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AGRICULTURAL SCIENCES

MONITORING OF AGRICULTURAL LAND CONDITIONS

Abatova M.,

11th grade student at the NIS PH&M in Kokshetau

Meiram R.,

11th grade student at the NIS PH&M in Kokshetau

Zhaksylyk D.,

11th grade student at the NIS PH&M in Kokshetau

Musagulova B.

Biology teacher at the NIS PH&M in Kokshetau https://doi.org/10.5281/zenodo.7788570

Abstract

Project Goal: To create a program for small flying devices (drones) to determine the area of weeds in agricultural fields based on color and length.

Tasks:

- 1. Become familiar with the literature on the use of chemical pesticides.
- 2. Become familiar with existing monitoring technologies.

Hypothesis: Creating a program for early monitoring of the level of weed contamination of agricultural land by plants will help increase yields.

Novelty: In creating a draft program for monitoring agricultural land, a new, improved drone model with a built-in camera and a sprayer was proposed for detecting weeds and then pollinating them with herbicides to regulate crop growth.

Research phases: bibliographic analysis of literature and internet material; writing a program algorithm; creating a drone model; conducting an experiment: scanning weeds for color; analyzing the experiment.

Degree of autonomy: in the implementation and creation of the project program, the student was assisted by his/her supervisor and by teachers of robotics and programming.

Conclusions:

- 1. A program to detect weeds based on color and height using small aircraft will significantly reduce the amount of herbicides used and lower the cost of their application.
- 2. Reducing the amount of chemicals sprayed will reduce contamination of soils and groundwater with hazardous substances.
- 3. A small aircraft allows spraying at low altitudes, reducing the contact area of chemical compounds with natural ecosystems.

fourth. Early detection of plant diseases will contribute to higher yields

Practical implications: An improved crop monitoring program can be proposed as a way to monitor and control weeds

Objective: to create a program for small flying vehicles (drones) to determine the area of agricultural land weed infestation.

Relevance: Weeds are a serious problem for all crops, including forage crops. Approximately 73% of weed species in cropping systems are not local [1]. On average, because of weeds, diseases and pests in Kazakhstan about 20% of grain yield is lost annually, but in some years underharvest can reach 50% or more, although the species composition of pests is not so numerous. For example, in Burabay district of Akmola region in spring wheat crops the most harmful weeds are oats, bristlegrass, field bindweed, bristle thistle, field thistle, creeping vetch, white crowberry, pickleweed and other weeds [2].

Today, inappropriate weed control damages the environment, leading to an overuse of herbicides, thereby upsetting the natural balance of nature.

Keywords: agroculture, weed, monitoring, code, machine vision, crop, camera, soil pollution, farmer, camera ,wheat, drone, height color, algorithm, python

1.1 Methods for monitoring phytosanitary status of fields.

For successful weed control it is necessary to carry outannual accounting of the weed infestation of the fields. Evaluation of weediness of crops is carried out on the basis of data from space and ground-based monitoring, and is timed to the period of maximum growth and development of crops [3].

Drones are rightfully considered the most effective and mobile tool for collecting data on the condition of crops. Usually they are launched at a height of 100-300 meters above the field, which makes the images more detailed than those of satellites. The speed of these devices is also remarkable - a drone covers 2.5 thousand hectares per day. The low imaging altitude and high resolution of the picture make it possible to create a map on which you can distinguish the crop

from the weeds. In some cases, it is even possible to identify a particular variety of pest plant and select the optimal type of herbicide [4].

1.2 Method of monitoring farmland using a drone.

After studying the existing technologies, the idea of full automation of not only monitoring the growth of cultivated plants and the degree of infestation of fields, but also the destruction of weeds in places of great localization was proposed.

Thus, the lethal device consists of the following components: drone, built-in camera with weed detection program, instruments for pollination and extraction of weed plants.

The method of weed control proposed by us consists of 4 main stages:

- 1) **Remote Video Surveillance:** The flying vehicle (drone) allows the farmer to monitor field debris at a distance, thus the drone will fly over the land at an altitude of less than 50 meters to take pictures as well as broadcast the screen online.
- 2) **Weed detection:** The camera attached to the drone performs broadcasting and detection functions.



Also, a written algorithm for color detection and detection integrated into the camera will make it possible to determine the localization of certain weeds by color.

- 3) **Herbicide pollination:** A container containing 5-10kg of herbicides will also be attached to the drone. Tubes will be attached along the main body, which are connected to the container and thus, having identified the weed plant, its dosed pollination will take place.
- 4) **Weed Extraction:** The drone will locate the weed and, upon receiving a signal from the farmer, perform a further extraction. A robotic arm attached to the drone on the underside of the main body will mechanically extract the weed.

1.3 Algorithm for detecting weeds.

One of the main details of the drone's work is the detection of weeds. This task is performed by the camera, to which the written algorithm will be connected [Appendix 1]. The program written in the Python programming language is able to distinguish such colors as:green, yellow and purple [Figure 1]. Thus, an unmanned aerial vehicle flying over the fields will be able to determine the localization of weeds and proceed to their further elimination.



Figure 1 Field model

1.4 Creating a 3D model.

In order to achieve the goal, the work was divided into several stages:

- 1. Selection of suitable elements and materials to create a layout of the drone's operation.
 - 2. Making a diagram of an aircraft.
- 4. Assembling a model drone (camera, main body, container, LEGO MINDSTORMS).

5. Conducting testing of the finished model.

The assembly of the model began with the construction of the main body of the drone. It was assembled from LEGO parts and was supposed to act as a support for the entire structure.

Our next task was to create a robotic arm.

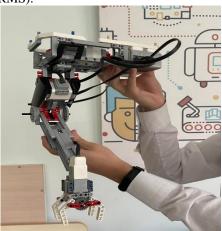


Figure 2 Drone model

It is also assembled from LEGO parts and connects to the LEGO MINDSTORMS hardware and software structure, to which code has been written allowing the user to arbitrarily control the robotic arm [Figure 2].

The next part of the model is the pollination device, which will be located along the propellers. Thereby, the pipes communicating with the tank will conduct herbicides to the taps due to artificially created pump and spray, detected weeds on signal [Figure 3].

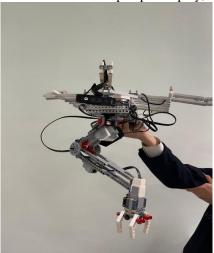


Figure 3 Drone model

1.5 Conclusion and Conclusions

Most cultivated plants are constantly competing with weeds for nutrients and water, causing the use of herbicides in large quantities, which leads to herbicide aftereffects, decreased yield of subsequent crops and further disruption of the natural balance of nature.

The presented method of weed control is a more effective way to significantly reduce the number of weeds, reduce the cost of applying herbicides and obtain high quality crops.

Conclusions:

- 1. A weed detection program using small aircraft will significantly reduce the amount of herbicides used and reduce the cost of their application.
- 2. Reducing the amount of chemical spraying will reduce contamination of soils and groundwater with hazardous chemical compounds.
- 3. The small aircraft will allow you to spray at low altitudes, reducing the area of exposure to chemical compounds in natural ecosystems.

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ARCHITECTURE

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NEW TECHNOLOGIES IN ARCHITECTURAL DESIGN

Saibdulatova A.

International Education Corporation, Almaty, Republic of Kazakhstan

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НОВЫЕ ТЕХНОЛОГИИ В АРХИТЕКТУРНОМ ПРОЕКТИРОВАНИИ

Сайбдулатова А.С.

Международная Образовательная Корпорация, Алматы, Республика Казахстан https://doi.org/10.5281/zenodo.7788598

Abstract

Issues of the article are products and solutions on a base of virtual reality technology, 3D visualisation, usingol interactive machines graphics and making automatic projecting. Development of technologies increase computers productivity. systems of 3 D visualization. system of Reed back, training etc.

Аннотация

В статье рассматривается вопрос о продуктах и решениях на базе технологии виртуальной реальности. 3D визуализация, использование возможностей интерактивной машинной графики и автоматизации проектировании. Развитие технологий повышает производительность компьютеров, систем трехмерной визуализации, систем обратной связи, тренинга и т.д.

Keywords: modeling, visualization, virtual reality, architectural models.

Ключевые слова: моделирование, визуализация, виртуальная реальность, архитектурные макеты.

Реальное архитектурное проектирование основано на организации жизненного пространства.

Представление о жизненном пространстве у архитекторов складывается из сопоставления зри-

тельных впечатлений. Поэтому очень важно максимально реалистически «видеть» и «присутствовать» разработчикам и потенциальным заказчикам в еще не построенном здании.

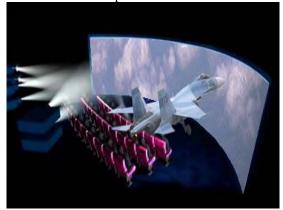


Рис. 1 Пример интерактивной графики.

Еще недавно эксперименты по использованию возможностей интерактивной машинной графики и виртуальной реальности напоминали нам опыты алхимиков и были доступны лишь небольшой группе специалистов, преимущественно ученых, которые занимались вопросами автоматизации проектирования, математического моделирования и различными военными технологиями.

Виртуальная реальность – это словосочетание за последние годы достаточно часто появлялось на

страницах прессы и стало весьма привычным для нашего слуха [1]. При этом за этим термином редко стояло понимание внедрения данной технологии. Нужно сказать, что в прессе было достаточно мало статей о конкретном использовании этой технологии в проектировании.

Между тем технологии виртуальной реальности уже многие годы приносят миллионы долларов экономикам в наиболее развитых стран.

С исторической точки зрения Виртуальную реальность можно рассматриваться как итог развития интерактивности системы «машина-человек», возможный благодаря развитию технологий повышения производительности компьютеров, систем трехмерной визуализации систем обратной связи, трекинга, и т.д.

Современные технологии виртуальной реальности и 3D визуализации, фактически являются базой для построения новых поколений мультимодальных человеко - компьютерных интерфейсов, которые позволяют создавать тренажеры [рис.2], стимуляторы, интерактивные обучающие виртуальные среды, различные решения для рекламы и маркетинга и т.д.

На определенном этапе пришел новый способ взаимодействия человека и машины. Осуществляя навигацию в мире зрительных образов проектировщик одновременно получает возможность направлять работу компьютерной техники. Новые возможности оборудования позволили нам шагнуть

внутрь компьютера, привнося с собой чисто человеческие способности ориентироваться внутри визуальных образов, эмоций, то есть все то, что недоступно неодушевленному компьютеру. Тандем «машина-человек» обрел качественно новые возможности.

Центр виртуального макетирования VE upCenter собрал в себе все последние мировые инновационные достижения в области 3D визуализации и виртуальной реальности. Они существенно раздвигают рамки пространственного моделирования и позволяют выйти на новый уровень интерактивного макетирования в архитектурном проектирование, городском планировании и архитектурном дизайне[2].

Использование VE upCenter позволяет в едином центре сосредоточить все функции по созданию интерактивных виртуальных макетов. Публикации интерактивных виртуальных макетов для широкого круга людей, с помощью технологий 3D интернет и выпуска интерактивных мультимедийных дисков.



Рис.2 Элементы виртуальной реальности.

Использование VE upCenter позволяет в несколько раз снизить трудозатраты и увеличить скорость разработки городского плана застройки, улучшить качество проектирования и существенно снизить затраты на разработку презентационных 3D материалов.

3D upCenter предназначен для:

- маркетинговых и инженерных подразделений строительных компаний;
- служб главного архитектора, комитета по городскому планированию, мэрии;
 - девелоперских компаний.

Каковы основные функции 3D upCenter:

- -интерактивное виртуальное макетирование городов, районов, зданий и интерьеров в реальном масштабе времени [рис.3-4];
- -виртуальная эксплуатация еще не построенного объекта;
- -визуализация данных в реальном масштабе времени для экспертных групп городского планирования;
- -презентации для инвесторов и лиц, принимающих решение;



Рис.3 Пример пространственного моделирования.

- центр создания интерактивных виртуальных макетов для мультимедиа презентаций и публикаций по технологии 3D-интернет.

Каковы преимущества 3D upCenter:

- -реальная экономическая эффективность;
- -качественное проектирование за счет объемного реального восприятия информации (восприятие глубины и перспективы)



Рис.4 Пример пространственного моделирования интерьера.

-работа с интерактивными виртуальными макетами, получение опыта эксплуатации сооружения еще на этапе разработки их концепции;

-возможность создания интерактивных архитектурных макетов масштаба города, района, здания или интерьера и последующая их демонстрация на системах виртуальной реальности (3D визуализации), демонстрация на обычных РС (создание CD, DVD), создание 3D сайтов (по технологии 3D интеренет);

-простота эксплуатации 3D upCenter, простота работы с ПО Virtools, которое не требует специальных навыков программирования и позволяет команде из 1-4 человек самостоятельно изготавливать интерактивные архитектурные макеты;

-возможность интеграции в существующие аудио-визуальные комплексы;

-возможность демонстрации обычной 2D информации (фото, видео и т.д.), а так же 3D стерео фотографий, 3D стерео видео.

Cocmaв 3D upCenter:

- 1. Проекционная система виртуальной реальности (3D визуализации) различной конфигурации. Для восприятия объема необходимы специальные очки;
- 2. графический генератор мощная специализированная графическая станция, или графический кластер позволяющий с помощью специализированного ПО абсолютно синхронно обрабатывать и выдавать требуемый поток визуальной 3D информации;

3.центр разработки с использованием программного комплекса Virtools Software Suite 4.0 мирового лидера в области 3D - компании Dassault Systemes;

4.необходимый набор программных модулей для создания интерактивных виртуальных макетов и создания интерактивных мультимедийных презентаций;

5.периферия систем виртуальной реальности - набор различных устройств, позволяющих «усиливать» степень интерактивности взаимодействия с виртуальным макетом.

В зависимости от конкретных функциональных требований к центру интерактивного виртуального макетирования, существует возможность выбора конфигурации и функциональных возможностей 3D upCenter.

В заключение хочется сказать, что человечество шагает семимильными шагами в сторону оптимизации строительства, а также, в сторону покорения новых вершин в технологиях проектирования.

В стоящее время нельзя точно знать, какие технологии развернутся в ближайшие десять лет, но без сомнений, мы готовы вступить в новую эру оптимизации работы архитекторов и строителей.

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BILOGICAL SCIENCES

MODERN DIAGNOSTIC METHODS USED IN DETECTION OF CYTOMEGALOVIRUS

Mammadov P.

Institution: V. Akhundov National Scientific Research Medical Prophylactic Institute Azerbaijan
Profession: Chief laborant
https://doi.org/10.5281/zenodo.7788709

Abstract

Human cytomegalovirus (HCMV), a betaherpes virus, is a major cause of birth defects and an important pathogen in immunocompromised individuals. Clinical symptoms may appear after initial infection, reinfection, or reactivation. Human cytomegalovirus (HCMV) usually does not cause obvious symptoms. Modern diagnostic methods indicate that HCMV is a widespread opportunistic infection in fetuses, bone marrow transplant patients, and AIDS patients. In this article, we will review the diagnostic methods used for cytomegalovirus.

Keywords: cytomegalovirus, diagnosis, virus, methods, herpes

Human cytomegalovirus (HCMV), a betaherpes virus, is a major cause of birth defects and an important pathogen in immunocompromised individuals. A virus with a linear double-stranded DNA genome of 230 kb is surrounded by a viral nucleocapsid and a bilayered lipid supercapsid. Clinical symptoms may appear after initial infection, reinfection, or reactivation (1). Human cytomegalovirus (HCMV) usually does not cause obvious symptoms. Modern diagnostic methods indicate that HCMV is a widespread opportunistic infection in fetuses, bone marrow transplant patients, and AIDS patients. The virus is not as harmless as it seems, as it sometimes results in death (2). Human cytomegalovirus (HCMV) causes serious disease primarily in immunocompromised individuals, particularly allograft recipients and premature infants, as well as in patients infected during pregnancy (congenital HCMV [cCMV]). These include pneumonitis, retinitis, hepatitis, sensorineural hearing loss (SNHL) in infants, and mental retardation (3). In healthy children and adults, HCMV infection is often mild, but the virus causes about 10% of cases of infectious mononucleosis (Epstein-Barr virus (EBV) infection). Diagnostic tests are critical to confirm cCMV, monitor viral infections and immune responses among organ transplant (SOT) and hematopoietic stem cell transplant (HSCT) recipients.

The basic principle of laboratory tests for the diagnosis of HCMV infections in the context of organ or hematopoietic stem cell transplantation is based on the direct detection of the virus and the measurement of the body's immune responses. Laboratory tests that directly detect HCMV are recommended for surveillance, diagnosis, and monitoring. For HCMV risk assessment and risk factor stratification, analysis of immune status is based.

Analyzes for virus detection.

Direct detection of HCMV in clinical specimens is the standard method for diagnosing HCMV infection in transplant patients (4). The most widespread method for direct detection of the virus is quantitative nucleic acid amplification tests (QNAT) with high sensitivity and quick results. Detection and quantification of the HCMV genome is possible using this test (5). Blood and plasma samples are mainly used for HCMV-QNAT analysis. Sometimes cerebrospinal fluid and bronchoalveolar lavage (BAL) are used. HCMV QNAT testing of blood or plasma is more appropriate for use in diagnosing diseases such as pneumonia or gastrointestinal disease, and when obtaining biopsy specimens for histopathology is risky (5).

Diagnosis of Maternal and Congenital CMV Infections.

cCMV infections are a major cause of SNHL and neurological disability in children. cCMV infection can follow primary and non-primary infection of the mother during pregnancy. Infected seronegative mothers are the greatest risk factor during pregnancy. Transmission to the fetus occurs in about 32% of these cases and causes disease in about 13% of congenitally infected newborns (6). Among HCMV seropositive women, reactivation of an endogenous HCMV strain or reinfection with another strain of the virus causes fetal infection in approximately 1% of pregnancies. This rate is much lower than for primary infections, but reactivation and reinfections are more common. As a result, HCMV-seropositive women are the main source of congenital infections worldwide (7). Primary and nonprimary maternal infections can cause serious consequences (6). If there is no effective vaccine against the disease, then other forms of prevention are needed. Several studies suggest that avoiding contact with bodily fluids of children can reduce HCMV seroconversion in pregnant women (8). Based on data from such cohort or case-control analytical studies, The International Congenital Cytomegalovirus Recommendation Group has recommended that, "all pregnant women should be educated about congenital cytomegalovirus infections and preventive measures" (9). Related to this, the US Centers for Disease Control and Prevention's guidance to health care providers states that "Avoiding contact with saliva and urine from young children might reduce the risk of CMV infection, although research studies don't provide a clear answer. Some examples of how to avoid contact include kissing children on the cheek or head rather than the lips and washing hands after changing diapers." (10). Clinical diagnosis of maternal HCMV infection is unreliable because most pregnant women with active infection are asymptomatic; therefore, laboratory diagnosis is the primary approach to identify women with primary HCMV infection (11).

Serology.

Although various HCMV serological methods are indicated as basic research methods, their inclusion in clinical diagnostic algorithms requires careful evaluation and interpretation. As a result of prenatal immunological diagnostic analyses, HCMV immunological parameters among pregnant women show individual variability. Therefore, immunological data are not reliable for determining the risk of fetal HCMV transmission. However, since the majority of maternal HCMV infections are asymptomatic, detection of women at risk of transmission of the virus to the fetus depends on the implementation of serological and virological tests early in pregnancy (before 12-14 weeks of pregnancy) (12).

Nucleic acid test.

Detection of primary HCMV in body fluids in immunocompromised individuals is primary in pregnant women but secondary in the diagnosis of HCMV infection. It can often be used to confirm a serological diagnosis. Data suggest that detection and quantification of HCMV-DNA in maternal body fluids may be useful for predicting intrauterine transmission in women with primary infection. Women who transmit the virus to their fetuses are about 2 times more likely to shed CMV-DNA in their blood, cervical secretions, and urine (13, 14).

Non-primary HCMV infection is difficult to diagnose. Serological testing is not the basis for identifying non-primary infections. Laboratory tests play a role in the diagnosis of non-primary HCMV infection in women with known serological status prior to pregnancy. However, extensive prospective studies are needed to determine the optimal time of sample collection, evaluation of serological tests, detection of viral DNA in various body fluids, development and validation of algorithms.

Prenatal Diagnosis of HCMV Infection.

Both invasive and non-invasive prenatal diagnosis are offered to pregnant women at high risk of HCMV transmission to the fetus, especially pregnant women with confirmed primary infection during pregnancy and abnormal ultrasound findings suggestive of cCMV infection. (15).

Invasive prenatal testing is performed for a variety of reasons, but the most common indication is fetal genetic testing (17). Quantification of viral DNA in amniotic fluid (AF) is the most appropriate method for diagnosing fetal HCMV infection (15). AF qPCR sensitivity decreases from 100% specificity to 80–90% when amniosynthesis is performed at least 8 weeks after the onset of maternal infection and after at least 20–21 weeks of gestation (16). Although high viral loads in AFs are associated with symptomatic or asymptomatic cCMV, high viral loads suggest the possibility of more severe disease (18).

Non-invasive prenatal diagnosis (NIPD) aims to detect fetal genetic disorders before birth by detecting markers in the peripheral blood of pregnant women, with the potential to reduce the risk of fetal birth defects (19). When fetal HCMV status is known, ultrasound is

useful for detecting and monitoring fetal abnormalities, such as brain abnormalities that are indicative of severe disease. (20).

It is difficult to determine the exact result for an infected fetus with no or mild abnormalities on ultrasound examination until about 30 weeks' gestation. (21).

Cell culture.

This method was used to detect CMV by immunofluorescence (IF) method in cell culture with monoclonal antibody against CMV antigen. Detection of early CMV antigen in cell culture is considered the fastest method (22).

Testing of saliva samples.

Oral saliva real-time polymerase chain reaction (RT-PCR) has been shown to be sensitive and specific for the detection of congenital cytomegalovirus (cCMV). Targeted screening RT-PCR testing for cCMV has high sensitivity but low positive predictive value and therefore requires additional confirmatory testing (23).

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CHEMICAL SCIENCES

SYNTHESIS AND INVESTIGATION OF THE ELECTROPHYSICAL PROPERTIES OF THE ZnTb₂Te₄ COMPOUND

Aliyev K.,

Departments "General and inorganic chemistry, Ph.D. Associate Professor Baku State University, Azerbaijan, Baku Azizli N. master's degree Baku State University

СИНТЕЗ И ИССЛЕДОВАНИЕ ЭЛЕКТРОФИЗИЧЕСКИХ СВОЙСТВ СОЕДИНЕНИЯ ZnTb₂Te₄

Алиев К.А.

Azerbaijan, Baku

кафедра «Общей и неорганической химии, к.х.н., доцент Бакинский государственный университет Азербайджан, Баку

Азизли Н.И.

магистр Бакинский государственный университет Азербайджан, Баку https://doi.org/10.5281/zenodo.7788713

Abstract

The electrical properties of the newly obtained ternary compound ZnTb₂Te₄ (electrical conductivity, thermal e.m.f., Hall coefficients and Hall conductivity) were studied in the temperature range of 300-800 K, and the band gap was calculated based on the temperature dependence of the electrical conductivity and the value ΔE = was determined 1.52 eV.

It was found that the thermo-e.m.f. coefficient decreases in the area of electrical conductivity and has p-type conductivity.

Аннотация

Электрофизические свойства вновь полученного тройного соединения ZnTb₂Te₄ (электропроводность, термо-э.д.с., коэффициент Холла и Холловская проводимость) исследованы в интервале температур 300-800 К, а ширина запрещенной зоны рассчитана на основе температурной зависимости электропроводности и определено значение $\Delta E=1,52$ эВ.

Выявлено, что коэффициент термо-э.д.с. уменьшается в области удельной электропроводности и имеет р-тип проводимости.

Keywords: synthesis, compound, temperature, electrical conductivity, properties Ключевые слова: синтез, соединение, температура, электропроводность, свойства

Синтез новых полупроводниковых соединений и исследование их физико-химических свойств в настоящее время являются одними из наиболее актуальных вопросов в области твердых тел современной физики и химии.

Основной целью работы является изучение характера взаимодействия теллурида цинка (ZnTe) и теллурида тербия-3 (Ть₂Те₃) и изучение электрофизических свойств соединения ZnTb₂Te₄, полученного при этом взаимодействии.

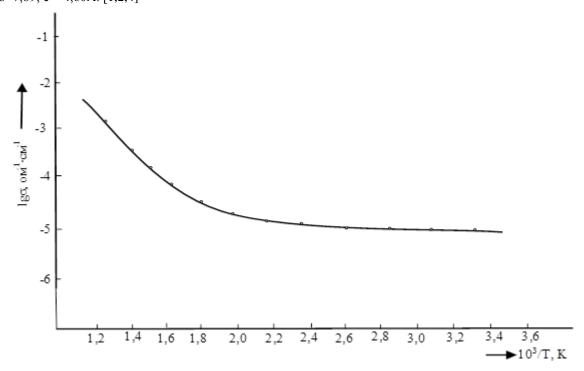
Для исследования сечения ZnTe-Tb₂Te₃ в системе Zn-Tb-Те было синтезировано 18 сплавов при определенном мол. % соотношении. Синтез сплавов проводили при температуре 1200-1300 К. Синтезированные сплавы кипятили в течение 150-250 часов. Термические свойства сплавов исследовали на приборе ВДТА 8М, рентгенофазовый анализ дифрактометр D8 Avance фирмы Bruker, микроструктурный анализ - на микроскопе МИМ-8, микротвердость - на приборе ПМТ-3, плотность - пикнометрическим и рентгеноструктурным методами.

По суммированию результатов исследований впервые построена диаграмма состояния системы ZnS-Tb₂Te₃ и установлено, что в этой системе образуется тройное соединение ZnTb₂Te₄, конгруэнтно плавящееся при 1320С, в соотношении 1 :1 основных компонентов.

Синтез используемого в эксперименте ZnTb₂Te₄ осуществляется следующим образом. Для этого берут кварцевую ампулу длиной l=18-20 см и диаметром 1,2-1,3 см. Взять теллурид цинка (ZnTe) и теллур тербия-3 (Tb_2Te_3) в стехиометрическом составе, взвесить с точностью 0,0001 мин на аналитических весах и поместить в кварцевую ампулу.

Воздух внутрь ампулы отсасывается до 0,013 Па с помощью вакуумного устройства, горловина газообразного кислорода запаивается в пламени газовой лампы. Процесс синтеза проводят при механическом перемешивании при температуре 900- 1000° С в течение 4 часов. Варится в течение 250 часов при температуре 800 К, чтобы обеспечить совершенство кристалла. Параметры решетки этих соединений определены методом рентгенофазового анализа. Было определено, что соединение $ZnTb_2Te_4$ кристаллизуется в ромбических сингониях. Параметры кристаллической решетки a=18,6; b=7,89; b=4,60Å. b=7,89; b=4,60Å. b=7,89; b=4,60Å. b=1,2,4

Температура плавления соединения $ZnTb_2Te_4$ составляет $1320^{\circ}C$. Микротвердость $H\mu$ = $2200M\Pi a$, плотность ρ =6,90 г/см3. Для того чтобы определить, является ли соединение $ZnTb_2Te_4$ полупроводником, были исследованы его электрофизические свойства в широком диапазоне температур (300-800 K). Для этого, измеряя синтезированный образец $ZnTb_2Te_4$, были изготовлены цилиндрические образцы длиной I=8-10 мм и диаметром d=4-6 мм. Электрические параметры измерялись зондовым методом на постоянном токе. Электропроводность и константа Холла соединения $ZnTb_2Te_4$ были измерены в диапазоне температур 300-800K, и полученные результаты показаны на рисунках 1 и 2 соответственно.



