1, albumin 1), which was absent in group 1 (Fig. 7). The frequency of administration and the overall volume of anti-inflammatory therapy in the groups did not differ in the first 7 days, continuing up to day 35 against the background of mechanical ventilation in a wave-like manner, then increasing up to 3 times and decreasing to 1 time per day in group 2 (Fig. 8), the question arises as to how legitimate was the reduction in the administration of anti-inflammatory drugs on the 7th, 9th, 11th, 17th, 19th, 27th, 35th days against the background of ongoing mechanical ventilation, if the next day there was a need to administer a hormone (dexamethasone or NSAIDs). On days 1-6 in group 1 in children without the need for mechanical ventilation, the volume of antibiotic therapy was slightly higher than in group 2, where almost all children were on artificial ventilation on the first day of intensive care according to indications (Fig. 9). Perhaps, this played an important role in increasing the duration of artificial ventilation in group 2. Apparently, the unreasonableness of reducing the correction of blood rheology disorders was the cause of the negative dynamics and continuation of anticoagulant correction after 29 days of artificial ventilation in child H. (age 3.1 years) admitted to the intensive care unit with a diagnosis of acute lobar pneumonia on the left, focal on the right. Left lobe atelectasis, ARF 3, AHF stage 2, sepsis, carditis, infectious toxic encephalopathy, hepatitis, toxic nephritis, anemia stage 2. Floppy child syndrome.

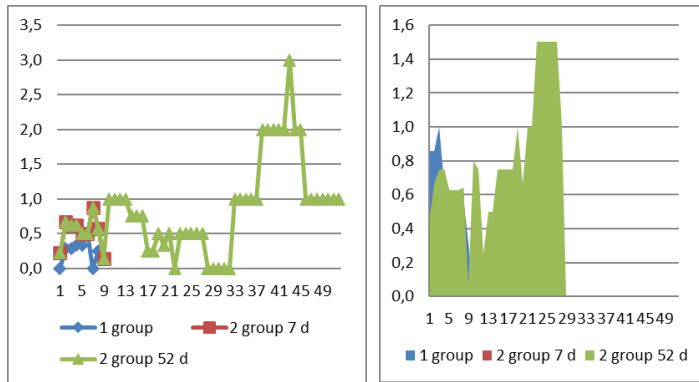


Figure 11. Vitamins of group B, C.

Figure 11. Vasodilators

Perhaps, earlier "supportive therapy" with vitamins and other medications included in this group would have allowed to obtain more optimistic results of complex intensive therapy with a decrease in the duration of apparatus respiratory support, a shortening of the duration of severe pneumonia, and a better, more complete restoration of the central nervous system function. It is noteworthy that children transferred to the specialized department received vasodilators throughout their stay in the intensive care unit (Fig. 11).

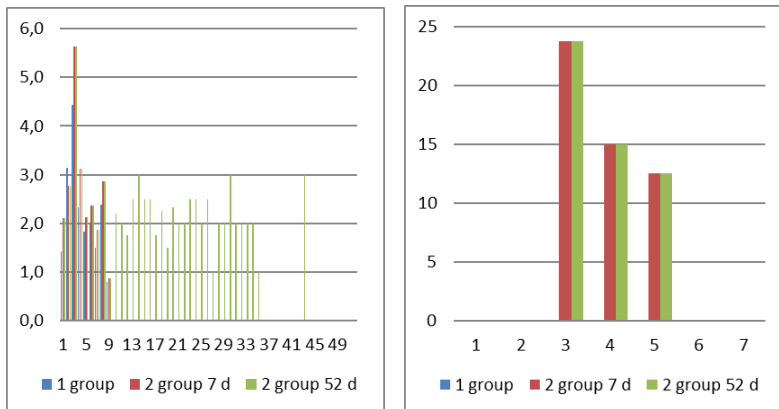


Figure 12. Dopamine

Figure 13. Hemo-plasma transfusion

Vasopressor is used in group 1 on days 1-2, in group 2 up to day 9 (Fig. 12). The need for hemo-plasma transfusion was noted only in children of group 2 on days 3-5.

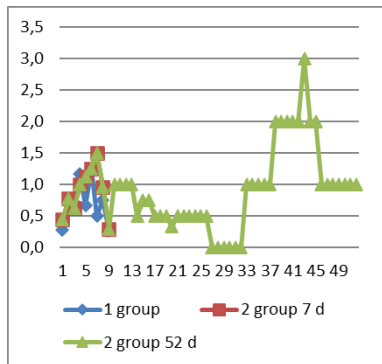


Figure 14. Nootropic therapy.

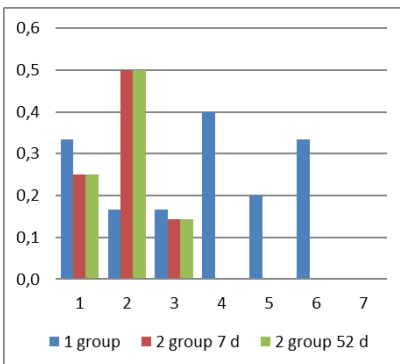


Figure 15. Furosemide.

It seems that more anti-nootropic therapy, started earlier, and not only on the 32nd day, would have created more favorable conditions for the effectiveness of the fight against OCI, which would have affected the restoration of breathing, reflexes, muscle tone, increasing the chances of more effective social recovery of the child (Fig. 14). The need to maintain the excretory activity of the kidneys was observed mainly in children of group 1 during the first 6 days of intensive care (Fig. 15).

Conclusion. The volume of fluid administered on the first day corresponded to the physiological standard of daily need by age in groups 1 and 2 (52 days). On the 6th day in group 2, there was a need to limit the water load by 35% relative to the indicator in children with spontaneous breathing. The average parenteral water load for 52 days of observation was 52% less than in the first 7 days in group 2. On days 1-6 in group 1, in children without the need for MCI, the volume of antibiotic therapy was slightly greater than in group 2, where almost all children were on mechanical ventilation on the first day of intensive care according to indications. Children in both groups transferred to the specialized department received vasodilators throughout their stay in the ICU. Vasopressor was used in group 1 on days 1-2, in group 2 up to day 9. The need for hemoplasma transfusion was noted only in children of group 2 on days 3-5. The need to maintain renal excretory activity was observed mainly in children of group 1 during the first 6 days of intensive care. More effective nootropic therapy started earlier, and not only on the 32nd day, would create more favorable conditions for optimizing the effectiveness of the fight against ACI, which would affect the restoration of breathing, reflexes, muscle tone, increasing the chances of more effective social recovery of the child.

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人工通气对3.1~7岁儿童急性脑衰竭相关因素的影响
**THE INFLUENCE OF ARTIFICIAL VENTILATION ON
CORRELATIONS IN ACUTE CEREBRAL FAILURE IN CHILDREN
AGED 3.1-7 YEARS**

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摘要。根据重症肺炎合并急性肾功能衰竭（ARF）和急性脑梗死（ACI）的指征，将患儿转入人工通气治疗，可显著降低肠外输液对血流动力学和呼吸的刺激作用（ 308.0 ± 26.5 ml/天），从而减轻心脏和呼吸功能负荷。第1组患儿无需机械呼吸支持（MRS）时，第1-6天抗生素治疗量略高于第2组。对于合并急性肾功能衰竭（ARF）和急性脑梗死（ACI）且需要体外呼吸辅助装置的更重症肺炎，人工通气不仅维持了抗凝治疗的积极作用，而且还增强了某些矫正作用，特别是与外周血管张力相关的矫正作用。人工通气几乎使利尿剂矫正的需求减少了一半，导致血流动力学对利尿剂治疗的反应存在一定差异。

关键词：人工通气，急性脑衰竭，儿童。

Abstract. *Transfer of children to artificial ventilation according to indications for severe pneumonia complicated by ARF and ACI significantly reduced the stimulating effect of parenterally administered fluid on hemodynamics and respiration within 308.0 ± 26.5 ml/day, reducing the functional load on cardiac and respiratory functions. On days 1-6 in group 1 in children without the need for mechanical respiratory support (MRS), the volume of antibiotic therapy was slightly higher than in group 2. In more severe pneumonia with ARF and ACI requiring external respiration prosthetics, artificial ventilation not only maintained the positive effects of anticoagulant therapy, but also enhanced some corrective effects, in particular, those associated with the tone of peripheral vessels. Artificial*

ventilation almost halved the need for diuretic correction, introducing certain differences in the hemodynamic response to the administration of a diuretic drug.

Keywords: *artificial ventilation, acute cerebral failure, children.*

Relevance. In children, the systemic inflammatory response is characterized by the fact that when an inflammatory focus occurs, a tendency to generalization is clearly defined due to the inability of the macroorganism to limit the local process, which depends on the age, anatomical and functional immaturity of the organs of immunogenesis and barrier tissues, which facilitates the penetration of pathogens and their toxins into the bloodstream and lymph. One of the many problems of complex intensive care of severe infections in childhood is infusion therapy. Routine infusion therapy necessary for the administration of drugs, correction of colloid-osmotic deviations, general and cellular dehydration, detoxification can have a negative effect, aggravating the ACI, ARF, AHF. One of the controversial issues is the volume of parenteral infusion therapy. Some authors prefer mainly the oral route of administration. The main principles of pneumonia treatment are reduced to the implementation of measures aimed at combating oxygen deficiency, infectious onset and toxicosis, restoring the impaired functions of various systems and organs, preventing possible complications, increasing resistance and improving the body's reactivity [1-5]. Due to the lack of information, we tried to analyze the features of the influence of artificial ventilation of the lungs on the formation of correlation links of water balance, hemodynamics in infection complicated by acute cerebral insufficiency in children aged 3.1-7 years.

Objective of the work. To study and evaluate the influence of artificial ventilation of the lungs on correlation links in acute cerebral insufficiency in children aged 3.1-7 years.

Material and methods of research. The article presents the results of continuous prolonged monitoring with hourly recording of hemodynamic parameters, myocardial oxygen demand (MOD), body temperature, and respiration in children admitted to the ICU of the Russian Scientific Center for Emergency Medicine in a serious condition caused by pneumonia complicated by acute respiratory and cerebral insufficiency at the age of 3.1 to 7 years. Intensive care was administered according to the recommendations in thematic clinical protocols. Group 1 included 7 children who had no indications for mechanical respiratory support upon admission to the clinic or during intensive care, which did not exclude oxygen therapy. Almost all patients in Group 2 (9 children) were transferred to mechanical ventilation from the moment of admission to the clinic according to indications. 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). The parametric Student's t-test (t) was used to assess the reliability of

differences between the two values. The relationship between the dynamics of the studied indicators was determined by the method of paired correlations. The critical level of significance was taken to be equal to 0.05.

Results and discussion. In group 1, an increase in the daily volume of infusion therapy (1715.1 ± 210.5 ml/day) caused an increase in the oxygen saturation index (0.74), with MCI this relationship significantly weakened (0.23). The stress-limiting effect of changing the total volume of water in group 1 was expressed in a decrease in HR (-0.69), AVT (-0.84), a decrease in PMC (-0.76), a decrease in elevated SBP (-0.84), and to a lesser extent a decrease in temperature response (-0.42). In group 2, the correlation relationships characterizing the stress-limiting effect of increasing the total volume of fluid occurred within 1499.3 ± 236.5 ml/day, confirming a decrease in HR (-0.81), AVT (-0.87), PMC (-0.93), and antipyretic effect - T (-0.86).

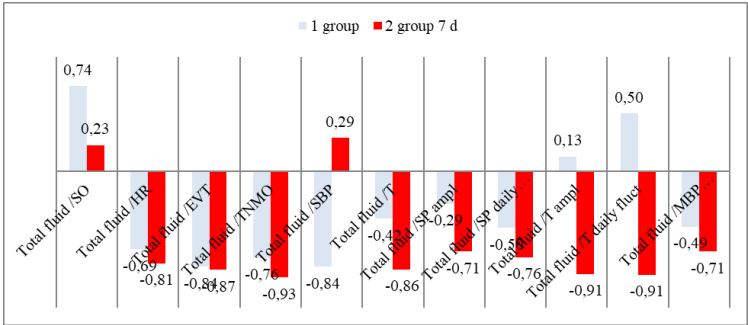


Figure 1. Correlation relationships of the administered volume of fluid, ml/day

In group 2, the corrective effect on the amplitude of the circadian rhythm of SBP (-0.71), daily fluctuations in SBP (-0.76), the stabilizing effect on the temperature response through the amplitude of the circadian rhythm T (-0.71), and the reduction in daily fluctuations in MAP (-0.71) also increased (Fig. 1).

Physiological compensatory reactions in severe pneumonia in group 1 were expressed in a direct correlation relationship between an increase in urinary activity and oxygen saturation (0.82), a favorable effect of an increase in urine output within 901.6 ± 123.1 ml/day on HR (-0.77), AVT (-0.88), PMC (-0.8), IOC (-0.73), and SBP (-0.73). In group 2, under conditions of more severe ARF and ACI, the use of MRS did not affect the correlation between the volume of diuresis and HR (-0.74), AVT (-0.89), and MVP (-0.92), but it increased the stress-limiting effect of mechanical ventilation on the amplitude of the circadian rhythm of SBP (-0.82), the daily range of SBP fluctuations (-0.83), the amplitude of the circadian rhythm of MAP (-0.81), the amplitude of the circadian rhythm of T (-0.94), and T fluctuations (-0.95). Thus, the stress-limiting effect of mechanical ventilation on the parameters of the circadian rhythm of hemodynamics, autonomic regulation, and MVP was confirmed (Fig. 3). Comparatively less targeted drug sedative effect in group 1 was expressed in a negative correlation between the frequency of administration and CI (-0.71), SV (-0.75), PBP (-0.77), and a positive correlation between the frequency of sedatives and body temperature (0.77). The latter reflected an increase in drug sedation during hyperthermia (Fig. 4). In more severe cases of pneumonia due to mechanical ventilation, the direct relationship between the frequency of sedative administration and HR (0.79) and an increase in PMC (0.71) increased, but at the same time the negative effect on SV (-0.42), PBP (-0.66), and hyperthermia (0.41) decreased (Fig. 4).

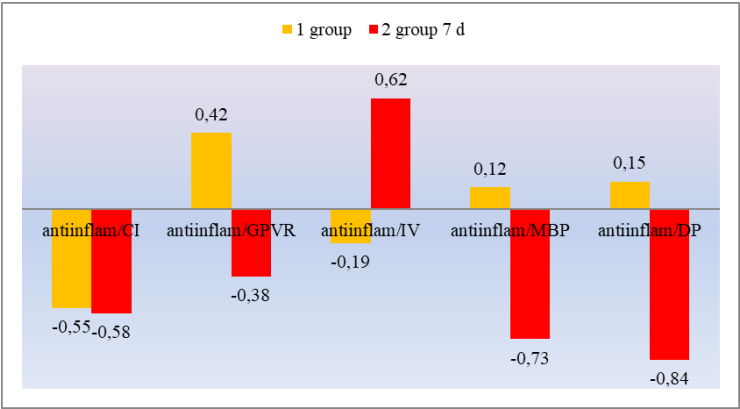


Figure 5. Correlation links of anti-inflammatory therapy.

An increase in the stress-limiting effect of anti-inflammatory therapy against the background of mechanical ventilation was revealed, which was expressed in the emergence of a tendency to increase SV (0.62), decrease in elevated sBP

(-0.73) and dBP (-0.84), which confirmed the increased effectiveness of correction of hemodynamic disorders by NSAIDs and hormones (dexamethasone) (Fig. 5).

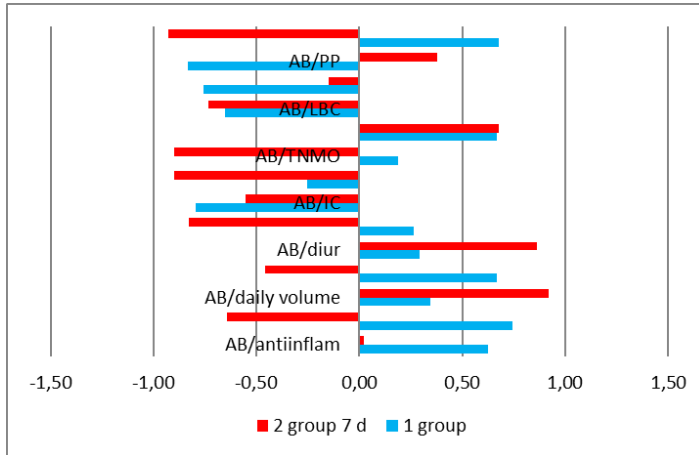


Figure 6. Correlation relationships of antibiotic therapy

In group 1, a direct correlation relationship was found between the frequency of administration of AB and sedatives (0.74), AB and intravenous infusion therapy (0.67), AB and total peripheral vascular resistance (0.67), AB and body temperature (0.68). At the same time, a negative effect of increasing the administration of AB on SV (-0.76), PBP (-0.83) was noted. On days 1-6 in group 1, in children without the need for MCI, the volume of antibiotic therapy was slightly higher than in group 2, where almost all children were on mechanical ventilation on the first day of intensive care according to indications. Perhaps, this played an important role in increasing the duration of mechanical ventilation in group 2. Although a stimulating effect on renal function (0.87) and a stress-protective effect were noted through a decrease in heart rate (-0.83), a decrease in AVT (-0.9), a decrease in cardiac output (-0.73), and a decrease in cardiac output (-0.9). Thus, mechanical ventilation in group 2 had a favorable stress-protective effect on the parameters of autonomic regulation and hemodynamics (Fig. 6).