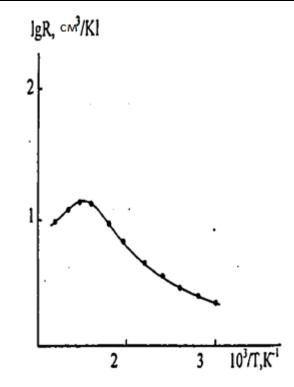
Puc.1. Температурная зависимость электропроводности соединения $ZnTb_2Te_4$

Изменение электропроводности и постоянной Холла с ростом температуры характерно для полупроводников, что видно из графика зависимости $lg\sigma\sim(103/T\pi)$ и $lgR\sim f(103/T\pi)$.

Как видно из рис. 1, при повышении температуры соединения $ZnTb_2Te_4$ от комнатной до 600 К происходит уменьшение удельного заряда, как и в случае металла. Причина возникновения такой ситуации заключается в том, что количество свободных носителей заряда в указанном температурном интервале остается постоянным, а вязкость уменьшается. Однако, начиная с температуры 600К, в результате перемещения носителей заряда в зону про-

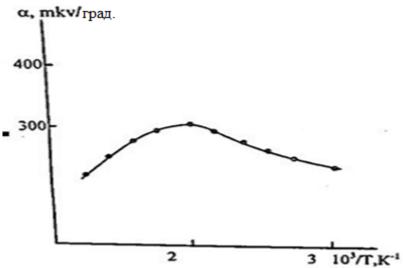
водимости, поглощая энергию, равную или превышающую ширину запрещенной зоны, стоимость проведения электричества возрастает.

При температурном исследовании коэффициента Холла соединения $ZnTb_2Te_4$ при температуре 300-800К установлено, что при повышении температуры от комнатной до 550К коэффициент Холла увеличивается, а в области удельной проводимости уменьшается (рис. 2). В целом удельная проводимость соединения $ZnTb_2Te_4$ и температурные зависимости коэффициента Холла подтверждают друг друга [3].



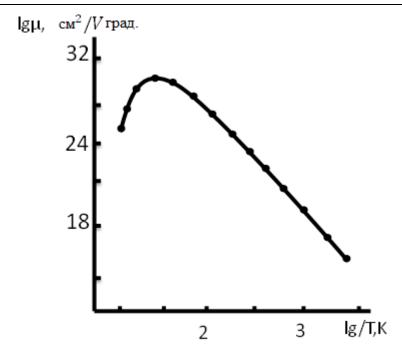
Puc.2 Зависимость константы Холла от температуры соединения $ZnTb_2Te_4$

Температурная зависимость термо э.д.с от температуры, изученная экспериментально для соединения $ZnTb_2Te_4$, представлена на рис. 3.



Puc.3 $3aвисимость термо э.д.с от температуры соединения <math>ZnTb_2Te_4$

Как видно из рис. 3, в интервале температур 300-500К увеличивается, а затем уменьшается.



Puc.4 Зависимость подвижности Холла от температуры соединения $ZnTb_2Te_4$

Аномальное увеличение коэффициента Холла и термо э.д.с. при низкой температуре, вероятно, является результатом сложной зонной структуры этой трехкомпонентной комбинации. На основании графиков зависимости электропроводности и константы Холла от температуры рассчитана ширина запрещенной зоны соединения $ZnTb_2Te_4$ в области удельной проводимости. Было рассчитано, что для исследуемого соединения $\Delta E=1,52$ эВ [3].

Для соединения $ZnTb_2Te_4$ определяли тип проводимости по изменению знака Холла и термоэ.д.с. и установили, что оно имеет р-тип проводимости в исследованном интервале температур.

В целом характер изменения электропроводности и теплового напряжения в зависимости от температуры можно непосредственно объяснить изменением проводимости носителей заряда в зависимости от температуры.

Изменение других параметров (α , σ) могут быть связаны с изменением носителей заряда исследуемого кристалла [3].

Температурный коэффициент подвижности приведен на рисунке 4. Как видно, из рисунка при низких температурах происходит снижение удельной электропроводности. Это снижение происходит по закону, близкому к закону $T^{-3/2}$. Это соответствует исследованию соединения $ZnTb_2Te_4$ на продольных акустических фонах носителей заряда.

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EARTH SCIENCES

SHORT DISTANCE BETWEEN THE BOTTOMHOLE AND THE PERFORATION INTERVAL AS A HINDERING FACTOR FOR HYDRAULIC FRACTURING

Kochetkov A.,

PJSC TATNEFT, Almetyevsk, Russia

Fattakhov I.,

Doctor of Technical Sciences, Associate Professor, Professor of Department of Exploration and Development of Oil and Gas Fields

Ufa State Petroleum Technical University (Oktyabrsky Branch), Oktyabrsky, Russia
Doctor of Technical Sciences, Associate Professor, Professor
Almetyevsk State Oil Institute, Almetyevsk, Russia
Head of the department for organization of enhanced oil recovery operations
PJSC TATNEFT, Almetyevsk, Russia

Khusnutdinov R.

LLC Gazpromneft-Khantos Khantymansiysk, Russia https://doi.org/10.5281/zenodo.7788791

Abstract

The purpose of the paper is to determine the presence and degree of influence of the close location of the well bottomhole to the perforation interval during standard proppant fracturing in vertical and directional wells to clarify the recommended measures in accordance with the conditions of hydraulic fracturing. In the industrial practice of some companies, the classification of hindering factors, including the short distance between the bottomhole and the perforation interval, through which the fracturing mixture is injected, is assumed. The paper presents a method to measure, confirm or deny the influence of this factor on the risks of hydraulic fracturing. The scientific novelty of the work lies in the application of a new approach to risk assessment of the considered factors, including the definition of metrics and statistical analysis of the level of correlation between the measured parameters and the proposed metrics. As a result, the method was developed and the calculation on its basis, which shows the refutation of the impact of the factor under consideration. Recommendations were developed to consider this fact, including inexpediency of treatment volume limitation in given conditions that potentially increases hydraulic fracturing efficiency when current bottomhole is close to the treatment interval.

Keywords: proppant fracturing, fracturing risks, backfill, sump, perforation interval, fracture packing, technological complexities of fracturing, categorical analysis.

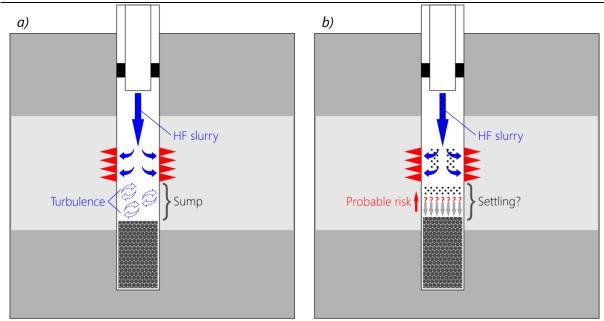
Short distance between the bottomhole and the perforation interval as a hindering factor for hydraulic fracturing

In industrial practice of hydraulic fracturing, as well as in a series of publications, there is a requirement to have a certain distance below the perforation interval, free for the movement of liquid or proppant mixture during the process [1]. This distance is often referred to as a sump, and in this publication the term sump will be taken as the distance from the bottom of the perforation interval to the current bottomhole during hydraulic fracturing, taking into account the planned backfill (Figure 1a). Service companies for hydraulic fracturing, as a rule, low value of the sump, and especially its absence, is accepted as a complicating factor [2]. Accordingly, in such cases, compensatory measures are suggested, including limitation of treatment volume, increase of fracturing fluid viscosity and pumping rate. Based on the sump data, limitations, which, in combination with other technical and geological conditions, reduce the potential effect of hydraulic fracturing, can be determined at the planning stage of hydraulic fracturing processes [3].

For many technical limitations of the fracturing process, their essence can be defined explicitly and no additional confirmation of the dependencies is required. For example, the influence of tubing diameter

on friction is noted in every well without exception and measured by direct method, which eliminates the need for confirmation. However, in some other cases, when the factor does not appear every time or cannot be measured directly, the influence of the factor passes into the category of risks appearing with a certain probability. In such cases, it is necessary to use statistics to confirm the risk in question. Also, in these cases, statistical analysis can be used to estimate the probability and consequences of the risk. The impact of a sump, as shown in detail below, belongs to this type of factor.

The hypothesis about the negative effect of a small sump is based on two assumptions. First, it is assumed that some proppant is settling at the bottom of the well during injection. Under this assumption, the small sump may decrease to 0 during injection, and then gradually settling proppant may partially or completely overlap the perforation interval, followed by an increase in frictional pressure loss in the perforations and process complications, respectively (Figure 1b). Second, the small sump value is associated with the risk of inaccurate determination of the current bottomhole depth and possible overlap of the perforations before work commences, with the risk of consequences similar to the first assumption. Figure 1 schematically illustrates the above processes.



Pic.1 Risk of proppant settlement during hydraulic fracturing.

An important remark to the settling assumption is the lack of experimental and theoretical data confirming the fact of the specified risk. Turbulent movement of the proppant-fluid mixture is expected to occur in the sump interval (Figure 1a), but proppant settling during this process (Figure 1b) has not been confirmed experimentally. Confirmation or rejection of this assumption is complicated by the lack of direct observation or recording of the process [4]. After stopping pumping, settlement of proppant residue does occur, as noted in laboratory tests, which limits the possibility of confirming with measurements of the current bottomhole after hydraulic fracturing. The second uncertainty is proppant settlement in the perforation interval during injection. For those cases where there is no sump during well preparation or presumed settlement has occurred during the process, it is unclear whether proppant settlement can continue while the mixture is moving from the production casing space into the perforations [5].

Statistics can be applied to confirm or reject the influence of the indicated factor. The conclusions presented on the basis of statistics cannot fully prove the validity of all details of the hypothesis, but statistically significant influence of the parameter can become the basis for further study of the detected phenomenon. Conversely, the lack of influence on explicit measurable metrics can be the basis for conclusions about the invalidity of such a hypothesis[6].

For statistical analysis, 620 non-horizontal wells with proppant fracturing were selected. The size of the sump was determined as a variable *Distance* by equation 1:

$$Distance = \begin{cases} h_b - Perf_d, for \ h_b - Perf_d > 0 \\ 0, for \ h_b - Perf_d \leq 0 \end{cases} (1)$$

Wherre h_b – depth of backfill or current face in the absence of backfill, $Perf_d$ – lower boundary of the perforation interval. Negative values of h_b – $Perf_d$ may be obtained for those cases where the perforation is partially overlapped by the backfill, in which case the sump should be assumed to be 0 [7].

For further categorical analysis, a categorical variable *Distance_{cat}* was added, dividing the sump into 3 categories: «0-1 m», «1-2 m» amd «More of 2m».

Two metrics have been selected to evaluate the effect of the variable. The first metric is $Propp_{needls}$, represents the mass of proppant left in the wellbore in excess of the planned underproduction. Thus, this metric would be 0 for a technologically successful process and >0 for a process complication, with the higher the complication, the higher the value of the metric. The average value of the metric is suitable for describing the technical complexity of a sample of fracturing processes.

The second metric, *ISIP*_{growth}, represents the increase in the actual ISIP of the fracture relative to the planned value. This metric allows to fix the non-predicted effect of fracture packing. An increase in the average value of the metric will indicate the presence of an additional fracture packing factor in the sample relative to the sample with a lower average value of this metric. Since a drop in the ISIP below the predicted value indicates a reduced or absent packing effect, or at least the absence of an additional, unaccounted for factor causing packing, to the same extent as a zero value, all negative values of the metric are equated to 0.

A general categorical analysis, as a first approximation, showed a decrease in the probability and volume of technological complication during hydraulic fracturing, as well as a decrease in the packing effect.

ahla 1

First approximation of categorical analysis

Category	Average metric Propp_needls	Average metric ISIP_growth
0-1 m	0,086	31,8
1-2 m	0,064	28,6
More of 2m	0,072	27,8
Average of all	0,072	28,2

Nonlinearity of the decreasing trend of the metric $Propp_{needls}$, as well as the slight difference between the samples in the different categories indicated the possible presence of hidden dependencies. A search was conducted by adding subcategories.

Extended categorical analysis

Table 2

	Entenaca categoricai anai	, 515		
Category	Average metric Propp_needls	Average metric ISIP_growth		
0-1 m				
Producing wells	0,086	31,8		
1-2 m				
Just drilled	0,000	7,3		
Producing wells	0,067	29,5		
More of 2m				
Just drilled	0,109	32,8		
Producing wells	0,069	27,3		
Average of all	0,072	28,2		

The extended categorical analysis includes a division within categories into subcategories of well type-operating or post-drilling fracturing. The extended categorical analysis showed a relatively greater influence of well status on metrics than the category by sump size, but relationships are apparent.

To clarify the presence of statistical relationships obtained, categorical analysis was conducted for the two most common processing objects in the sample under consideration.

Categories by development object

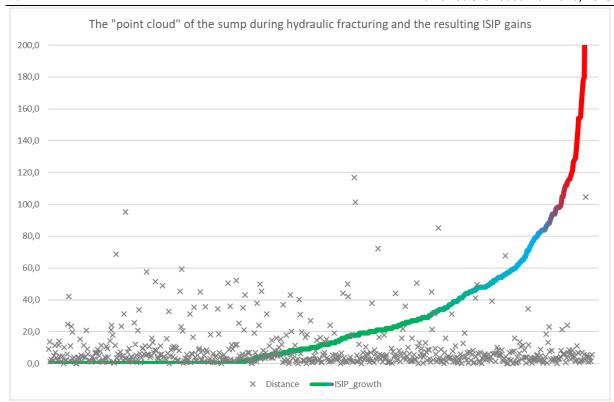
Table 3

Category	Average metric Propp_needls	Average metric ISIP_growth
D 0	0,079	36,3
0-1 m	0,433	43,2
1-2 m	0,000	60,8
More of 2m	0,071	34,7
D1a	0,142	32,1
0-1 m	0,000	16,9
1-2 m	0,104	32,5
More of 2m	0,170	33,8
Average of all	0,104	34,6

A comparison across development objects showed an unexpected result. Previously revealed dependence, despite its weak manifestation, manifested itself for different data slices, but for formation D1a, contrary to the initial hypothesis, showed an opposite trend for both metrics. Such trends are possible only if two conditions are met simultaneously - low value of absolute difference of values and presence of distortions when converting a real variable into a categorical one. The resulting scatter is really not large - in the first approximation

it is a deviation of no more than 9 kg of proppant and 3.5 atm from the overall average value. Differences of this magnitude could have been caused by distortions in the conversion of the variables.

To visually assess the possible existence of a relationship between complicated fracture conditions and the sump value, below is a graph where the sorted *ISIP*_{growth} metric is compared with the sump values as a "point cloud".



Pic.2 Sumpf and ISIP metrics

The uniform density of sump points in Figure 2 visually demonstrates the lack of correlation between the measured parameter and the metric. Thus, the study of the data set showed that there does not seem to be a significant influence of sump size on the technological risks of hydraulic fracturing and this factor should not limit the use of proppant hydraulic fracturing technologies, including the volume of proppant used.

Conclusions and recommendations

- 1. Conducting a simplified statistical analysis similar to the presented analysis allows to exclude at the initial stage the hypotheses that potentially have no effect on the technologically significant parameters of hydraulic fracturing.
- 2. The result of the analysis does not exclude the possibility of proppant settlement on the well bottomhole, but shows the absence of significant influence of the sump on the risks during hydraulic fracturing, which may be due to stopping the proppant settlement process when the sump is filled with proppant.
- 3. Based on the fact that there are no additional complications, it is recommended to exclude the factor of close location of perforation interval to the bottomhole from the risk factors when performing standard propapnt fracturing.
- 4. The analysis identified potentially higher risk categories, including post-drilling fracturing and D1a layered fracturing it is recommended to conduct additional data review, including for confirmation of these hypotheses with the help of statistics.

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ECONOMIC SCIENCES

SECURITIES IN ISLAMIC FINANCE, SUKUK WORLD

Kopbaeva R. Meirbaev B.

Al-Farabi Kazakh National University, Almaty, Kazakhstan, Chairman of the Scientific Council, Ph.D. https://doi.org/10.5281/zenodo.7789229

Abstract

The purpose of this article is to determine the importance of sukuk operations in the financing of large government projects as a result of the expansion of the sukuk market, which is one of the most important forms of Islamic finance. One of the most important forms of Islamic finance is debt securities, which have been proven to be interest-free bonds, ie sukuk, "equity certificates representing joint ownership of assets in a portfolio of fixed assets." Given the current economic situation and the crisis, it was found that the possibility of investing in a new class of assets is interpreted as a way to use capital more efficiently and effectively. A comparative overview of the neighboring Turkish market showed that the success of the Islamic banking system in sukuk operations in Kazakhstan has increased. It was noted that the introduction of sukuk in the Kazakhstan market has brought many prospects.

Keywords: sukuk, bonds, securities, Islamic banking, assets.

Introduction

When considering the main sources of Islamic finance, it is accepted that Islamic finance takes the Holy Qur'an as its main source, and then consists of financial activities carried out within the framework of Islamic principles, especially in the stages of application. In this context, this market was created by purchasing existing investment instruments that conform to Islamic principles or developing new investment instruments that conform to Islamic principles. The main elements prohibited by Islamic rules are transactions and payment of interest, engaging in illegal activities such as gambling, and activities related to uncertainty.

Today, Islamic finance with the advent of Islamic banking, which provides interest-free products and services, and over time, mudaraba (labor capital partnership), Musharaka (profit-loss partnership), Murabaha (cost plus margin sales), insurance and Ijara in the capital market (rent) many other financial products in accordance with Sharia rules financing, Takaful (Insurance), exception (purchase based on order). In principle, the Islamic mutual fund market is a very dynamic and open market. Islamic Investment Fund, in other words, Islamic securitization, sukuk; this means that Islamic value papers are issued to finance projects, including the development of infrastructure, the improvement of production, etc. [13, 283]

In this context, the purpose of issuing a Sukuk is to start a new project, develop an existing project, or use the funds raised to finance commercial activities according to the share due to the funds raised. In the sukuk system, the income received by the investor or sukuk holder; comes from the right to receive income from business activities, ownership of a certain asset, or a joint venture. Sukuk investors are not paid interest; specific economic transactions based on sharing or leasing assets are distributed. When the reasons for the release of sukuk are considered from the point of view of issuers; Although financing is the expansion and diversification of the investor base, from the point of

view of investors; the possibility of investing in a new asset class can be interpreted as a way to use capital more efficiently and efficiently, and it can be explained from the point of view of the possibility of applying it to some government projects in Turkey and Kazakhstan.

The main part DEFINITION AND TYPES OF SUKUK Definition and content of sukuk

Sukuk are long-term and short-term securities (also called "Islamic bonds") issued under Sharia law, covered by tangible assets. Sukuk papers allow Muslims to invest funds for profit purposes without contradicting Islamic law, which does not allow them to receive trade interest (RIBA). It attracts the funds of Islamic investors who cannot invest in simply borrowed financial instruments related to religious faith. [8.66] the issuers of sukuk are Islamic and non-Islamic organizations. Sukuk is Arabic. "Sakk" — "legal document, act, receipt" is an incorrect concept that is considered a "Sukuk Islamic bond". Sukuk AAOIFI (accounting and audit organization for Islamic financial institutions) "Co-named securities representing private property interests in existing or future asset portfolios. Here, debtbased sukuk agreements also differ from ordinary bonds. Simple bond: imposing a net debt burden on the Issuer. The creditor, the borrower is the ratio of money to money. Sukuk certificate: share of ownership in an actual or planned asset. The relationship between the issuer and the investor is based on a clear understanding in the business in question. The debt issued under sukuk is not charged with adding any surcharges for money. Only from the profits from the project, the partners will be able to separate the corresponding trophies from each other. In Arabic, the word Senet is used for bills and bonds, while for Islamic bonds, the word "sukuk", which is the plural form of the word saqq, is used. [3. 315-329]

Accounting and audit institution of Islamic financial institutions (AAOIFI) .

Sukuk, representing the same values after issue; the amounts from issue are invested as planned; certificates representing rights and shares in fixed assets, depending on the type of investment made, or granting partnership rights to a project or special investment activity.

In principle, sukuk indicates the right to own or profit from an asset. The right and claim in sukuk is not only the right of money circulation, but also the right of property.

According to the Islamic Academy of fiqh, the concept of sukuk is mainly related to two rules. The rules under consideration can be represented as follows.

Property owned by any individual can be represented by written bonds and documents.

These bonds and documents can be sold at market prices.

In the basic sense, we can summarize the features of sukuk as follows;

- This is the plural of SACC and they are equally valuable testimonies. They represent property rights with Indivisible shares.
- They are also called interest-free bonds on the market.

- Ensures the establishment of rights in favor of certificate holders for special projects or assets subject to special investment.
- They are asset-based ("asset-based", "asset-backed")
- As a rule, the underlying assets are transferred to a special purpose company (APL/SPV). They establish the right to income from assets.
- Since it is possible to quote in organized markets, the rating organizations can be evaluated.
 - They can be sold in the secondary market.
 - They can be fixed or variable income.

Sukuk provides its investor with a basis for financing in exchange for interest income on traditional bonds.

It provides a share of profit from the income received from the asset it owns, which differs from traditional bonds in this respect [5. 33]. This feature distinguishes sukuk from traditional bonds. While traditional bonds consist of interest-bearing securities, sukuk are essentially investment certificates consisting of ownership in the asset basket [14. 78-100]. In this context, the main differences between bonds and sukuk are as shown in Table 1.

Differences between sukuk and traditional bonds

	bonds	sukuk	
Credit risk	Issuer risk	Issuer risk	
Terms and conditions	Using the standard bond	Like Bond	
Pricing	Depending on the credit rating and demand	Conditional bonds are taken as indicators	
Interest payment	Regular coupon payment	Regular payment, such as coupon payment	
Credit rating	Like the credit profile of the debtor company	Like the credit profile of the debtor company	
Investor profile	Ordinary investor	Although there are Islamic investors in general, this profile changes over time.	
Hedge	GDI / interest rate swaps	There is no tool for direct hedge sukuk.	
Maturity	Can be short, medium and long-term	It is medium-term, usually 3-5 years, and its paybac period is slowly extended.	

The purpose of the issue of sukuk is to conclude a new transaction based on the funds raised and the share in the possession. Starting a project, developing an existing project, or using the funds raised for commercial purposes to finance an action. In the sukuk system, the income received by the investor or sukuk holder; the right to receive income from business activities, a particular asset, property or joint venture arises from his possession. On the other hand, the sukuk technique also differs from other securities that can be called in the form of an asset certificate or securitized asset (securitized assets) it must be based on being [15. 2009:13]. Understanding the sukuk system first of all, it is necessary to know the asset-backed securities (ADMK) system. A company that has a portfolio of receivables in the VDMC system, sells the portfolio to a Special Purpose Vehicle (Special Purpose Vehicle/SPV) and SPV

turns a portfolio into securities. At the same time, investment banks mediate the sale of assets to investors. In the sukuk system, material, real business relations (for example, profit and loss, partnership) or accounts receivable arising from a financial lease agreement. Because sukuk is carried out on the basis of

securitization, can also be classified as Secured Bonds [15. 2009:14]. As the most crucial difference between sukuk and bonds; an asset - based sukuk certificate whereas a bond is a certificate based on the amount of money borrowed.

This also means that although bonds have a certain amount of income guarantee, sukuk does not have such a guarantee. However, in addition to ownership in sukuk, other guarantees may be granted.

The purpose of issuing a Sukuk is to start a new project, develop an existing project, or use the funds raised to finance commercial activities in accordance with the share due to the funds raised. In the sukuk system, the income that an investor or sukuk holder receives; on the other hand, sukuk is derived from other securities that can technically be referred to as asset securities or securitized assets, otherwise it must be based on existence [15. 2009:13]. To understand the sukuk system, you first need to know the asset-backed securities (VDMK) system. A company with a portfolio of receivables in the VDMK system sells this portfolio to a Special Purpose Vehicle (special Purpose Vehicle

cle/SPV), and the SPV exchanges the portfolio for securities. At the same time, investment banks mediate the sale of these securities to investors. Since the sukuk system has asset-based securitization of receivables arising from specific commercial relationships (e.g. profit sharing) or financial leasing contracts, sukuk is backed by asset bonds [15. 2009: 14]. As the most crucial difference between a Sukuk and a bond; a Sukuk is

an asset - based certificate, while a bond is a certificate based on borrowed money. In addition, while the bonds have a certain income guarantee, sukuk does not have such a guarantee. However, other guarantees may be provided in addition to ownership in sukuk. Sukuk types defined by AAOIFI [6. 8]

Sukuk	species	are	defined	hv	AAOIFI
Dunun	SUCCICS	arc	ucinicu	LJ Y	

1	Sukuk Al-Ijara	8	Sukuk Al-Murabaha
2	Sukukuzharah mousubuthuma	9	Sukuk Al-Musharaka
3	Sukukmanfaijarah	10	Sukuk Al-mudaraba
4	Sukukmanfaijarah mousubuthuma	11	Sukuk Al-waqala
5 Sukkimilkiyat Al-khadamat 12 Su		Sukuk Al-muzraa	
6	Sukuk Al-istisna	13	Sukuk Al-moussaka
7	Sukuk al-Salam	14	Sukuk Al-muqarasa

As can be seen from this table, there are many types of sukuk defined by the organization for accounting and supervision of Islamic financial institutions. The study discusses leasing indexed sukuk (Ijara sukuk), venture capital indexed sukuk (mudaraba

sukuk), profit and loss partnership investment indexed sukuk (Musharaka sukuk), forward supply contract indexed sukuk (hi sukuk), general purpose financial support Sukuk (types such as sukuk), Special Infrastructure Financing indexed Sukuk (Istisna Sukuk).

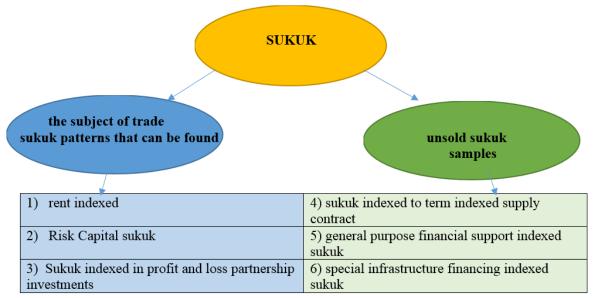


Figure 1: main types of Sukuk

Indexed by rent sukuk: Izhara sukuk.

The word Ijara means "allow". As a term, it refers to Financial Leasing, which is used by interest-free banks and is similar to conventional banks. In this type of sukuk, interest-free banks, equipment, buildings, etc.he buys things and rents them out to his customers in exchange for a fixed rental income [11. 129].