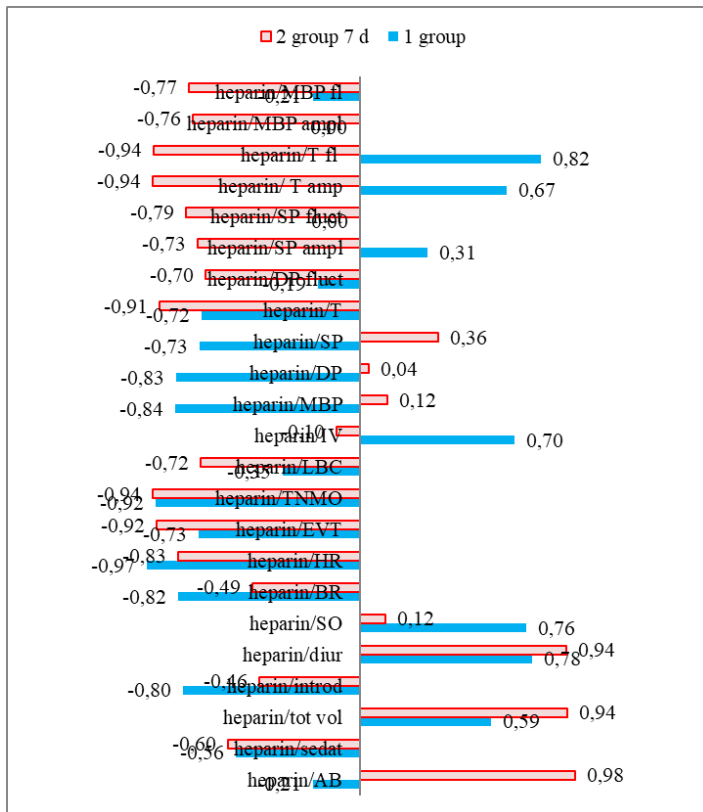


Figure 7. Correlation relationships of anticoagulant therapy.

In group 1, with a heparin administration frequency of 3.1 ± 0.4 (in group 2 3.1 ± 0.7), a direct relationship was found with urinary activity (0.78), oxygen saturation index (0.76), SV (0.7), an oppositely directed relationship was found between heparin and the volume of intravenous infusion (-0.8), RR (-0.82), HR (-0.97), AVT (-0.73), RMC (-0.93), sBP (-0.84), DBP (-0.83), T (-0.72), which indicated an improvement in cardiac output with a simultaneous decrease in sympathetic regulation, a decrease in the tone of peripheral vessels, PMC, a decrease in dyspnea, and the antipyretic effect of the therapy. In group 2, with the same anticoagulant correction activity, a direct strong correlation was found between the frequency of heparin administration and the administration of AB (0.98), daily fluid volume (0.94), and the increase in diuresis volume (0.94). At the same time, the conducted artificial ventilation did not change the inverse relationship with HR

(-0.83), AVT (-0.92), and MVP (-0.94) that arose during spontaneous breathing. Despite the same frequency of administration of anticoagulant therapy in group 2 relative to group 1, the inverse dependence on the volume of parenteral administration decreased (-0.46), the positive effect on the oxygen saturation index (0.12), on RR (-0.49), on SV (-0.10), sBP (0.12), diastolic BP (0.04), but at the same time the same strong inverse dependence of T (-0.91) was noted, when the reduction of anticoagulant therapy caused / contributed to a hyperthermic reaction against the background of mechanical ventilation of complex intensive care. Thus, in more severe pneumonia with ARF and ACF, requiring external respiration prosthetics, the conducted mechanical ventilation not only preserved the positive effects of anticoagulant therapy, but also enhanced some corrective effects, in particular those associated with the tone of peripheral vessels (Fig. 7).

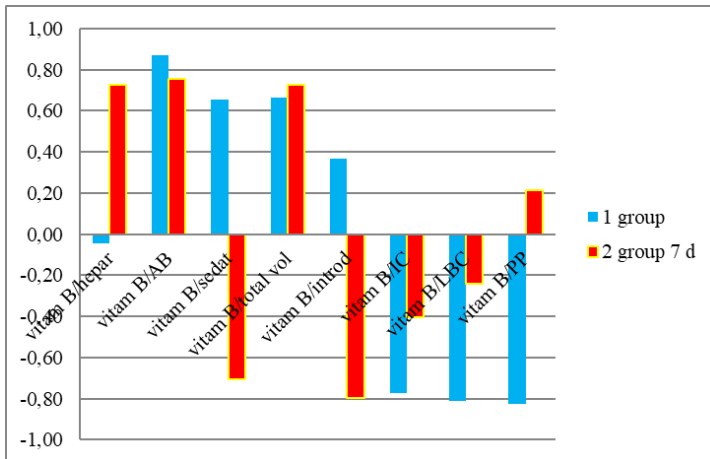


Figure 8. Correlation links of metabolite therapy

Today, the beginning of the use of metabolite therapy and its appropriateness in the acute period of the disease remain controversial. In both groups (group 1 was administered 0.2 ± 0.1 , group 2 – 0.6 ± 0.1), a direct correlation was noted between the administration of vitamins and AB (0.87 and 0.75, respectively), vitamins and the daily volume of administered water (0.66 and 0.72, respectively). However, in group 2, a direct correlation appeared between vitamins and heparin (0.73), and an inverse correlation with sedative therapy appeared in group 2 (-0.71), which in group 1 was 0.66. Due to artificial ventilation, the negative correlation between the administration of vitamins and MBV (in group 1 -0.84, and in group 2 it was -0.24), with CI (group 1 -0.77 and group 2 -0.4), with PAP (group 1 -0.83 and in group 2 0.21) (Fig. 8) significantly decreased.

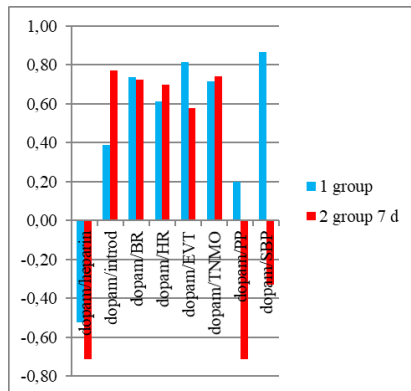


Figure 9. Correlations of vasopressor therapy.

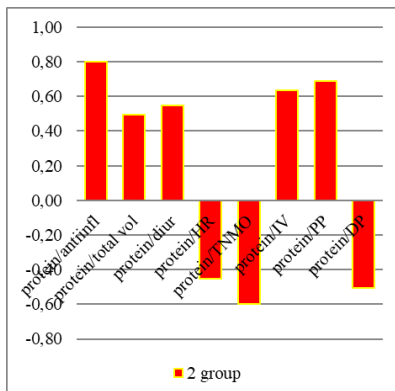


Figure 10. Correlations of albumin transfusion

In group 1, dopamine was used for 1 day in 2 children, which on average for the group was 0.04 ± 0.01 , in group 2 0.4 ± 0.1 . Even short-term (2 days) maintenance of hemodynamics with dopamine in group 1 and in group 2 during the first 7 days despite mechanical ventilation revealed almost the same degree of positive correlation between vasopressor and RR (0.74 and 0.72, respectively), with HR (0.61 and 0.7), MVP (0.72 and 0.74), heparin (-0.53 and -0.71). The direct relationship with the OVT somewhat weakened (1 g 0.82 and 2 g 0.58) and the relationship with the volume of parenteral administration increased (1 g 0.39 and 2 g 0.77) (Fig. 9). Correction of circulating blood volume disorders was performed according to indications only in group 2 (Fig. 10). A direct correlation was found between the amount of the administered protein drug and the frequency of anti-inflammatory therapy (0.8), a moderate decrease in PMC (-0.6), an increase in stroke volume (0.63), a decrease in heart rate (-0.45), and an increase in diuresis (0.55), which generally corresponded to the positive corrective effect of hemo-plasma-albumin transfusion during mechanical ventilation.

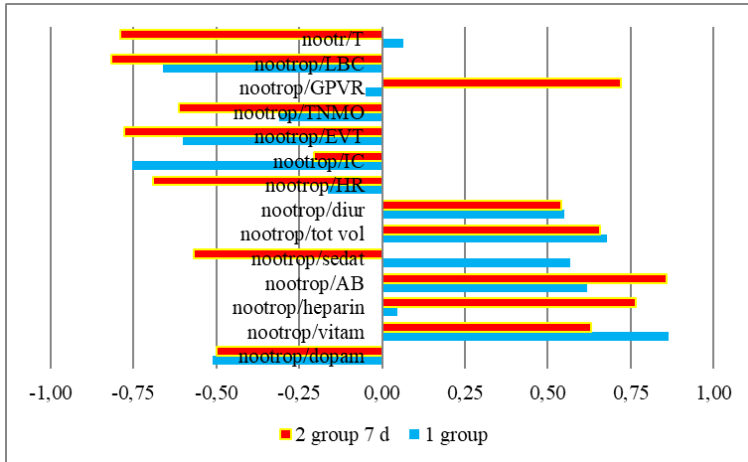


Figure 11. Correlation links of nootropic therapy.

Discussions continue about the advisability of early nootropic therapy (from the first day immediately after correction and relief of terminal deviations of homeostasis) or at the rehabilitation stage. The latter routine option turned out to be insufficiently effective, in this regard, the search for more optimistic treatment options continues. There are different views regarding earlier intensive "supportive", drug, including nootropic correction, aimed at maintaining viability and restoring structure and function at the cellular level in the early period, possibly at the height of the systemic inflammatory reaction in the process of efforts aimed at maintaining the reversibility of disorders of the structural and functional characteristics of the central nervous system and other organs and systems. In group 1, nootropic therapy was accompanied by a decrease in CI (-0.75), AVT (-0.6), MBV (-0.66), and a tendency to increase diuresis (0.55). Transfer to mechanical ventilation somewhat changed the hemodynamic response to the introduction of nootropics. Thus, if in group 1 the introduction of nootropics was accompanied by a tendency to increase sedative therapy (0.57), then in group 2 this relationship became the opposite (-0.57). The antiarrhythmic effect of nootropic drugs in group 2 increased (-0.69), a favorable effect on PMC (-0.61) and temperature reaction (-0.79). But at the same time, a stimulating effect on TPR appeared (0.72) (Fig. 11).

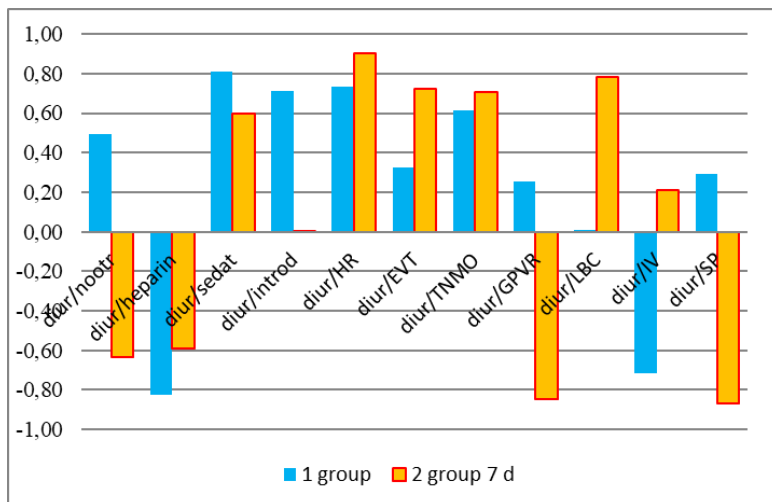


Figure 12. Correlation relationships of diuretic therapy.

The frequency of diuretic administration in group 1 was 0.23 ± 0.1 , in group 2 0.13 ± 0.1 . The need to increase anticoagulant therapy was revealed (the correlation relationship between the administration of furosemide and heparin was -0.82 , which decreased in group 2 to -0.59). Artificial ventilation almost halved the need for diuretic correction, introducing certain differences in the hemodynamic response to the administration of a diuretic drug. Thus, the correlation between furosemide and the volume of intravenous infusion, which in group 1 was 0.71 , completely disappeared, the stimulating effect on the AVT (0.73), on the cardiac output (0.85), increased the tendency to decrease the total peripheral vascular resistance (-0.85), and the systolic blood pressure (-0.87) (Fig. 12). The findings generally corresponded to the positive effect of moderate forcing of diuresis in both groups of children against the background of the above-mentioned maintenance of fluid balance.

Conclusion. Transferring children to mechanical ventilation significantly reduced the stimulating effect of parenterally administered fluid on hemodynamics and respiration within 308.0 ± 26.5 ml / day, reducing the functional load on the cardiac and respiratory functions.

On days 1-6 in group 1 in children without the need for MCI, the volume of antibiotic therapy was slightly greater than in group 2. In more severe pneumonia with ARF and ACF requiring external respiration prosthetics, the conducted artificial ventilation not only preserved the positive effects of anticoagulant therapy, but also enhanced some corrective effects, in particular, those associated with the

tone of peripheral vessels. Artificial ventilation almost halved the need for diuretic correction, introducing certain differences in the hemodynamic response to the administration of a diuretic drug. Thus, the correlation between furosemide and the volume of intravenous infusion, which in group 1 was 0.71, completely disappeared, the stimulating effect on AVT (0.73), on MBV (0.85), with a tendency to decrease in TPR (-0.85), SBP (-0.87) increased. The findings generally corresponded to the positive effect of moderate forcing of diuresis in both groups 1 and 2 of children. Against the background of mechanical ventilation, the antiarrhythmic effect of nootropic drugs in group 2 increased (-0.69), a favorable effect on PMC (-0.61) and temperature response (-0.79).

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人工通气对7岁以上儿童体温昼夜节律的影响

THE EFFECT OF ARTIFICIAL VENTILATION ON THE CIRCADIAN RHYTHM OF BODY TEMPERATURE IN CHILDREN OVER 7 YEARS OLD

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摘要。从其他医院转诊的7岁以上重症肺炎、急性脑供血不足患者的特点是，观察期内各组（组1：自主呼吸，组2：呼吸机辅助）体温平均值差异不显著，均在正常范围内。组2：体温不稳定，且波动幅度有增大趋势，提示病情较为严重。组1中加重一般状况的因素包括重症肺炎（88%（7）例）、急性心力衰竭（AHF）1-2A级（50%（4）例）和急性肾功能衰竭（ARF）1-2级（75%（6）例）。而第2组患儿病情严重程度及需用体外呼吸假体的情况与肺炎严重程度、继发性脑病、急性呼吸衰竭2-3级、急性呼吸衰竭2AB级、惊厥综合征分别与100%（8）、87%（7）、75%（6）和37%（3）的发生率相关。第1组患儿体温昼夜节律波动较小（在0.1℃以内），而第2组患儿体温波动幅度为0.3℃。第2组患儿入院时体温昼夜节律波动幅度为1.1℃，若第26天和第35天该指标反复升高，提示炎症反应持续存在，有发展为慢性炎症的风险。

关键词：人工肺通气；儿童体温昼夜节律全身炎症反应

Abstract. Patients with severe pneumonia, acute cerebral insufficiency over the age of 7 years, transferred from other hospitals are characterized by the fact that the average values of temperature reaction by groups during the observation period (group 1 with spontaneous breathing and group 2 on mechanical ventilation) did not differ significantly and were within the normal range. Unstable with a tendency to increase the amplitude of fluctuations in group 2 corresponded to a more severe condition. Factors aggravating the general condition of patients in group 1 were severe pneumonia, observed in 88% (7), AHF grade 1-2A 50% (4), ARF grade 1-2 in 75% (6) of children. While in group 2 the severity of the condition and the need for external respiration prosthetics were associated with the severity of pneumonia in 100% (8), secondary encephalopathy in 100% (8), acute respiratory failure grade 2-3 in 87% (7), acute respiratory failure grade 2 AB in 75% (6), and convulsive syndrome in 37% (3). The average circadian rhythm in group 1 was characterized by calmer fluctuations (within 0.1°C), while in group

2 the fluctuation amplitude was 0.3°C . In group 2, upon admission, the amplitude of the circadian rhythm of body temperature was 1.1°C . A repeated increase in the indicator on the 26th and 35th days indicated a persistent inflammatory response with the risk of chronic inflammation.

Keywords: artificial lung ventilation, systemic inflammatory response of the circadian rhythm of body temperature in children.

Relevance. The main risk of untimely or ineffective treatment of pneumonia is respiratory failure, purulent pleurisy, cicatricial transformation of lung tissue (fibrosis), sepsis, lung abscess, multiple organ failure, cardiac arrhythmia, kidney damage, meningitis, etc. Another important area of pneumonia complications is neurological disorders. The leading mechanism of damage to the nervous tissue in any pneumonia is indirect, as a result of severe intoxication. The intoxication may also involve the meninges - the intensity of this process determines whether it will be just irritation or their severe inflammation. A complication of acute severe pneumonia can be encephalopathy, which is characterized by damage and complete death of brain cells. The pathology develops as a result of disruption of the brain's oxygen supply and blood supply. Encephalopathy is not singled out as a separate disease. This is a complex concept that includes pathologies of different nature, but leads to the same result. Encephalopathy of the brain 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 sepsis is already reduced. The leading place in the development of SVR in the child's body is given to inflammation mediators. More than 300 inflammation mediators are known, but only dozens of them are used in clinical practice as markers, while the rest need to be discussed from the standpoint of reliability, sensitivity and specificity. The most severe complication of SVR 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, an attempt was made to assess the impact of mechanical respiratory support on the inflammatory response complicated by acute cerebral insufficiency based on the study of circadian rhythm monitoring data for temperature response [1-4].

Objective. To study and assess the impact of acute cerebral insufficiency on the circadian rhythm of body temperature at the age of 7.1-18 years.

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 RRCM 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, 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. In both groups, boys accounted for 82% (7 out of 8). Of the 8 children in group 1 over 7.1 years old, 7 were male and 1 was female, 8 children in group 2, of which 1 was female, i.e. male patients accounted for 88% in each group.

Table 1.
Characteristics of the clinical material

Diagnosis, complication, concomitant disease	Group 1 (spontaneous breathing)	Group 2 (artificial ventilation)
Pneumonia (polysegmental/focal/destructive)	42% (7)	50% (8)
Sepsis	6% (1)	6 % (1)
Systemic lupus erythematosus	0	6 % (1)
Hydrothorax, ascites/polyserositis	3	6 % (1)
Rheumatism 3 degree of activity	6 % (1)	0
Leukoencephalitis	6 % (1)	0
Brain tumor (drained)	0	6 % (1)
Secondary encephalopathy (coma 1-2 st.)	6 % (1)	50% (8)
Prolapse of the mitral, aortic valves 2-3 degrees	6 % (1)	0
Carditis	6 % (1)	12% (2)
DCM	6 % (1)	12% (2)
Hepatitis	6 % (1)	6 % (1)
Nephritis	6 % (1)	12% (2)
Convulsive syndrome	6 % (1)	36% (3)
CO poisoning	0	6% (1)
Organophosphate poisoning (acute and complications)	0	12% (2)
SPO septococciplasty	0	6 % (1)
OSN 1-2A-2B st.	24% (4)	36% (6)
ARN 1-2 st.-3 st.	36% (6)	42% (7)
Post-resuscitation disease	0	12% (2)
Down syndrome	6 % (1)	0

% are given from the total number of subjects (16 patients).

As presented in Table 1, the factors aggravating 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 were in children 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 a complication of the underlying disease were observed in group 2. These are severe complicated pneumonias, which accounted for 50% of the total cohort of patients under study, secondary encephalopathy complicated by grade 1-2 coma (50%), convulsive syndrome (36%), acute respiratory failure 42%, acute heart failure – 36%.

Results and their discussion. The average values of temperature reaction by groups during the observation period did not differ significantly and were within the normal range. This can be explained by the fact that most patients were transferred from other hospitals or the surgical department, where they were started on intensive care, but due to insufficient effectiveness, diagnostic difficulties, deterioration of the condition, the need for special care and monitoring, they were transferred to the intensive care unit of the RRCEM.

Table 1.
Average values of the parameters of the phase structure of the circadian rhythm of body temperature in patients over 7 years of age

Groups	Mesor	In acrophase	In the bathyphase	Amplitude	Daily range
1	36,7±0,1	37,0±0,2	36,5±0,1	0,3±0,1	0,4±0,2
2	36,7±0,2	37,2±0,2	36,4±0,2	0,4±0,2	0,8±0,3

A slight tendency for temperature increase was noted in the first four days in children of group 2 (Table 2). Thus, the systemic inflammatory response of the body was clinically stopped already upon admission to the ICU, although this was not accompanied by positive dynamics of improvement of the children's condition. The revealed features of the systemic inflammatory response in this age group can be interpreted as a secondary immunodeficiency state caused by the severity of the infection, the underlying disease, the aggravating effect on the immune system of concomitant congenital or acquired abnormalities of the immune response. In some cases, iatrogenesis was not excluded. As the condition improved, the patients were transferred to specialized departments. Thus, out of 8 patients of group 1, 5 children remained in the ICU on the 4th day, 1 on the 9th day, in group 2, 2 children remained on the 12th day, and 1 patient on the 22nd

day. The average bed-day in the intensive care unit was 11.7 ± 4.2 days in group 1 and 17.5 ± 6.1 days in group 2.

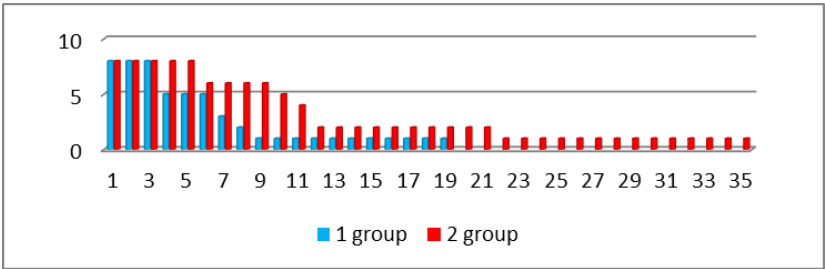


Figure 1. Number of patients in the intensive care unit.

Table 2.

Mesozoic circadian rhythm of temperature

Hours	1 group	2 group
8	36,7±0,1	36,8±0,3
9	36,8±0,2	36,8±0,3
10	36,7±0,1	36,7±0,3
11	36,8±0,1	36,7±0,3
12	36,7±0,1	36,6±0,3
13	36,7±0,1	36,6±0,3
14	36,7±0,1	36,6±0,3
15	36,7±0,1	36,6±0,2
16	36,7±0,1	36,6±0,3
17	36,7±0,1	36,7±0,2
18	36,7±0,1	36,7±0,2
19	36,8±0,2	36,7±0,2
20	36,7±0,1	36,7±0,2
21	36,7±0,2	36,7±0,2
22	36,7±0,1	36,7±0,2
23	36,7±0,1	36,8±0,2
24	36,7±0,1	36,8±0,2
1	36,7±0,1	36,8±0,2
2	36,7±0,1	36,7±0,2
3	36,7±0,1	36,8±,2
4	36,7±0,1	36,8±0,2
5	36,7±0,1	36,8±0,2
6	36,7±0,1	36,9±0,2
7	36,6±0,1	36,9±0,2

Table 3.
Average circadian rhythm T

Days	1 group	2 group
1	36,9±0,2	37,1±0,2
2	36,5±0,01	37,1±0,1
3	36,6±0,02	37,0±0,1
4	36,7±0,01	37,0±0,1
5	36,7±0,01	36,9±0,1
6	36,6±0,1	36,9±0,1
7	36,6±0,1	36,9±0,1
8	36,7±0,1	36,9±0,1
9	37,0±0,1	36,8±0,1
10	36,7±0,1	36,7±0,1
11	36,6±,01	36,7±0,1
12	36,7±0,1	36,6±0,1
13	36,6±0,1	36,8±0,1
14	36,7±0,1	36,7±0,1
15	36,7±0,1	36,5±0,1
16	37,0±0,2	36,6±0,2
17	36,7±0,1	36,6±0,1
18	36,7±0,2	36,6±0,1
19	36,7±0,1	36,4±0,2
20		36,7±0,1
21		36,7±0,1
22		37,0±0,2
23		36,7±0,2
24		36,2±0,1
25		36,4±0,3
26		36,5±0,3
27		36,6±0,3
28		36,3±0,3
29		36,8±0,2
30		36,5±0,3
31		36,7±0,2
32		36,9±0,2
33		36,8±0,3
34		37,0±0,2
35		36,7±0,3

The circa-weekly biorhythms of the temperature response were deformed by shortening the circa-weekly wave to 5-4 days in both groups (Fig. 2). The unstable amplitude of oscillations with a tendency to increase in Group 2 corresponded to a more severe condition. The tendency to a hyperthermic reaction was due to secondary complications of prolonged mechanical ventilation (tolerance to antibiotics due to mutation of pathogenic flora, difficulty in adequately selecting a ventilation mode, which increased the risk of formation of new foci of infiltration in the lungs). One of the most common aggravating factors is the so-called underestimation of the severity of the initial condition at the onset of an acute inflammatory response of the body to infection during the first visit to the doctor, causing inadequate intensive care and untimely detection and correction of homeostasis disorders invariably accompanying children with genetically determined failure of the immune system, which we assumed in 4 children of Group 1. While in the 2nd group, the aggravating factors were acute poisoning in 3 patients, and a brain tumor in 1. While in the remaining 4 patients of the 2nd group, the severity of the condition was directly related to inadequate resuscitation measures, late diagnosis of multiple organ failure, and the severity of the condition.

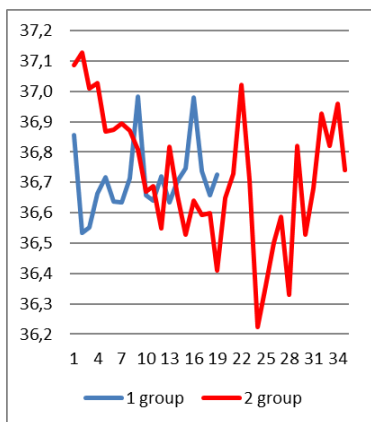


Figure 2. Mesor of circadian temperature rhythm

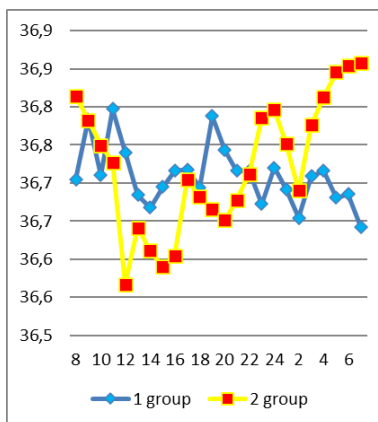


Figure 3. Average circadian temperature rhythm

The average circadian rhythm in group 1 was characterized by calmer fluctuations (within 0.1°C), while in group 2 the amplitude of fluctuations was 0.3°C , indicating a more pronounced inflammatory reaction in the early morning hours (4-7 o'clock), the bathyphase moved to 12 o'clock in the afternoon. Such a restructuring of the phase structure of the circadian rhythm is characteristic of a stress-induced increase in the functional activity of the thermoregulatory center (Fig. 3).

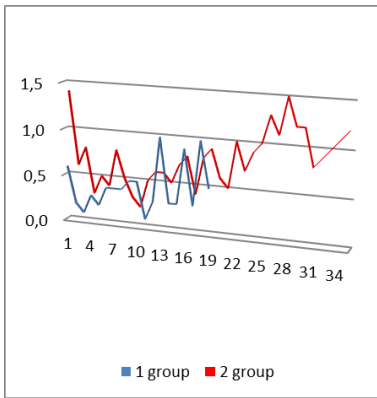


Figure 4. Amplitude of the circadian rhythm of temperature

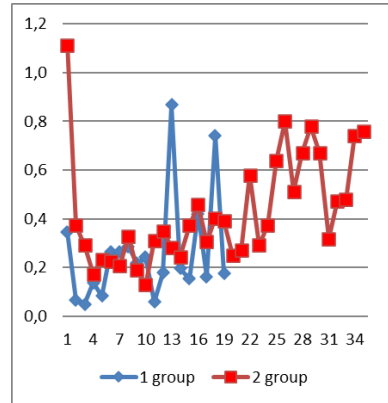


Figure 5. Range of daily temperature fluctuations

An increase in the amplitude of the circadian rhythm of the indicator corresponds to adaptive mobilization to changing conditions of life at the cellular, organ, and organismic levels. The highest amplitude of the circadian rhythm of body temperature in group 1 was detected on the 13th and 18th days, but less than one degree (given the fact that the physiologically acceptable amplitude is 0.5 degrees). While in group 2, upon admission, the amplitude of the circadian rhythm of body temperature was noted to be 1.1 °C. A repeated increase in the indicator on the 26th and 35th days indicated a persistent inflammatory reaction with the risk of chronic inflammation (Fig. 4). Thus, monitoring made it possible to detect acute SVR on day 1 and a repeated exacerbation on the 27th and 35th days in group 2 against the background of mechanical ventilation (Fig. 5).

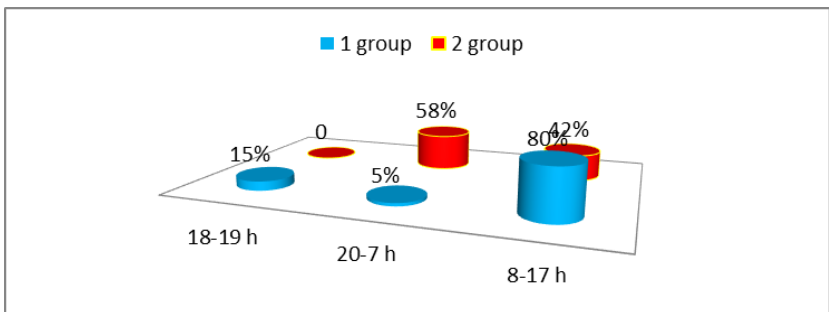


Figure 6. Duration of the shift in the acrophase of temperature

The longest inversion of the circadian rhythm of body temperature was in group 1 (80%), and less significant in children of group 2 (42% of the time spent in the ICU) (Fig. 6). Comparative assessment of the correlation links of the phase structure of the circadian rhythm of body temperature during spontaneous breathing and mechanical ventilation over 7 years allowed us to state an increase in the direct dependence of the mesor level on the growth of the indicator in the acrophase (0.77) and bathyphase (0.82) in group 2. In group 1, the indicator was (0.55 and 0.51, respectively).

Conclusion. . Patients with severe pneumonia, acute cerebral insufficiency, transferred from other hospitals are distinguished by the fact that the average values of the temperature reaction by groups (spontaneous breathing and mechanical ventilation) during the observation period did not differ significantly and were within the normal range. Unstable amplitude of oscillations with a tendency to increase in group 2 corresponded to a more severe condition. Factors aggravating 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). The average circadian rhythm in group 1 was distinguished by calmer oscillations (within 0.1 ° C), while in group 2 the oscillation amplitude was 0.3 ° C.

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高水平竞技运动运动员心脏形态测量与血流动力学参数的比较分析——以手球为例

**COMPARATIVE ANALYSIS OF MORPHOMETRIC AND
HEMODYNAMIC PARAMETERS OF THE HEART OF HIGH-
QUALIFICATION SPORTSMAN IN GAME SPORTS, USING
HANDBALL AS AN EXAMPLE**

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注释：本文探讨了高水平运动员心血管系统对不同方向负荷的适应性指标。研究并分析了参加俄罗斯锦标赛大联盟和超级联赛的手球运动员的数据。重点关注与心脏形态和血流动力学指标相关的人体测量数据。此外，还考虑了心动周期不同阶段的心脏形态和血流动力学指标。确定了反映心脏在长期手球训练过程中有效承受不同方向负荷能力的指标。

关键词：适应性、心肌、二尖瓣血流、心肌重塑、体力活动、高水平运动员、各种体力活动。

Annotation. *The article examines the indicators of adaptation of the cardiovascular system of highly qualified athletes to loads of various directions. The data of handball players performing in the major and super leagues of the Russian Championship are studied and analyzed. Attention is paid to anthropometric data in relation to morphometric and hemodynamic indicators of the heart. In addition, morphometric and hemodynamic indicators of the heart are considered in different phases of the cardiac cycle. The indicators reflecting the ability of the heart to effectively tolerate loads of various directions in the process of long-term training in handball are determined.*

Keywords: *adaptation, myocardium, transmitral blood flow, myocardial remodeling, physical activity, highly skilled athletes, various types of physical activity.*

Introduction. The adaptation capabilities of athletes to physical activity are traditionally considered from the standpoint of an integrated approach and require a constant search for physiological parameters that reflect the ability to effectively tolerate various types of physical activity, especially the parameters of adaptation of the cardiovascular system [3]. By types of physical activity, we mean training and competitive loads of various types (aerobic, aerobic-anaerobic, anaerobic glycolytic, anaerobic alactate). In high-performance and top-level sports, constant monitoring of the athletes' condition is necessary. This requires improving the system of medical and biological support and equipping professional teams with modern equipment. With the help of appropriate equipment, there are opportunities, including morphometric and hemodynamic (functional) current monitoring of the parameters of the cardiovascular system (CVS) in the educational and training process. The latter is extremely important for the correct dosing of physical activity and the selection of medicinal supportive permitted correction of the condition with the possible use of physiotherapeutic and reflex therapeutic methods of recovery [2].