In Ijara sukuk, one of the parties buys the equipment that the customer wants to use by paying a rental fee and leases it to the customer for a rental fee,

Securitized asset under Islamic financing; Sukuk world and Turkish market overview

The lease term and fee are set in advance, and the ownership of the property that is the subject of the contract remains with the lessor. This type of sukuk offers the owner an equal partnership or ownership of the leased property under the usufruct of the property. Ijara sukuk gives its owners the right to own the property, receive the rent and dispose of the sukuk in such a way

that it does not affect the rights of the tenant, for example, to buy and sell. Izhara sukuk holders bear the costs of maintaining said property [15. 2009:19].

way to work;

- -The debtor sells the asset in question to the SPV at a pre-agreed price.
- By issuing the same sukuk certificates at the price purchased by the SPV

provides financing.

- The lease agreement stipulates that the presence of an obligation is the lessee for a certain period of time.
- It is signed between the SPV and the debtor with re-leasing.
- The SPV periodically receives rent from the borrower.
- The rent is distributed to investors (sukuk holders).
- At maturity or in case of fragmentation, the SPV will be at a predetermined price

returns the asset to the debtor. This amount must be equal to all debts on the terms of icara sukuk.

Venture capital indexed sukuk: mudaraba sukuk.

Mudaraba is the provision of equity through management support for all types of enterprises within the framework of a profit and loss partnership, and in this regard, it attracts a structure similar to venture capital. In mudaraba sukuk, the issuer of the certificate is mudarib (entrepreneur). Financiers are owners of capital, and the funds raised are mudaraba capital. Certificate holders are the owners of assets in the Mudaraba business and a share of the profit from the transaction. Certificate holders also bear the costs if they occur. Mudaraba sukuk represents joint ownership and grants the sukuk buyer the right to participate in individual projects against the sukuk issuer. The mudaraba sukuk treaty is based on the official notification at the time of the issuance, which contains all the information indicating the type of capital, the rate of return and other conditions in accordance with the rules of Sharia [15. 2009: 18].

way to work;

- Mudarib agrees with the project owner for the launch/construction of the project.

come on.

- SPV issues sukuk to raise funds.
- Mudarib receives final capital receipts and a fixed return payment from the project activities.
- Mudarip will deliver to the owner after the project is completed.

Sukuk indexed in the investment of a profit and loss partnership. Musharaka sukuk

Musharaka is a partnership of Labor and capital. It is possible to have a partner with a different or the same amount of capital participation. Each partner has the right to use capital within established limits. Commercial activities may be limited to only one area, or they may be designated as applicable in many areas if an agreement is reached. Although the distribution of losses is distributed at the rate of participation in capital, according to the agreement, the distribution of profits can be different. [17. 129]. In Musharaka sukuk, the issuing party is the party that invokes a special finance company (SPV) created to carry out a specific project or activity. The funders are partners of the Musharaka treaty. The funds raised as shares represent the contribution of the participants to the capital of Musharaka. Sukuk holders also own the assets of the company and are entitled to the profits that are carried out. The main difference between Musharaka and mudaraba is that the capital comes from both sides [15, 2009: 18].

way to work;

- The company (as Musharaka) contributes to the soil or other physical assets that are the target of Musharaka.
- SPV (as Musharik) gives cash (emission income of investors in Musharak, etc.).
- Musharaka appoints an agent authorized by the company to develop land or physical valuables and sell/lease valuables developed on behalf of Musharaka, with the addition of additional cash to Musharaka.

- The Authorized Agent (company) receives a stimulating variable remuneration in addition to the regular agency fee.
 - The profit is distributed to sukuk shareholders.
- -The company provides a non-refundable guarantee for the purchase of Musharaka SPV shares on a semi-annual basis at a pre-agreed price, and at the end of the specified period, the SPV will not have a Musharaka share.

Sukuk indexed to forward delivery contract: Salem sukuk

Salem – a contract of sale, which is carried out when the seller undertakes to transfer the goods to the buyer at a later date [18. 128]. Salem sukuks-documents issued as equivalent to the collection of Salem capital. Buyers of documents exported with this accumulated capital acquire ownership of the goods sold on the basis of Salem. The issuer of documents is the seller of these goods. Members are buyers of goods. Membership fees to be paid are the cost of purchasing goods. Those who issue Salem documents are the owners, and these owners have the right to sell Salem-based goods with issued Salem sukuk documents [8, 66].

way to work;

- VKSH signs an agreement with the debtor to find both goods and buyers.

The obligator undertakes to buy the goods on behalf of the sukuk-buyers and then sell the goods for profit on behalf of the sukuk owners.

- Hello documents are issued to investors and VKSH sukuk receives a refund. - Salem returns are given to the debtor, who sells the goods later. - VKSH receives the goods from the debtor.

"They sell the goods for profit on behalf of the mandatory sukuk holders.

- Sukuk holders receive income from the sale of goods [7. 24].

Sukuk indexed to support general purpose funding: Murabaha sukuk

Murabaha is defined as a sales transaction made by adding the amount of agreed profit to the value of the goods [11. 26]. Murabaha sukuk is the certificate giver, the seller of the goods, the buyer of the goods who receives the Murabaha, and the fund is the cost of purchasing the goods. Certificate holders own Murabaha merchandise and are entitled to the final selling price when reselling the merchandise [15. 21].

way to work;

- The main contract is concluded between the SPV and the borrower.
- SPV issues sukuk to investors and receives sukuk returns.
- SPV immediately buys the goods from the seller.
- Add the profit margin of the SPV product within the agreed period from the spot price

sells to the debtor for installments.

- The debtor sells the goods there to the buyer of the goods.
- Investors receive the final selling price and income.

Sukuk indexed for private infrastructure financing: Istisna ' Sukuk

An exception is a purchase and sale agreement between the seller and the buyer for the production of goods. This method is usually used in the sale of goods that take a lot of time to produce or take time to deliver. According to the situation in the contract, the sale can be paid in cash, in installments or later. [16. 150]

Istisna sukuk-certificates of equal value issued in order to ensure the necessary funds for the production of products belonging to the certificate holder. While the proceeds from membership are the cost of the product, the issuers of the certificates are the manufacturers (seller/supplier) and the members are the buyers of the planned product. The buyers of the certificate own the product and are entitled to the sale price of the product sold, except for the sale price of the certificate or in parallel. Istisna sukuk is useful for financing large infrastructure projects. Istisna is suitable for financial intermediation because it allows the contractor in Istisna to conclude a parallel exception agreement with the subcontractor. For this reason, a financial institution can carry out a construction operation for profit and transfer the construction operation to a specialized firm with a subcontractor agreement [15. 22]. On the other hand, when considering graph 1, it is seen that the types of sukuk most commonly used in Islamic Capital Markets, International and domestic markets are the same as the aforementioned types of sukuk.

OVERVIEW OF SUKUK MARKETS IN THE WORLD AND TURKEY.

The Gulf of Malaysia region, which ranks first in the world sukuk market, is one of the main places for the issue of sukuk; the first sukuk was issued in Malaysia in 1983 [14. 79]. On the other hand, looking at the continuation of sukuk applications, in 2001 the Malaysian government carried out the production of sukuk on a large scale. Initially exported at US 5 500 million, 51% of Malaysian sukuk was sold in the Gulf countries, 30% in Asia, 15% in Europe and 4% in the United States [9. 98]. The implemented structure is the Federal Land Authority of Malaysia, which is a government agency that ensures the transfer of land under its ownership by an established SPV (Public Asset Company) and the rental income received from there through the sale to the Malaysian treasury. SPV issued sukuk as income to the individuals sold. It was built in the building. The capital market Council of Malaysia has linked the issuance of sukuk to strict regulations. Unlike other bond issues, it brought additional obligations. For example, to issue sukuk in Malaysia, the consent of the "Shar-i Soviet commission", consisting of persons recognized and declared by the SC, is required. Thus, the compliance of export-based activities with Islamic principles was recorded. Export-related data and documents and export-related explanations are published in the list. All issues should be evaluated by rating agencies recognized by the SC. In addition, if all Islamic financial instruments are not listed on the Malaysian stock exchanges, they must be subject to a fully automated issuance/tender system implemented by SC and a real-time electronic transfer system of funds and securities.

In fact, the sukuk market has shown growing growth in the world over the past 10 years. According

to the International Islamic Financial Market Data, International Sukuk transactions amount to US 1 100-200 million per month. The issue is still small compared to traditional bonds issued mainly by the government (Bahrain, Malaysia, Qatar and Pakistan), the private sector, international organizations and, to a lesser extent, Islamic banks.

Sukuk world within Islamic financing.

Regarding the issue of sukuk in Turkey, The Capital Market Council (SMB) prepared a communique in 2010. According to the CMB communiqué, sukuk is defined as a rental certificate in Turkey. The communiqué notes that the lease certificate is offered to our capital market as a tool similar to sukuk, which has become a global investment instrument and is also defined as "interest-free bonds", since the withdrawal of funds from capital markets by issuing leasing certificates to private sector companies. In the CMB communiqué, the lease certificate is defined as a tool that allows private sector companies (primary institution) to obtain financing through the use of assets owned or acquired through leasing through an "asset leasing company" (VKS). give-rent-take method. It was noted that a structure called a special purpose organization (trust) VKSH abroad is regulated as a joint-stock company, which is created with a minimum of obligations, since it is not in the legal system of our country. In order to protect the rights of investors with a communique and prevent the abuse of assets accepted by the VKS on behalf of investors or the income from these assets, the APL Charter is mandatory. must meet certain conditions and be approved by the CMB.

The rental certificate issuance system is basically based on a primary institution receiving funds by leasing assets later transferred to the ALC. VKS covers the financing of these assets acquired by it at the first stage with a lease certificate issued by it and makes periodic payments of these certificates with periodic rental income from the original institution. The income received from said assets returned to the original institution at the end of the maturity period is distributed to the holders of the lease certificate in proportion to their shares, and the issued lease certificate is depreciated. this allows them to have rights in accordance with their share in income. In this definition, an asset leasing company (ALC); is a joint-stock company created only by intermediary institutions, banks and resource institutions for the issuance of lease certificates. What does being mean; any movable or immovable property and intangible assets purchased or leased by an asset leasing company. If the original institution; It is a joint-stock company that transfers assets owned or leased to a leasing company (SPK, Communique, 2010). Study of sukuk experience in Turkey Kuwait Türk Katılık Bankası A.The first issue made by Sh on August 17, 2010 was долларды 100 million and the securities were traded at a fixed income rate of 0.5.25% and a maturity date until August 2013. In Turkey, where the population is predominantly Muslim, this first use of the sukuk issue, which is a bond under Islamic rules, attracted great attention and was seen as an indicator of the country's openness and readiness for alternative Islamic financial structures. On the other hand, on September 18,

2012, the Treasury Board authorized a trio of Citigroup, HSBC and Liquty houses, and a cy 1.5 billion Sukuk was put up for sale. As a result of the first tender, 5 requests were received. 58% of sukuk represents the Middle East, 13% Europe, 12% Asia, and 9% sukuk represents the aggregate and retained share of ownership in a tangible asset as it relates to a specific project or specific investment activity. The investor in sukuk does not own the bond issuer's debt obligation, but rather owns a portion of the asset associated with the investment. This means that Sukuk owners, unlike bondholders, receive a portion of the income from the relevant asset. The most common type of sukuk comes in the form of a certificate of trust. These certificates are regulated by Western laws, however, the structure of this type of sukuk is much more complex. The fundraising organization first creates an offshore special purpose vehicle (SPV). The SPV then issues certificates of trust to qualified investors and puts the proceeds from the investment into a financing agreement with the issuing organization. In return, investors receive a portion of the profit associated with the asset.

Sukuk structured as trust certificates only apply if SPV can be established in an offshore jurisdiction that allows such a trust. This is sometimes impossible. If SPV and trust certificates cannot be established, sukuk can be structured as an alternative civil law entity. In this scenario, an asset leasing company will be created in the country of issue, which will profitably purchase the asset and return it to the organization in need of financing.

Production of sukuk on the market of Kazakhstan.

On July 20, 2013, JSC" Development Bank of Kazakhstan "(DBK) "Sukuk" Al-Murabaha " successfully issued Islamic bonds in the amount of 240 million Malaysian riggits at 5.50% per annum and with a maturity of 5 years [4]. The bank reported that 62% was distributed among Malaysian investors, and the remaining 38% in the Kazakhstan market. "Development Bank of Kazakhstan" became the first state in the former Soviet government to issue Islamic precious Kagaz sukuk in accordance with the principles and norms of Sharia. Development prospects of the Islamic Development Bank [1.47-50]. Kazakhstan and the Islamic Development Bank have developed a partnership strategy for 2012-14. The volume of investments covered by target sectors of the economy, such as transport and energy infrastructure, agriculture, science and technology, is more than доллардан 1 billion. For 10 years, the Islamic Development Bank has been ranked highly by 3 main international rating agencies. Zero risk in the projects in which he participated, does not pose any threat to the national and world economy, does not pose any problems [4]. "The program "" successfully "" will be implemented in September this year at the expense of funds raised by the Islamic Development Bank (IDB), ""fund for financial support of Agriculture "" JSC plans." Aktobe, Pavlodar and South Kazakhstan regions were approved as pilot regions for the implementation of the program.

Conclusion

The Islamic financial system is built on the principle of Justice. Just as there is justice in society, in the family, in the service, there must be justice in the financial system. The distribution of both income and expenses by Islamic banks on an equal basis with the entrepreneur is a real manifestation of this Justice. In developed states, only rich people see the fun of both banking and earnings. And in a country that has adopted the Islamic financial system, all this is common to the people. Like other countries of the world, Kazakhstan must adopt the Islamic financial system if it wants to get out of the economic crisis. The Islamic economy will benefit all people with different living standards, effectively solving the problem of unemployment. The baidaly orator has a saying: "first of all, what is bad is bad." Without sharing the risk with the client, the return skyrocketed the interest rate of the funds, and the raft of banks that were easily overwhelmed by excess money disappeared. If the Islamic Development Bank is permanently established in the country and operates regularly, there is great hope for the future of the economy of our state, especially the financial system. In my opinion, I am sure that the financial situation of our country will be better if such a situation is established. Because, firstly, this system is based on purity. It also has a clear goal – to improve the social situation of the population. Today, in our country and even around the world, there is an understanding that "we can live on credit." That is, people are completely accustomed to credit. And Islamic financing is of great importance in the final elimination of this unpromising trend.

The financial market is a part of the loan capital market, where capital is redistributed between lenders and borrowers in the form of the issue and purchase and sale of sukuk securities. The financial market can be considered as a combination of primary and secondary markets. The primary market appears at the time of issue of securities, on which financial funds are mobilized. In the secondary market, these reserves are redistributed several times. The secondary market is divided into exchange and over-the-counter markets. On the exchange market, which are specialized stock exchanges, shares of leading companies are bought and sold, and on the over-the-counter market, securities whose price is not set on the exchange for various reasons. From an institutional point of view, the financial market is credit and financial institutions, through which financial flows flow from owners to borrowers and vice versa. Such inflows take the form of transferring financial funds directly from lenders to borrowers without any financial intermediaries. The incompatibility of interests is eliminated by financial intermediaries, which include financial institutions: commercial banks, credit unions, stock exchanges, financial companies, pension and insurance funds, investment banks, construction societies, etc. Financial intermediaries, if necessary, combine the funds of several lenders to meet the significant needs of borrowers and take on a potential risk (risk), thus playing an important role in the stabilization of KN.

It has shown that all potential issuers can follow the leadership of securities and effectively use the sukuk platform to expand the investor base, improve liquidity and access Islamic financial products in new markets. It contributes to the development of the Islamic finance industry in Kazakhstan and the region, as well as the positioning of sukuk as an International Center for Islamic finance.

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CRITERION AND ASSESSMENT OF THE EFFICIENCY OF THE IMPLEMENTATION OF THE EFFICIENT MANAGEMENT OF THE INDUSTRIAL ENTERPRISE

Huanq Tianzen

Postgraduate Student, Department of Banking Economics Belarusian State University Minsk, Republic of Belarus

КРИТЕРИЙ И ОЦЕНКА ЭФФЕКТИВНОСТИ РЕАЛИЗАЦИИ ЭФФЕКТИВНОГО УПРАВЛЕНИЯ ПРОМЫШЛЕННЫМ ПРЕДПРИЯТИЕМ

Хуан Тяньцэнь,

аспирант кафедры банковской экономики Белорусский государственный университет г. Минск, Республика Беларусь https://doi.org/10.5281/zenodo.7789239

Abstract

The article develops a criterion for the effectiveness of the development of an industrial enterprise using a dynamic system of indicators, which allows you to measure the effectiveness of purposeful activities in dynamics and taking into account the development trends of a business entity. On the basis of the developed criterion, an assessment was made of the effectiveness of managing an industrial enterprise in China, taking into account the specifics of indicators of production and economic activity used in the industrial complex of the country.

Аннотация

В статье разработан критерий эффективности развития промышленного предприятия с использованием динамической системы показателей, который позволяет измерять эффективность целенаправленной деятельности в динамике и с учетом тенденций развития субъекта хозяйствования. На основе разработанного критерия проведена оценка эффективности управления промышленным предприятием Китая с учетом специфики используемых в промышленном комплексе страны показателей производственно-хозяйственной деятельности.

Keywords: industrial enterprise, management, dynamic scorecard, efficiency criterion.

Ключевые слова: промышленное предприятие, управление, динамическая система показателей, критерий эффективности.

Введение. Реализация эффективного управления промышленным предприятием (ПП) является необходимым условием повышения его конкурентоспособности в долгосрочной перспективе, улучшения финансовых результатов и финансового состояния субъекта хозяйствования. При этом актуальной проблемой является разработка критерия эффективности управления ПП, обеспечивающего ее оценку в динамике с учетом тенденций развития субъекта хозяйствования и его целенаправленной деятельности. В связи с этим дальнейшего исследования требуют вопросы разработку критерия и оценки эффективности управления ПП.

Основная часть. Реализация эффективного управления ПП требует четкой постановки стратегической цели и определения задач его развития, выделение функций и разработки критериев эффективности деятельности субъекта хозяйствования, формирования организационно-экономического обеспечения достижения поставленной стратегической цели в соответствии с разработанными критериями и выделенными задачами деятельности ПП.

Стратегической целью развития системы может выступать достижение определенных социальных результатов, представляющихся желательными для данного состояния в данное текущее

время понимания обществом своих будущих потребностей [1, с.21]. В свою очередь в качестве стратегической цели ПП может выступать совокупность результатов его хозяйственной деятельности, представляющимися желательными с точки зрения понимания высшим руководством компании ее будущего состояния с учетом факторов макро- и микросреды ПП, его внешней и внутренней среды [2, с. 15].

Реализация эффективного управления ПП требует комплексного и системного рассмотрения субъекта хозяйствования. ПП, как любую экономическую систему, можно представить в качестве [1, с. 25]:

- структуры;
- взаимодействия;
- процесса.

С этой точки зрения ПП представляет собой [2, с. 17]:

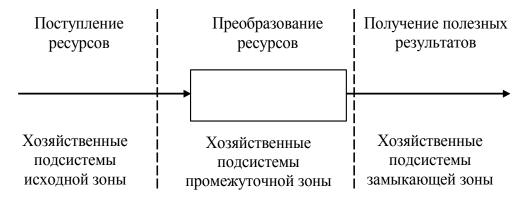
- систему, имеющую организационную структуру управления;
- систему, включающую совокупность организационно-функциональных подсистем, реализующих специфические функции ПП и обеспечивающих взаимодействие как внутри субъекта хозяйствования, так и с его внешней средой;

 систему, включающую совокупность хозяйственных подсистем, на вход которой поступают разнообразные ресурсы, преобразуемые в системе, что позволяет получить на выходе необходимые полезные результаты.

Наличие различных подходов к рассмотрению ПП позволяет выделить различные подходы к формированию и развитию его деятельности, реализации эффективного управления субъекта хозяйствования.

Структуру ПП, исходя из его рассмотрения с позиций системного подхода, можно представить в виде трех блоков хозяйственных подсистем (рисунок 1) [2, c.17]:

- исходной зоны, хозяйственные подсистемы которой обеспечивают снабжение необходимыми для осуществления деятельности ПП ресурсами;
- промежуточной зоны, в которой сгруппированы хозяйственные подсистемы, реализующие преобразование поступающих ресурсов в полезные результаты;
- замыкающей зоны, в которой сгруппированы хозяйственные подсистемы, отражающие достижение поставленных целей ПП.



 $Puc.\ 1- Обобщенная\ структура\ \Pi\Pi$ как системы с точки зрения процессного подхода к рассмотрению его деятельности

Источник: Источник: авторская разработка на основе [2, с.17].

В соответствии с предлагаемым подходом предприятие представляет собой систему, состоящую из отдельных блоков – хозяйственных подсистем. Хозяйственная подсистема – это группа структурных элементов, объединенных по признаку высокого уровня связи всей их деятельности с функцией предприятия, завершенностью цикла выработки и реализации решений.

Итак, при рассмотрении предприятия с позиций системного подхода все множество полезных результатов можно разбить на три качественно разных группы:

- исходные полезные результаты, представляющие собой восприятие системой входных характеристик ее работы;
- промежуточные полезные результаты, представляющие собой продукт труда и творчества тех звеньев системы, которые не имеют непосредственного доступа ни к ее входам, ни к ее выходам;
- замыкающие полезные результаты, представляющие собой элементы выхода системы и реализующие влияние системы на среду.

В представленном случае исходным полем для структурирования выступает предприятие в целом. При смене масштаба системы весь цикл анализа повторяется вновь. Так, если предметом структурного рассмотрения становится, например, хозяйственная подсистема управления кадрами, то в ней вновь

должны быть выделены исходная, промежуточная и замыкающая зоны и так до уровня конкретных рабочих мест.

Каждая зона характеризуется теми полезными результатами, которые в ней «производятся». При условии инновационного развития предприятия как экономической системы темпы прироста полезных результатов замыкающей зоны должны превышать темпы прироста полезных результатов промежуточной зоны, которые в свою очередь должны опережать прирост показателей исходной зоны. Рассмотрение предприятия как системы, на вход котопоступают разнообразные ресурсы, преобразуемые в системе, что позволяет получить на выходе необходимые полезные результаты, обеспечивает возможность обосновано подходить к разработке критериев эффективности управления

Подход к построению интегральной оценки эффективности управления $\Pi\Pi$ возможен на основе использования положений теории хозяйственных систем [1; 2; 3].

Предположим, что для оценки состояния и развития ПП достаточно конечного числа первичных показателей. При планировании определяются значения этих показателей. Оцениваются желательные значения этих показателей на конец планового периода. Пример для трех показателей (P_1 , P_2 , P_3) приведен на рисунке 2.

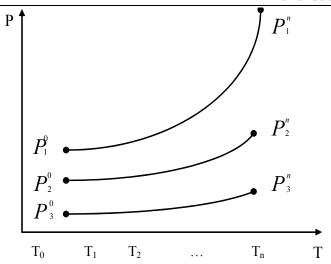


Рис. 2 – График динамики роста первичных показателей

Примечание. Условные обозначения: T_0 – момент определения значений первичных показателей, или начало анализируемого периода; T_n – момент времени, на который оцениваются значения показателей, или конец анализируемого периода; T_1 , T_2 , ..., T_n – моменты времени для оценки текущей эффективности деятельности ПП; P_1^0 , P_2^0 , P_3^0 – значения показателей, характеризующих ПП в начале анализируемого периода; P_1^n , P_2^n , P_3^n – желательные значения показателей в конце анализируемого периода.

Источник: авторская разработка на основе [1, с.64; 2, с.25].

Из графика видно, что хозяйственная система будет развиваться эффективно, если значения показателей будут быстрее всего увеличиваться для P_1 и медленнее всего для P_3 . Можно построить эталонный ряд, в соответствии с которым должны увеличиваться *приросты значений выделенных показателей*. Чем ближе реальный порядок приростов значений показателей к эталонному, тем выше эффективность деятельности экономической системы.

Для приведенного на рисунке 6 случая эталонный ряд, в соответствии с которым должны увеличиваться приросты значений показателей, будет следующим:

 P_1 P_2

 P_3

Для определения эталонного порядка показателей можно использовать методы экспертных оценок (например, метод индивидуальной экспертной оценки, метод интервью, метод Дельфи, метод эвристического прогнозирования [4], метод коллективной генерации идей), в процессе применения которых проводится опрос лиц, выражающих интересы развития рассматриваемой экономической системы, чтобы выяснить относительную важность и сроки совершения гипотетических событий.

Сущность метода экспертных оценок заключается в проведении экспертами интуитивно-логического анализа проблемы с количественной оценкой суждений и формализованной обработкой результатов. Получаемое в результате обработки обобщенное мнение экспертов принимается как решение проблемы.

Определение параметров развития экономической системы и ее субъектов методом экспертных оценок сводится к отбору наиболее значимых пока-

зателей, отражающих их деятельность, а оценка может быть проведена на основе следующих действий:

- определение перечня показателей, объективно отражающих деятельность рассматриваемого субъекта экономической системы;
 - разработка методики опроса экспертов;
 - разработка анкет и таблиц;
 - подбор квалифицированных экспертов;
- выявление и обобщение индивидуальных мнений экспертов.

Для оценки степени согласованности экспертов используется коэффициент конкордации W-общий коэффициент ранговой корреляции для группы, состоящей из m экспертов.

Коэффициент конкордации рассчитывается по формуле, предложенной Кендаллом (1) [4]:

$$W = \frac{12S}{m^2 (n^3 - n)}. (1)$$

Коэффициент конкордации принимает значения от 0 до 1. W, равное 1, означает полную согласованность мнений экспертов; W, равное 0, — полную рассогласованность.

Отбор и закрепление желательного порядка возрастания отобранных показателей экспертами производятся в определенной последовательности в зависимости от значимости показателей для достижения заданного результата.

Критерий эффективности (динамическая система показателей эффективности) представляет собой эталонный ряд, в соответствии с которым должна осуществляться динамика показателей, выраженная отношением значения прироста данного года к значению прироста в предыдущем году. Раз-

ница (степень совпадения) между эталонным и реальным порядком ускорений значений показателей характеризует эффективность деятельности.

Динамическая система показателей обладает следующими свойствами [1; 2]:

- результативность функционирования ПП оценивается в динамике (состояние системы в рассматриваемый момент времени сравнивается с ее состоянием в предшествующие моменты);
- $-\,$ оценка отражает структуру реального потока продуктов ПП;
- показатели, включаемые в динамическую систему, являются учитываемыми и регистрируемыми в процессе хозяйственной деятельности ПП;
- принципы построения динамической системы не зависят от масштабов и характера оцениваемой деятельности ПП.