Purpose of the study– to study and compare the morphometric and hemodynamic parameters of the heart in the training process of highly qualified men's handball teams competing in the Higher and Super Leagues of the Russian Handball Championship.

Methods of mathematical statistics. Statistical data processing was performed using the statistical analysis package STATISTIKA 8.0. Reliability was calculated using the Kruskal-Wallis ANOVA test. Data are presented as $X_{cp} \pm SE$. Correlation analysis was performed to identify the relationship between the studied indicators. The reliability of the calculated indicators was assessed at a 5% significance level.

Methodology and organization of the study:

The study involved 19 highly skilled athletes, who play in the main team, regularly participating in the Russian Handball Championship among men's teams of the Super League (EG - experimental group). And 19 skilled handball players, playing in the Russian Championship among teams of the Higher League (CG - control group). The age of the examined athletes ranged from 18 to 32 years. The average age of skilled handball players is 24 ± 5.3 , the team of highly skilled athletes - 24.7 ± 5.6 years. The average experience of sports activities is from 10 to 15 years. All athletes participating in the experiment had admission to professional sports in accordance with the legislation of the Russian Federation.

Among the anthropometric parameters of athletes of both groups, the body mass index (BMI - kg/m^2) and body surface area (S body surface, m^2) were assessed. The morphometric and hemodynamic parameters of the heart were assessed using echo-doppler cardiography (ECHO-CG). The following diagnostic

ultrasound equipment was used: Mindray Z60, GE VIVID E 95, GE VIVID I. The following parameters of left ventricular (LV) remodeling were measured: left ventricular myocardial mass (LVMM), g; LVM index (LVMI), g/m². Normal LV geometry was considered to be relative wall thickness (RWT) < 0.42 with normal parameters of LVMM less than 115 g/m² in men and less than 95 g/m² in women [5,16].

An additional indicator proposed for assessing LV remodeling is the sphericity index (SI), which has a standard value of 0.6 conventional units [5]. According to the classification of V.S. Alexandrov and A.P. Makhnov (2002), the standard value of the sphericity index is in the range of 0.6-0.7 conventional units. Data in the range of 0.71-1.0 conventional units indicate a moderate increase in SI [9].

To assess the hemodynamic parameters of diastolic function, the following parameters of transmittal blood flow were used: maximum velocity of early diastolic filling (Peak E), m/s; maximum velocity of filling in atrial systole (Peak A), m/s; ratio of peaks E and A (E/A) in conventional units; LV isovolumic relaxation time (IVRT) in milliseconds (ms); mitral flow ejection time (ET) (in ms), which corresponds to the parameters of early and late diastole [11].

Discussion

Results of the study of individual anthropometric (BMI and body surface area) and morphometric parameters of the myocardium in the observed groups presented in Table 1. According to the calculated data, no statistically significant differences were determined between the CG and EG ($p < 0.05$). According to the previously given values, the parameters of the myocardial condition in the subjects of both groups of highly qualified athletes belong to the normal type of LV geometry.

Table 1
Indicators of physical development and morphometric parameters of the myocardium ($X_{cp} \pm SE$)

No.	Indicators	Groups of athletes examined	
		KG (n=19)	EG (n=19)
1.	BMI	22.66±2.39	25.37±2.62
2	Body surface area, m ²	1.98±0.25	2.27±0.18
3	MMZh, city	167.5±33.12	200±40.83
4	LVMI, g/m ²	82.29±13.68	88.31±14.55
5	OTS LZH	0.34±0.32	0.35±0.03
6	IS	0.67±0.07	0.65±0.07

Note: * - indicates a significant difference from the control group ($p < 0.05$)

It should be noted that in previous studies we identified reliable differences in the studied indicators of athletes from the indicators of individuals who are not

involved in sports, but are allowed to engage in physical education due to health reasons [13,14].

It is obvious that with a balanced the constructed training process, athletes, in the system of long-term training can achieve high sports qualifications without violating the parameters of normal heart geometry, while maintaining normal sizes of the heart chambers and the thickness of the myocardial walls and the ability to show high sports results. This is confirmed by both our studies and the analysis of the results of other studies with a large sample of athletes in different sports [4].

Athletes with a predominance of the classic components of the athletic heart at rest may have a high level of athletic fitness, while maintaining the parameters of normal LV geometry in the long term, assessed according to the recommendations for the quantitative assessment of the structure and function of the heart (Table 1) [16].

It is evident from the data in Table 1 that the LVMI and TBMI are within the parameters of the normal LV geometry state. The assessment was made taking into account the body surface area and body mass index [7]. In our opinion, a moderate increase in the BI in both groups of athletes (taking into account the standard LVMI and TBMI indicators) may be adaptive to loads of various types. This is the case if we focus on the standard indicator of 0.6 conventional units, according to research [5]. Considering that handball is a sport where the athlete's body, regardless of the role, experiences a very complex combination of different types of both educational and training and competitive loads, ranging in direction from aerobic to anaerobic alactic (mainly speed-strength) and at the same time, with a large percentage of aerobic-anaerobic and anaerobic glycolytic, it can be assumed that with a training experience of 10 years or more, the sphericity index indicator is likely to be adaptive to loads.

Table 2
Transmitral blood flow indicators in the examined individuals ($X_{cp} \pm SE$)

No.	Indicators	Groups of athletes examined	
		KG (n=19)	EG (n=19)
1.	Heart rate bpm at rest	64.5±7.62	58.1±3.8
2.	E/A c.u.	2.33±0.42	2.3±0.5
3	IVRT ms.	100.27±19.76	87.1±10.2
4	ET ms.	605.16±155.21	721.4±241.3

Note: * - indicates a significant difference from the control group ($p < 0.05$)

The results of the study presented in Table 2 show that during the training process, they, in aggregate, can be considered as a hemodynamic marker of an athletic heart with a “supernormal” configuration of transmittal blood flow with

normal LV geometry parameters [6,12], and also taking into account the resting heart rate parameters. In our previous studies, we obtained the values of the correlation coefficient (-0.72) between the mitral flow ejection time (ET) and resting heart rate [15]. In our opinion, this may be a point for a more in-depth study of the parameters of early and late diastole with the study of the diastasis time (slow passive relaxation phase) at rest. According to the data presented, the resting heart rate of highly qualified athletes is significantly lower (by 6 bpm) on average than that of qualified team players, and the mitral flow ejection time is more than 100 ms longer. The differences between the data are unreliable, but have high practical significance (the teams compete in different leagues of the Russian Handball Championship). At the same time, in our opinion, further studies of the transmittal blood flow parameters are required when athletes endure high-intensity training and competitive loads. The data we obtained on the ratio of the maximum early diastolic filling velocity (m/s) (Peak E) and the maximum filling velocity in atrial systole (m/s) (Peak A), i.e., E/A, more than 2.0 conventional units, are consistent with the data of A. Y. Tatarinova (2013), who noted that this is typical for people involved in sports [10].

The results of our studies allow us to conclude that the “Supernormal” variant of cardiac mechanics remodeling with early and late diastole indices at rest are prognostically significant in determining the body’s readiness for significant physical exertion of various (aerobic and anaerobic glycolytic orientation). Additional confirmation is the presence of a relationship between the IVRT index and the result of glycolytic capacity shown in the test with the manifestation of anaerobic glycolytic endurance in the “300 m run” test (0.63) (with lactate data of 9-11 mmol/l) [13,14]. In our opinion, the study of this relationship is promising from the standpoint of both planning and achieving a sports result.

The results of the studies presented in Table 2 allowed us to conclude that the IVRT + ET (early and late diastole) indices in both observed groups do not have reliable differences, which is a reflection of the myocardium’s response to long-term load [14]. At the same time, in athletes performing at the level of the Super League of the national championship, these indices by average values exceed the values of athletes performing in the Major League.

To date, the criteria that differentiate between a normal cardiac response to physical activity and an overtraining response remain poorly understood [5]. Thus, athletes in the experimental group demonstrate a more stable CVS response to various types of training loads in the competitive period of the annual training cycle, taking into account the average IVRT data, in contrast to handball players in the control group. It is worth noting that higher ET values reflect a decrease in resting heart rate, which confirms our previously reported data [15]. Stable indicators (E/A at a level of 2 c.u. and higher) of transmittal blood flow remodeling in

the form of “Supernormal” diastolic function of the heart at rest may be promising indicators in terms of assessing the readiness of qualified athletes for loads of various types both at individual stages of preparation and in the annual training cycle.

Conclusion

Monitoring the state of the cardiovascular system in highly qualified athletes, which is carried out using a set of diagnostic methods, including individual indicators of physical development (body surface area and BMI), morphometric indicators of the myocardium (LVM, LVM, RVOT and SI) and indicators of transmittal blood flow (E/A, IVRT, ET) taking into account the heart rate at rest, allows us to assess the level of readiness for loads of various directions.

The given indicators can be used in the selection of athletes for highly qualified teams and national teams, as they have prognostic significance.

It is advisable to apply the proposed approach to monitoring the state of the cardiovascular system of highly qualified athletes in the training process and the system of long-term preparation of the sports reserve, as it allows assessing the level of adaptation of athletes to loads of various directions.

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混凝土路面压、胀缝温度变形对平整度指标影响分析

**ANALYSIS OF THE IMPACT OF TEMPERATURE-INDUCED
DEFORMATION IN COMPRESSION AND EXPANSION JOINTS
BETWEEN CONCRETE PAVEMENT SLABS ON SMOOTHNESS
INDICATORS**

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摘要: 本文分析了水泥混凝土路面在运行过程中由于温度应力引起的路基板间翘起现象。重点研究了在太阳辐射、气温和风速的影响下,混凝土路基板内形成的温差,以及由此引起的压缝和伸缩缝的位移。

本研究测量了水泥混凝土路面的上部温度 T_{upper} 和下部温度 T_{lower} ,并测定了温差 ΔT 、热膨胀量 ΔL 、倾角 θ 、翘起高度 δ 和国际平整度指数(IRI)。

分析结果表明,随着温差的增大,路基板会出现弯曲和翘起,导致IRI值增大,路面平整度下降。

关键词: 平整度、翘起、接缝、IRI、温度、弯曲、路面、变形、伸缩缝、路基板。

Abstract. This article analyzes the elevation of slabs between cement-concrete road slabs during operation due to temperature stress. The main focus is on the temperature differences formed in concrete slabs under the influence of solar radiation, air temperature, and wind speed, as well as the resulting movements in the compression and expansion joints.

In the scientific work, it was performed the following tasks: the upper temperature T_{upper} and lower temperature T_{lower} of the cement-concrete pavement, the temperature difference ΔT , the thermal expansion ΔL , the angle of inclination θ , the height of rise δ , and the International Roughness Index (IRI) determined.

According to the analysis results, as the temperature difference increases, bending and lifting of the slabs are observed, which leads to an increase in the IRI value and a deterioration in road smoothness.

Keywords: Smoothness, lifting, joints, IRI, temperature, bending, road, deformation, expansion joint, slab.

Introduction

The modernization of road transport infrastructure and the construction of modern, high-quality roads are among the priority areas of state policy in our republic. Specifically, the Resolution of the President of the Republic of Uzbekistan No. PP-111 dated January 25, 2022, “On Measures for Fundamental Reform of the Road Management Sector and Improvement of the Management System,” as well as Resolution No. PP-125 dated April 14, 2023, set forth tasks for creating high-quality and durable road surfaces and aligning road smoothness with international standards. In particular, the issues of widespread implementation of cement-concrete pavements and ensuring their long-term operation are explicitly emphasized [1,2].

Cement-concrete pavement operates under complex stress conditions, subjected to repeated vehicle loads and variable temperature and moisture effects on the roadbed and pavement. Additionally, cement-concrete materials are characterized by internal stresses, which are caused by the heterogeneity of these materials’ structure, as well as the continuous formation and destruction of an intersecting structure. Improving the resistance of road concrete to operational impacts is directly related to enhancing its physical-mechanical properties and structure [3,5].

Despite the high durability of cement-concrete road pavements, one of the problems encountered during their operation is vertical uplift between slabs. These uplifts are primarily associated with solar radiation, air temperature, surface temperature of the pavement, temperature of the pavement’s lower layer, and the resulting temperature differential. This leads to the expansion of the slabs, causing their edges to rise upwards. This situation reduces the road’s smoothness level and leads to a deterioration in the IRI (International Roughness Index) indicator [4].

This article analyzes the elevations that occur in cement concrete slabs due to temperature effects. This process is evaluated using the following mathematical models: determination of upper and lower temperatures, temperature difference, elevations at compression and expansion joints, thermal expansion, formation of inclination angle due to temperature effects, and IRI indicators.

In this scientific study, research was conducted at the 439 km mark of the A-380 “Guzar-Bukhara-Nukus-Beyneu” highway as the object of investigation to measure the impact of temperature-induced elevations and smoothness between cement-concrete road pavement slabs. The temperature difference is shown in the first figure.



Figure 1. Showing air temperature, surface temperature, and bottom temperature of the plate

Research methodology

This article presents a calculation method used to assess changes in temperature-induced uplifts in cement-concrete pavement slabs. Based on the research, the temperature differences occurring on the upper and lower surfaces of the slab, thermal expansion, bending angle, and the International Roughness Index (IRI) indicator of road surface smoothness were studied using the following formulas.

Research findings

On the 439 km section of the A-380 “Guzar-Bukhara-Nukus-Beyneu” highway, we determined the temperature differences occurring on the upper and lower surfaces of the slab, thermal expansion, bending angle, compression and expansion of the slab due to temperature effects, as well as the IRI indicators of road surface smoothness (Fig. 2-11). We studied the impact of elevations at compression and expansion joints on longitudinal smoothness and presented it graphically (Fig. 8-11).

The temperature of the surface and lower parts of the cement-concrete pavement was determined using the first and second formulas [6] and is shown in Fig. 2-3.

$$T_{\text{high temperature}} = T_{\text{outside air}} + \beta \cdot G - \gamma \cdot V, \quad (1)$$

$$T_{\text{low temperature}} = T_{\text{Air temperature}} + k \cdot (T_{\text{high temperature}} - T_{\text{Air temperature}}) \quad (2)$$

Here:

- T_{air} – outside air temperature ($^{\circ}\text{C}$), G – solar irradiance (W/m^2)
- β – solar heat gain coefficient ($^{\circ}\text{C} \cdot \text{m}^2/\text{W}$), V – wind speed (m/s)
- γ – cooling coefficient ($^{\circ}\text{C} \cdot \text{s}/\text{m}$), k – temperature coefficient

When we measure the temperature of the surface part of the cement-concrete pavement and its lower part, a temperature difference arises. We determined the expansion of the pavement due to this temperature difference using the following formula [6], as shown in Figures 2-3.

$$\Delta T = T_{\text{high temperature}} - T_{\text{low temperature}} \quad (3)$$

$$\Delta L = \alpha \cdot L \cdot \Delta T \quad (4)$$

Here:

- α — the coefficient of thermal expansion for concrete

- L — slab length, m
- ΔT — temperature difference, °C

We determined the angle of bending of the slab using the following formula [7,8], which is based on the temperature difference between the surface and lower parts of the cement-concrete pavement. The results are shown in Figures 3-4.

$$\theta \approx \frac{h \cdot \Delta T \cdot \alpha}{2} \quad (5)$$

h — plate thickness, m

We determined the height of the cement concrete pavement rise due to temperature differences, and by calculating this rise height, we determined its influence on the longitudinal smoothness (IRI) at the compression joint using the following formula [7,8]. The results are presented in Figures 5-8.

$$\delta = \frac{\alpha \cdot \Delta T \cdot L^2}{8h} \quad (6)$$

$$IRI \approx 2 \cdot \frac{\delta}{L} \cdot 1000 \quad (7)$$

Here:

δ — height of the compression joint rise due to temperature influence, m

L — slab length, m

We determined the effect of expansion joint elevation on longitudinal smoothness (IRI) using the following formula [7,8], as shown in figures 10-11. This calculation involved adding the elevation at the existing expansion joint to the elevation height of the compression joint in the cement concrete pavement (caused by temperature effects), and then subtracting this sum from the slab length.

$$IRI \approx 2 \cdot \frac{(\delta + \delta_1)}{L} \cdot 1000 \quad (8)$$

Here:

δ_1 — rise height of the existing expansion joint, m

Here, the IRI is measured in m/km and indicates road surface smoothness. An increase in elevation raises the IRI value, which means that elevations at expansion joints lead to a deterioration in road smoothness.

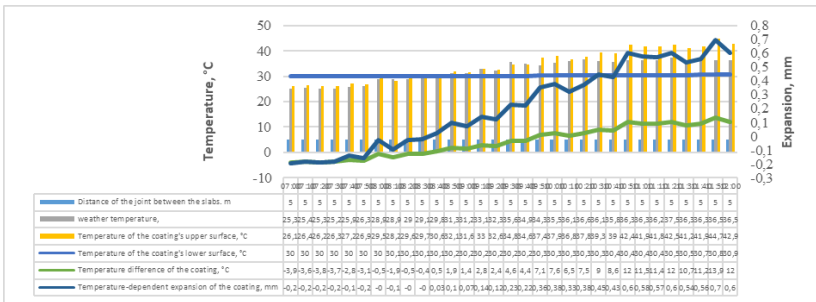
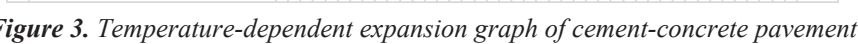
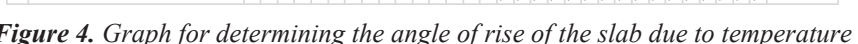


Figure 2. Temperature-dependent expansion graph of cement-concrete pavement



0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99



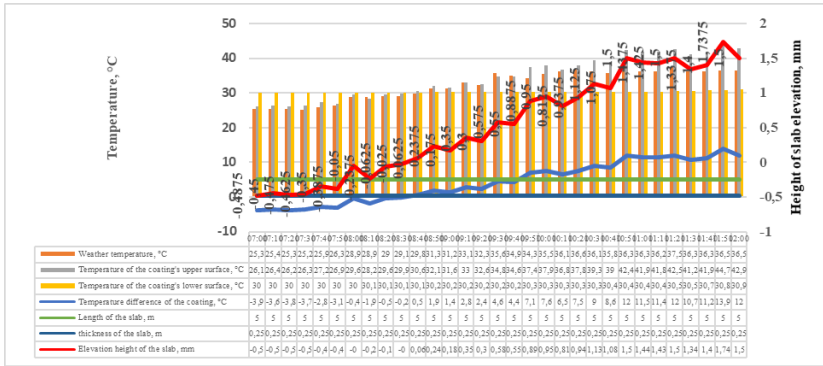


Figure 6. Elevation of cement concrete pavement at compression and expansion joints due to temperature changes

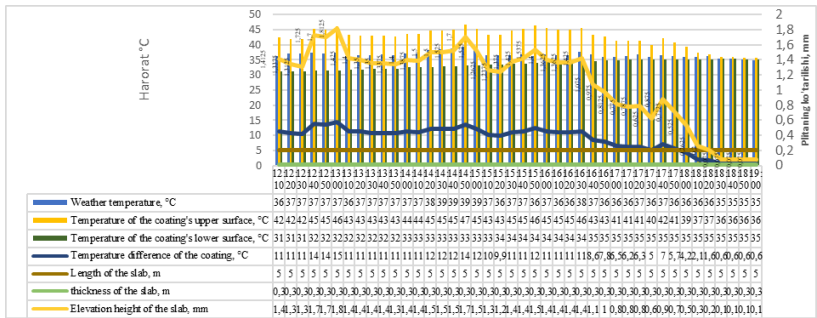


Figure 7. Elevation of cement concrete pavement at compression and expansion joints due to temperature changes

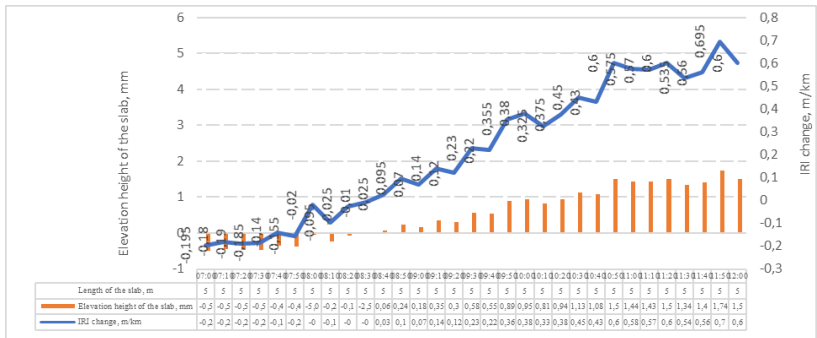


Figure 8. Graph showing the elevation height of compression joints in cement-concrete pavement due to temperature effects and its impact on road smoothness (IRI)

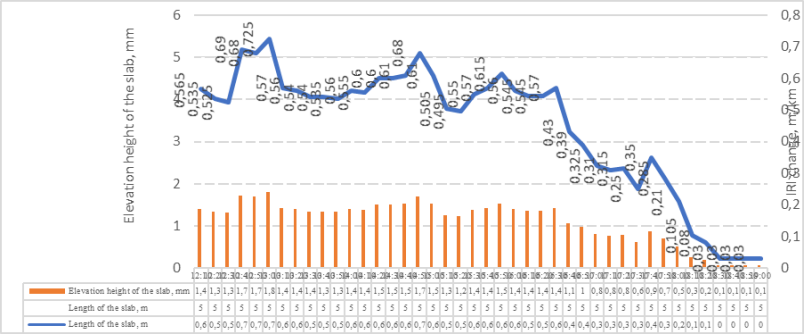


Figure 9. Graph showing the elevation height of compression joints in cement-concrete pavement due to temperature effects and its impact on road smoothness (IRI)

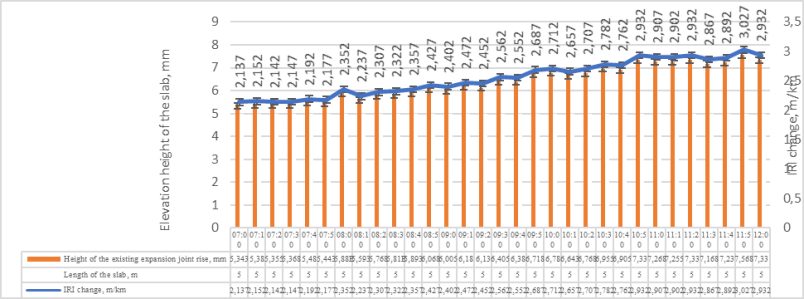


Figure 10. Graph showing the change in smoothness (IRI) due to the height increase of expansion joints in cement-concrete pavement under temperature influence

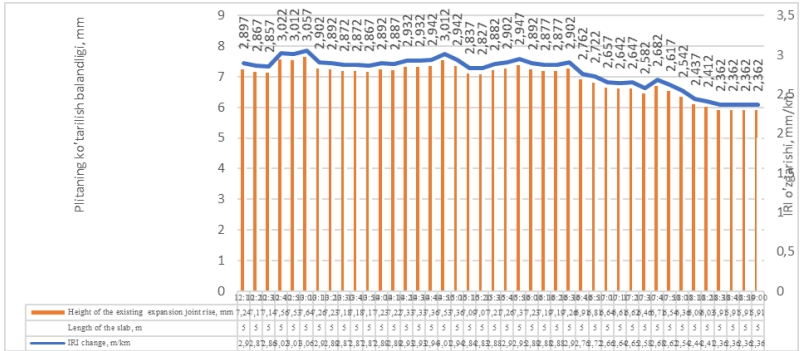


Figure 11. Graph showing the change in smoothness (IRI) due to the height increase of expansion joints in cement-concrete pavement under temperature influence

Conclusion

This scientific study investigated the uplift that occurs due to temperature differences between cement-concrete road pavement slabs.

The highest temperature difference in the cement concrete slab was observed at 13:00, with the upper part at $T_{\text{upper}}=46^{\circ}\text{C}$ and the lower part at $T_{\text{lower}}=31.5^{\circ}\text{C}$, resulting in a temperature difference of $\Delta T=14.5^{\circ}\text{C}$.

The thermal expansion of the cement concrete slab with a thickness of $h=0.25$ m and a length of $L=5$ m was $\Delta L \approx 0.725$ mm, with a lifting angle of $\theta \approx 0.003625$ radians, which led to a lifting height of the compression joint of $\delta \approx 1.8125$ mm.

Additionally, the calculated IRI (International Roughness Index) smoothness indicator of the road surface at the compression joint is 0.725 m/km and at the expansion joint is 3.057 m/km, which leads to a significant deterioration in the smoothness of the concrete road surface.

Based on these results, it can be concluded that there are significant temperature differences in cement-concrete road slabs used in various climatic conditions. This leads to defects such as lifting and cracking of the slabs.

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Petri网与无向二部多重图集成在资源分配系统建模中
**INTEGRATION OF PETRI NET AND UNDIRECTED BIPARTITE
MULTIGRAPH IN MODELING RESOURCE ALLOCATION
SYSTEM**

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摘要: 在分布式架构系统建模领域, Petri 网 (有向二分多重图) 被广泛应用。在流程建模过程中, Petri 网中的每个转换只能沿弧指定的方向发起。资源分配系统中出现的死锁和陷阱在模型中会反映为流程停止。为了绕过死锁以继续建模过程, 需要更改转换触发顺序, 这些顺序可以从某个先前的标记 (通常事先未知) 开始, 或者从初始标记开始。本文提出了一种复杂网络, 在资源分配系统建模中, 使用无向二分多重图和 Petri 网来定义与被分配资源相关的位置和转换。无向二分多重图被赋予返回标记的功能, 从而允许更改转换触发顺序以消除死锁。

关键词: 反向转换触发, 无向二分多重图, 死锁绕过。

Abstract. *In the field of modeling systems with distributed architecture, Petri nets are widely used - directed bipartite multigraphs. Each transition in the Petri net during process modeling can only be launched in the direction specified by the arcs. Deadlocks and traps that arise in resource distribution systems are reflected in the models as a process stop. To bypass a deadlock in order to continue the modeling process, the sequence of transition firing is changed starting either from some earlier marking, usually unknown in advance, or from the initial marking. The article proposes a complex network that uses an undirected bipartite multigraph together with a Petri net when modeling resource distribution systems, defining positions and transitions associated with the resources being distributed. The undirected bipartite multigraph is assigned the function of returning to the marking, which allows for a change in the sequence of transition firing to eliminate a deadlock.*

Keywords: *reverse transition firing, undirected bipartite multigraph, deadlock bypass.*

I. Introduction

Directed bipartite multigraphs – Petri nets [1] are widely used in modeling modern systems with distribution and asynchronous parallel operation. Petri nets

are constantly being improved to increase the adequacy of the developed models. Thus, publications devoted to improving Petri nets [2, 3, 4], aimed at increasing the adequacy of models, are associated with various modifications of the processes of executing networks, based on changing the rules for triggering transitions.

In modern systems, including resource distribution systems, the occurrence of conflicts, deadlocks and states characterized as traps is quite natural. They implement the processes of returning to previously passed states for correction and continuation of the process, ensuring the bypass of deadlocks and traps. However, based on Petri nets, there are no regular methods for modeling systems with deadlocks, and this does not allow building adequate models. Petri nets do not provide a simple return to previous markings without cumbersome additions to the network structure of new positions and transitions, and this with initially unknown values of the position markings.

Thus, the rigid orientation of the arcs of Petri nets creates restrictions on the firing of transitions - it excludes a change in the direction of their firing, which leads to the impossibility of modeling reverse processes associated with obtaining precondition markings of events from postcondition markings.

II. Statement of the problem

The purpose of the research is to improve the adequacy of modeling resource distribution systems, which consists in achieving the ability to obtain markings preceding the marking of the resulting deadlock. Petri nets, as indicated above, do not provide such a possibility due to the orientation of the arcs. It is possible to resolve the existing contradiction by combining a Petri net with a net that has unoriented edges between positions and transitions (an unoriented analogue of a Petri net).

It is necessary to develop an undirected bipartite multigraph – an undirected analogue of the Petri net, which in combination with the Petri net will expand the functional capabilities of the model, providing bidirectionality of the required transitions and thereby increasing the adequacy of the model to a wide class of objects with reverse behavior.

III. Main part

In this article, we will not provide the well-known formal definition of the Petri net [1]. Let us dwell on the definition of a bipartite undirected multigraph, the so-called net T.

Formally, the net T is a triple:

$$C = (P, T, F),$$

where P is a finite set of positions;

T is a finite set of transitions;

F is a function that assigns certain numbers of positions to transitions on the left and right.

$F = F_L \cup F_R$, где F_L – a function that specifies a certain number of positions to the left of the transition, - a function that specifies a certain number of positions to the right of the transition.

The choice of the left and right sides of the transitions is arbitrary.

The basic form of representation of the network T is an algebraic structure.

Let us consider a network T with an algebraic structure of the form:

$$C = (\{p_1, p_2, p_3\}, \{t_1, t_2\}, F_L, F_R).$$

The functions that correspond to transitions to the left and right of positions have the form:

$$F_L(t_1) = \{p_1, p_1, p_2\};$$

$$F_R(t_1) = \{p_1, p_1, p_3\};$$

$$F_L(t_2) = \{p_3\};$$

$$F_R(t_2) = \{p_2\}.$$

The most informative form of representation of the network T is its graphical representation. For the considered algebraic structure, Figure 1 shows a graphical representation of the network T. The left sides of the transitions are marked with dots (•).

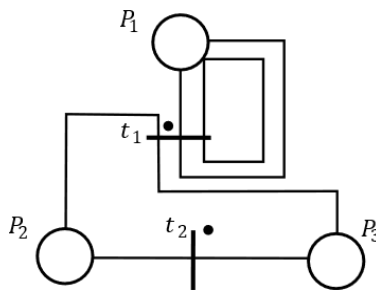


Figure 1. Graphical representation of the T network

In the T network, labels assigned to positions are used to display processes. The number and position of labels may change during the execution of the T network.

Display $\mu: P \rightarrow N \cup \{\emptyset\}$, where N – the set of integers greater than 0, provides the marking of the network T.

Figure 2 shows the graph of the marked network T.

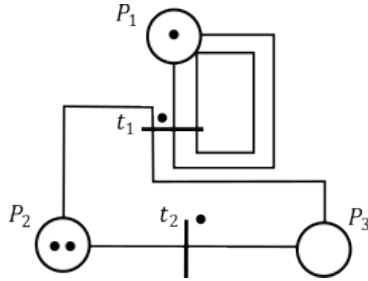


Figure 2. Graph of labeled network T

For labeled network T , we define the concepts: permission to start a transition, start a transition, and perform marking.

Permission to start a transition of network T $t_j \in T$ exists if for all $p_i \in P$ the condition is met $\mu(p_i) \geq \#(p_i, F_{L(R)}(t_j))$. Here $\#(p_i, F_{L(R)}(t_j))$ – the multiplicity of a position p_i relative to the transition t_j left (right), i.e. the number of occurrences of a position in the transition set on the left (right). A set is a generalized set that includes multiple repeating elements.

The transition of the network T is launched by removing all enabling labels from the positions on the left (right) relative to the transition and then placing one label for each edge in each of the positions on the right (left) of the transition. Multiple labels are transmitted through multiple edges.

A transition t_j in a marked network T with a marking μ can be fired whenever it is allowed. As a result of firing an allowed transition t_j a new marking is formed μ' defined by the relation:

$$\mu'(p_i) = \mu(p_i) - \#(p_i, F_{L(R)}(t_j)) + \#(p_i, F_{R(L)}(t_j)).$$

The marking of the network T is performed by an arbitrary sequence of transition firings, and in any permitted direction relative to the transitions.

The features of the network T associated with the non-orientation of the edges between positions and transitions make it possible to fire transitions in any permitted direction, which is prohibited in Petri nets.

To represent the dynamics of changing the markings of the network T , it is possible to use a reachability tree [1], however, for the network T , which allows changing the directions of firing transitions, we will use a reachability graph in which oriented connections - arcs between the network markings, will indicate the firing of transitions marking the arcs. To demonstrate the marking of the network T , let us consider the graph of the network T shown in Figure 3. The points located next to the transitions mark their left sides, which can be set on any side of the transition.

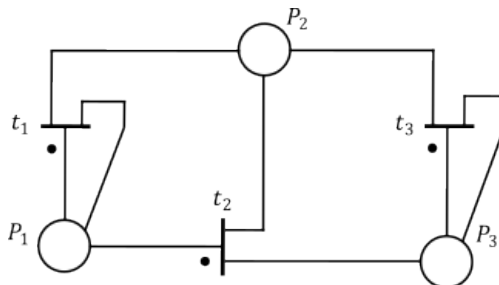


Figure 3. Network graph T to demonstrate the implementation of marking

In the reachability graph in Figure 4, the notations are as follows: $\bullet t_i$ – transition triggering t_i on the left; t_j – transition triggering t_i on the right.

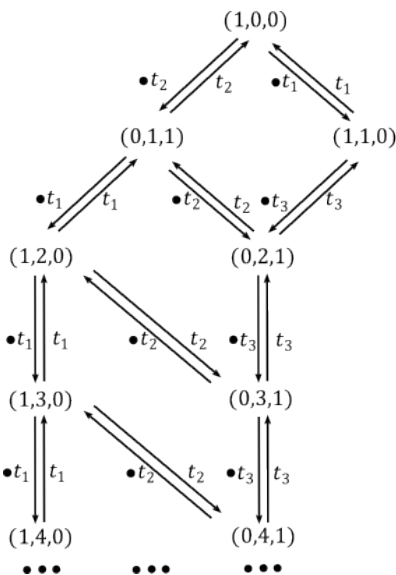


Figure 4. Network T reachability graph

Network T reachability graph demonstrates reachable markings in the network from the initial marking.