Интегральный показатель эффективности ПП (ИПЭ) рассчитывается на основе сравнения эталонного порядка изменения значений показателей и реального по формуле (2):

$$\mathcal{U}\Pi\mathcal{G} = \frac{\left(1 + K_{om\kappa\pi}\right)\left(1 + K_{uns}\right)}{4}, \qquad (2)$$

где $K_{\text{откл}}$ – коэффициент ранговой корреляции Спирмена (по отклонениям) (формула (3));

 $K_{\text{инв}}$ — коэффициент ранговой корреляции Кендалла (по инверсиям) (формула (4)).

$$K_{om\kappa n} = 1 - \frac{6\sum_{s=1}^{n} Y_s^2}{n(n^2 - 1)},$$
(3)

$$Y_s = s - X_s, \qquad s = 1, 2, \dots, n$$

где Y_s — разность между рангом в фактическом упорядочении и местом показателя s;

s — место показателя в эталонном упорядочении;

n — число показателей, включенных в эталонную динамическую систему;

 X_s – ранг показателя в фактическом упорядочении.

$$K_{une} = 1 - \frac{4\sum_{s=1}^{n} m_{s}}{n(n-1)}, \qquad (4)$$

$$m_{s} = \sum_{p}^{n} a_{p}, \qquad a_{p} = \begin{cases} 1, X_{s} > X_{p} \\ 0, X_{s} < X_{p} \end{cases},$$

где m_s — число инверсий для показателя s;

s — место рассматриваемого показателя в эталонном упорядочении;

n — число показателей, включенных в эталонную динамическую систему;

 a_p — функция, показывающая, находится или нет показатель в инверсии с рассматриваемым показателем s, и если находится, то a_p =1, а если нет, то a_p =0;

 $X_s(X_p)$ — ранг, который в фактическом упорядочении имеет показатель, занимающий в эталонном упорядочении место s(p);

P- место показателей, сравниваемых с рассматриваемым.

Значения интегрального показателя эффективности ИПЭ изменяются в диапазоне от 0 до 1. В случае совпадения реального порядка увеличения темпов приростов показателей с эталонным значение интегрального показателя эффективности будет равно 1. В случае диаметрально противоположного порядка для значений показателей и эталонного порядка интегральный показатель эффективности будет равен 0.

Последовательность построения критериев эффективности будет следующей. Прежде всего, устанавливается, что является входом для рассматриваемого ПП, какие процессы протекают внутри ПП и какие результаты имеются на его выходе. На этом этапе происходит первоначальное определение назначения ПП и дается характеристика процессов в исходной, промежуточной и замыкающей зонах. Далее выявляются функции ПП.

Следующий этап — регистрация всех используемых в процессе управления ПП показателей. Выбранные показатели группируются на показатели исходной, промежуточной и замыкающей зон системы. Из составленного списка необходимо устранить все показатели, которые рассчитываются как производные, например производительность труда, рентабельность и т.д. Удаляются также показатели, на значение которых рассматриваемая система влияния не имеет.

Такой отбор позволяет получить перечень показателей, необходимых для построения критерия эффективности функционирования $\Pi\Pi$.

Перечень показателей является основой для построения окончательного варианта интегрированного показателя эффективности функционирования ПП. Как уже отмечалось выше, при определении нормативного порядка показателей можно использовать экспертный опрос лиц, выражающих интересы развития рассматриваемого ПП.

Таким образом, для построения критерия эффективности функционирования ПП используется подход, основанный на формировании порядка роста значений показателей, характеризующих реализацию целей развития данного субъекта хозяйствования. Как уже указывалось, в этом случае более эффективной признается деятельность, при которой порядок роста темпов прироста значений показателей, отобранных в нормативный ряд, приближается к нормативно закрепленному порядку.

Представление структуры ПП в виде совокупности комплексов исходной, промежуточной и замыкающей зон позволяет установить критерий эффективности его функционирования.

Рассмотрение ПП в виде системы предполагает определение его функций как подсистемы системы более высокого уровня и как системы с собственными интересами и целями. Функция ПП как подсистемы системы более высокого уровня выявляется в соответствии с ее местом и специализацией среди субъектов экономики более высокого уровня. Функция ПП как системы с собственными

интересами и целями устанавливается исходя из понимания его назначения в удовлетворении потребностей клиентов, обеспечивающее необходимый уровень финансовых результатов и конкурентоспособности ПП. Определение функции ПП дает возможность выделить показатели замыкающей, промежуточной и исходной зон.

Цель ПП как подсистемы системы более высокого уровня – увеличение объемов выпуска продуктов, как необходимое условие обеспечения удовлетворение потребностей домашних хозяйств, а также повышение эффективности общественного производства.

Предложенная методика оценки эффективности развития ПП с на основе динамической системы показателей включает следующие этапы.

- 1. Определение целевой функции ПП.
- 2. Определение совокупности показателей, соответствующей функции ПП и адекватно отражающей происходящие в нем процессы.
- 3. Закрепление эталонного порядка показателей, в соответствии с которым должны изменяться

значения отобранных показателей, на основе результатов экспертного опроса специалистов и исходя из теоретических представлений – формирование критерия эффективности развития ПП (динамической системы показателей).

4. Расчет на основе ранговых статистик (формулы (2)–(4)) интегрального показателя эффективности развития ПП на основе измерения динамики изменения значений показателей, включенных в критерий, за анализируемый период времени.

С помощью разработанного критерия эффективности развития ПП и расчета на его основе интегрального показателя деятельности можно оценивать успешность движения ПП к желательному состоянию, характеризующемуся достижением определенных результатов.

В качестве основного результирующего показателя коммерческой организация является прибыль, которая зависит от ряда факторов (рисунок 3).



Рис. 3 — Факторы, определяющие величину чистой (налогооблагаемой) прибыли коммерческой организации

Источник: авторская разработка на основе [5].

Необходимо отметить, что представленная на рисунке схема декомпозиции основной цели «Увеличение прибыли» носит в определенном смысле условный характер и имеет ряд допущений. Так, например, такое направление увеличение прибыли ПП, как увеличение цен, может быть реализовано и за счет снижения цен. Такое возможно при условии, что спрос на продукцию ПП имеет высокую эластичность и даже незначительное снижение цены приведет к существенному росту спроса, а соответственно объемов производства и продаж. Это, в

свою очередь, особенно при высоком удельном весе постоянных затрат в себестоимости продукции приведет к его снижению в связи с ростом объема производства и распределением постоянных затрат на большее количество производимой продукции. И, наконец, как следствие снижение себестоимости и увеличение объема продаж может привести к увеличению прибыли от реализации продукции ПП.

Как уже отмечалось ранее, основной целью ПП может выступать совокупность результатов его хозяйственной деятельности, представляющимися

желательными с точки зрения понимания высшим руководством компании ее будущего состояния с учетом факторов макро- и микросреды ПП, его внешней и внутренней среды. При этом основным финансово-экономическим результатом деятельности ПП выступает чистая прибыль, которая формируется за счет, прежде всего, прибыли от основной деятельности (операционная прибыль). Также для улучшения финансовых результатов ПП необходимо обеспечение соответствующей динамики добавленной стоимости, включающей такие важные элементы как заработная плата, амортизация и, непосредственно, сама операционная прибыль. Также с учетом необходимости формирования инновационной направленности деятельности ПП в качестве важнейшего из показателей, определяющих эффективность субъекта хозяйствования, выступают «Выручка от продаж новой продукции» и «Количество патентных заявок».

Таким образом, в результате формирования возможного набора показателей, характеризующих эффективность деятельности развития ПП, эффективность управления субъектом хозяйствования, а также в процессе экспертного опроса и в результате ранжирования показателей, их набор в замыкающей зоне и последовательность закрепления (эталонный ранг движения) стали следующими:

- 1. Чистая прибыль.
- 2. Операционная прибыль.
- 3. Добавленная стоимость.
- 4. Выручка от продаж новой продукции.
- 5. Количество патентных заявок.

Соответственно, эффективной можно назвать такую деятельность ПП, которая приводит к наиболее динамичному росту значений выделенных показателей. Последовательность закрепления показателей «Операционная прибыль», «Добавленная стоимость», «Выручка от продаж новой продукции», «Чистый денежный поток от операционной деятельности» и «Количество патентных заявок» определяется степенью влияния отражаемых ими процессов на возрастание значений показателя «Чистая прибыль».

Выбор и закрепление набора показателей в замыкающей зоне критерия эффективности функционирования ПП позволяют определить структуру показателей промежуточной и исходной зон. В промежуточной зоне должен осуществляться процесс преобразование ресурсов в результаты, которые нашли свое отражение в замыкающей зоне крите-

рия эффективности. Показателями процесса преобразования могут быть: затраты на разработку новых продуктов, сумма инвестиций в НИОКР, затраты на внедрение, адаптацию и усвоение зарубежных технологий, инвестиции в основные средства и нематериальные активы, а также численность персонала, занятого НИОКР. Далее выделив показатели, характеризующие важные условия для реализации эффективной деятельности ПП, необходимо провести закрепление их порядка. Таким образом, состав и последовательность закрепления показателей промежуточной зоны критерия эффективности может быть следующей:

- 1. Количество патентных заявок.
- 2. Затраты на разработку новых продуктов.
- 3. Сумма инвестиций в НИОКР.
- 4. Затраты на внедрение, адаптацию и усвоение зарубежных технологий.
- 5. Инвестиции в основные средства и нематериальные активы.

Динамика изменения этих показателей в направлении достижения поставленных целей должна обеспечивать повышение эффективности управления ПП и инновационности его деятельности.

Выбор набора показателей и закрепление их порядка в исходной зоне осуществляется исходя из выделения наиболее важных ресурсов, поступающих на вход ПП. Так, для обеспечения деятельности ПП необходимо потребление различных видов ресурсов – трудовых, материальных и энергетических. В связи с этим перечень показателей исходной зоны критерия эффективности развития ПП и порядок их закрепления (эталонный ранг движения) следующий:

- 1. Затраты на оплату труда.
- 2. Потреблено топливно-энергетических ресурсов.
 - 3. Материальные затраты.

После ранжирования показателей и проведения экспертизы была определена степень согласованности экспертов путем расчета коэффициента конкордации для случая строгого ранжирования. Полученное значение коэффициента конкордации W=0.97 свидетельствует о высокой степени согласованности экспертной группы.

Критерий эффективности развития НЭС с позиции домашних хозяйств приведен в таблице 1. При этом необходимо отметить, что все стоимостные показатели необходимо представлять в сопоставимых ценах.

Таблица 1.

Критерий эффективности развития ПП

Эталонный ранг движения	Показатель	Единица из- мерения	Зона
<u>движения</u> 1	Чистая прибыль	млн юаней	Замыкающая
2	Операционная прибыль	млн юаней	Замыкающая
3	Добавленная стоимость	млн юаней	Замыкающая
4	Выручка от продаж новой продукции	млн юаней	Замыкающая
5	Количество патентных заявок	шт.	Замыкающая
6	Затраты на разработку новых продуктов	млн юаней	Замыкающая
7	Сумма инвестиций в НИОКР	млн юаней	Промежуточная
8	Затраты на внедрение, адаптацию и усвоение зарубежных технологий	млн юаней	Промежуточная
9	Инвестиции в основные средства и нематериальные активы	млн юаней	Промежуточная
10	Численность персонала, занятого НИОКР	чел.	Промежуточная
11	Затраты на оплату труда	млн юаней	Исходная
12	Затраты на топливно-энергетические ресурсы	млн юаней	Исходная
13	Затраты на сырье, материалы, полуфабрикаты и комплектующие	млн юаней	Исходная

Источник: авторская разработка.

С помощью разработанного критерия эффективности развития ПП и расчета на его основе интегрального показателя эффективности можно оценивать успешность движения системы к желательному состоянию, характеризующемуся достижением определенных результатов.

Таким образом, используемая методика оценки эффективности развития экономических систем на основе формирования динамической системы показателей и использования метода ранговых статистик позволяет обоснованно подходить к разработке критерия эффективности развития ПП. Отличиями предлагаемой методики от существующих являются учет динамического характера деятельности ПП и возможность интегральной оценки эффективности и инновационности его развития, а

также наличие условий для сопоставления результатов с поставленными целями развития. В свою очередь, разработанный критерий эффективности развития ПП и расчет на его основе интегрального показателя эффективности позволяют оценивать успешность движения системы к желательному состоянию, характеризующемуся достижением определенных результатов с учетом поставленных целей и тенденций развития ПП.

Для оценки эффективности развития ПП в соответствии с рассмотренной методикой и разработанным критерием необходимо сделать следующее.

1. За несколько периодов (n) сведем в таблицу 2 абсолютные значения показателей, входящих в критерий эффективности развития $\Pi\Pi$, представленный в таблице 1.

Таблица 2

Абсолютные значения	показатанай кинтапия	addarminia ani	розрития ПП
АОСОЛЮТНЫЕ ЗНАЧЕНИЯ	показателей критерия	эффективности	развития гиг

Поморожать	31	Эталонный				
Показатель	2017	2018	2019	2020	2021	ранг движения
Чистая прибыль	660,0	665,5	671,8	673,6	676,4	1
Операционная прибыль	600,6	698,3	751,6	691,4	712,3	2
Добавленная стоимость	4373,8	3412,0	1622,0	2671,8	4384,0	3
Выручка от продаж новой продукции	1489,0	1038,0	948,0	1135,0	1300,0	4
Количество патентных заявок	24	24	23	21	21	5
Затраты на разработку новых продуктов	101,5	74,0	68,3	64,5	72,6	6
Сумма инвестиций в НИОКР	157,0	120,6	112,8	102,8	123,6	7
Затраты на внедрение, адаптацию и усвоение зарубежных технологий	41,8	37,1	28,9	22,5	23,4	8
Инвестиции в основные средства и нематериальные активы	96,5	90,7	87,2	86,5	88,3	9
Численность персонала, занятого НИОКР	46	46	45	44	44	10
Затраты на оплату труда	51,9	52,5	50,5	49,9	51,1	11
Затраты на топливно-энергетические ресурсы	311,8	303,6	283,2	291,2	297,4	12
Затраты на сырье, материалы, полуфабрикаты и комплектующие	828,8	729,9	707,8	683,4	718,2	13

Источник: авторская разработка на основе данных ПП.

2. Определим приросты значений показателей, представленных в таблице 2, за периоды времени T_2 — T_1 , T_3 — T_2 , ..., T_n — T_{n-1} (2018—2017, 2019—2018,

2020–2019, 2021–2020): отношение значения показателя последующего года к значению показателя предыдущего года (таблица 3).

Таблица 3. **Прирост значений показателей критерия эффективности развития ПП**

•	Отношение з	Эталонный			
Показатель	значе	нию показател	я предыдущег	о года	ранг движе-
	2018/2017	2019/ 2018	2020/ 2019	2021/2020	ния
Чистая прибыль	1,0083	1,0096	1,0027	1,0040	1
Операционная прибыль	1,1626	1,0765	0,9199	1,0302	2
Добавленная стоимость	0,7801	0,4754	1,6472	1,6408	3
Выручка от продаж новой продукции	0,6971	0,9132	1,1973	1,1453	4
Количество патентных заявок	0,9905	0,9448	0,9104	1,0249	5
Затраты на разработку новых продуктов	0,7285	0,9229	0,9449	1,1253	6
Сумма инвестиций в НИОКР	0,7680	0,9345	0,9115	1,2022	7
Затраты на внедрение, адаптацию и усвоение зарубежных технологий	0,8861	0,7786	0,7786	1,0400	8
Инвестиции в основные средства и нематериальные активы	0,9402	0,9612	0,9919	1,0209	9
Численность персонала, занятого НИОКР	0,9941	0,9879	0,9800	0,9882	10
Затраты на оплату труда	1,0118	0,9613	0,9885	1,0234	11
Затраты на топливно-энергетические ресурсы	0,9737	0,9328	1,0283	1,0213	12
Затраты на сырье, материалы, полуфабрикаты и комплектующие	0,8806	0,9697	0,9656	1,0508	13

Источник: авторская разработка на основе таблицы 2.

^{3.} Определим значения темпов изменения приростов значений показателей за периоды T_3 — T_1 , T_4 — T_2 , ..., T_n — T_{n-2} (2019—2017, 2020—2018, 2021—2019): отношение последующего значения прироста показателя к предыдущему значению прироста (таблица 4).

Таблица 4.

Темпы изменения приростов значений показателей критерия эффективности развития ПП

темпы изменения приростов значении по	okasaresten kpni	терии эффект	nbhocin pasbi	1111/1 1111		
	Отношение по	следующего з	начения при-	Эталон-		
Показатель	роста показате	роста показателя к предыдущему значе-				
	Н	ию прироста		движения		
Чистая прибыль	1,0013	0,9932	1,0013	1		
Операционная прибыль	0,9259	0,8545	1,1199	2		
Добавленная стоимость	0,6094	3,4650	0,9961	3		
Выручка от продаж новой продукции	1,3099	1,3112	0,9566	4		
Количество патентных заявок	0,9539	0,9636	1,1258	5		
Затраты на разработку новых продуктов	1,2668	1,0239	1,1909	6		
Сумма инвестиций в НИОКР	1,2169	0,9753	1,3190	7		
Затраты на внедрение, адаптацию и усвоение зарубежных технологий	0,8787	1,0000	1,3357	8		
Инвестиции в основные средства и нематериальные активы	1,0223	1,0319	1,0292	9		
Численность персонала, занятого НИОКР	0,9938	0,9920	1,0084	10		
Затраты на оплату труда	0,9501	1,0283	1,0353	11		
Затраты на топливно-энергетические ресурсы	0,9580	1,1024	0,9932	12		
Затраты на сырье, материалы, полуфабрикаты и комплектующие	1,1012	0,9957	1,0883	13		
	2		· · · · · · · · · · · · · · · · · · ·			

Источник: авторская разработка на основе таблицы 3.

4. Используя данные таблицы 4, определим фактический ранг показателей, входящих в состав критерия эффективности развития ПП (таблица 5).

Таблица 5. Определение фактического ранга движения показателей критерия эффективности развития ПП на основе темпов изменения их приростов

Цормотири и роче	Темп прироста и фактический ранг показателей критерия					ия
Нормативный ранг движения показателей	темп	фактиче-	темп	фактиче-	темп	фактиче-
движения показателеи	прироста	ский ранг	прироста	ский ранг	прироста	ский ранг
1	1,0013	6	0,9932	9	1,0013	10
2	0,9259	11	0,8545	13	1,1199	5
3	0,6094	13	3,4650	1	0,9961	11
4	1,3099	1	1,3112	2	0,9566	13
5	0,9539	9	0,9636	11	1,1258	4
6	1,2668	2	1,0239	6	1,1909	2
7	1,2169	3	0,9753	12	1,3190	1
8	0,8787	12	1,0000	7	1,3357	3
9	1,0223	5	1,0319	4	1,0292	8
10	0,9938	7	0,9920	10	1,0084	9
11	0,9501	10	1,0283	5	1,0353	7
12	0,9580	8	1,1024	3	0,9932	12
13	1,1012	4	0,9957	8	1,0883	6

Источник: авторская разработка на основе таблицы 4.

$$\begin{split} K_{om \kappa il} &= 1 - \frac{6 \times 402}{13 \times \left(13^2 - 1\right)} = -0,406 \\ K_{om \kappa il} &= 1 - \frac{6 \times 442}{2184} = -0,159 \\ K_{om \kappa il} &= 1 - \frac{6 \times 380}{2184} = -0,044 \\ K_{uh61} &= 1 - \frac{4 \times 40}{13 \times \left(13 - 1\right)} = -0,026 \end{split}$$

$$\begin{split} K_{_{UH62}} = & 1 - \frac{4 \! \times \! 43}{156} = -0,\! 103 \\ K_{_{UH63}} = & 1 - \frac{4 \! \times \! 40}{156} = -0,\! 026 \\ \text{ИПЭ}_{\Pi\Pi_1} = & \frac{(1 - 0,\! 406)(1 - 0,\! 026)}{4} = 0,\! 218 \\ \text{ИПЭ}_{\Pi\Pi_2} = & \frac{(1 - 0,\! 159)(1 - 0,\! 103)}{4} = 0,\! 189 \\ \text{ИПЭ}_{\Pi\Pi_3} = & \frac{(1 - 0,\! 44)(1 - 0,\! 026)}{4} = 0,\! 233 \end{split}$$

5. Далее, используя формулы (2)–(4), рассчитаем значения коэффициентов ранговой корреляции Спирмена (K_{omkn}) и Кендала (K_{ung}) и интегрального показателя эффективности развития ПП ($U\Pi \mathcal{F}_{\Pi\Pi}$) для различных периодов. При этом первый период включает сверстку значений показателей за 2017–2019 гг., второй – за 2018–2020 гг. и третий – за 2019–2021 гг. соответственно.

Сведем полученные результаты в таблицу 6 и отобразим их графически на рисунке 5.

Таблица 6. Значения коэффициентов Коткл, Кинв

и интегрального показателя эффективности развития ПП (ИПЭпп)

Номер периода (годы) Наименование показателя (2017-2019 гг.) (2018–2020 гг.) (2019-2021 гг.) -0,044 Коткл -0,104 -0,159Кинв -0,026-0,103-0,026ППЕПИ 0,218 0,189 0,233

Источник: авторская разработка на основе расчетов.

Как видно из таблицы 6 и рисунка 5, в соответствии с разработанным критерием эффективности развития $\Pi\Pi$ в период с 2017 по 2021 г. интегральный показатель эффективности имел разнонаправленную динамику.

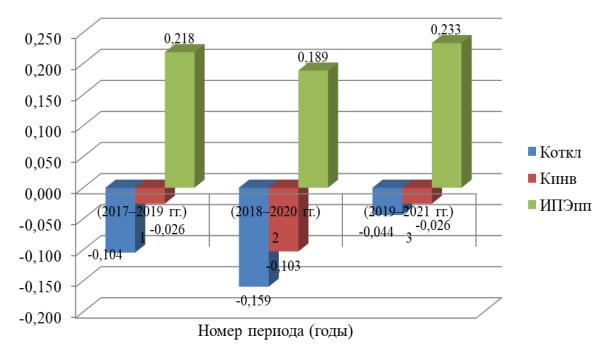


Рисунок 5. — Динамика коэффициентов $K_{om\kappa\pi}$, K_{uhb} и интегрального показателя эффективности развития ПП (ИПЭ $_{\Pi\Pi}$)

Источник: построено по данным таблицы 6.

Так, интегральный показатель эффективности управления и развития ПП наибольшего значения (0,233) достиг в третьем периоде, включающем сверстку показателей за 2019-2021 годы. Это свидетельствует о некотором повышении эффективности управления и развития ПП в данном периоде по сравнению с первым периодом, включающем сверстку показателей за 2017-2019 годы (значение интегрального показателя составило 0,218), и вторым периодом, включающем сверстку показателей за 2018-2020 годы (значение интегрального показателя составило 0,189). Однако значение интегрального показателя во всех трех периодах, охватывающих 2017-2021 годы, значительно ниже максимально возможного, равного 1, что свидетельствует о низкой эффективности управления и развития

В соответствии с предложенным критерием эффективности управления ПП и проведенной ее оценкой можно предложить следующие рекомендации, позволяющие субъекту хозяйствования достичь следующих результатов:

- 1. Увеличение чистой и операционной прибыли за счет повышения эффективности и инновационности развития ПП.
- 2. Сокращение энергоемкости и материалоемкости выпускаемой продукции за счет увеличения затрат на научно-исследовательские работы и внедрение новых технологий в процесс производства.
- 3. Увеличение производительности труда за счет более быстрого роста инвестиций и расходов на НИОКР.
- 4. Снижение себестоимости производства продукции на основе обеспечения роста более быстрыми темпами результатов производства по сравнению с затратами.

Таким образом, разработанная методика оценки эффективности развития ПП с использованием динамической системы показателей позволяет измерять эффективность целенаправленной деятельности в динамике и с учетом тенденций развития экономики ПП, а также обоснованно подходить к разработке механизмов достижения поставленных целей развития в соответствии с предложенным критерием эффективности.

Для достижения вышеназванных целей развития субъектов экономических отношений необходимо обеспечить:

— выделение многообразия элементарных задач, получаемых декомпозицией показателей критерия эффективности на подзадачи в соответствии с основными этапами производственно-хозяйственной деятельности ПП (снабжение, производство и сбыт), по признаку ресурсного обеспечения (материально-технического, финансового, кадрового и информационного), по уровням управления (институциональный уровень, управленческий уровень, технический уровень, технический уровень и уровень конкретного работника), и по этапам управленческого цикла (прогнозирование, планирование, организация, анализ и др.);

– разработку организационно-экономического обеспечения решения выделенных задач, включающего совокупность методов, приемов, способов распределения ресурсов (материальных, финансовых, трудовых и др.) в пространстве и во времени и реализующихся соответственно в структуре и стратегии.

Необходимо особо подчеркнуть, что при разработке направлений повышения эффективности управления ПП необходимо учитывать его влияние на показатели, характеризующие финансовые результаты и эффективность производственно-хозяйственной деятельности субъекта хозяйствования.

Заключение. Таким образом, реализация эффективного управления ПП включает постановку стратегической цели и определение задач его развития, выделение функций и разработки критериев эффективности деятельности субъекта хозяйствования, формирование организационно-экономического обеспечения достижения поставленной стратегической цели в соответствии с разработанными критериями и выделенными задачами. Разработан критерий эффективности развития ПП с использованием динамической системы показателей, который позволяет измерять эффективность целенаправленной деятельности в динамике и с учетом тенденций развития субъекта хозяйствования, а также обоснованно подходить к разработке организационно-экономического обеспечения достижения поставленных целей развития в соответствии с предложенным критерием. В соответствии с предложенным критерием эффективности управления ПП и проведенной ее оценкой можно предложить следующие рекомендации, позволяющие субъекту хозяйствования достичь следующих результатов: увеличение чистой и операционной прибыли за счет повышения эффективности и инновационности развития ПП; сокращение энергоемкости и материалоемкости выпускаемой продукции за счет увеличения затрат на научно-исследовательские работы и внедрение новых технологий в процесс производства; увеличение производительности труда за счет более быстрого роста инвестиций и расходов на НИОКР; снижение себестоимости производства продукции на основе обеспечения роста более быстрыми темпами результатов производства по сравнению с затратами.

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MEDICAL SCIENCES

INFLUENCE OF THE DENTAL STATUS OF ELDERLY AND OLD AGE PATIENTS ON THE QUALITY OF LIFE

Aliyev T.,

Doctor of Philosophy in Medicine, assistant
Department of Pediatric Dentistry
Azerbaijan Medical University
Baku, Azerbaijan

Huseynova R.,

Department of Therapeutic c Dentistry Assistent Azerbaijan Medical University Baku, Azerbaijan

Jalilova G.

Department of Pediatrik Dentistry Assistant Azerbaijan Medical University Baku, Azerbaijan https://doi.org/10.5281/zenodo.7789252

Abstract

Human health should be considered as a multifaceted concept that implies the physiological, psychological well-being and social adaptation of a person. In elderly and senile patients, the manifestation of many diseases of the organs and tissues of the mouth is associated both with the natural aging processes of the body and with the presence of diseases of the internal organs. There is no doubt that the combination of existing diseases reduces the quality of life of elderly and senile patients and contributes to their social isolation.