Processes implemented by networks T allow reaching previously passed markings and providing the search for the required markings, i.e. implementing the process of “rollback” of the modeled system, with the purpose of subsequently bypassing deadlocks, traps, conflicts or other critical states of the system.

IV. Example

As an example, let us consider the application of network T in the resource allocation model, represented by the Petri net [1]. The Petri net is shown in Figure 5.

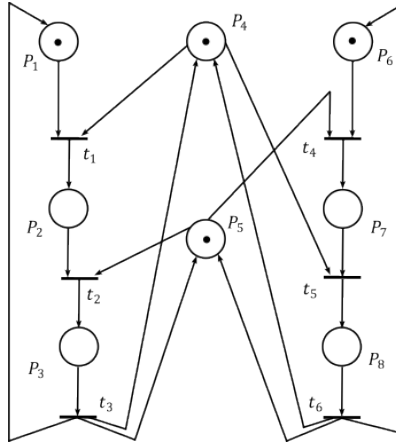


Figure 5. Initial marking of Petri net representing resource allocation

The resource allocation Petri net includes two different resources, specified by the labels at the positions P_4 and P_5 , and two processes: the first, defined by a sequence of positions and transitions – $P_1 t_1 P_2 t_2 P_3 t_3$, and the second – $P_6 t_4 P_7 t_5 P_8 t_6$. Both processes need both resources, each requests resources and releases them. One way to implement this network is to fire transitions in sequence. $t_1 t_2 t_3 t_4 t_5 t_6$, to others – $t_4 t_5 t_6 t_1 t_2 t_3$. None of these sequences leads to a dead end. However, the sequence that begins with transitions $t_1 t_4$, leads to a system blockage and no process can continue, a deadlock occurs. A deadlock is a transition or set of transitions that cannot be started. In this case, the deadlock occurs due to the impossibility of starting the transitions t_2 and t_5 .

The deadlock is preceded by marking the Petri net with labels at the positions P_2 and P_7 .

Let us consider a complex network modifying the Petri net by introducing a fragment of the T net in order to achieve the ability to reverse the modeling process in a situation where a deadlock occurs. The complex network with initial marking is shown in Figure 6. The fragment corresponding to the T net is highlighted in color.

The initial marking of the complex network has labels in positions P_1, P_4, P_5, P_6 . T network transitions t_1 and t_4 have left-hand side marks marked with dots.

Relationships between positions $P_1, P_2, P_4, P_5, P_6, P_7$ are edges, i.e. they have no orientation.

In a complex network, a dead end also occurs due to the impossibility of starting transitions t_2 and t_5 , it is preceded by marking of the complex network with labels in positions P_2 and P_7 Figure 7.

To get out of a deadlock, in a situation where the modeling process has stopped, transitions are launched t_1 and t_4 on the left. As a result, the modeling process breaks out of the deadlock and a marking appears that corresponds to the one shown in Figure 6. Further, the process of triggering transitions must be carried out in a different sequence - either in the sequence $t_1 t_2 t_3 t_4 t_5 t_6$, or in sequence $t_4 t_5 t_6 t_1 t_2 t_3$ which will not lead to a dead end.

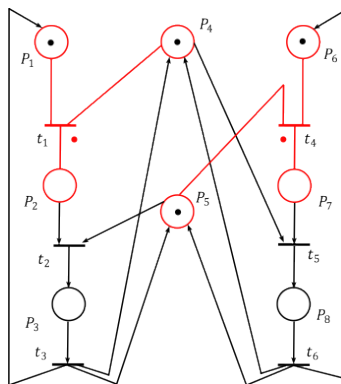


Figure 6. An integrated network representing resource distribution

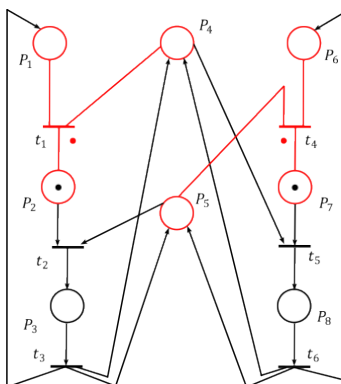


Figure 7. Marking of the integrated network that occurs during a deadlock

V. Conclusions

The scientific novelty of the research consists in the development of a new network model - an undirected analogue of the Petri net, the so-called T net, which differs from the known undirected connections between transitions and positions, for integration with the Petri net. This allows modeling reverse processes, which can be used to bypass deadlocks and traps. Integration of the T net and the Petri net increases the adequacy of network models to modern systems with a distributed architecture and asynchronous parallel operation, expands the functionality of the models.

The theoretical significance is associated with the development of theoretical foundations for network modeling of modern systems. The presented model can be associated with an analogue from the field of electronics - the concept of “common bus”.

Further research can be aimed at studying various classes of T networks, studying the properties of T network classes, solving problems of T network analysis, including those aimed at matrix analysis methods.

From the practical point of view, T networks can be used, for example, to solve problems in the field of fault tolerance of systems. By associating the operability property of the modeled system with the transitions of the T network, it is possible to solve problems of bypassing inoperative sections.

T networks can also be used in modeling parallel processes containing reverse fragments, as well as modeling counter-directed processes.

The features of the functioning of T networks will allow them to be used to solve search and optimization problems in various fields of science and technology.

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联合收割机适配装置的改进及其在优质大豆偷补种中的应用

**IMPROVEMENT OF COMBINE ADAPTIVE DEVICES AND THEIR
APPLICATION FOR QUALITY SOYA SEEDS IN STEALING AND
SUPPLEMENTATION**

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摘要。在提高大豆产量方面，减少因压榨造成的间接损失至关重要，因为压榨会对种子的质量产生不利影响，尤其是在收获和加工作物时。由于大豆特殊的物理和机械性质，联合收割机在收获大豆时无法达到最佳运行模式。这项研究的目的是提高大豆收获技术的效率，其基础是开发适合联合收割机的装置，以最大程度地获得第一批优质种子的产量，然后在播种时使用，无需进行其他加工（播前浸种除外）。这项研究是在2021–2024年收获期内，使用现代化的叶尼塞-1200联合收割机在全俄大豆研究所联邦研究中心联邦国家预算机构的实验田上进行的。联合收割机的现代化改造使其能够在储料仓的单独区域收集 60% 的优质、杂草杂质含量低的大豆种子。成熟的大豆种子在第一个脱粒滚筒的柔和运转模式下浸泡，单独收集可提高头粒种子的田间发芽率和生物产量。使用联合收割机上部筛磨机的筛子，筛板长度增加到 70 毫米，同时增加空气流量，可确保头粒种子的纯度达到一级播种标准。头粒种子的机械损伤为 4.2%，不超过联合收割机压碎和微沉积的既定标准（5%）。将头粒种子用于播种而不进行额外处理，可减少大豆的间接损失，从而降低制种成本。成熟的大豆种子在第一个脱粒滚筒的轻柔运转下浸泡，单独收集可提高一等种子的田间发芽率和生物产量。联合收割机上部筛磨机的筛网采用加长至70毫米的百叶窗筛网，并增加空气流量，确保一等种子的纯度达到一级播种标准。一等种子的机械损伤占4.2%，不超过联合收割机规定的破碎和微损伤标准（5%）。将一等种子直接用于播种，无需人工操作，可减少大豆的间接损失，从而降低制种成本。

关键词：大豆、种子、破碎、微损伤、千粒重、联合收割机、清理、滚板、螺旋钻、提升机、两段式料斗。

Abstract. *In increasing soybean production, an important role is given to reducing indirect losses from grain crushing, which adversely affect the quality of seeds, especially when harvesting and processing crops. The impossibility of achieving the optimal mode of operation of the combine at soybean harvesting is due to the peculiarity of the physical and mechanical properties of soybeans. The purpose of the research is to increase the efficiency of the soybean grain harvesting technology based on the development of adapting devices to the combine to obtain the maximum yield of the first fraction of high-quality seeds, followed by their use in sowing without part-time processing (except for pre-sowing etching). The studies were carried out using the modernized Yenisei-1200 combine during the harvesting period 2021-2024 on the experimental field of the Federal State Budgetary Institution of the Federal Research Center of the All-Russian Research Institute of Soybeans. Modernization of the combine makes it possible to collect 60% of high-quality soybean seeds with a low content of weed impurity in a separate section of its bunker. Ripened soybean seeds are soaked in soft modes of operation of the first threshing drum, a separate collection of which increases field germination and biological yield of the first seed fraction. Application of sieves of upper sieve mill of combine harvester cleaning with increased length of blinds petals up to 70 mm together with increased air flow ensures purity of seeds of the first fraction at the level of the first class of sowing standard. Mechanical damage to soybean seeds of the first fraction, which is 4.2%, does not exceed the established standard for crushing and micro depositing combines (5%). The use of seeds of the first fraction in sowing without additional processing reduces the indirect losses of soybeans and, accordingly, the costs of seed production. Ripened soybean seeds are soaked in soft modes of operation of the first threshing drum, a separate collection of which increases field germination and biological yield of the first seed fraction. Application of sieves of upper sieve mill of combine harvester cleaning with increased length of lower petals up to 70 mm together with increased air flow ensures purity of seeds of the first fraction at the level of the first class of sowing standard. Mechanical damage to soybean seeds of the first fraction, which make 4.2%, does not exceed the established standard for crushing and micro damage combines (5%). Using the seeds of the first fraction in sowing without working, reduces indirect losses of soybeans and, accordingly, the costs of seed production.*

Keywords: *soya, seeds, crushing, micro damage, 1000 seed weight, combine, cleaning, rolling board, auger, elevator, two-section hopper.*

Introduction

In crop production in the Far East, soybean production is dynamically developing, which is due to the ever-increasing demand for soy products from the food and feed industry [12], [13].

Amur region for soybean production in the Far Eastern Federal District occupies a leading position. In 2021-2024, growing soybeans on an area of an average of 860 thousand, in total, over 1.6 million tons of soybeans, the average yield of which was 1.89 t / ha and was higher by 9.25% than in the Primorsky Territory (1.73 t / ha), where this crop is grown on an area of 280 thousand tons ha [4], [8], [14].

Soybean cultivation technology involves the use of modern technology from sowing to harvesting. Application of innovative technologies of soybean cultivation ensures high yield. In increasing soybean production, an important role is given to reducing direct and indirect crop losses (10-15% crushing and microdamage in marketable grain and up to 8% in seeds).

Indirect losses lead to a decrease in sowing and food qualities of soybeans. On their size and nature is the mechanical effect of the working organs of the combine harvester and, above all, the threshing machine (the impossibility of achieving the optimal regime associated with the peculiarity of the physical and mechanical properties of soybeans). Therefore, reducing indirect losses in the form of mechanical damage to soybean grain is no less important than reducing direct quantitative losses of the soybean crop [10].

A lot of work is devoted to the issue of reducing damage to soybean grain during harvesting and post-harvest work [3], [5], [6]. Academician VASHNIL Y.A. Dr. Weiss and Dr. of Agricultural Sciences K.G. Kolganov, exploring the process of threshing, found a large amount of damaged grain obtained due to the hard work of the drum. On the basis of their research, they proposed new two-drum threshing schemes, the use of which makes it possible to obtain, less crushed and micro damaged grain.

The idea of two-phase (differentiated) grinding of grain was expressed in 1935 academician in V.P. Hot. It consisted in the fact that the heavier and larger grain is less firmly connected with the colossus and is also less durable in relation to the impact effects than the small one.

The first combine harvester with a two-phase milling scheme was developed and tested by VIM in conjunction with CIMEX. The results of the test of this combine confirmed the advantage of two-phase threshing. On the basis of the works of VIM, CHIMESH, VISHOM, and subsequently KB of the Krasnoyarsk combine harvester plant in 1965, the design of the two-drum combine SKD-5 «Siberiak», adopted for production in 1969, was created. Further development and justification of the two-phase method of threshing received in the works of M.N. Letoch-

neva of Z.I. Lipkovića, S.A. Alferova, E.V. Zhalnina, M.M. Prisyazhnogo, N.V. Aldoshin and other researchers [2]. It should be noted that the vast majority of studies of biphasic threshing were conducted on colossal crops.

In order to update the outdated harvester park and harvest the increasing volume of harvest, the farms of the Amur region acquire new, more productive harvesters of various manufacturers and models. The most actively purchased harvesters production «Rostselmash». Analysis of the Agricultural Technical Assessment of the Combine's work «Vector-410» at soybean harvesting showed that the purity of bunker grain is at a sufficiently high level of 99.1—99.8% (according to the requirements of GOST not less than 96%). Disadvantages include a high amount of crushing and microdamage of grain, amounting to more than 10% (according to the requirements of GOST - not more than 5%). To obtain seeds and use them on sowing, the bunker grain is processed accordingly. The crushed parts of the grain are not completely sorted and are supplemented with new crushed and micro damaged seeds, which reduce the laboratory and field germination of the seeds. Currently, the company LLC «Volga Combine Plant» produces harvesters «Agromash-3000» with a two-phase threshing scheme, on the structural basis of which it is possible to create a harvester for harvesting seed plots of grain and soybeans and receive seeds (seed fraction) directly from the harvester, meeting the necessary requirements of the state standard [7], [9], [11], [15].

The yield of soybeans depends on the genetic characteristics of the variety, environmental conditions, sowing times, sowing rate, relative ripeness of the varieties and the width of the intercross during cultivation [16].

The sowing rate for soybeans is determined by the mass of 1000 grains of the sown material, and the percentage in the mass of the sown material of crushed grain leads to an increase in the sowing rate of seeds, since crushed grain does not produce seedlings.

Studies aimed at improving harvesting technology to obtain quality seeds while reducing indirect losses of the soybean crop are relevant.

The purpose of the research is to improve the efficiency of soy harvesting technology based on the development of adaptive devices for the harvester to obtain the maximum yield of high-quality seeds with their subsequent use on sowing without employment (except for pre-sowing etch). The relevance of the tested technical solutions is confirmed by the patents of the Russian Federation for the invention – № 2679508, 2765580.

2. Methods

Mechanical damage to soybean seeds is the local or general destruction of the grain as a single and complex biological system. By degree and type, these destructions are different and they reduce field germination and yield (a crushed soybean grain does not give rise, a microdamaged one reduces germination by 70%) [10].

To determine the number of crushed seeds from an average sample weighing 2 kg, selected in accordance with GOST 12037, using a divisor, two 100 g attachments are isolated... From each attachment, crushed by type are selected, weighed with an accuracy of ± 0.01 g. And they calculate the indirect losses as a percentage of the weight of the whole grain. This part of the grain does not belong to the seeds and should be sorted when working.

To determine the microdamage from each attachment, two hundred seeds are selected in a row without a choice (only on the average sample of 400 grains). Seeds of each hundred are viewed using a binocular microscope—Multiple increase. Damaged seeds are weighed with an accuracy of ± 0.01 g. The results of the analysis of each hundred seeds are recorded in the journal and the final conclusion is obtained after the analysis of four hundred seeds.

Modernization of the Yenisei-1200 combine consisted of: re-equipment to reduce the rotation frequency to 300 min^{-1} of the first threshing drum, which provides a soft mode of grinding soybeans with the first threshing drum and reducing the crushing of grain of the first fraction. The installation of an additional shaking board, which diverts a small soy pile from the second threshing drum to the second half of the upper grating of the harvester, prevents the mixing of the ground seeds with the second drum with the first fraction from under the first threshing drum. The first half of the harvester cleaning comes about separated small soybean pile from under the first threshing drum. Deck is divided into two parts. The first part of the plank removes the grain threshed with the first threshing drum and cleaned in the first half of the mill grate. The allocated grain enters the trough-shaped casing of the grain auger with a brush framing the edge of the screw and the elevator and moves to the first section of the two-section bunker of the combine. The second sliding board provides the supply of refined grain from the second half of the grated mill (second fraction) to the second grain auger and an additional elevator provides the supply of the second fraction from under the second threshing drum to the second section of the bunker. Studies to determine the optimal technological regimes and design parameters of the ISU combine harvester of two-phase threshing and two-thread cleaning «Yenisei-1200» for harvesting soybean seeds were carried out at the modernized combine harvester during the cleaning period of 2022-2024 on the experimental field of the FGBNU FNC VNII Soy. Optimization parameters included:

1. the ratio of the yield of seeds in % of the first fraction to the second;
2. the content of crushed and microdamaged grain in 1 and 2 fractions - $Y_{\partial 1}, V_{M1}$ and $Y_{\partial 2}, V_{M2}$;
3. purity of seeds of the 1st and 2nd fractions (content of weed admixture) - Y_{1cn}, Y_{2cn} , %;
4. the mass of 1000 seeds of the first and second fractions - M_{1000} , g.
5. underground in the floor, %.

Conducted 9 experiments in three times repetition. The mathematical processing of the results obtained and the verification of the adequacy of the regression equations obtained are carried out according to the methodological instructions of Y.P. Adler [1].

Studies conducted (2021-2024) on the site of the experimental field FGBNU FNC VNII soy, with a variety of soy Sentyabrinka (table. 1).

Table 1.
Characteristics of the Sentyabrinka soybean

№ p/p	Indicators, sort of soy Sentyabrinka	Average
1	Biological yield of grain, t/ha	3,2
2	The width of the rows, see	45
3	Number of plants, things/m ²	61
4	Height of soybean plants, see	68,4
5	Massa of 1000 seeds, g	182,6
6	Ratio of grain mass to straw and leaf mass	1:0,47:0,4
7	Humidity, %	
	- grains	7,32
	- stalks	14,1

3. Results

Optimization of parameters was carried out by solving graphical compromise problems. As a result, the optimal technological modes of operation of the combine with two-phase threshing and with two-flow air-grid cleaning are determined and the ratios of the yield by mass of quality seeds of the first fraction from the first threshing drum and the second fraction from the second drum are obtained.

Table 2.
Factor levels and experiment results

№ p/p	X ₁	X ₂	Turnover of 2nd drum, min ¹ (V)	Angle of disclosure degrees, degrees, (O)	Exit of the first fraction of soy seeds,% (Y)			
					Y ₁	Y ₂	Y ₃	Y secondar
1	-1	-1	540	15	48,34	49,27	46,73	48,11
2	-1	+1	540	45	62,65	60,27	61,02	61,31
3	+1	-1	660	15	44,20	45,54	45,22	44,99
4	+1	+1	660	45	59,49	63,17	61,51	61,39
5	+1	0	660	30	52,28	52,28	51,52	51,69
6	-1	0	540	30	49,76	53,70	53,99	52,48
7	0	-1	600	15	38,90	47,42	45,71	44,01

8	0	+1	600	45	55,17	60,42	55,42	57,00
9	0	0	600	30	42,90	51,95	42,92	45,92

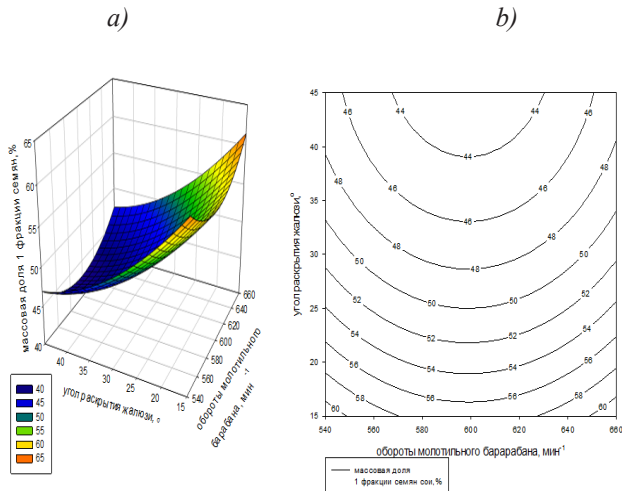
As a result of statistical processing of the results of a multifactor experiment, a proper regression equation has been obtained for F fact = 1,8 < F table = 2,6.

$$y = 47,33 + 7,1x_2 - 4,21x_1^2 + 2,61x_2^2.$$

In the decoded form, the equation was as follows:

$$y = 492,97 - 1,40614 \cdot V - 1,169918 \cdot O + 0,00117414269 \cdot V^2 + 0,011611 \cdot O^2$$

Figure 1 (a, b) shows the response surface and its cross section of the mass fraction of the yield of the soybean seeds of the 1 fraction, depending on the change in the angle of opening the shutters of the upper grille of the harvester and the frequency of rotation of the second threshing drum.



Rice. 1. Response surface (a) and response surface cross section (b)

As a result of the analysis of the pair effect of factors on the optimization criterion, the maximum yield of the first fraction of soybean seeds at a level of more than 60% was revealed, depending on the angle of opening the upper sieve shutters from 15 to 30° and the frequency of rotation of the second threshing drum from 620 to 660 minutes⁻¹.

At the same time, soy seeds of the first fraction are characterized by a low content of organic weed impurities, ranging from 0.1 to 0.25%. Mature seeds of soy, have increased growth energy and laboratory germination, absolute mass and productivity. They're, are ground on the soft modes of operation of the first

threshing drum, the separate collection of which increases the field germination of the first seed fraction by 10% (table. 3). The use of slats of the upper trellis with an increased length of the relief petals of the slats up to 70 mm together with an increased air flow ensures the purity of the seeds of the first fraction at the level of the first class of the sowing standard mechanical damage to the seeds of the first fraction, amounting to 4.2%, does not exceed the established standard for the combine for crushing and microdamage, amounting to 5%.

Table 3.

Qualitative indicators of seeds obtained in the modernized combine harvester «Yenisei-1200» at soybean harvesting

№ p/p	Indicators	The first faction	The second faction
1	Seed release, %	60	40
2	Field appearance, %	90,8	65,0
3	Grain purity, %	99,8	95,4
4	Fractured, %	3,3	5,87
5	Micro-damage, %	0,9	1,27
6	Massa of 1000 seeds, g	182,5	173,0

The possibility of using the seeds of the first fraction on sowing without moonlighting, obtained directly when harvesting in the modernized Yenisei-1200 combine, reduces indirect losses of soybeans and, accordingly, the costs of seed production.

4. Conclusion:

Biologically complete soybean seeds at the level of 60% of the crop, which can be used on sowing without overtime (except for pre-sowing etch), can be obtained using the modernized combine harvester «Yenisei-1200».

The use of 60% seeds of the first fraction, obtained directly during harvesting, the modernized Yenisei-1200 harvester reduces indirect losses of soybean seeds by 10%, increases field germination by 10% and accordingly reduces the cost of seed production.

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芝麻育种以提高种子经济产量
**SESAME BREEDING FOR INCREASING SEEDS ECONOMIC
YIELD**

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摘要: 芝麻生产者面临的一个问题是种子脱落。对形态和生物学特性各异的印度芝麻选育品系进行种子脱落程度分析后发现, 种子表面粗糙的芝麻基因型会从粘连成堆的蒴果中脱落。与散粒种子相比, 粘粒种子的特性可将其损失减少4倍, 从而提高经济产量。

关键词: 芝麻, 蒴果, 物候期, 假分裂, 种子粘连, 种子脱落, 经济产量。

Abstract. *One of the problems faced by sesame seed producers is their shedding. The conducted analysis of the selection lines of Indian sesame, diverse in morphological and biological characteristics, for the degree of seed shedding showed that sesame genotypes with a rough seed surface fall out of the capsules stuck together in piles. The property of seed adhesion reduces their losses by 4 times compared to loose ones, increasing the economic yield.*

Keywords: *sesame, capsules, phenophases, false partitions, seed adhesion, seed shedding, economic yield.*

Introduction

Indian sesame (*Sesamum indicum* L.) belongs to the family Pedaliaceae - the most widespread in culture among other species of the genus *Sesamum*. Its seeds contain 48-63% oil, 16.3-19% protein, 15.7-17.5% soluble carbohydrates. Sesame oil is one of the best food oils [1]. Indian sesame plants are grown mainly for seeds and high-quality oil from them. The seeds are widely used in cooking and medicinal purposes due to their unique chemical composition. Sesame seeds contain a

variety of macro-, micro- and ultramicroelements, as well as vitamins. The seeds are especially valued for their content of readily available calcium from the macroelement group, the mass fraction of which is 783 - 1474 mg%, which is 113.6% of the daily human requirement [2]. According to its biological characteristics, it belongs to heat-loving and drought-resistant crops. This crop began to be cultivated in ancient times, especially in tropical countries. Due to climate change towards warming and aridization in Pridnestrovie, Ukraine, and the southern regions of Russia, interest in the cultivation of this oilseed crop is increasing sharply.

According to statistical data, global production of sesame seeds is growing annually. Seed production has increased especially sharply since 2010, when its amount exceeded 6 million tons, and in 2020 and 2022 it reached 6.8 million tons [3, 4, 5].

However, one of the problems faced by sesame seed producers is their shedding.

The aim of the research was to establish the causes of seed shedding.

Source material and research methodology

The source material was selection lines of Indian sesame, diverse in morphological and biological characteristics.

Before harvesting, seed shedding was recorded in the capsules located at the base of the productive part of the stem. The locations of the seeds - cells - are clearly visible in the sesame capsules (Fig. 4 - 7).

Seed shedding was determined by counting the cells in the capsules and the number of seeds remaining for harvesting. Seed shedding was determined as a percentage. The number of cells in the capsules was taken as 100%. The number of spilled seeds was determined by the difference between the number of cells for seeds and the actual number of sesame seeds for harvesting, expressed as a percentage. The nature of the surface of the seed coats and their location in the capsule were visually studied.

Research Results

Sesame plants are annual, sometimes grow up to 2 meters or more in height, and with wide-row sowing methods, they branch out to the second or more orders. The flowering of the sesame plant occurs from the bottom up and continues until frost sets in. When flowering begins, two or three flowers open simultaneously on the shoots, the main and lateral, every day. For example, the flowering of the sesame variety Mulatka in the conditions of Pridnestrovie began mainly in mid-July (Table 1).

Table 1.

Dates of the onset of phenological phases of development in sesame of the Indian variety Mulatka in the conditions of the Republican Botanical Garden of Tiraspol

Year	Dates of onset of phenological phases			
	Seedlings	Budding	Bloom	Seed maturation
2015	12.05	2.07	15.07	30.09
2017	23.05	5.07	17.07	18.09
2018	10.05	25.06	9.07	24.09
2019	31.05	28.06	16.07	19.09
2020	22.06	29.07	10.08	03.10
2021	17.05	01.07	15.07	27.09
2022	31.05	17.07	29.07	07.09

The length of the phenological phases of development varied significantly depending on the climatic conditions of the year. The number of days from germination to budding varied from 28 to 51; from budding to flowering – from 12 to 18, mostly about two weeks; from flowering to seed ripening – from 40 to 77. The length of the growing season, from germination to seed ripening, varied from 99 to 141 days over the years of observation (Table 2).

Table 2.

Duration of phenological phases of development and length of the growing season of Indian sesame, days.

Year	Duration of phenophase:			Length of the growing season (seedlings – blossoming)
	Seedlings-budding	Budding - flowering	Flowering - seed maturation	
2015	51	13	77	141
2017	43	12	63	118
2018	46	14	77	137
2019	28	18	65	111
2020	37	12	54	103
2021	45	14	74	133
2022	47	12	40	99

The beginning of the ripening of seeds of the Mulatka variety in the conditions of Pridnestrovie fell mainly on September, and harvesting was carried out in October. This is due to the non-simultaneous ripening of the capsules on the plants, which is associated with the morphology of the plants and the nature of their flowering (Fig. 1, 2).



Figure 1. *Indian sesame plants*



Figure 2. *Flowering of Indian sesame*

One of the main problems faced by sesame seed producers is seed shedding. Seed shedding leads to a decrease in commercial yield. A distinction is made between biological and commercial yield. Biological yield is the amount of produce grown per unit area. Commercial yield is always less than biological yield by the amount of harvesting losses [6].

Uneven flowering, and accordingly, uneven ripening of capsules, leads to the fact that the lower capsules, which ripen first, remain on the plants for a long time before harvesting, sometimes up to two months. This circumstance leads to seed loss for various reasons: poorly developed false partitions of capsules, severe cracking of capsules during ripening, and swaying of plants in windy weather.

The sesame fruit is a flat, elongated capsule consisting of two or four carpels, which, bending inward, form false partitions. When ripe, the capsules crack. The number of capsules on a plant varies from 50 to 500 or more in different varieties (depending on the genotype, growing conditions and agricultural technology). Each capsule contains 70-80 seeds, arranged in vertical rows (“stacks”) (four rows for two-carpelled, or eight rows for four-carpelled). Mature capsules open with longitudinal valves, and the seeds easily spill out, especially if the false partitions are poorly developed or practically absent (Fig. 3, 4).



Figure 3. A ripe sesame capsule (side view) with varying degrees of capsule opening during ripening: left – weak, right – strong (photo by the author)



Figure 4. Development of false partitions: on the left – almost none; on the right – well developed (photo by the author)

The cracking of the capsules occurs due to the separation of the upper parts of the internal false partitions (Fig. 5 - 7), which serve as a kind of spacers.



Figure 5. Half of a sesame capsule (one carpel) (photo by the author)



Figure 6. Internal structure of the two-carpellate capsule of Indian sesame (photo by the author)



Figure 7. Upper part of a ripe capsule (side view) (photo by the author)

We have noticed that the seeds in sesame pods (stacks) can be stuck together (Fig. 8) or loose (Fig. 10).



Figure 8. Sesame seeds stuck together (photo by the author)

The surface of the stuck-together seeds is rough (Fig. 9). During the period of being on the plants in the field until harvesting, they practically do not fall off, as they hold on to each other even when the capsule is completely cracked. In order to extract such seeds from the capsules, it is necessary to apply significant mechanical impacts. They are knocked out of the capsules in «stacks».



Figure 9. The nature of the surface of adhering seeds (photo by the author)

Non-sticky seeds have a smooth surface (Fig. 10). Such seeds easily fall out when on the plant in the field, and when the plant is turned over (the holes in the seedpods are at the top), they fall out easily even without tapping.



Figure 10. Surface characteristics of non-sticky seeds (photo by the author)

Sesame seed losses were calculated based on the number of seeds knocked out during harvesting, divided by the number of cells in the capsules. According to our observations, sesame seed losses in genotypes with non-sticky seeds were 34.9%, and in genotypes with sticky seeds – 8.9% (Table 3).

Table 3.
Sesame seed losses during ripening depending on the nature of pile formation in carpels

Character of seed spillage from the capsule	Number of cells for seeds in a box, pcs.	Number of seeds in a capsule, pcs.	Percentage of surviving seeds	Seed losses, %
Not stuck together	72,4	47,1	65,1	34,9
Sticked together (stacks)	78,2	67,4	91,1	8,9

Sesame selection for seed non-shattering was carried out in the selection department of the All-Union Order of Lenin and the Order of the Red Banner of Labor Research Institute of Oil Crops named after V. S. Pustovoit during 1963-1969 (Krasnodar).

A dissertation on this problem was defended in 1973. Complete non-cracking of sesame capsules was used as a sign of seed non-shattering. However, the obtained lines retained the property of non-cracking of capsules, but had a number of negative characteristics: strong leaf curling, long growing season, high suscepti-

bility to diseases, low yield, etc. Despite the noted shortcomings, this material was used as the basis for selection for non-shattering [7].

Conclusions: the shedding of sesame seeds depends not only on the degree of cracking of the capsules during ripening and the development of false partitions, but also on the nature of the surface of the seeds and their location relative to each other. Genotypes in which the seeds in the capsules are stuck together and knocked out in “stacks” have four times less seed loss than genotypes with loose seeds.

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水飞蓟(*Silybum marianum* (L.) Gaertn.)种子粗糙度测定方法
**SILYBUM MARIANUM (L.) GAERTN. SEEDS HUSKINESS
DETERMINING METHOD**

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摘要。测定奶蓟种子果壳含量的方法可用于根据给定的果壳含量进行奶蓟育种。

测定奶蓟种子果壳含量的方法如下: 称量风干种子样品, 然后使其发芽, 直至其长出1-3毫米长的胚根并撑开果皮。然后收集果皮, 干燥至恒重后称重, 并以所取种子质量的百分比(果壳含量)作为质量分数(果壳含量)。

关键词: 奶蓟, 果壳含量测定方法, 果皮。

Abstract. The method for determining the husk content of milk thistle seeds can be used in breeding milk thistle for a given husk content of seeds.

The method for determining the husk content of milk thistle seeds consists in weighing a sample of air-dried seeds and then germinating them until they develop 1–3 mm long embryonic roots and push apart the fruit coats. Then the fruit coats are collected, dried to a constant weight and weighed, and the mass fraction (husk content) is determined as a percentage of the mass of the seeds taken for analysis.

Keywords: milk thistle, method for determining husk content, fruit coats.

Introduction

Milk thistle (*Silybum marianum* (L.) Gaertn.) has become known primarily as a medicinal plant used in folk and official medicine. The medicinal value is mainly

in the milk thistle fruits. Research by many scientists has established that the fruits contain 20-30% fatty oil, which is mainly found in the seed kernel (the inner part of the seed, cleared of the fruit shell), which includes higher polyunsaturated carboxylic acids [1-4].

In addition, rare natural compounds - flavonolignans - were found in the fruits. The chemical composition of milk thistle fruits determines the hepatoprotective and hepatoprotective properties. Oil and meal (a source of flavonolignans) are obtained from the fruits.

The content of flavonolignans depends on the natural and climatic conditions of milk thistle growth and can vary. According to literary sources, their amount is from 1.5 to 4.0% [2]. For example, in the fruits of milk thistle growing in Dagestan, their amount is 3.4% [5]. The Amulet variety (originator: Federal State Budgetary Scientific Institution "Russian Research and Design and Technological Institute of Sorghum and Corn") has 3.1% [6].