Keywords: gerontology, dentistry, quality of life, dental health, dental questionnaires

Over the past century, a steady trend of population aging has formed in the world. Some authors argue that this process is a consequence of a decrease in the birth rate, an increase in the death rate of people of working age and, as a result, an increase in the population of elderly and senile age [1]. Other scientists attribute the natural aging of the population to an increase in life expectancy, which was facilitated by the progress of science and reforms in the health care system, allowing early diagnosis and treatment of somatic diseases, which to this day are the main cause of death in the population. The health of organs and tissues of the mouth is an important part of human health as a whole, when this conceptual concept is considered not only as the absence of a particular disease, but rather as the presence of an optimally functioning organism, psychologically and socially adapted in society [3]. Dental care elderly and senile age has a number of features. In this category of patients, it is difficult to find preserved dentitions. Most teeth have previously been treated for caries and its complications. It is quite difficult to reliably determine whether a tooth is intact or not, since most of the remaining teeth at this age are covered with artificial crowns. It is in patients of the older age group that root caries prevails over crown caries and, according to a number of authors, the frequency of this pathology is about 80% [2].]. Along with caries and its complications, the number of patients suffering from periodontal diseases also increases with age. At the same time, along with inflammatory forms caused by the presence of general somatic diseases, there is an increase in dystrophic forms associated with the development of involutive processes in an aging organism [1]. As a result of

the high prevalence of diseases of the organs and tissues of the mouth, by the age of 60, patients are missing up to half of all teeth, and further the process of tooth loss is aggravated [4, 5]. Conducted studies of the dental status of elderly and senile patients have shown that the frequency of complete absence of teeth is 28.9% in the elderly and 43.3% in the elderly [5, 6]. In elderly dentistry, the manifestation of many diseases of the organs and tissues of the mouth is associated with the presence of diseases of the internal organs. According to the literature data, diseases of the cardiovascular system occupy the first place in the structure of the incidence of elderly and senile people. This is followed by a group of oncological diseases, diseases of the nervous system, musculoskeletal system, gastrointestinal tract and respiratory organs [1]. The incidence of elderly and senile people has a number of significant features. One of them is polymorbidity - the presence of two or more long-term chronic diseases in a patient. Also, when providing medical care to the elderly, it is necessary to take into account their special psychological state and social status. Together, these factors quite often destroy constructive communication between a medical professional and an elderly patient, which is so necessary in the process of diagnosing, treating and rehabilitating patients of this age group in order to obtain a stable positive result. Partial or complete absence of teeth entails dissatisfaction with appearance, embarrassment when smiling, laughing or talking, inability to eat favorite foods, inability to taste, speak or swallow. All this significantly complicates the daily activities of a person, negatively affects social behavior and self-confidence

[7, 8]. There is no doubt that the combination of existing diseases, both dental and somatic, reduces the quality of life of elderly and senile patients and contributes to their social isolation. One of the main factors that determine the quality of life is persistent chronic pain. It negatively affects the emotional, physical and economic state of a person, disrupting the rhythm of his daily life. People are more likely to stay at home, avoid meetings with friends and family members, worry about their health status and constantly consult with doctors [3]. as an autonomous anatomical structure associated with the body is very conditional. Proceeding from this provision, studies of assessing the state of dental health are based on subjective information - patient complaints and objective information - examination results, data from clinical and laboratory studies [2, 3, 7, 8]. Rarely evaluate indicators such as an open smile, free laughter, conversation, not overshadowed by bad breath, the ability to eat your favorite food in a public place. The relationship between dental health and possible insomnia, nausea, headache, and overweight is even less often assessed [7, 8]. An analysis of the state of dental health in terms of assessing the quality of life can help resolve many issues of organizing dental care for the elderly and senile population. By studying the criteria for assessing the quality of life, it is possible not only to improve oral health, but also to improve the quality of medical care and the level of well-being of people. A correctly selected questionnaire for assessing the quality of life will make it possible to accurately assess violations in the state of health of patients, more clearly present the essence of the clinical problem, determine a rational approach to treatment, and evaluate the results of work in terms of parameters that are at the junction of the scientific approach of a specialist and the subjective point of view of the patient.

[9]. People of elderly and senile age can be called a socially vulnerable group of the population. The main criteria determining social insecurity are a low level of monthly income, a restriction in the provision of social benefits in the provision of dental care, the impossibility of regular visits to the dentist as a result of the presence of general somatic diseases or territorial remoteness from the dental clinic. Therefore, during the period of demographic instability, medical care for people the elderly can and should be considered as one of the priority areas of the modern health care system.

Findings.

In the course of the study, it was found that older people who continue to work, live in families, have an average and high average monthly income, lead an active lifestyle, initially had higher quality of life indicators than people who do not work, with low incomes, lonely and forced to lead a passive lifestyle.

It is concluded that the analysis of the state of dental health in terms of assessing the quality of life can help in solving many issues of organizing dental care for the elderly and senile population. By applying quality of life criteria, not only can oral health be improved, but the quality of care and well-being of older people can also be improved.

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AWARENESS OF DIFFERENT POPULATION GROUPS ABOUT PARASITIC DISEASES OCCURRED IN THE TERRITORY OF THE REPUBLIC OF AZERBAIJAN

Salehov A.,

Doctor of Sciences in Medicine Scientific Research Institute of Medical Prevention named after V.Y. Akhundov, Baku, Azerbaijan

Rzayeva R.,

Azerbaijan State University of Oil and Industry, Baku, Azerbaijan, Lecturer
Baku. Azerbaijan

Janahmadova Sh.,

Candidate of Sciences in Medicine, associate professor Scientific Research Institute of Medical Prevention named after V.Y. Akhundov Baku, Azerbaijan

Vakilova S.

Scientific Research Institute of Medical Prevention named after V.Y. Akhundov, Baku, Azerbaijan, Researcher

ИНФОРМИРОВАННОСТЬ РАЗНЫХ ГРУПП НАСЕЛЕНИЯ О ПАРАЗИТАРНЫХ БОЛЕЗНЯХ, ВСТРЕЧАЮЩИХСЯ НА ТЕРРИТОРИИ АЗЕРБАЙДЖАНСКОЙ РЕСПУБЛИКИ

Салехов А.А.

Доктор медицинских наук

НИИ медицинской профилактики им.В.Ю.Ахундова, Баку, Азербайджан

Рзаева Р.В.

Азербайджанский государственный университет нефти и промышленности, Баку, Азербайджан, преподаватель

Лжанахмедова Ш.Н.

Кандидат медицинских наук, доцент

НИИ медицинской профилактики им.В.Ю.Ахундова, Баку, Азербайджан

Векилова С.В.

НИИ медицинской профилактики им.В.Ю.Ахундова, Баку, Азербайджан научный сотрудник

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Abstract

Awareness of the population about parasitic diseases found in the territory of the Republic of Azerbaijan is insufficient. Most people are aware of only some parasitoses. It should be noted that about 32 types of intestinal helminthiases and 15 intestinal protozoa are found on the territory of the Republic of Azerbaijan. Therefore, it is advisable to periodically conduct sanitary and educational work among the population, including parasitosis.

Аннотация

Результаты проведенных исследований показывают, что информированность населения о паразитарных болезнях, встречающихся на территории Азербайджанской Республики недостаточна. Большинство людей имеют представление лишь о некоторых паразитозах. При этом необходимо учесть, что на территории Азербайджанской Республики встречаются около 32 видов кишечных гельминтозов и 15 кишечных протозоозов. Поэтому, целесообразно периодически проводить среди населения санитарно-просветительские работы, в том числе и по паразитозам.

Keywords: parasitosis, awareness, population survey

Ключевые слова: паразитозы, информированность, опрос населения

Среди факторов, отрицательно влияющих на здоровье населения, паразитарные болезни занимают особое место среди многих стран мира, в том числе и в Азербайджанской Республике. На территории Азербайджанской Республики встречается около 32 видов кишечных гельминтозов и 15 кишечных протозоозов. Широкое распространение гельминтозов и их значительное влияние на здоровье населения, особенно детей обязывало органы здравоохранения резко усилить работу по оздоровлению населения от гельминтов [2, 5, 6]. Поэтому, борьба и профилактика с этими болезнями остаётся одной из приоритетных задач, стоящих перед органами здравоохранения республики [1, 3, 4]. Для решения этой проблемы важным вопросом является

своевременная обращаемость населения к врачу по поводу диагностики и лечения паразитарных болезней [2, 7].

Учитывая вышесказанное, нами был проведён опрос среди 2670 человек разного возраста, профессии, пола и т.д.

Возраст опрошенных колебался от 18 до 76 лет. Для опроса использовали 12 паразитозов, наиболее часто встречающихся среди населения Азербайджанской Республики. Из них 2 простейших (лямблиоз, бластоцистоз) и 10 гельминтозов (аскаридоз, энтеробиоз, трихоцефалез, стронгилоидоз, гименолепидоз, эхинококкоз, анкилостомидоз, тениаринхоз, трихостронгилоидоз, фасциолез). Результаты опроса приведены в таблице 1.

Таблица 1

Информированность населения о разных паразитозах

Паразитозы	Число лиц, имеющих информацию о паразитозах, n=2670			
	Абс.	P%±mp%		
Лямблиоз	953	35,69±0,93		
Бластоцистоз	29	1,09±0,20		
Аскаридоз	1810	67,79±0,90		
Энтеробиоз	1159	43,41±0,96		
Трихоцефалез	475	17,79±0,74		
Стронгилоидоз	102	3,82±0,37		
Гименолепидоз	72	2,70±0,31		
Эхинококкоз	1039	38,91±0,94		
Анкилостомидоз	85	3,18±0,34		
Тениаринхоз	216	8,09±0,53		
Трихостронгилоидоз	19	0,71±0,16		
Фасциолез	16	0,60±0,15		

Среди опрошенных людей $35,69\pm0,93\%$ имело информацию о лямблиозе, $1,09\pm0,20\%$ человек — о бластоцистозе, $67,79\pm0,90\%$ опрошенных информировано об аскаридозе, $43,41\pm1,96\%$ - об энтеробиозе, $17,79\pm0,74\%$ - о трихоцефалезе, $3,82\pm0,37\%$ имело информацию о стронгилоидозе, $2,70\pm0,31\%$ - о гименолепидзе, $38,91\pm0,94\%$ - об эхинококкозе,

 $3,18\pm0,34\%$ - об анкилостомидозе, $8,09\pm0,53\%$ - о тениаринхозе, $0,71\pm0,16\%$ - трихостронгилоидозе, $0,60\pm0,15\%$ - о фасциолезе.

Кроме того, нами была проанализированно информативность населения паразитозами в зависимости от возраста (таблица 2).

Таблица 2

TT 1				
Информированность	паселения о п	I V CCOTRICCARI	ээрисимости с	T DOOMACTA
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		Возраст				
	14-17	18-40	41-60	61 и выше	F	CDA
Паразитозы	n=368	n=1094	n=816	n=392	P p	СВФ
	Абс.	Абс.	Абс.	Абс. Абс.		(95% ДИ)
	P%±mp%	P%±mp%	P%±mp%	P%±mp%		
Лямблиоз	53	434	355	111	F=40,377	СФВ=4,35
SOUITOWKIT	14,40±1,83	39,67±1,48	43,50±1,74	28,32±2,08	p < 0,001	(4,07-4,63)
Гластолическа		29			F=14,517	СФВ=1,61
Бластоцистоз	_	$2,65\pm0,49$	_	_	p < 0,001	(1,32-1,90)
Аакаринаа	164	769	621	256	F=44,278	СФВ=4,75
Аскаридоз	44,57±2,59	$70,29\pm1,38$	$76,10\pm1,49$	65,31±2,39	p < 0,001	(4,47-5,03)
Энтопобило	96	481	381	201	F=20,378	СФВ=2,24
Энтеробиоз	26,09±2,29	43,97±1,50	46,69±1,75	51,28±2,52	p < 0,001	(1,95-2,53)
Титиотофотор	8	244	158	65	F=27,711	СФВ=3,02
Трихоцефалез	$2,17\pm0,76$	22,30±1,26	19,36±1,38	16,58±1,88	p < 0,001	(2,74-3,31)
Строинилино		75	21	6	F=17,683	СФВ=1,95
Стронгилоидоз	_	$6,86\pm0,76$	$2,57\pm0,55$	$1,5\pm0,61$	p < 0,001	(1,66-2,24)
Гимоно додиндор		36	28	8	F=4,706	СФВ=0,53
Гименолепидоз	_	$3,29\pm0,54$	$3,43\pm0,64$	$2,04\pm0,71$	p = 0.003	(0,23-0,82)
Эхинококкоз	90	451	300	198	F=20,391	СФВ=2,24
Эхинококкоз	24,46±2,24	41,22±1,49	36,76±1,69	50,51±2,53	p < 0,001	(1,96-2,53)
Анинастолинас		36	28	21	F=6,180	СФВ=0,69
Анкилостомидоз	_	$3,29\pm0,54$	$3,43\pm0,64$	5,36±1,14	p < 0,001	(0,40-0,98)
Тениаринхоз	T		63	40	F=20,892	СФВ=1,21
тениаринхоз	$1,09\pm0,54$	$9,96\pm0,91$	$7,72\pm0,93$	$10,20\pm1,53$	p < 0,001	(0.92 - 1.50)
Триуостронения		5	12	2	F=3,529	СФВ=0,40
Трихостронгил-з	_	$0,46\pm0,20$	$1,47\pm0,42$	$0,51\pm0,36$	p = 0.014	(0,10-0,69)
Фасциолез			14	2	F=8,805	СФВ=0,98
Фасциолез	_	_	$1,72\pm0,46$	$0,51\pm0,36$	p < 0,001	(0,69-1,27)

Как видно из таблицы, информированность населения о паразитозах в зависимости от возраста различается. Среди школьников этот показатель для лямблиоза составляет $14,40\pm1,83\%$, среди лиц в возрасте 41-60 лет $-43,50\pm1,74\%$, а у лиц старше 61 года $-28,32\pm2,08\%$.

Информацией о бластоцистозе обладают лишь лица в возрасте 18-40 лет (2,65±0,49%). По сравнению с другими инвазиями большей информацией население обладает об аскаридозе и, после неё, об энтеробиозе. Например, среди лиц в возрасте 14-17 лет информацией об аскаридозе обладает 44,57±2,59%. Среди лиц в возрасте 18-40 лет информированность аскаридозом составила 70,29±1,38%, а энтеробиозом — 43,97±1,50% (р<0,001).

Больше всех информированность этими гельминтами отмечается среди лиц в возрасте 41-60 лет (соответственно $76,10\pm1,49\%$ и $46,69\pm1,75\%$; p<0,001). Среди лиц в возрасте 61 год и старше информацией об аскаридозе обладает значительно больше людей, чем об энтеробиозе (соответственно $65,31\pm2,39\%$ и $51,28\pm2,52\%$; p<0,001).

Среди детей от 14 до 17 лет информированность трихоцефалезом составила $2,17\pm0,76\%$, в возрастной группе 18-40 лет $-22,30\pm1,26\%$ (p<0,001), среди лиц в возрасте 41-60 лет $-19,36\pm1,38\%$ (p>0,05), у лиц в возрасте 61 и старше $16,58\pm1,88$ (p>0,05).

Степень информированности населения о стронгилоидозе значительно ниже. Например,

школьники в возрасте 14-17 лет не имеют об этом возбудителе даже незначительную информацию. А среди лиц в возрасте 18-40 лет, обладающих информацией, этот показатель составляет $6,86\pm0,76\%$. По следующим возрастным группам распределение такое: 41-60 лет $-2,57\pm0,53\%$ (p<0,001), 61 год и старше $-1,50\pm0,61\%$ (p<0,001). В возрастных группах 18-40 лет (3,29 $\pm0,54\%$), 41-60 лет (3,43 $\pm0,64\%$) и в возрасте 61 год и старше (2,04 $\pm0,71\%$) (p>0,05) степень информированности почти одинакова.

Информацией об эхинококкозе обладают сравнительно больше людей, чем о гименолепидозе и стронгилоидозе.

Самая высокая степень информированности отмечается среди лиц в возрасте 61 год и старше ($50,51\pm2,53\%$) по сравнению с группой 41-60 лет ($36,76\pm1,69\%$; p<0,001), группой 18-40 лет ($41,22\pm1,49\%$; p<0,001) и с группой 14-17 лет ($24,46\pm2,24\%$; p<0,001).

Информацией об анкилостомидозе среди школьников никто не обладал. В возрастной группе 18-40 лет информацией об анкилостомидозе обладало $3,29\pm0,54\%$, в группе 41-60 лет этот показатель составил $3,43\pm0,64\%$. А среди лиц в возрасте 61 лет и старше $5,36\pm1,14\%$ (p<0,001). То есть, по сравнению с предыдущими возрастными группами процент информированности значительно выше.

С тениаринхозом картина предстоит несколько иначе. Как ни странно, возрастная группа 14-17 лет обладает информацией об этом паразите $(1,09\pm0,54\%)$. Хотя по сравнению с этой возрастной

группой в других группах (18-40 лет, 41-60 лет и 61 год и старше) процент информированности значительно выше (соответственно $9,96\pm0,91\%$, $7,72\pm0,93$ и $10,20\pm1,53\%$; p<0,001).

Информацией о трихостронгилоидозе среди школьников никто не обладал. В возрастной группе 18-40 лет информацией об этом возбудителе обладало 0,46±0,20%. Среди лиц в возрасте 41-60 лет степень информированности составил 1,47±0,42%. А среди лиц в возрасте 61 лет и старше 5,36±1,14% (p<0,001).

И, наконец информированность населения о фасциолезе представлена следующим образом. Две возрастные группы (14-17 лет и 18-40 лет) о фасциолезе никакой информацией не обладают. А в группе 41-60 лет информированность выше $(1,72\pm0,46\%)$, чем в группе 61 год и старше $(0,51\pm0,36\%;$ p<0,001).

Среди населения степень информированности населения паразитозами была проанализирована и в зависимости от образования. Результаты обследований представлены в таблице 3.

Таблица 3

Информированность населения паразитозами в зависимости от образования

инфор.	мированность насел	тения паразитозами	і в зависим	ости от оо	разования	
Паразитозы	Среднее образование (n=1136)	Высшее образование (n=1056)	ОШ (95% ДИ)	χ2 p	СВФ (95% ДИ)	F P
Лямблиоз	207 18,22±1,15	294 27,84±1,38	0,58 (0,47 – 0,71)	χ2=28,72 p<0,001	1,33 (1,15 – 1,50)	F=29,47 p<0,001
Бластоцистоз	6 0,53±0,22	18 1,70±0,40	0,31 (0,12 – 0,77)	χ2=6,99 p=0,008	0,32 (0,15 – 0,50)	F=7,03 p=0,008
Аскаридоз	335 29,49±1,35	683 64,68±1,47	0,23 (0,19 – 0,27)	χ2=272,44 p<0,001	14,19 (14,04 – 4,34)	F=362,23 p<0,001
Энтеробиоз	355 31,25±1,38	620 58,71±1,52	0,32 (0,27 – 0,38)	χ2=167,13 p<0,001	8,25 (8,09 – 8,42)	F=197,02 p<0,001
Трихоцефалёз	86 7,57±0,78	336 31,82±1,43	0,18 (0,14 – 0,23)	χ2=206,99 p<0,001	10,43 (10,27 – 0,58)	F=254,95 p<0,001
Стронгилоидоз	13 1,14±0,32	75 7,10±0,79	0,15 (0,08 – 0,27)	χ2=50,41 p<0,001	2,35 (2,18 – 2,53)	F=52,80 p<0,001
Гименолепидоз	9 0,79±0,26	56 5,30±0,69	0,14 (0,07 – 0,29)	χ2=38,70 p<0,001	1,80 (1,62 – 1,97)	F=40,08 p<0,001
Эхинококкоз	151 13,29±1,01	716 67,80±1,44	0,07 (0,06 – 0,09)	χ2=680,16 p<0,001	44,99 (44,8– 45,09)	F=1791,0 p<0,001
Анкилостомидоз	13 1,14±0,32	65 6,16±0,74	0,18 (0,10 – 0,32)	χ2=40,04 p<0,001	1,86 (1,69 – 2,03)	F=41,52 p<0,001
Тениаринхоз	61 5,37±0,67	131 12,41±1,01	0,40 (0,29 – 0,55)	χ2=33,90 p<0,001	1,57 (1,40 – 1,74)	F=34,95 p<0,001
Трихостронгилои- доз	-	18 1,70±0,40	0,02 (0,00 – 0,41)	χ2=17,49 p<0,001	0,85 (0,68 – 1,03)	F=18,88 p<0,001
Фасциолиоз	2 0,18±0,12	14 1,33±0,35	0,13 (0,03 – 0,58)	χ2=8,46 p=0,004	0,46 (0,28 – 0,63)	F=10,07 p=0,002

Как видно из таблицы, лица со средним образованием ($18,22\pm1,15\%$) обладают значительно меньше информацией о лямблиозе, чем лица с высшим образованием ($27,84\pm1,38\%$; p<0,001).

Информацией о бластоцистозе обладает в 2 раза больше лиц с высшим образованием $(1,70\pm0,40\%)$, чем лиц со средним образованием $(0,53\pm0,22\%; p<0,001)$.

Степень информированности аскаридозом и среди лиц со средним образованием (29,49±1,35%),

и среди лиц с высшим образованием ($64,68\pm1,47\%$; p<0,001) была высока. Но как видно из таблицы, среди лиц с высшим образованием, этот показатель выше.

Аналогичная картина наблюдалась и с энтеробиозом (соответственно $31,25\pm1,38\%$ и $58,71\pm1,52\%$; p<0,001).

О трихоцефалезе по сравнению с аскаридозом и энтеробиозом информацией обладали меньше

людей. Здесь также показатель у лиц с высшим образованием выше $(31,82\pm1,43)$, чем у лиц со средним образованием $(7,57\pm0,78\%; p<0,001)$.

Информацией о стронгилоидозе лица со средним образованием (1,14 \pm 0,32%) обладают в 5 раз меньше, чем лица с высшим образованием (7,10 \pm 0,79%; p<0,001).

Ещё меньше люди обладают информацией о гименолепидозе (соответственно $0,79\pm0,26\%$ и $5,30\pm0,69\%$; p<0,001).

Информированность эхинококкозом у людей больше, особенно среди людей с высшим образованием (67,80 \pm 1,43%), чем среди лиц со средним образованием (13,29 \pm 1,01%; p<0,001).

Об анкилостомидозе степень информированности ниже (соответственно $6,76\pm0,74\%$ и $1,14\pm0,32\%$; p<0,001).

Ещё меньше информацией опрошенные обладают о трихостронгилоидозе. Лица со средним образованием такой информацией не обладают вообще, а среди лиц с высшим образованием этот показатель составил $1,70\pm0,40\%$.

Информированность о тениаринхозе среди лиц со средним образованием составила $5,37\pm0,67\%$, а среди лиц с высшим образованием $-12,41\pm1,01\%$ (p<0,001).

Фасциолез среди населения Азербайджана встречается редко и информация о нём также скудна. Так, среди опрошенных лиц со средним образованием этот показатель составил лишь 0,18±0,12%, а среди лиц с высшим образованием – 1,33±0,35% (p<0,001).

Что касается отношения шансов (ОШ), то по лямблиозу этот показатель в группе со средним образованием по отношению к группе с высшим образованием составил 0,58 с 95% доверительным интервалом 0,47-0,71 (χ 2=28,72). Это означает, что в группе с высшим образованием встретить лиц, информированных о лямблиозе шансов в \approx 1,6 больше, чем в группе со средним образованием.

Для сравнения приведём пример с эхинококкозом. Отношение шансов составило 0,07 с 95% доверительным интервалом 44,89-45,09 (χ 2=680,16). Это означает, что в группе с высшим образованием шансов встретить лиц, информированных об эхинококкозе в \approx 14 раз выше, чем в группе со средним образованием.

Однако самый низкий показатель оказался по трихостронгилоидозу. Отношение шансов составило 0,02 с 95% доверительным интервалом 0,00-0,41 ($\chi 2=17,42$). Это означает, что в группе с высшим образованием шансов встретить лиц, информированных о трихостронгилоидозе в ≈ 50 раз выше, чем в группе со средним образованием.

Таким образом, результаты исследований среди населения о паразитарных болезнях в зависимости от возраста, профессии, места жительства, образования и т.д., показывают, что информированность населения о разных паразитозах не одинакова. Большинство людей имеют представление лишь о некоторых паразитозах. Среди школьников этот показатель ниже, чем среди взрослых. Среди

лиц с высшим образованием информация о паразитозах в общем и по отдельным нозологиям намного больше, чем у лиц со средним образованием. Поэтому, целесообразно периодически проводить среди населения санитарно-просветительские работы, в том числе и по паразитозам. Для школьников и студентов необходимо разработать специальные программы и семинары.

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CONTRIBUTION OF THE PHYSICIAN HARVEY COOK AND THE DENTIST MENDEL NEVIN TO THE DEVELOPMENT OF LOCAL ANESTHESIA IN DENTISTRY

Stolyarenko P.,

PhD, assistant professor of the Chair of maxillofacial surgery and dentistry Samara State Medical University, Russia, Samara ORCID: https://orcid.org/0000-0002-8298-6947

Bayrikov I.,

Associate Member of the Russian Academy of Sciences, winner of the Lenin Komsomol Prize, Honored Worker of Higher Education of the Russian Federation, Doctor of medical sciences, professor, head of the chair of maxillofacial surgery and dentistry of Samara State Medical University, Samara, Russia,

ORCID: https://orcid.org/0000-0002-4943-2619

Clement A.

Oral and maxillofacial surgeon Stomatology department; Max Fourestier hospital; Nanterre, france

ВКЛАД ВРАЧА ХАРВИ КУКА И ДАНТИСТА МЕНДЕЛЯ НЕВИНА В РАЗВИТИЕ МЕСТНОЙ АНЕСТЕЗИИ В СТОМАТОЛОГИИ

Столяренко П.Ю.

кандидат медицинских наук, доцент кафедры челюстно-лицевой хирургии и стоматологии Самарского государственного медицинского университета, Россия, Са-

ORCID: https://orcid.org/0000-0002-8298-6947

Байриков И.М. член-корреспондент РАН, доктор медицинских наук, профессор, лауреат премии Ленинского Комсомола, заслуженный работник высшей школы РФ, заведующий кафедрой челюстно-лицевой хирургии и стоматологии Самарского государственного медицинского университета, Самара, Россия, ORCID: https://orcid.org/0000-0002-4943-2619

Клемент А.

Челюстно-лицевой хирург, Отделение стоматологии; госпиталь «Макс Фурестье»; нантер, франция https://doi.org/10.5281/zenodo.7789324

Abstract

The review illustrated article describes the prerequisites for creating a cartridge system in dentistry, provides analogues and patents for a hypodermic syringe, the contribution of the physician Harvey Cook to the development of local anesthesia technology (syringe, needle, cartridge), and little-known information about him. The problems of manufacturing and use of local anesthetics at the beginning of the twentieth century are considered. The contribution of the dentist Mendel Nevin is briefly presented: he created the Novocol Chemical Manufacturing Company, Incorporated, improved the methods of intraoral conduction and infiltration anesthesia, published a textbook on anesthesia in dentistry, many books on the problems of anesthesia with novocaine and other anesthetics, was the editor-in-chief of the American quarterly journal Modern Dentistry, a public figure of international level.