Separation of fruit coats from milk thistle seed kernels by industrial means and subsequent determination of important chemical components in them showed a significant difference in the percentage content of biologically important components (Table 1) [7]

Table 1.
Chemical composition of milk thistle seed hulling products (%) [7]

Product	Proteins	Fats	Carbohydrates	Fiber	Flavolignans
Seeds	12,2	21,2	50,6	31,1	3,5
Kernel	22,5	40,6	25,6	2,0	0,1
Shells	1,9	1,9	75,6	60,2	6,9

The data in the table show that milk thistle seeds, separated into kernels and shells, can serve as raw material for more rational extraction of oil from kernels and flavonolignans from seed shells. In the studies of S.V. Zverev and T.P. Vyugina (2023), it was shown that the content of flavonolignans in shells is twice as high as their content in whole seeds [7]. In this regard, it is important to conduct selection for both increased and decreased husk content, depending on the purpose of using the seeds.

Source material and research methods

Milk thistle seeds served as the source material. Seed germination was carried out according to GOST 12038-84 [9]. The mass fraction of husk (husk content) collected after seed germination was determined as a percentage of the mass of seeds taken for analysis in an air-dry state.

Results of the research

From the botanical point of view, milk thistle fruits are achene. This is a dry one-seeded fruit, with which the pericarp does not grow together. Achene fruits

are typical for representatives of the Asteraceae family. In milk thistle, it is impossible to husk the seeds manually or with tweezers due to their very high density. Even goldfinches, which peck milk thistle seeds out of baskets, eating out the kernels of the seeds, damage them only at the milky-wax ripeness stage. In the characteristics of zoned varieties of milk thistle, there are basically no data on the husk index, probably due to the impossibility of separating the seed husk without damaging the kernel, and, accordingly, the impossibility of accurately determining its content.

There is no GOST for determining the husk content of milk thistle seeds.

The method for determining the husk content of oilseeds according to the standard is to husk them manually. For this purpose, two samples are taken from an average seed sample, previously cleaned of impurities: for sunflower and safflower seeds - 10 g each, peanuts and castor beans - 20 g each, weighed with an accuracy of 0.01 g. The seeds of each sample are hulled using tweezers [8]. Milk thistle is not included in the list of crops. It is not possible to hull milk thistle seeds experimentally using tweezers.

To determine the husk content of milk thistle seeds, it is proposed to use the collection of seed coats after the beginning of their germination. The emerging rootlet pushes apart the fruit coats, which are easily separated from the kernels (Fig. 1).



Figure 1. *The beginning of germination of milk thistle seeds
(photo by the author)*



Figure 2. On the left are the kernels of milk thistle seeds, on the right are the fruit shells (photo by the author)

To determine the husk content of different genotypes of milk thistle, it is necessary to take two samples of healthy, full seeds, 100 pieces each, weigh them in an air-dry state with an accuracy of 0.01 g. Place them in Petri dishes on filter paper for germination at a temperature of 20-30 ° C according to GOST 12038-84. [9].

When germination occurs and embryonic roots appear, the seed coats move apart, which are very easily separated from the kernels (Fig. 2). The collected shells (husk) are dried naturally to an air-dry state and constant weight. Then they are weighed and the percentage of husk from the weight of the seeds in an air-dry state taken for analysis is calculated. Husk content is calculated as the arithmetic mean of the values of two replicates. The difference in the husk content of two replicates should not exceed 1%. Otherwise, the determination is repeated.

Conclusions

A simple method for determining the husk content of milk thistle seeds is based on separating the fruit coats during germination.

This makes it possible to select for a certain husk content depending on the purpose of using the seeds: for oil (with low husk content) or raw material for obtaining medicinal products with hepatoprotective and hepatoprotective action (with high husk content).

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冻干、贮藏时间及条件对乳酸杆菌黏附活性及生化特性的影响
**THE INFLUENCE OF FREEZE DRYING, STORAGE TIME
AND CONDITIONS ON THE ADHESIVE ACTIVITY AND
BIOCHEMICAL PROPERTIES OF LACTOBACILLI**

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摘要。AVIBIOLACT益生菌复合物中的乳酸杆菌培养物经冷冻干燥后，在+4° C至+6° C的温度下保存24个月。之后，乳酸杆菌在乳酸乳球菌培养基中更新传代3次，再接种到MRS琼脂表面。对生长出的菌落进行了培养、染色和生化特性研究，并考察了其粘附活性。采用API 20 Strep和API 50 CHL测试系统（法国生物梅里埃公司）对乳酸杆菌的生化特性进行了研究。乳酸杆菌培养物的粘附活性采用V. I. Brilis (1986) 的方法测定，使用1%的公鸡红细胞悬浮液。研究表明，乳酸乳球菌、乳酸乳球菌和嗜酸乳杆菌的培养物保留了其通用的和特有的生化特性。所有乳酸杆菌培养物均对公鸡红细胞具有较高的粘附性，并在其表面形成簇。

关键词：益生菌、乳酸杆菌、粘附性、家禽养殖。

Abstract. *Lactobacillus cultures included in the AVIBIOLACT probiotic complex were freeze-dried and stored at temperatures from +4° C to +6° C for 24 months. Then they were renewed and 3 passages were carried out on a dairy medium, followed by re-sowing on the surface of MRS agar. Grown colonies were researched for cultural, tinctorial and biochemical properties, theirs adhesive activity was studied also. The biochemical properties of lactobacilli were studied using the API 20 Strep and API 50 CHL test systems (BioMerieux, France). The degree of adhesive activity of lactobacillus cultures was determined by the method*

of V.I. Brilis (1986) using 1% suspension of rooster erythrocytes. The results of the research showed that the cultures of *Lactococcus cremoris*, *Lactococcus lactis* and *Lactobacillus acidophilus* retained their generic and specific biochemical properties. All *Lactobacillus* cultures had high adhesion to rooster erythrocytes and formed clusters on their surface.

Keywords: probiotic microbes, *laktobacilli*, adhesion, poultry farming.

Introduction.

As a result of breeding achievements in modern poultry farming, bird crosses have been created that are distinguished by high productivity. An increase in productive qualities is often accompanied by a decrease in the level of resistance to infectious diseases of birds and stress factors [1, 2]. Probiotic preparations are used as a non-specific prevention and treatment of gastrointestinal diseases of birds of bacterial etiology, as well as to restore the balance of microflora after the use of antibiotics. This helps to reduce pathogenic bacteria and restore the intestinal microbiocenosis of birds [3, 4].

Lactobacilli inhabit the digestive tract of birds along its entire length, so their inclusion in probiotic preparations is of key importance in the prevention of bacterial diseases of birds [5, 6]. Due to the fact that *lactobacilli* have the ability to attach to the intestinal epithelium, they can constantly persist in the gastrointestinal tract of birds and exert their beneficial effect on the body [7]. One of the main criteria for assessing the functional potential of probiotic microorganisms is their adhesive activity - the ability to attach to the epithelium of the intestinal wall and colonize it [8, 9]. A high level of adhesive activity of *lactobacilli* prolongs their content in the intestine and increases the duration of their beneficial effects in the host organism.

The aim of our study was to determine the effect of lyophilization and storage for 24 months at a temperature of +4°C to +6°C on the level of adhesive activity and biochemical properties of *lactobacilli*: *Lactobacillus acidophilus*, *Lactococcus lactis* sub species *cremoris*, *Lactococcus lactis* sub species *lactis*, included in the probiotic biocomplex "AVIBIOLAKT".

Material and research methodology. The liquid mass of *lactobacilli* cultures – *acidophilus bacillus* (*Lactobacillus acidophilus*), creamy *lactococcus* (*Lactococcus lactis* sub species *cremoris*) and lactic streptococcus (*Lactococcus lactis* sub species *lactis*) – was poured into sterile insulin vials of 1.0 cm³ and lyophilized for 36 hours. The vials were then sealed under vacuum at a pressure of no more than 30 Pa (250 μm of mercury). *Lyophilized lactobacilli* cultures were stored for 24 months at a temperature of +4°C to +6°C. The cultures were restored in sterile saline, then 3 passages were carried out on a milk medium, and then transferred to the surface of MRS agar. *Acidophilus bacillus* was incubated under anaerobic

conditions using an anaerostat and gas-generating bags “KAMPILOGAZ” with a CO₂ content of 8-10% at 37 ° C, creamy lactococcus and *lactic streptococcus* at a temperature of 30 ° C under aerobic conditions for 48-72 hours. The cultural, tinctorial and biochemical properties of the grown colonies were confirmed.

Smears were prepared from isolated colonies grown on MRS agar and stained according to Gram. Biochemical properties of lactobacilli were studied using the test systems API 20 Strep and API 50 CHL (bioMerieux, France).

To determine the adhesive activity, isolated colonies typical for each lactobacillus culture grown on MRS agar were reseeded on MRS agar as a lawn. After 48 hours, the cultures were washed with sterile saline and a cell suspension was prepared at a concentration of $5.2\text{--}5.8 \times 10^9$ CFU/cm³. The degree of adhesive activity of the studied lactobacilli cultures was determined according to the method of V.I. Brilis (1986) using a 1% suspension of rooster erythrocytes [10]. Blood was obtained from the rooster heart in test tubes with sodium citrate. The erythrocytes were washed twice by centrifugation at 1000 rpm for 30 min. in a phosphate-isotonic solution of sodium chloride and a 1% suspension was prepared. For this purpose, 99 cm³ of sterile saline was added to 1 cm³ of erythrocytes and carefully mixed until a homogeneous suspension was formed.

The prepared erythrocyte suspension was added in 0.5 cm³ portions into test tubes, then 0.5 cm³ of the lactobacillus strain suspension was added, the suspension was carefully mixed and kept in a thermostat at $39 (\pm 0.1)^\circ\text{C}$ for 30 min with constant shaking, then washed twice by centrifugation at 1000 rpm for 10 minutes in a buffered phosphate solution of sodium chloride. Smears were prepared from the sediment, stained according to Gram, the number of microorganisms attached to 50 erythrocytes was counted, the average adhesion index (AAI), adhesion coefficient (AC) and microorganism adhesiveness index (MAI) were calculated. Three independent determinations were made in each series of experiments.

Results and discussion. The results of the studies showed that all lactobacilli cultures retained their cultural, tinctorial and biochemical properties after storage in a lyophilized state for 24 months at a temperature from +4°C to +6°C. On MRS agar, the growth of *Lactococcus cremoris* and *Lactococcus lactis* was noted as smooth round white colonies, and *Lactobacillus acidophilus* as rough white colonies.

When staining *Lactobacillus acidophilus* cultures according to Gram, characteristic gram-positive, immobile rods were found, and when staining *Lactococcus cremoris* and *Lactococcus lactis* cultures, non-spore-forming cocci located in short chains were found.

Biochemical properties of *lactobacilli* (Table 1, 2).

Table 1

Biochemical properties of Lactococcus cremoris and Lactococcus lactis, included in the probiotic biocomplex "AVIBIOLAKT"

Biochemical test	<i>Lactococcus cremoris</i>	<i>Lactococcus lactis</i>
Voges-Proskauer reaction	+	+
Hydrolysis of hippuric acid	-	-
β -glucosidase	-	+
Pyrrolidonyl-arylamidase	-	-
α -galactosidase	-	-
β -glucuronidase	-	-
β -galactosidase	-	+
Alkaline phosphatase	-	-
Leucine aminopeptidase	+	+
Arginine dihydrolase	-	+
Ribose	-	+
Arabinose	-	-
Mannitol	-	+
Sorbitol	-	-
Lactose	+	+
Trehalose	-	+
Inulin	-	-
Raffinose	-	-
Starch	-	+
Glycogen	-	-

Note: "+" - positive test, "-" - negative test

Table 2

Biochemical properties of Lactobacillus acidophilus, which is part of the probiotic biocomplex "AVIBIOLAKT"

Biochemical test	Result	Biochemical test	Result
Glycerol	-	Salicin	+
Erythritol	-	D-cellobiose	+
D-arabinose	-	D-maltose	+
L-arabinose	-	D-lactose	+
D-ribose	-	D-melibiose	-
D-xylose	-	D-sucrose	+
L-xylose	-	D-trehalose	-
D-adonitol	-	Inulin	-
Methyl- β D-xylopyranoside	-	D-metlesitose	-
D-galactose	+	D-raffinose	+

D-glucose	+	Starch	+
D-fructose	+	Glycogen	-
D-mannose	+	Xylitol	-
L-sorbose	-	Gentibiose	+
L-rhamnose	-	D-turanose	-
Dulcitol	-	D-lyxose	-
Inositol	-	D-tagatose	-
D-mannitol	+	D-fucose	-
D-sorbitol	-	L-fucose	-
Methyl- α D-mannopyranoside	-	D-arabitol	-
Methyl- α D-glucopyranoside	-	L-arabitol	-
N-acetylglucosamine	+	Potassium gluconate	-
Amygdalin	+	Potassium 2-ketogluconate	-
Arbutin	+	Potassium 5-ketogluconate	-
Esculin	+		

Note: «+» - positive test, «-» - negative test

During biochemical testing of *Lactococcus cremoris*, *Lactococcus lactis* and *Lactobacillus acidophilus* strains, it was determined that their properties after lyophilization and storage at a temperature of +4°C to +6°C for 24 months remain stable. The cultures retained their generic and species biochemical properties. The biochemical profiles of the studied cultures corresponded to the species *Lactococcus cremoris*, *Lactococcus lactis* and *Lactobacillus acidophilus*.

When examining smears, active attachment of *lactobacilli* to the surface of chicken erythrocytes was observed (Fig. 1). Results of the adhesive activity of *lactobacilli* (Table 3).

Table 2

Indicators of adhesive activity of lactobacilli after lyophilization and storage at a temperature of +4°C to +6°C for 24 months, n=3

Adhesion indices	Types of microorganisms		
	<i>Lactobacillus acidophilus</i>	<i>Lactococcus lactis subsp. lactis</i>	<i>Lactococcus lactis subsp. cremoris</i>
AAI, cells	5,1 \pm 0,59	7,4 \pm 1,18	8,6 \pm 1,21
CA, %	64,4 \pm 3,96	71,5 \pm 2,2	77,7 \pm 2,4
IMA, cells/er	7,7 \pm 0,45	10,3 \pm 1,4	10,9 \pm 1,21

It was found that the average adhesion index (SPA) of *Lactococcus cremoris* was the highest and amounted to 8.6 units, the SPA of *Lactococcus lactis* was 7.4 units, and *Lactobacillus acidophilus* was 5.1 units.

The coefficient of microorganism adhesion (CA) was determined by calculating the percentage of erythrocytes with lactobacilli on their surface from among the erythrocytes taken into account. Lactococci actively attached to erythrocytes and amounted to an average of 71.5 to 77.7%. The CA of acidophilus bacillus was an average of 64.4%.

The index of microorganism adhesion (IAM) characterizes the average number of lactobacilli cells on one erythrocyte. For *Lactococcus cremoris*, this indicator averaged 10.9 cells per erythrocyte. This indicator was slightly lower for *Lactococcus lactis* and amounted to 10.3 cells per erythrocyte, and for *Lactobacillus acidophilus* – 7.7 cells per erythrocyte.

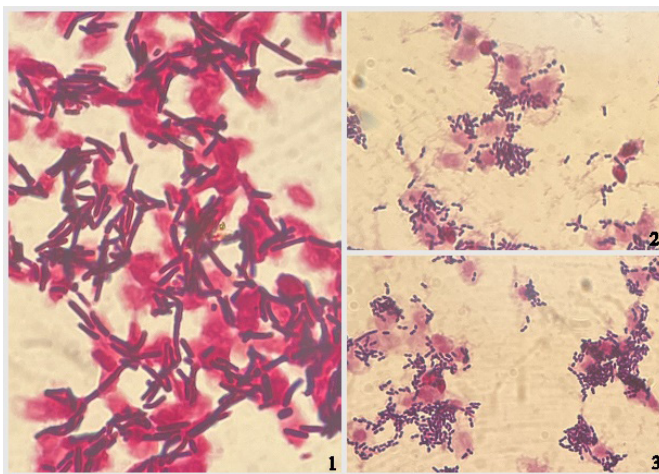


Figure 1. Adhesion of lactobacilli to rooster erythrocytes: 1 – *Lactobacillus acidophilus*, 2 – *Lactococcus lactis*, 3 – *Lactococcus cremoris*.

Microscopic examination revealed that autoaggregating cells of lactobacilli formed entire clusters on the surface of erythrocytes.

Conclusion.

Indicators of microorganism adhesive activity are an important criterion for assessing the functional potential of probiotic preparations. Lyophilization and long-term storage can change the biochemical properties of lactobacilli and negatively affect the level of adhesive activity and, as a result, reduce the effectiveness of probiotic preparations.

The conducted studies have established that lyophilization and storage for 24 months at a temperature of +4°C to +6°C did not affect the stability of the biochemical properties of lactobacilli included in the probiotic biocomplex “AVI-BIOLAKT”. The studied cultures showed high adhesive activity.

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