Аннотация

В обзорной иллюстрированной статье описаны предпосылки создания картриджной системы в стоматологии, приводятся аналоги и патенты на подкожный шприц, вклад врача Харвея Кука в разработку технологии местной анестезии (шприц, игла, картридж), малоизвестные сведения о нем. Рассмотрены проблемы изготовления и применения местных анестетиков в начале ХХ века. Кратко представлен вклад дантиста Менделя Невина: создал химическую производственную компании «Новокол», усовершенствовал методы внутриротовой проводниковой и инфильтрационной анестезии, издал учебник под обезболиванию в стоматологии, много книг по проблемам анестезии новокаином и другими анестетиками, был главным редактором американского ежеквартального журнала «Современная стоматология», общественным деятелем международного уровня.

Keywords: Harvey Cook (1888–1934), syringe, cartridge, Mendel Nevin (1881–1950), local anesthesia, dentistry.

Ключевые слова: Харви Кук (1888–1934), шприц, картридж, Мендель Невин (1881–1950), местная анестезия, стоматология.

Введение. Большим достижением для стоматологической анестезиологии явилась разработка картриджной технологии, основанной на выпуске местных анестетиков в герметичных картриджах (цилиндрических ампулах, карпулах). Эта технология обеспечивает чистоту и стерильность препарата, точную дозировку анестетика и вазоконстриктора, снимает ответственность за качество и дозировку анестетика с врача, перекладывая её на компанию-производителя. Важным элементом картриджной технологии стало также создание специального картриджного шприца, дающего возможность проведения аспирационной пробы для предотвращения внутрисосудистого введения анестетика. Кроме того, с помощью картриджа можно создать высокое давление, под которым необходимо вводить раствор местного анестетика в ткани при интралигаментарной или внутрикостной анестезии, или разрежение для проведения аспирационной пробы. Как же работали дантисты в начале XX века, кому мы обязаны появлением современной технологии местной анестезии? Одними из пионеров в области местной анестезии были Харви Кук и Мендель Невин.

Харви Самуэль Кук – основоположник современной картриджной

системы местной анестезии в стоматологии

Важнейшим достижением начального периода применения местной анестезии явилась разработка функционального дентального шприца немецкими дантистом Гвидо Фишером (1877–1959) и челюстно-лицевым хирургом Карлом Парчем – рис. 1. Главными их признаками были навинчивающаяся канюля и упоры для пальцев и ладони (рис. 2).



Puc. 1. Carl Partsch, 1855–1932

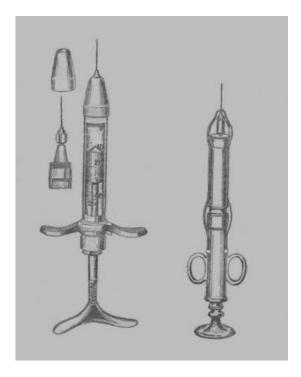
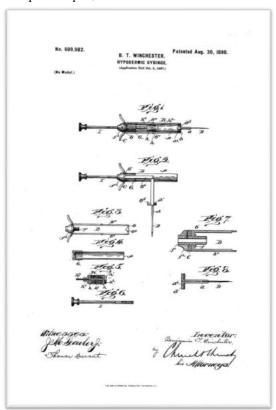


Рис. 2. Шприц Фишера, модель 1920 г. (слева) и шприц Парча. (Ил. из материалов Трудов I Всерос. одонтол. съезда. М., 1924, с. 251.)

В начале XX века зубные врачи для местной анестезии пользовались специальными металлическими шприцами.

В 1906 году в России внедрён в производство многоразовый разборный шприц «Рекорд-Брюно» со стеклянным цилиндром, металлическим поршнем с резиновыми уплотнительными кольцами, герметично притёртым к стенкам цилиндра. На боковой стенке цилиндра были нанесены деления с двух сторон, что позволяло оценить количество раствора в шприце.



Puc. 3. Иллюстрация патента США W.T. Winchester (1898)

Зубоврачебная картриджная система для инъекций начала вводиться в Америке и Западной Европе в 20-е годы прошлого столетия. Она включает в себя специальный шприц, картридж и иглу с двумя острыми концами. Предпосылками к разработке картриджной системы явились изобретения вариантов усовершенствования подкожного шприца Уильяма Болла (1909), Джозефа Пейна (1911), Джорджа Х. Кисперта (1915) и др. [1 – 4] (рис. 3 – 6].

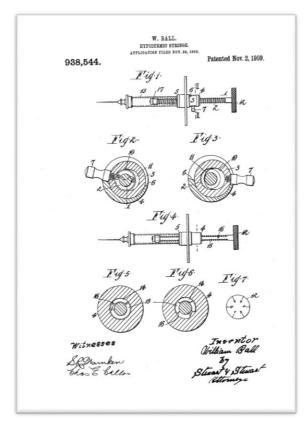


Рис. 4. Иллюстрация патента США Уильяма Болла (1909)

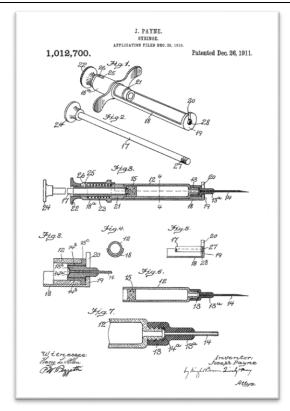


Рис. 5. Иллюстрация патента США Джозефа Пейна (1911)

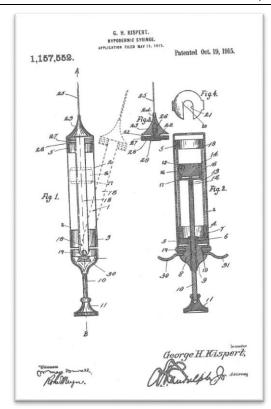


Рис. 6. Иллюстрация патента США Джорджа X. Кисперта (1915)

Картридж (цилиндрическую ампулу), прообраз современной карпулы, и специальный шприц для него изобрёл североамериканский армейский

хирург Харви Самуэль Кук из г. Вальпараисо, штат Индиана в 1917 г. во время Первой мировой войны (рис. 7).



Puc. 7. Harvey Samuel Cook (1888–1934)

В связи с потребностью максимально быстрого использования местного анестезирующего средства у него возникла идея воспользоваться принципом зарядки патронов армейскими стрелками (рис. 8).



Рис. 8. Затвор винтовки с патроном

В патроне (картридже) было действующее вещество (местный анестетик). Роль «винтовки» должен был исполнять специальный шприц. Доктор Кук сделал иглу с двумя острыми концами (рис. 9 – внизу справа), разрезал стеклянную трубку и использовал резинки от карандашей в качестве резиновых пробок. Картридж представлял собой стеклянную цилиндрическую трубку длиной около 3 дюймов, закрывающуюся с одной стороны резиновым поршнем (пробкой), а с другой – резиновой

мембраной, которая прокалывалась иглой перед инъекцией. Шприц (рис. 9 вверху) «заряжался» картриджем, как оружие снарядом, — через затвор (рис. 9 — внизу слева). Сначала он сам производил вечером стерилизацию и заполнение их, а на следующий день использовал [5–7]. Игла не навинчивалась как в шприце Фишера, а закреплялась фиксатором при завинчивании наконечника на шприц Кука (по такому принципу фиксируется стержень в современной шариковой авторучке).



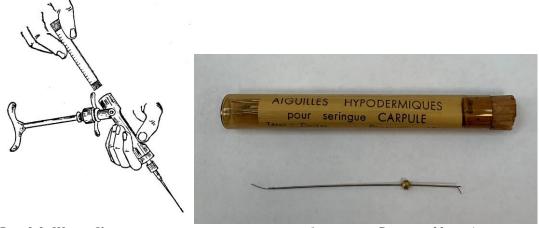


Рис. 9-9. Шприц Кука и иглы, которым пользовался зубной врач в Самаре в 30-е годы прошлого столетия (из коллекции доцента Т.А. Киселевой) — вверху. Внизу слева — введение картриджа в шприц (схема); справа — дентальная игла с мандреном размером 17/42 из футляра, закрывающегося пробкой

Всего Харви С. Кук получил 7 патентов США. Авторство единоличное. Ниже приводим эти патенты.

- 1. Подкожный шприц. Переизданный (исправленный) патент № 16,836. Заявка подана 21 октября 1916 г. Первоначальный (приоритет) № 1 231 497, датированный 26 июня 1917 г., порядковый № 126 984. Заявка на издание исправленного патента подана 1 июля 1921 г. Порядковый № 481 993.
- **2. Картридж** для лекарств, объединённый с идентичным шприцем. № 1,687,323. Выдан 9 октября 1928 г. Заявка подана 1 июля 1921 г.
- **3. Картридж с дозированным лекарством. №** 1,564,048. Выдан 1 декабря 1925 г. Заявка подана 2 марта 1922 г.

- **4. Шприц и картридж для него.** № 1,661,818. Выдан 6 марта 1928 г. Заявка подана 2 марта 1922 г.
- **5. Асептический держатель иглы.** № 1,694,76. Выдан 11 декабря 1928 г. Заявка подана 2 марта 1922 г.
- **6. Шприц.** № 1,694,767. Выдан 11 декабря 1928 г. Заявка подана 5 августа 1922 г.
- 7. Картридж с дозированным лекарством. № 1,783,956. Выдан 9 декабря 1930 г. Заявка подана 1 июля 1921 г. Порядковый № 481,997. Повторная заявка в связи с разногласиями подана 20 декабря 1926 г. Порядковый № 155,838.

Как видно из выше представленного списка первая заявка на изобретение шприца была подана в 1916 г., 21 октября (рис. 10).

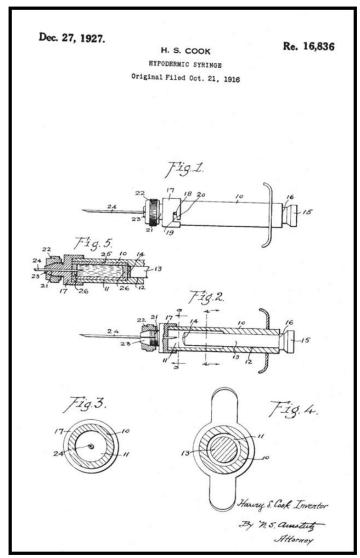


Рис. 10. Иллюстрация из первого патента Харви С. Кука

Приводим фрагмент описания этого патента с сокращениями.

Рис. 1 – вид шприца сбоку; рис. 2 – вид инструмента в продольном разрезе без ёмкости (контейнера) для раствора лекарства; рис. 3 – поперечное сечение относительно линии 3-3 из рис. 2, и рис. 4 – подобный вид относительно линии 4-4. Рис. 3 и 4 показаны в большем масштабе. Рис. 5 является про-

дольным разрезом, показывает структуру или организацию инструмента, включая его ёмкость (контейнер) для раствора лекарства ...

Игла 24 проходит через отверстие в наконечнике 21 и колпачок 17, может скользить в продольном направлении там всякий раз, когда отвинчена гайка (зажимная муфта) 22 и ослаблены захваты

(щёчки) 23, но при сжатии захватов на игле, последняя становится жёстко фиксированной с колпачком и цилиндром шприца 10.

Игла 24 является полой, а оба ее конца заострены, чтобы любой конец мог использоваться для введения под кожу.

Шприц описанной конструкции быстро заправляется и легко освобождается, потому что колпачок и поршень без труда отсоединяются от цилиндра. Поршень имеет цилиндрическую форму, одинаковый диаметр на концах, плотно прилегает к стенкам цилиндра и удерживает жидкость внутри цилиндра, препятствуя загрязнению или задержке лекарственного препарата в цилиндре. Игла легко извлекается из колпачка, чтобы ее можно было очистить или простерилизовать, а колпачок, предпочтительно гладкий с внутренней стороны, не имеет поднутрений для оседания каких-либо антисанитарных частиц. Вводимая жидкость находится в контейнере или ампуле цилиндрической формы 25, сделанной из стекла. Контейнер или ампула имеет трубчатую форму, соответствующую камере цилиндра 11. Концы контейнера закрыты и изолированы пластинками 26 из отпрессованной резины, пробки, или материала, которые легко перфорируются внутренним концом иглы 24. При давлении на поршень жидкость поступает в иглу. Контейнеры содержат определённое количество раствора для инъекций.

Стеклянная трубка имеет отверстия, закрывающиеся резиновыми пробками. Резина, являясь упругим материалом, плотно обхватывает иглу и предотвращает утечку жидкости. Кроме того, при удалении иглы нет опасности загрязнения лекарственного вещества. Резина плотно прижимается к внутренней поверхности стеклянной трубки и создаёт герметичность после удаления иглы, адаптируется к внутреннему отверстию трубки и позволяет скользить поршню по трубке без угрозы растрескивания стекла... [8].

Зубоврачебная картриджная система для инъекций начала вводиться в Америке и Западной Европе в 20-е годы прошлого столетия. Она включает в себя специальный шприц, картридж и иглу с двумя острыми концами.

В 1921 г. доктор Кук предложил картриджный шприц и картридж анестезирующего средства и в Чикаго в его лаборатории по созданию шприцев (Cook Laboratories) был разработан первый картриджный шприц. Эта герметичная и экономичная система позволила обеспечивать высокий уровень асептики, предупреждать возможность ошибочного введения растворов других лекарственных средств. До этого растворы анестетиков использовали в металлических или стеклянных шприцах. Был предложен специальный стерилизатор для шприцев Кука (рис. 11–13).



Рис. 11. Комплект картриджного инъекционного шприца лаборатории Кука, Нью-Йорк



Рис. 12. Стерилизатор для шприцев Кука



Рис. 13. Стоматолог США в 20-е годы прошлого века

Малоизвестные сведения в Харви Куке

Харви Самуэль Кук родился в городе Гилман (округ Ирокез, штат Иллинойс, США) 18 марта 1888 года в семье Джеймса Харви Кука (James Harvey Cook) и Мэри Элизабет Стивенсон (Mary Elizabeth Stephenson) – рис. 14. Он начал свое медицинское образование в университете Вальпараисо (рис. 15, 16), а затем учился в Чикагском медикохирургическом колледже. Харви Самюэль Кук женился на Иде М. Доти (Ida M. Doty) и имел 2 детей. Вскоре после начала практической деятельности в

Иллинойсе Кук был мобилизован в качестве военного врача и участвовал в Первой мировой войне. Во время войны он понял необходимость быстрого введения раненым обезболивающих. На основе этих знаний Кук изобрел шприц для подкожных инъекций — медицинский инструмент, который в дальнейшем радикально изменил принцип местной анестезии в зубоврачебной практике.



Рис. 14. Семья Джеймса Харви Кука и Мэри Элизабет Стивенсон. Харви Кук стоит в центре

ALUMNI RECORD
Name Dr. Harvey S. Cook, MD (Deceased)
Address 207 Chicago St., Valparaiso, Ind.
Maiden Name
Course Taken MD When Graduated 1913
Occupation V. Health Phy. Date of Information 1936
Source of Information Dr.GW
Remarks (Member of Class Motto Committee).
(Over)

Puc. 15. Карта выпускника медицинского факультета университета Вальпараисо Харви С. Кука, в котором он учился с 1909 по 1913 год. Ил. любезно предоставлена Judith K. Miller, Special Collections Librarian Christopher Center, Valparaiso (США)



Рис. 16. Группа студентов 2-го курса, в которой учился H.S. Cook (Вальпараисо, 1913 г.). Ил. любезно предоставлена Judith K. Miller, Special Collections Librarian Christopher Center, Valparaiso (США)

После окончания войны Кук основал собственную лабораторию для создания шприцев в Чикаго. Позже он переехал в Вальпараисо и открыл там больницу и санаторий (рис. 17). На оснащение больницы самым современным оборудованием было потрачено более 25 тысяч долларов. В больнице проводи ли операции, рентгенологические ис-

следования, а также оказывали неотложную помощь. Из-за ухудшения здоровья Кук прекратил свою деятельность, и больница была закрыта примерно в 1934 году. Сегодня дом Конрада и Кэтрин Блох, а также здание больницы и санатория Вальпараисо сохранились и внесены в Национальный реестр исторических мест [9].



Рис. 17. Исторический жилой дом Конрада и Кэтрин Блох, владельцев процветающего обувного бизнеса, был построен в 1873 году. В 1923 году дом был сдан в аренду доктору Харви Куку, который превратил здание в частную больницу в Вальпараисо, штат Индиана

С появлением анестетиков в цилиндрических ампулах было разработано много типов картриджных шприцев, и за эти годы произошло их значительное усовершенствование [10], но принцип, положенный Харви Куком в основу системы, сохранился.

Только с появлением лидокаина, обеспечивавшего надёжное обезболивание двумя миллилитрами раствора, эта инъекционная система вошла в широкую стоматологическую практику.

Главным достоинством стоматологической картриджной системы является быстрая (менее минуты) подготовка к инъекции и гарантированная производителем стерилизация тех элементов (иглы

и картриджи), которые контактируют с субэпителиальными тканями [11, 12].

Одним из недостатков классической картриджной системы была невозможность аспирации – обратного оттягивания поршня, чтобы исключить случайное попадание иглы в просвет сосуда. Для совмещения поршня-пробки картриджа со штоком шприца были предложены винтовое (Novocol Company, 1947) и гарпунное соединение (Cook-Weite Laboratories, 1957). Это потребовало конструктивных изменений как самого картриджа, так и шприца. В 1947 г. Novocol Company на основе шприца Кука сделала доступным для врачей стоматологический аспирационный шприц (рис.18).



Рис. 18. Различные варианты плунжера для проведения аспирационной пробы в современных шприцах (слева – копьевидное, справа – типа «штопор»)

В 1959 году фирмой Cook-Waite, Roehr Co начата продажа доступных одноразовых стерильных дентальных игл к этому шприцу [13].

Картриджи, используемые в США, содержат 1,8 мл анестезирующего средства в растворе. Название «карпула» – изменённая торговая марка, введена компанией Cook-Waite Laboratories.

Проблемы с приготовлением местных анестетиков. Основными компонентами обычного используемого дантистами анестетика в начале XX века являлись прокаин (обычно называемый новокаином) и адреналин (также известный как

эпинефрин, супраренин), каждый из которых выполнял свою функцию для достижения желаемого результата. Свежеприготовленный раствор анестетика совершенно бесцветен, но на раствор адреналина быстро влияет контакт с воздухом, и по мере прогрессирования этого окисления о нем свидетельствуют заметные изменения цвета. Раствор сначала становится светло-коричневым, затем розовым, потом коричневым и, наконец, темным — цвета шоколада. Эта чувствительность к воздуху, а также вызываемые ею характерные изменения

окраски, были широко известны химикам в течение по крайней мере двадцати пяти или более лет [14].

Раньше у каждого дантиста был обычай готовить свой собственный анестезирующий раствор из таблеток либо для использования на отдельных пациентах, либо путем приготовления флакона с раствором, который можно было использовать некоторое время. Хотя дантист таким образом мог быть уверен в свежести раствора, этот способ приготовления имел определенные недостатки, в том числе трудности сохранения стерильности раствора и обеспечения однородности концентрации. Развитием стала практика производителей смешивать раствор в надлежащих пропорциях в своих лабораториях и продавать его в индивидуальных дозах, содержащихся в ампуле, состоящей из стеклянной

трубки, конец которой суживали и запаивали после заполнения трубки. Это предохраняло адреналин от окисления, и приготовленный таким образом анестетик не обесцвечивался. Перед анестезией конец ампулы отламывали и содержимое набирали в шприц. Недостатками этого были возможные опасности повреждения от осколков стекла при разбивании конца ампулы, а также инфицирования от инструмента или руки, использованных при ее разбивании.

Вклад Невина Менделя

С незапамятных времен благороднейшие умы вечно стремились облегчить боль страдающего человечества. Одним из таких людей был дантист Мендель Невин (рис. 19).



Puc. 19. Mendel Nevin (1881–1950)

Мендель Невин был российским евреем, эмигрировавшим в США. После окончания в 1907 году Нью-Йоркского стоматологического колледжа и начала профессиональной деятельности, он вскоре осознал недостатки своих знаний о том, как сделать стоматологические операции менее болезненными. Он прекрасно понимал, насколько это важно для успешной профессиональной деятельности, сама природа которой заключалась в причинении боли. Каждая стоматологическая операция проводилась на тканях, иннервируемых терминальными ветвями сенсорных нервов, которые, по общему признанию, наиболее чувствительны и очень сильно реагируют на стимуляцию и боль.

Мендель Невин тщательно изучил всю зубоврачебную и медицинскую литературу, касающу-

юся анестезии. Это стало для него почти навязчивой идеей: «Меня вдохновляли и приносили пользу труды по этой теме таких специалистов, как Герман Принц, Райтмюллер, Теодор Блюм, Гвидо Фишер, Браун, Шилдс, Томас, Аллен, Смит и многие другие. Труды этих людей помогли мне овладеть местной анестезией и упростить свою технику» [15].

В 1911 году М. Невин основал Novocol Chemical Manufacturing Company, Incorporated для производства прокаина (Novol) и других местных анестетиков, в частности, монокаина гидрохлорида, химически близкого прокаину, синтезированного Семуэлом Д. Гольдбергом (Samuel D. Goldberg, 1911–1985) в 1935 году. Он выпускался в таблетках, как и прокаин растворялся в фарфоровых чашках (рис. 20, 21). Производитель объединил этот анестетик с эпинефрином и некоторыми



Рис. 20. Процесс приготовления раствора новокаина [19]

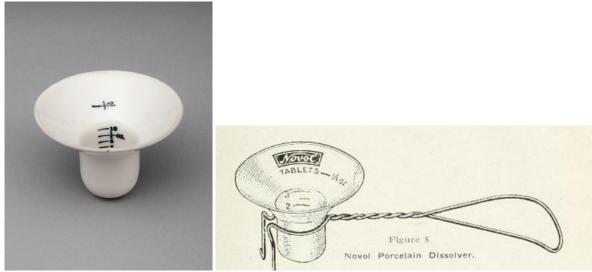


Рис. 21. Чашка из глазурованного фарфора для растворения таблеток анестетика. Производитель: Химическая производственная компания

«Новокол» [19] https://www.denverartmuseum.org/en/object/2003.932

буферными агентами и заявил, что препарат оказывает синергетическое действие с эпинефрином, поэтому выпускался в 1,5% растворе (рис. 22). Гидрохлорид монокаина был представлен в стоматологической клинике Мемориального госпиталя Оушен Хилл (Ocean Hill Hospital) в Бруклине Менделем Невином в 1936 году [16]. Кроме местных

анестетиков производились картриджи, шприцы и другая стоматологическая продукция (рис. 23-25). Компания имела крупные производственные предприятия в Бруклине, Торонто, Лондоне, Буэнос-Айресе и Рио-де-Жанейро.

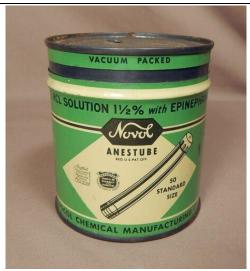


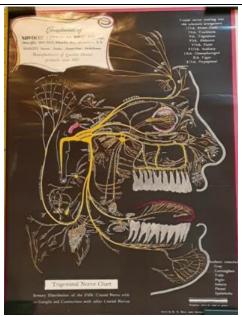
Рис. 22. Картриджи 1,5% раствора монокаина с эпинефрином в металлической вакуумной упаковке, запатентованной Гольдбергом [17]



Рис. 23. Картриджный шприц Кука, выпускаемый в картонной коробке. Производитель: Химическая производственная компания «Новокол», Бруклин, Нью-Йорк



Рис. 24. Шприц. Реклама прокаина (Новол) [19] Надпись на корпусе этого стального шприца: "NOVOCOL CHEMICAL MFG. CO. INC. N.Y.".



Puc. 25. Novocol Chemical Mfg Co. Плакат со схемой тройничного нерва

В 1919 году Невин опубликовал иллюстрированную брошюру «Проводниковая и инфильтрационная анестезия с использованием новых таблеток новокаина» [18] — рис. 26. Он писал: «Обычный практикующий врач часто бывает озадачен массой

статей и книг, написанных на эту тему, и различными методиками, которые пропагандируют разные авторы. Поэтому наша цель – представить вниманию дантистов наиболее простые и практичные, на наш взгляд, методы».

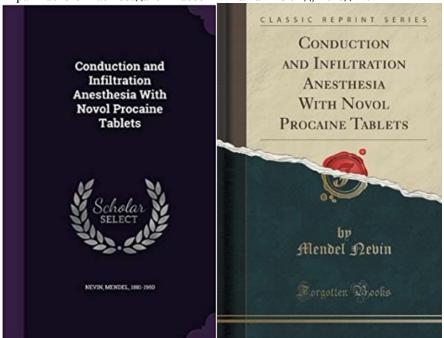


Рис. 26. Книги Невина из «Серии классических переизданий»

В 1923 году Невин издал учебник «Проводниковая и инфильтрационная анестезия», который

быстро стал библиографической редкостью и переиздавался 6 раз (рис. 27, 28) [15]. Во второе издание в 1924 году был добавлен раздел

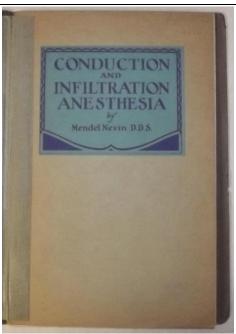


Рис. 27. Обложка учебника М. Невина «Проводниковая и инфильтрационная анестезия»

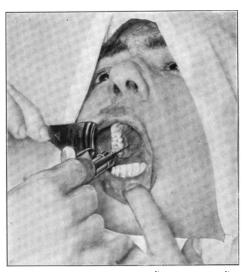


Рис. 28. Метод блокады подглазничного нерва и второй ветви тройничного нерва внутриротовым доступом через крылонёбный канал (1917) [15]

по наркозу (соавтор P.G. Puterbaugh) [20]. Этот учебник использован не одним поколением студентов и практикующих врачей. Последнее переиздание было в 2022 году [20].

Невин был сотрудником и директором издательства «Стоматологические предметы, представляющие интерес» (Dental Items of Interest), United States Procaine Company, Atlantic-Warwick Corporation и Atlantic Manufacturing Corporation, дочерних компаний Novocol Chemical. Он также был редактором журнала «Современная стоматология», ежеквартального издания, посвященного применению местных анестетиков, и занимал пост председателя стоматологического отделения Еврейского благо-

творительного фонда, директора Бруклинской торговой палаты и президента международного клуба "Хайленд Парк Киванис". Он был членом клуба «Единство» и принимал активное участие в корпорации «Совете девочек-скаутов Большого Нью-Йорка».

Д-р Мендель Невин, дантист и производитель, возглавлявший компанию «Формула анестетика» скончался в возрасте 69 лет от сердечного приступа в среду 8 ноября 1950 года в Чикаго. Некрологи опубликованы в газете Нью-Йорк Таймс (рис. 29) и журнале Dental Subjects of Interest [22, 23].

После смерти Невина в 1954 году была переиздана книга «Проблемы местной анестезии в стоматологии» [24] – рис. 30.

DR. MENDEL NEVIN, MANUFACTURER, 69

Dentist Who Headed Anesthetic Formula Corporation Is Dead —Once Served Hospitals

Dr. Mendel Nevin, dentist and president of the Novocol Chemical Manufacturing Company, Inc., manufacturers of local anesthetic products, died of a heart attack in Chicago on Wednesday. His age was 69. He lived at 130 Arlington Avenue, Brooklyn.

Born in Russia, Dr. Nevin was graduated from the New York College of Dentistry in 1907. He had been an oral surgeon at Greenpoint Hospital in Brooklyn and at the Hospital for Joint Diseases in Manhattan and a consultant anesthetist at Ocean Hill Memorial Hospital, Brooklyn. He was a former president of the Kings County Dental Society.

Dr. Nevin gave up dentistry and founded the Novocol firm in 1911 to make anesthetic formulas he had developed. The company has major manufacturing plants in Brooklyn, Toronto, London, Buenos Aires and Rio de Janeiro. He was an officer and a director of the Dental Items of Interest Publishing Company, United States Procaine Company, Atlantic-Warwick Corporation and the Atlantic Manufacturing Corporation, subsidiaries of Novocol Chemical.



DR. MENDEL NEVIN

He also was editor of Modern Dentistry, a quarterly publication devoted to the administration of local anesthetics, and had served as chairman of the dental division of the Jewish Welfare Foundation, a director of the Brooklyn Chamber of Commerce and president of the Highland Park Kiwanis Club. He was a member of the Unity Club and had been active in the Girl Scout Council of Greater New York, Inc.

Surviving are his widow, Mrs. Mollie Nevin; two sons, Dr. Hillard R. Nevin of Brooklyn and Dr. Marshall I. Nevin of Jamaica, Queens; three sisters and three brothers.

The New Hork Times

Published: November 11, 1950 Copyright © The New York Times

Рис. 29. Некролог в газете «Нью-Йорк-Таймс»

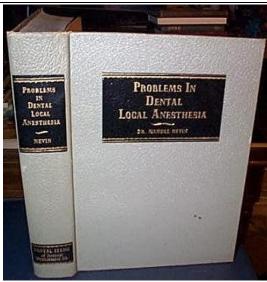


Рис. 30. Книга «Проблемы местной анестезии в стоматологии»

Заключение. Приведенные в этой статье сведения неполные, но и они позволяют констатировать мировое значение вклада Харви Кука и Менделя Невина в развитие местной анестезии в стоматологии и смежных специальностях. Они заложили основы современной технологии местного обезболивания. Создание компаний Cook Laboratories и Novocol Chemical Manufacturing Company, Incorporated способствовало прогрессу в инструментальном и медикаментозном обеспечении стоматологов, что сделало лечение безболезненным для пациентов и оптимизировало работу врача.

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PHILOLOGICAL SCIENCES

STRATEGIES OF SPEECH MASKS IN RADIO DISCOURSE

Gladko M.

Cand. of Philology; Doctoral Student; Associate Professor
Minsk State Linguistic University,
Belarus
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Abstract

A fragment of a comprehensive study on the identification of role-masks as components of the game in the media text is presented. The purpose of the work is to create a typology of role-masks presented in the communicative space of radio. Strategies of entertaining, status and communicative-regulatory mask roles, their dominant lexical markers are described. The functions of the identified roles-masks are established: providing convenience for the perception of scientific information, consolidating, therapeutic, hedonistic, the function of putting forward a significant idea, etc.

Keywords: radio, discourse, speech masks, communicative strategy, tactics.

In the communicative space of radio a special game continuum is organized with the help of speech masks system. The mosaic nature of the images of the author and the addressee is reflected in the "split" of the author's images, which is represented in the communicative space through strategies. Gaming and communicative-regulatory strategies are associated with the creation of a speech mask in entertainment media texts as a special speech-behavioral model. They are important elements of the structure of the media text and allow solving various communicative tasks. The essence of these strategies is to transform the addresser into another linguistic personality. They are based on linguistic "joking", humor with a mindset for fun, the creation of hedonistic emotions among the addressees, as well as outrageous, theatrical and entertaining.

The radio discourse reflects the subject-subject focus on the formation of entertaining-playing, phatic interaction between the presenter and the listener. It is coordinated on the basis of the speech behavior (presentation) of the presenter and the organization of emotional and axiological community with the addressee due to the communicative strategies of the speech mask. The *aim* of the article is to identify the dominant communicative strategies and tactics of speech masks in entertainment and informative radio discourse. The *research material* consists of 400 radio programs broadcast by Belarusian radio channels from 2000 to 2023.

The communicative-pragmatic functions of the radio discourse provide the following strategies: *entertaining, status* and *communicative-regulatory speech masks*.

Strategies of Speech Masks in Entertainment Radio Discourse

Orientation towards the hedonistic orientation of interaction, communicative hedonism (pleasure from communication), which are the pragmatic dominants of the radio discourse, is actively manifested through the tactical repertoire of *entertainment strategies speech masks* (SM) Cheerful and Joker.

The entertaining and playful beginning can be traced in the implementation of the tactics of SM Cheerful: humor (1), funny story (2), self-criticism (3), dispute (4), which create a system of communicative attractions that make up a structural and meaningful text whole: Moderator: Your task is to determine, where is the fake with us ... (3) Just turn off the receiver, otherwise I hear myself. And my voice infuriates me, especially in the morning. Presenter: And your wife lives with you and hears this every day! Moderator: (1) I represent, of course, and I get paid every day for it. So, first news. ... Presenter: The second news. The news at the Oslo Institute, this is Norway, there is such a city ... They created a special electric sheet. ... Host: I mean, are you normal? Do you have electric sheet? (1) Yes, I went off the air! I'm surrounded by people with electric sheets! Where is my straitjacket? My cat warms me! ("Fake or not fake", Radio Unistar, 09.09.20).

The actualization of the entertaining mode is promoted by colloquial, pejorative vocabulary - manifestations of the tactics of self-criticism; emotional-evaluative regulatives, language game - markers of humor tactics; vocabulary-markers of disagreement (oh, come on, it's not true, etc.). Such attractive demonstrators are intended for the pleasure of the audience, often consisting of "a carnival reversal of stereotyped ideas, opinions and behaviors" [Karasik, p. 232].

The communicative style of SM *Cheerful*, which is typical for an entertaining conversational radio, is characterized by a high proportion of humor, parody, theatricality, spontaneity and play. Among the most recurrent objects that Cheerful humor is directed at are situations and facts from the personal life of the host and participants in communicative interaction, the participants in the program and their abilities, qualities and skills of the host, as well as interpersonal relationships.

Strategy of *SM Joker* is implemented by clowning tactics, the most common in radio broadcasts in the period 2000-2018. The clownish nature of the communicative interaction is supported by the host's parodying someone else's behavior (a woman, a young girl, etc.) in a conversation with the listener, distortion, mangling

of sounds, changing the stress in words to create a laughable effect.

The strategies of communicative-regulatory speech masks act as a means of embodying an emotionally-adjusting discourse plan that intimizes communicative interaction and forms an emotional atmosphere, the mood of the audience. The emotional, axiological space of sincerity, built on the basic needs of recognition, respect and internal interests of the audience, can be considered as a discursive ideology of radio. Ideology in this case is understood in its broadest sense - as a system of value meanings implicitly present in the genre and language ways of organizing content, a system that manifests itself in the process of "unconscious" displacement "of obligatory units (rethinking, modal interpretation) towards" discursive interests " [Rezanova, p. 60]. Its formation is aimed at modeling a sense of community (experience, life stories, emotions, etc.), spiritual, cordial relationships with the addressee. Social relationships of all kinds are the more real, reliable and authentic, the closer they affect the internal psychological interests of everyone [Batsenkova, p.

To create a friendly area where the listener can feel meaningful and valued the radio discourse employs the strategy of *SM Inspiring Well-Wisher*.

Emotionally shaping dominants in radio serve to involve the addressee in communicative interaction, to attract attention - tactics that implement the strategy of Inspiring well-wisher: *indications of acceptance, praise, demonstration of the significance of the addressee, wishes.*

The communicative space of radio in recent years is being formed as a space for a special way of thinking - acceptance, which researchers define as "a worldview position expressed in an unconditional value attitude to life, to oneself and others, which is developed in the process of developing life experience on the basis of a conscious choice of respect for diversity of the surrounding world ... recognition of the diversity, multivariance, otherness of everything that exists and agreement with this" [Ryazantseva]. The ideals of the "new sincerity" - honesty, openness and authenticity - determine the implementation of this category in the communicative tactics of indicating acceptance, the markers of which are statements of a stating nature containing inclusive pronouns and lexemes with the meaning of difference, uniqueness: You see how different we are all (Radio Rocks); Everyone feels and lives in their own way, we are all different, unique (Radio New Wave); Yes, there are strange situations like this (Radio Minsk).

The tactics of praise reflects the axiological dominant of modern radio - sensitivity, "new sincerity", expressed in increased sensitivity. Emotional regulatives become linguistic manifestations (clever! Ah, well done!), emotional-evaluative vocabulary demonstrating a high degree of quality, vocabulary of uniqueness semantics, designations of emotions (proud, respect, rejoice): But such a unique thing as yours, Tatyana, is not no one will have. There will be no such risk somewhere in a cafe to meet a girl in the same dress. I'm sure it's a cool experience and incredible skills! ... Tell your

stories ... be sure to share what it is, your way. I'm sure there is something to be proud of! (Radio Unistar, 03.03.2023).

The tactic of demonstrating the significance of the addressee is aimed at emphasizing the desirability of contact with a partner, recognizing the importance of his communicative interests and communicative efforts due to the lexemes of the semantics of importance, necessity; friendly treatment (friends, our loved ones): Friends, your opinion and your stories are important to us (Minsk Wave); We call you now to our studio, our dear news experts. This is because we can't do without you ("News Expert", Radio Rocks, 09/27/2022).

The *tactic of wishing* is a discursive marker of the communicative space of radio, as it creates the basis for headlines, phatic speech genres (greeting, farewell), as well as dialogic interaction between the presenter and the addressee, for example, *Live greedily, take everything from life!* ("Finally a show", Radio Unistar, 2018); *Have a productive day for everyone and have a good mood!* (Radio Rocks VKontakte, 2022).

An emotionally rich communicative space focused on reducing the distance between information and the addressee is formed by the tactics of gratitude, which often constitutes a communicative model in combination with other tools of communicative-regulatory speech masks strategies (tactics of praise, demonstrating the significance of the addressee, etc.): Come on, we are waiting for your wonderful, frank stories. ... Our dear listeners, thank you all for trusting us and sincerely sharing your interesting stories. ... Let everything in your life be super, super, super! (Radio Rocks, 2022).

Strategies of Speech Masks in Informative Radio Discourse

The picture of communicative interaction with the addressee in informative radio discourse is formed by the entertainment strategies of SM Cheerful and Refuter as well as status strategy of speech masks *One of your, Expert*.

Monologic radio genres, characteristic of the 20th - early 21st centuries, were transformed into dialogic ones. This entailed a transformation of the role of the journalist. The desire of a journalist to thin out the information density and form a hedonistic space for obtaining knowledge gives rise to the use of entertaining strategies of speech masks. The strategy of SM Cheerful is the most typical for dialogic cognitive genres. It is represented by tactics of *humorous commentary*, *humorous mockery*, and *humor*.

In the radio discourse, polyphony is represented mainly by thematic and tonal-stylistic (changing the tone and style of communication) variability, which manifests itself in the generation of a secondary thematic line when discussing a cognitive topic. The polyphony of switching is ensured by editing cognitive topics (presented by an expert) and topics that provide a phatic resource, an emotional background for communication, which are updated through idle speech communication of the hosts on the air: Host: *Is strip plastic not suitable for men? Well, you never know.* Expert: *Everything is possible in the modern world.* Pre-

senter 2: If you decide to change your career so drastically, then we will support you, of course. Presenter 1: This is all that I can do with my own hands. Presenter: It's probably more about legs, plastic strip. Presenter 2: You don't see, the person is starting. Presenter 1: You haven't seen my numbers, Katya, just wait ("Guest on the topic", Radio Mir, 02/07/2023).

The axiological dominant of the radio discourse conflict - gets deliberately marked in the strategy of SM *Refuter*. The clash of opinions of the expert and the presenter or several presenters of the program contributes to the activation of the attractive (emotional, entertaining) side of communication. Tactically, the Refuter's is actualized through the tactics of dispute as *a provocation* (source of information), dispute as an exchange of opinions.

In the course of communicative interaction, the text-forming model of a cognitive text is implemented by the strategies of the status of speech masks of a journalist. The structure of instructive genres is made up of the following tactical model of the speech mask *Expert*: tactics of advice, instruction, commentary, approval/disapproval, which demonstrates ordinary knowledge or assessment, contrasting with the knowledge or analysis of the expert: Presenter: In such a situation, that they themselves got, respectively, exactly you can get out of there. In no case do not refuse to colleagues, in no case do not refuse close acquaintances to help neighbors. But do it a little bit, little by little, cutting back on the amount of help that you provide. ... Psychologist: On the one hand, I agree. On the other hand, I have some internal contradictions. I'll explain now. Look here, imagine the situation. Everyone is used to the fact that Olga does all the work for them, and no matter how much she puts a little bit of boundaries back, people still won't understand this. ... Olya, you set the time frame ("Formula of Happiness", Radio Unistar, 10/22/2018). The contrast of everyday and expert knowledge becomes the structural and content engine of the radio text.

The role of the translator of knowledge has changed to the role represented by the speech mask *One of you* as a representative who voices the impressions

and interests of the media audience. The host broadcasts on the air potential objections, the emotions of the listener. This strategy, which manifests itself in the tactics of bewilderment, objection, agreement, disagreement, evaluation, is aimed at reflecting the intended or potential opinion and feelings of the listener in order to include him as much as possible in the communicative situation, as well as demonstrate closeness (communicative and psychological), form equal relations: Expert: At this time of the year, some citizens try to feed (ducks) and in this way we disrupt the natural process of bird migration. That is, the birds do not fly away. Host: So what? I would like to ask the harsh scientists. Are you walking with a child in the park and no contact with the cute world of birds? Are you just looking at them? And all? Or maybe sometimes you can still feed the birds? ("Green world. We feed the birds in the park", Radio Mir, 2022).

To conclude, it's necessary to point out that speech mask strategies act as a structure-forming element of the communicative space of a media text. They actively form a trusting, friendly, informative or inspiring, playful, jokingly ironic or mocking tone of an entertaining media text. Being aimed at the organization of communication, speech mask strategies provide convenience in the perception of information, perform entertaining, hedonistic and therapeutic functions.

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УЛК 811.111

LEVEL OF PERCEPTION OF NATURAL SCIENCE IN A FOREIGN LANGUAGE IN NON-ENGLISH SPEAKING STUDENTS

Kismetova G.,

Candidate of Pedagogical Sciences, Associate Professor Makhambet Utemisov West Kazakhstan University

Zhaskairatova D.

Master's student of the philological faculty, Makhambet Utemisov West Kazakhstan University https://doi.org/10.5281/zenodo.7789424

Abstract

The article defines interdisciplinary integration and discusses its role in teaching non-English speaking students when learning foreign languages. It also provides various data on recent changes in the pedagogical process of domestic education.

Keywords: interdisciplinary integration, foreign language, education, non-English speaking students.

At the present time in Kazakhstan there is the formation of a new system of education, focused on entering the world space. To achieve this goal, it was necessary to introduce the process of trilingual education, which includes the languages of the trinity (Kazakh, Russian and foreign languages). This process is accompanied by significant changes in the theory and practice of the pedagogical process. Here is some evidence of significant changes over the past six years.

Since 2017, organizations of general secondary education have been teaching individual subjects of the natural and mathematical cycle (NSC) in English. Teaching is carried out taking into account the opinion of parents and students, the willingness of teachers, as well as on the basis of the decision of the Pedagogical Council of the school [7].

Since 2018, for the first time, school leavers have been given the opportunity to take the test in English. In 2021, 351 graduates took Unified national testing (UNT) in English. The average score of graduates taking UNT in English was 84.8 points. In addition, the number of students taking the IELTS and SAT exams increases each year. For example, in the 2020-2021 school year, more than 570 teachers took the certification exams (IELTS), a 39% increase from 2018.

This is a great indicator that today's young people, most of them students and teachers, are aware of and have the opportunity to learn a foreign language so that they can achieve their educational goals from all over the world without any language barriers.

Since 2020, domestic digital multilingual educational platforms such as Bilimland.kz, Kundelik, BilimAl, Daryn online, which have content in English, have started functioning. This is a good opportunity for secondary school students to learn an additional foreign language, which in the future will help them to become a person in their chosen professional field.

In the 2021-2022 school year, there are 3,864 schools teaching subjects in English, including 2,219 rural schools, of which 439 schools are fully immersed and 3,425 are partially immersed. The number of students enrolled natural and mathematical cycle (NSC) subjects in English is 243,324.

Also each year, 1,000 grants are given to universities that train teachers in English language instruction in four specialties of the science and mathematics cycle: «Physics», «Computer Science», «Chemistry», and «Biology».

When comprehending the great truth of nature, students feel the volume of insufficiently systematized knowledge about it. This problem can be solved by integrating subjects. One of the forms of implementation of the integrated approach to learning is the establishment of interdisciplinary links in the lessons of the natural cycle. They play an important role in increasing the practical and scientific-theoretical training of students, the essential feature of which is the mastery of the generalized nature of cognitive activity by schoolchildren. The integrated nature of the acquired knowledge gives the opportunity to apply it in specific situations, when considering private issues, both in the educational and extracurricular activities [5].

Integration is not an end in itself, but a certain system in the teacher's activity; it must solve certain problems of integrated teaching [1]:

- increase the level of knowledge of students in the subject, which is manifested in the depth of the acquired concepts, patterns through their multifaceted interpretation using the information of integrated sciences;
- change the level of intellectual activity by looking at learning material from the perspective of leading ideas, establishing natural correlations between the problems studied;
- Increase the cognitive interest of students, which manifests itself in a desire for active and independent work in class and outside of school hours;
- Include students in creative and research activities.

Interdisciplinary integration plays an important role in teaching foreign language to non-language students. This is due to a number of factors, which were identified in the process of observing the learning process of students of a pedagogical university.

Firstly, non-English speaking students are not always interested in learning a foreign language because

they do not perceive it as a subject contributing to their professional competence. The main source of strengthening the motivational aspect of learning a foreign language at university is the rational use of interdisciplinary integration [9].

Secondly, constant interdisciplinary integration of special subjects and foreign language allows educating students interested in their future professional activity, creative attitude to work, significantly affects the formation of their personality.

Thirdly, interdisciplinary integration allows changing the priority from assimilation of ready-made knowledge to independent active cognitive activity taking into account the need to form an integrated style of thinking in students. An important goal of learning in the conditions of interdisciplinary integration is to achieve not only the results of scientific cognition, but also the very way of obtaining these results, the formation of interdisciplinary structure of knowledge and cognitive independence of the student, the development of creative abilities. Interdisciplinary integration, as an independent stimulus of cognitive interest of students, restructures the learning process: strengthens the generalizing nature of the content of the material studied, the search orientation of the learning activity, its collectivity, mutual assistance of students in its organization; expands business contacts between students and teachers [8].

Thus, using the reliance on interdisciplinary integration, the teacher includes students in active learning and research activities.

In my opinion, interdisciplinary integration is a fundamental methodological principle that contributes to the convergence of different academic disciplines, combines knowledge, skills, and abilities of educational-research activities in different subjects into a coherent system and, thus, resolves the conflict between the subject teaching of a foreign language and formation of teaching and research skills without losing qualitative features of the studied subject.

Also, it should be noted that in English classes you can use linguocountry materials, which should be carefully selected by the teacher. It is the competent selection of linguocountry study materials that is one of the important factors in teaching foreign languages. The solution to this problem largely depends on the teacher, on his ability to effectively implement the selected and developed material in the classroom. Tasks of a linguocountry study nature, which are used in English lessons, should be [6]:

- authentic (representing speech works generated in real communication situations);
- typical (standardized speech works, regularly reproduced in repetitive situations of communication);
- topical (reflecting the current stage of socioverbal interaction of communicants).

It is very important to understand that mastering the culture of the country of the target language is based on the principles of authentic communication, interactivity, and learning the language in a cultural context [3]. The system of multilingualism among the subjects of natural and mathematical direction determines the relevance of the problem of integration in education, which provides for the creation of fundamentally new educational information with appropriate content of educational material, educational and methodological support, new technologies.

Finally, it encourages students to redefine their need and ability to communicate in three languages.

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PHILOSOPHICAL SCIENCES

HEGEL'S CONCEPT OF SENSATION, EXPERIMENTAL DATA OF PSYCHOPHYSIOLOGIE, AND QUALIA IN THE PHILOSOPHY OF MIND

Suvorov V.

Assistant professor Research Computing Center Lomonosov Moscow State University ORCID: https://orcid.org/0000-0001-5451-9033

HEGELS BEGRIFF DER EMPFINDUNG, EXPERIMENTELLEN DATEN DER PSYCHOPHYSIOLOGIE UND QUALIA DER PHILOSOPHIE DES GEISTES

Suvorov V.

Assistenzprofessor Forschungsrechenzentrum Staatliche Lomonossow-Universität Moskau ORCID: https://orcid.org/0000-0001-5451-9033 https://doi.org/10.5281/zenodo.7789430

Abstract

Modern publications on Hegelian anthropology and psychology testify to the growing interest in this topic. This is due to the increasing relevance of philosophical anthropology in the context of the "anthropological turn", and also due to the need for meaningful semantics of psychological concepts for computer modeling. The present article is devoted to the epistemology of Hegel, and the concept of sensation that is presented in the section "Anthropology of the Philosophy of the Subjective Mind" is analyzed. Connections between the Hegelian concept of sensation, experimental data of psychophysiologie, and qualia of the philosophy of consciousness are shown. It follows from this consideration that Hegel's investigations of sensation conducted within the framework of speculative philosophy find not only further confirmation in the discoveries of modern science, but also a productive conceptual framework for consideration in the body of knowledge about sensation, as well as a proposal for modeling artificial intelligence.

Abstrakt

Zeitgenössische Veröffentlichungen zur Hegelschen Anthropologie und Psychologie zeugen von einem wachsenden Interesse an diesem Thema. Dies liegt an der wachsenden Relevanz der philosophischen Anthropologie im Kontext des "anthropological turn", sowie an der Notwendigkeit einer aussagekräftigen Semantik psychologischer Konzepte für die Computermodellierung. Dieser Artikel ist Hegels Erkenntnistheorie gewidmet, wobei der im Abschnitt "Anthropologie der Philosophie des subjektiven Geistes" vorgestellte Empfindungsbegriff analysiert wird. Zusammenhänge zwischen dem Hegelschen Empfindungsbegriff, experimentellen Daten der Psychophysiologie und Qualia der Bewusstseinsphilosophie werden aufgezeigt. Aus dieser Überlegung folgt, dass die im Rahmen der spekulativen Philosophie durchgeführten Hegelschen Empfindungsstudien nicht nur eine weitere Bestätigung in den Entdeckungen der modernen Wissenschaft finden, sondern auch einen produktiven konzeptionellen Rahmen für die Betrachtung im Gesamtwissen über die Empfindung als Vorschlag zur Modellierung künstlicher Intelligenz.

Keywords: epistemology, hegelian anthropology, psychophysiology, philosophy of mind, qualia, sensation **Schlüsselwörter**: Erkenntnistheorie, Hegelsche Anthropologie, Psychophysiologie, Philosophie des Geistes, Qualia, Sensation

Hegels Anthropologie – dialektisch-spekulative Methode zur Entdeckung des Geistes durch den Menschen

Der Gegenstand der Anthropologie in *Die Philosophie des Geistes* [3, 38]. Die Hegelsche Anthropologie und Psychologie hat im Vergleich zu anderen Gebieten der Philosophie, die Hegel ausarbeitete, bis heute wenig Resonanz gefunden. Die steigende Zahl der diesem Thema gewidmeten Veröffentlichungen in den letzten Jahrzehnten zeugt jedoch von wachsendem

Interesse (Federico Sanguinetti, Richard Dien Winfield, Hans Friedrich Fulda, Willem deVries, Reiner Wiehl, M.J. Petry und andere), was unter anderem auf die zunehmende Aktualität der philosophischen Anthropologie im Kontext der "anthropologischen Wende" (Max Scheler, 1928, Schlaeger Jürgen, 1996) zurückzuführen ist.

Die Hegelsche Anthropologie zeichnet sich dadurch aus, dass ihr Ziel nicht der Erwerb von Kenntnissen über einen Menschen durch "die psychologische, sonst gewöhnliche Betrachtungsweise" [3, 38] ist,

bei der "die Seele als fertiges Subjekt vorausgesetzt ist" [3, 38]. Darüber hinaus hat diese Betrachtungsweise nicht "die Bedeutung nur einer Selbsterkenntnis nach den partikulären Fähigkeiten, Charakter, Neigungen und Schwächen des Individuums" [3, 9]. Als Hauptgegenstand der Anthropologie bestimmt Hegel in Die Philosophie des Geistes nicht den Menschen in der Vielfalt seiner Lebensäußerungen, sondern den Geist als Wesen des Menschen: "Der subjektive Geist ist [...] an sich oder unmittelbar; so ist er Seele oder Naturgeist; Gegenstand der Anthropologie" [3, 38]. Im selben Sinne wird behauptet – "Wir müssen also von dem noch in der Natur befangenen, auf seine Leiblichkeit bezogenen [...] Geiste anfangen. Diese [...] Grundlage des Menschen ist der Gegenstand der Anthropologie" [3, 40].

Als treibende Kraft der Inhaltsentfaltung sieht Hegel die innere Dialektik des Geistes an, die Zersplitterung der Einheit in sich ausschließende Gegensätze, die sich danach in einem Zusammenhang befinden und ineinander übergehen [3, 13], wobei die "spekulative Betrachtung für die Auflösung der Widersprüche unmittelbar als notwendig gezeigt wird" [3, 13]. Die Aufmerksamkeit richtet sich darauf, 'was dialektischen Fortgang von der erwachenden Seele zur Empfindung betrifft" [3, 95]. Die menschliche Tätigkeit in dialektisch-spekulativer philosophischen Erforschung besteht laut Hegel, die im Bewusstsein des Philosophen entstehenden objektiven Bekundung des real existierenden Geistes zu beobachten und festzuhalten: "Die Philosophie hat also gewissermaßen nur zuzusehen, wie die Natur selber ihre Äußerlichkeit aufhebt [...] Dieser Übergang von der Notwendigkeit zur Freiheit ist [...] ein Stufengang von vielen Momenten, deren Darstellung die Naturphilosophie ausmacht" [3, 24].

Das Wesen des Menschen - als Geist. Den Ausgangspunkt für die Forschung des absoluten Geistes bedeutet Hegel in den ersten Sätzen Die Philosophie des Geistes das Gebot des Orakels von Delphi – "Erkenne dich selbst!", das er als Aufruf an den Menschen, sein eigenes Wesen als Geist zu erkennen, interpretiert: "Erkenne dich selbst, dies absolute Gebot hat [...] die Bedeutung der Erkenntnis des Wahrhaften des Menschen wie des Wahrhaften an und für sich, - des Wesens selbst als Geistes" [3, 9]. Die Entwicklung deses Gedankens erfolgt in dem Sinne, dass, obgleich gilt - "Das Absolute ist der Geist; dies ist die höchste Definition des Absoluten" [3, 29], dennoch für den Menschen die Erkenntnis des Geistes in der Natur beginnt: "Der Geist hat für uns die Natur zu seiner Voraussetzung, deren Wahrheit und damit deren absolut Erstes er ist" [3, 17]. Hegel behauptet eine für den rationalen Verstand paradoxe Inversion - das Ergebnis geht voran zum vorausgehenden Inhalt: "Der Geist ist als die Wahrheit der Natur geworden [...] dies Resultat die Bedeutung der Wahrheit und vielmehr des Ersten gegen das Vorhergehende hat" [3, 43]. Die Umkehrung zeigt, dass Hegel den Geist als Wahrheit annimmt, die vom Menschen entdeckt wird, aber objektiv bereits vor ihrer Verwirklichung in der Natur und Entdeckung durch den Menschen in Form einer abstrakten Idee existiert.

Das oben dargelegte stellt den ersten Schritt auf dem Weg zur Identifikation des Inhalts dar, der sich in dem Menschen als sein Wesen manifestiert, aber gleichzeitig die Anwesenheit des sich dem Menschen offenbarenden Geistes in diesem zum Ausdruck bringt.

Die Empfindung ist die fürsichsein des Geistes Äußerung durch Erwachen der Seele

Die Empfindung im Erwachen. Den nächsten Schritt der Entfaltung des Geistes bezeichnet Hegel als Eintritt der Empfindung beim Erwachen. Aus der Sicht der Dialektik findet dabei ein qualitativer Übergang statt – ein Sprung. Laut Hegel – "das Erwachen werde dadurch bewirkt, daß der Blitz der Subjektivität die Form der unmittelbarkeit des Geistes durchschlage" [3, 90]. In diesem Sprung sind untrennbar miteinander verbunden: das Erwachen der Seele, der Eintritt der Empfindung und der Auftritt der Subjektivität. Die genannten Bestimmtheiten bezeichnen die Grenze zwischen der Pflanzen- und dem Tierwelt, diese beiden Welten gehören jedoch zur Lebensstufe. Der Geist findet sich in der Empfindung als eie individuelle Seele - ein Subjekt. Für den Menschen "das Wachen ist das konkrete Bewußtsein dieser gegenseitigen Bestätigung jedes einzelnen Momentes seines Inhalts durch alle übrigen des Gemäldes der Anschauung. Dies Bewußtsein hat dabei nicht nötig, deutlich entwickelt zu sein" [3, 88].

Die Entstehung der Empfindung beim Erwachen äußert die Logik der Idee, die in ihrer (der Idee) natürlichen Entfremdung realisiert wird – "wenn im § 398 das Erwachen ein Urteil der individuellen Seele hat genannt werden dürfen [...] wir in der Empfindung das Vorhandensein eines Schlusses behaupten und daraus die vermittels der Empfindung erfolgende Vergewisserung des Wachseins ableiten können" [3, 97]. Da Gesagte wird durch Das Gesagte wird durch den Rückschluss des Menschen über sein Erwachen auf der Grundlage der sensuellen Empfindung illustriert - "Indem wir erwachen [...] Um daher zum völligen Wachsein und zur Gewißheit desselben zu gelangen, öffnen wir die Augen, fassen wir uns an, untersuchen wir, mit einem Wort, ob etwas bestimmtes Anderes, ein bestimmt von uns Unterschiedenes für uns ist" [3, 97].

Die Empfindung in den Denkbestimmungen. Hegel spricht von der Empfindung als von einem Zustand, der beim Erachen des Menschen eintritt und parallel auch in einer allgemeineren Bedeutung, als vom Erreichen durch den Geist einer bestimmten Stufe seiner Entfaltung – "in der Anthropologie betrachten wir aber das Erwachen nur insofern, [...] daß der Geist sich selber und eine ihm gegenüberstehende Welt überhaupt findet, - ein Sichfinden, das zunächst nur zur Empfindung fortschreitet" [3, 90]. Die Bewegung des Geistes zur Empfindung erfolgt in der Natur stufenweise -"Schon in der Pflanze zeigt sich ein in die Peripherie ergossenes Zentrum [...] Eine noch vollständigere Überwindung der Äußerlichkeit stellt der tierische Organismus dar". [3, 19] Infolge der unmittelbaren Reflexivität des Tieres in sich selbst wird es zur Subjektivität, und hat eine Empfindung, "die Empfindung ist eben diese Allgegenwart der Einheit des Tieres in allen seinen Gliedern, die jeden Eindruck unmittelbar dem einen Ganzen mitteilen" [3, 19].

In der *Empfindung* entdeckt der Geist für sich eigene Definitionen durch die Verleiblichung einigen

Bestimmungen, durch die Negation von sich selbst als einen anderen, zurückkehrend aus der materiellen Welt mittels Idealisierung des gegenständlichen Inhalts und von sich selbst, wobei dieser Inhalt für sich selbst gemacht wird. In der Anthropologie bekommt die Empfindung die folgende Hauptdefinition: "In dem Fürsichsein der wachen Seele ist das Sein als ideelles Moment enthalten; sie findet so die Inhaltsbestimmtheiten ihrer schlafenden Natur, welche als in ihrer Substanz an sich in derselben sind [...] Als Bestimmtheit ist dies Besondere von der Identität des Fürsichseins mit sich unterschieden und zugleich in dessen Einfachheit einfach enthalten, - Empfindung" [3, 95]. Weiteren Definitionen zuvorkommend, wird eine Umformulierung des bereits Gesagten angeführt: Die Empfindung ist ein Zustand der Unterscheidung durch den wachen Geist seines eigenen Inhalts als einfache Bestimmung in der genau so einfachen Identität seiner Seele.

In dieser Definition besteht das Wichtigste in den folgenden Mpmenten: erstens, die Verbindung der Empfindung mit dem Wachsein, was eine Integrität der Seele in die Außenwelt bedeutet, die sich als Ursache und Bestätigung des Erwachens und des Entstehens der Empfindung erweist; zweitens, die Immanenz der Empfindung mit der Seele, die Zuordnung der Empfindung zum inneren Inhalt der Seele, dabei kann die Erregungsquelle extern sein, und, drittens, die Simplität wie der empfindenden Seele, sowie auch des Inhalts der Empfindung, die hier nicht in einer Detailvielfalt, sondern als ein einfaches Ganzes auftritt: "Jedes Individuum ist ein unendlicher Reichtum von Empfindungsbestimmungen, Vorstellungen, Kenntnissen, Gedanken usf.; aber ich bin darum doch ein ganz Einfaches [...] Erst wenn ich mich an eine Vorstellung erinnere, bringe ich sie aus jenem Innern heraus zur Existenz vor das Bewußtsein" [3, 122].

Das Attribut der Einfachheit der Empfindung ist von prinzipieller Bedeutung in der Verbindung des Bewusstseins mit dem Inhalt der sinnlichen und der geistigen Sphäre. "Zunächst haben wir es dabei nur mit der Form des Empfindens zu tun. Was die Seele empfindet, ist erst im zweiten Teil der Anthropologie zu bestimmen" [3, 51]. Der Inhalt der Empfindung entsteht als die Ausdehnung der Empfindung in sich selber zur ahnenden Seele [3, 51], es ist ein Ergebnis des nach der Emfindung folgenden Apperzeptionsprozesses.

Die Empfindung des Menschen ist ein Organ des Lebewesens zur Wahrnehmung des Inhalts der sinnlichen und der geistigen Sphäre. In der Einleitung, und danach auch im Abschnitt Empfindung Die Philosophie des Geistes geht es fast in ein und denselben Ausdrücken zuerst im negativen, und danach im positiven Sinn um den Zusammenhang der Empfindung mit dem geistigen Inhalt. Im ersten Fall wird vermerkt, dass ein religiöser, sittlicher etc. Inhalt nicht als besondere Arten der Empfingung betrachtet werden kann; im zweiten Fall, dass "Alles ist in der Empfindung und [...] alles, was im geistigen Bewußtsein und in der Vernunft hervortritt, hat seine Quelle und Ursprung in derselben [...] Es genüge nicht [sagt man], daß Grundsätze, Religion usf. nur im Kopfe seien, sie müssen im Herzen, in der Empfindung sein" [3, 97]. Mit anderen Worten, ist das Geistige keine Art der *Empfindung*, das Bewusstsein hat jedoch für sich die *Empfindung* als Quelle und Mittel, um unmittelbar den Inhalt aus der geistigen Sphäre zu erhalten. Bezüglich der ersten (negativen) Definition erläutert Hegel – "an einer niedrigeren, abstrakteren Bestimmung das Höhere sich schon empirisch vorhanden zeigt" [3, 17].

Die Empfindung entsteht beim Erwachen in Zusammenhang mit einer Erregung der Sinnesorgane, der Inhalt der Empfindung kommt jedoch nicht ausschließlich und unmittelbar von außen - "Was die empfindende Seele in sich findet, ist [...] das natürliche Unmittelbare, als in ihr ideell und ihr zueigen gemacht" [3, 100]. Andererseits, wird jeweils nach der Entwicklung des Geistes der geistige Inhalt empfunden - "das ursprünglich dem Fürsichsein, das ist, wie es, weiter in sich vertieft, Ich des Bewußtseins und freier Geist ist, Angehörige zur natürlichen Leiblichkeit bestimmt und so empfunden" [3, 100]. Demgleich unterscheidet Hegel "eine Sphäre des Empfindens, welches zuerst Bestimmung der Leiblichkeit [...] ist [...] und eine andere Sphäre der im Geiste entsprungenen [...], die, um als gefundene zu sein, um empfunden zu werden, verleiblicht warden" [3, 100].

Besondere Aufmerksamkeit schenkt Hegel dem Ausdruck des Inhalts der geistigen Sphäre in der Form der *Empfindung*. Er spricht in diesem Zusammenhang von der Umsetzung in der *Empfindung* von Denkprozessen und von der Zweckmäßigkeit der Entwicklung einer neuen Wissenschaft – der psachischen Physiologie: "Das System des inneren Empfindens in seiner sich verleiblichenden Besonderung wäre würdig, in einer eigentümlichen Wissenschaft, einer psychischen Physiologie , ausgeführt und abgehandelt zu werden [...] es würde die interessanteste Seite einer psychischen Physiologie sein, [...] wie Nachdenken, geistige Beschäftigung im Kopfe, dem Zentrum des sensiblen Systemes, empfunden wird" [3, 101].

Zusammenfassend können folgende Definitionen der *Empfindung* als Attribut der Seele in der Stufe der Entdeckung des Fürsichseins durch den Geist formuliert werden:

- 1. Die Empfindung ist einfache Bestimmung der Seele.
- 2. *Empfindung* sinhalt manifestiert sich der in der Ausweitung der *Empfindung* bis zur vorfühlenden Seele .
- 3. Die *Empfindung* ist die Allgegenwart der Einheit in allen seinen Gliedern.
- 4. Die *Empfindung* gehört zu zwei Sphären: die Sphäre der *Empfindung*en der körperlichen Herkunft und die Sphäre der Bestimmungen, die im Geist entstehen und durch Verleiblichung empfunden werden können.
- 5. 5. Der Übergang vom geistigen Inhalts zur Verleibliche *Empfindung* sollte in der psychischen Physiologie untersuchen "einer eigentümlichen Wissenschaft".
- 6. Auch Denkprozesse beziehen sich zu den empfundenen Bestimmungen der geistigen Sphäre.

Hegels Anthropologie und wissenschaftliche Forschungsmethoden der psychischen Erscheinungen

Hegels Empfindungsdefinitionen in die Realität. Der Begriff der Empfindung in Die Philosophie des Geistes wird bei der Gedankenbewegung von den grundlegenden philosophischen Prinzipien bis hin zu der Geistesstufen und konkreteren Definitionen des Gedankens entfaltet. Die Verwirklichung der Hegels Absicht in der dialektisch-spekulativen Auslegung ist nicht logisch beweiskräftig. Man kann auch nicht sagen, dass die dargelegten Ergebnisse unmittelbar klar oder offensichtlich wären. In diesem Zusammenhang entsteht die Frage, inwiefern die Hegels Empfindungsdefinitionen in einem breiteren Erkenntniskontext realistisch und produktiv ist.

Die erste Frage ergibt sich aus wissenschaftlicher Sicht: gibt es in der Realität explizit markierte Verbindung zwischen dem Erwachen und Empfinden? Dazu lassen sich in erster Linie medizinische Daten anführen. Bereits in der zweiten Hälfte des 19. Jahrhunderts schrieb der russische Physiologe I.M. Setschenow in seinem Werk "Reflexe des Gehirns" (1863): "Wenn man alle Rezeptoren abschaltet, sollte der Mensch in einen komaartigen Schlaf fallen, aus welchem er nie mehr erwachen würde". Diese theoretische Annahme fand eine Bestätigung in der klinischen Praxis, als ein anderer russischer Wissenschaftler S.P. Botkin einen Patienten beobachtete, bei dem aus allen Rezeptoren des Körpers lediglich ein Auge und ein Ohr intakt waren. Sobald man dem Patienten das Auge schloss und das Ohr zuhielt, schlief er sofort ein. Bei späteren Versuchen des russischen Physiologen B. S. Galkin wurden Hunden operativ gleichzeitig die Seh-, Gehör- und Geruchsrezeptoren entfernt. Sie schliefen 20 – 23 Stunden am Tag. Sie erwachten nur unter dem Einfluss innerer Bedürfnissen oder eindringlicher Einwirkung auf die Hautrezeptoren. Inwzischen gibt es viele andere Beobachtungen, die diese Erkenntnisse bestätigen.

Moderne wissenschaftlich-technische Mittel ermöglichen psychische Vorgänge, unter anderem *Empfindung*en, durch objektiv messbare Korrelate der Psychophysiologischer Methoden erforschen. Außerdem stattfindet Fortschritt in der Philosophie des Bewusstseins hinsichtlich der Abfassung von objektiv bestimmbaren Begriffen zur Darstellung des subjektiv erlebten Inhalts. Insbesondere bezieht sich das Phänomen der (*Qualia*) unmittelbar auf *Empfindung*en.

Psychophysiologische Empfindungs korrelate. Von fundamentaler Bedeutung für die Erforschung der Dynamik und einer Reihe von Besonderheiten der psychischen Prozesse sind heute die Methoden der indirekten Messung der elektrischen Hirnaktivität mittels Registrierung der Signale von Sensoren, die auf der Hautoberfläche des Kopfes angebracht werden - das Verfahren der Evozierten Potentiale (EP – Verfahren) und das Verfahren der Ereigniskorrelierten Potentiale des Kopfhirns (EKP - Verfahren) [1]. Diesen Verfahren liegt die Aufnahme eines Elektroenzephalogramms zu grunde, welches mit Spezialgeräten und mathematischen Methoden bearbeitet wird. Dabei geht es hier nicht um eine operative Entzifferung der ablaufen den psychischen Prozesse, sondern um die Bearbeitung der Gesamtheit der Ergebnisse von mehrfach ausgeführten gleichartigen Messungen. Im Resultat einer solchen Bearbeitung entsteht ein Diagramm, auf dem die Maximen hervorgehoben werden, die mit bestimmten Ereignissen mittels Anbindung, einer seits, an die ausgeführten Einwirkungen (Lichtblitze, Signaltöne, mitgeteilte Informationen oder eine geistige Aufgabe etc.) und, anderer seits, – an die Antwortreaktion der Testpersonen (Tastendruck, Sprachantwort etc.), synchronisiert werden

Das Vorhanden sein bestimmter Maximen auf dem Diagramm, der enzeitliche Verzögerungen, Amplituden und Polaritäten erlauben auf einen Nachweis der formulierten Definitionspunkte des Empfindens zu schließen, insbesondere:

- Die Synchronität $(0.1-0.3 \, \mathrm{Sek.})$ der Signale von den Rezeptoren, die eine *Empfindung* mit der Registrierung einer Aktivitätsphase des Nervensystems, die dem wachen Zustand entspricht, zum Zeitpunkt des Erwachens hervorrufen, dient als Nachweis untrennbaren Verbindung des Wachseins und des Empfindens (Ziff. 1 der Definitionen).
- Der Auftritt eines kennzeichnen den "Maximums" auf dem EP Registrierungs diagramm nach ca. 0,3 Sek., welches dem Bewusstwerden der *Empfindung* bei beliebiger Reizmodalität zu vorkommt, weist auf einen Universal mechanismus für den Signalempfang von der Peripherie durch das Zentrum hin; falls das Signal eine bestimmte Schwelle überschreitet, entsteht eine spezifische "Orientierungsreaktion" (Ziff. 3).
- Das Vorhandensein auf dem Diagramm von Komponenten, die sich auf konsequent eintretende Phasen der Wahrnehmung und der *Empfindung* beziehen, bildet für beliebige Einwirkungen die erste Komponente, die die einfache (nicht differenzierte) Tatsache des Eintritts eines Ereignisses bedeuten (Ziff. 2).
- Die Ähnlichkeit der Kennwerte der entsprechenden Maximen auf den Diagrammen für die sensorische Erregung (EP) und für eine geistige Beschlussfassung (EKP) weist auf die Gemeinsamkeit der psychischen Mechanismen hin, die Ereignisse im körperlichen und im mentalen (geistigen) Sphäre registrieren (Ziff. 4 und Ziff. 6).
- Die Eröffnung des EP- und des EKP-Verfahrens und sonstiger experimentaler Methoden, darunter auch der visuellen, demonstriert die Existenz von physiologischen Mechanismen, die mit der Umsetzung korreliert sind (Ziff. 5 der Definitionen).

Qualia ist eine gewußten Form der Empfindung bestimmter Zustände im geistigen und sinnlichen Sphären. Im Kontext der in der vorliegenden Arbeit der dialektisch-spekulativen Auslegung der Empfindung, ist das Phänomen der Qualia von besonderem Interesse nicht vom Standpunkt der umfangreichen Problematik dessen Erforschung, sondern in seiner Grundidentifikation als "Geistiger Zustand ist bewusst, wenn es einen qualitativen *Empfindung* gibt – es ist die Qualität der Erfahrung. Diese qualitativen Empfindung ist Qualia" {2, 4]. Zu den Hauptmerkmalen der Qualia zählt man: die unmittelbare Gegebenheit im Bewusstsein (wobei es Qualia der Empfindungen, der Emotionen und der Gedanken geben kann); die Immanenz des individuellen Bewusstseins (Unzugänglichkeit für Außenbetrachter); die Simplizität (Unteilbarkeit des Inhalts der Qualia); die Einzigartigkeit (die Identifikation einzelner *Qualia* durch das Bewusstsein). Die aufgezählten Merkmale treffen in vollem Umfang auf die *Empfindung* in der besprochenen Interpretation zu. In Analogie zum geistigen Sphäre der *Empfindung*en in Hegels Anthropologie spricht D. Chalmers von der *Empfindung* der Gedanken: "Es ist oft schwer zu fassen, gerade was das qualitative Empfinden einer vorkommende Gedacht ist, aber es ist sicherlich gibt. Es ist etwas, es ist wie zu mit solchen Gedanken" [2, 11.

Die Erkennung der *Qualia* in Interpretation von D. Chalmers ist ein Argument für die Bedeutsamkeit des von Hegel ausgearbeiteten Begriffs der *Empfindung*.

Fazit. Die Empfindung in der dialektisch-spekulativen Abhandlung – eine konzeptuelle Grundlage für die Integration und das Verständnis der heutig Erkenntnisse über die Empfindung

Die Auslegung des Begriffes der Empfindung in Die Philosophie des Geistes, wird im Gegensatz zu den Auslegungen, die aus anderen bekannten Definitionen folgen, von Hegel mittels Offenlegung des allgemeinen Grundsatzes im Verlauf der dialektisch-spekulativen Abhandlung gegeben. Sie hat die Bedeutung einer theoretischen Identifizierung des psychischen Phänomens der Empfindung als einer menschlichen Fähigkeit und gleichzeitig als einer Entstehungsstufe der Natur und der Geist. Als allgemeinen Grundsatz definiert Hegel den Geist, der dem Menschen in Form des Inhalts des Menschen selbst gegeben ist, und zum Gegenstand seiner Erkenntnis wird. Diese Auslegung eine konzeptuelle Grundlage für die Integration und das Verständnis in der Einheitlichkeit der Erforschungs ergebnisse der Empfindung, die auf verschiedenen Wissensgebieten erhalten wurden, sowie für die Entwicklung einer Methodologie für die Entwicklung einer starken künstlichen Intelligenz bilden kann.

Bezüglich des Zusammenhangs *Die Philosophie des Geistes* mit der Problematik der künstlichen Intelligenz soll bemerkt werden, dass Hegels ewiger, endloser, unerschöpflicher Geist dazu verdammt ist bei seiner Bildung zu vertrage "die Negation seiner individuellen Unmittelbarkeit, den unendlichen Schmerz" [2, 26], dabei "das Negative, der Widerspruch, die Entzweiung gehört also zur Natur des Geistes" [2, 26]. Man könnte denken, dass die Schaffung von künstlicher Intelligenz, die in gewisser Weise der kreativen

menschlichen Denkweise gleicht, sich nicht auf die Realisierung von fertigen Modellen einschränken und den dialektischen Prozess seines Werdens vermeiden kann. Analog zu den Definitionen der Empfindung in Die Philosophie des Geistes, könnte der Prozess der Schaffung von künstlicher Intelligenz wie eine stufen weise Genesis des Systems in einem untrennbaren gegenseitigen Zusammenhang mit dem Erhalt von Daten, der "empirischen Erfahrung des Empfindens" des Systems, im Gegensatz von der technischen Dateneingabe, erfolgen, und durch die Formierung von einzigartigen Identifikatoren für die Unterstrukturen, die Qualia gleich sind; eine permanente gegenseitige Abstimmung der Komponenten füllung; die Bildung eines universalen Manipulations mechanismus auf der Ebene der Identifikatoren mit Informations ressourcen (analog zum sinnlichen und geistigen Sphären) begleitet werden.

* *

Abschließend kann man die These über den zweifellosen Wert und die Produktivität für das moderne Wissen und die Praxis der Erforschung des philosophischen Erbes von Hegel, sowie von anderen Philosophen äußern, die auf ihrem historischen Niveau in der Erfahrung der eigenen Bewusstseins die Einigkeit des menschlichen Geistes und des sinnlichen Daseins umgesetzt und damit Lösungen für reelle Fragen der nachfolgenden historischen Epochen vorbereitet haben.

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PHYSICAL SCIENCES

THE RELEVANCE OF GEOPHYSICAL RESEARCHES OF PORTALS¹

Antonov A.

PhD, HonDSc, HonDL, ResProf., H.ProfSci Independent researcher, Kyiv, Ukraine https://doi.org/10.5281/zenodo.7789444

Abstract

The article proves that the version of the special theory of relativity (STR) presented in physics textbooks is incorrect. This is because in the early 20th century science lacked experimental knowledge required for the STR to be created, and the postulate (called the principle of light speed non-exceedance) that replaced the knowledge turned out to be incorrect and has been experimentally refuted in the 21st century. It is explained that tsunami and piano music would not exist, church bells would not ring and even swings would not swing on playgrounds, if the generally accepted version of the STR were true. Moreover, this version of the STR also implies that Ohm's law as interpreted by Steinmetz used daily by millions of radio and electrical engineers in their practice does not exist, and therefore radio engineering and electrical engineering should not exist either.

That is why, an alternative version of the STR has been created instead of the incorrect one. It follows from this that there is an invisible Multiverse whose universes are interconnected by numerous portals, including those located on Earth. And at least some of anomalous zones are entrances to portals. Geophysical exploration of portals are very necessary, as they will allow us to obtain new valuable knowledge about our Multiverse and confirm the correctness of the alternative version of STR.

Keywords: portals, parallel universes, Multiverse, special theory of relativity, physical reality of imaginary numbers, dark matter, dark energy

1. Introduction

Portals, sometimes also called 'star gates' [1], understood as transitions from some universes to others, are the subject of research in the article. Therefore, it is clear that one can speak of portals only if there are at least two universes, i.e. Multiverses. The term 'Multiverse' meaning two and more universes was proposed by the American philosopher-psychologist William James in 1895 and introduced to practice by the English science fiction writer Michael John Moorcock. To date, a large number of Multiverse hypotheses have been proposed. The most informative of them are [2]-[13].

But the special theory of relativity (STR) [14]-[16] recognized in physics as the greatest scientific achievement of the 20th century, denies existence of Multiverses at all and claims that there is only our visible universe.

Yet, there are a very large number of the so-called anomalous zones [17]-[20] planet. They are fraught with phenomena incapable of being explained by modern science. At least some of them are supposedly entrances to portals. Geophysical exploration of portals will allow visiting them safely and solving some important problems of modern astrophysics successfully.

2. The version of the special theory of relativity presented for study in physics textbooks is incorrect

The alternative version of the STR states the generally recognized version of the STR studied in physics textbooks to be incorrect [21]-[32], because:

- the relativistic formulas obtained therein are incorrect;
- the relativistic formulas have been incorrectly explained using the incorrect principle of light speed non-exceedance;
- the relativistic formulas have entailed wrong conclusions consisting in physical unreality of imaginary numbers and existence of only our visible uni-

Hence the alternative version of the STR thereby asserts exactly what we need - the existence of other universes, besides our universe, which together form the Multiverse. This follows from its relativistic formulas that are different from those in the generally accepted version of the STR. In order to understand the relativistic formulas of the alternative version of the STR better, let us first consider the simpler relativistic formulas of the generally accepted version of the STR. They are as follow

$$m = \frac{m_0}{\sqrt{1 - (\frac{v}{c})^2}}$$

$$\Delta t = \Delta t_0 \sqrt{1 - (\frac{v}{c})^2}$$

$$l = l_0 \sqrt{1 - (\frac{v}{c})^2}$$
(2)
(3)

$$\Delta t = \Delta t_0 \sqrt{1 - \left(\frac{v}{c}\right)^2} \tag{2}$$

$$l = l_0 \sqrt{1 - (\frac{v}{c})^2}$$
 (3)

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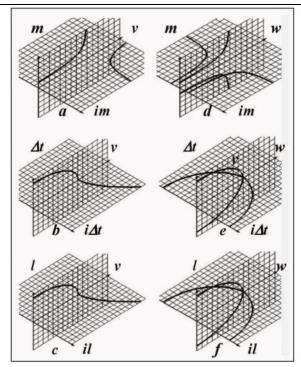


Fig. 1. Graphs of functions m(v), $\Delta t(v)$ and l(v) corresponding to the existing and alternative versions of the STR in the subluminal v < c and hyperluminal v > c ranges

where m is the relativistic mass of a moving body;

 m_0 is the rest mass of a moving body;

 Δt is the relativistic time of a moving body;

 Δt_0 is the rest time of a moving body;

l is the relativistic length of a moving body;

 l_0 is the rest length of a moving body;

 \mathcal{V} is the velocity of a moving body;

C is the speed of light.

Fig. 1a,b,c presents the graphs of the formulas. As can be seen, all formulas for v < c lead to results measured by real numbers, and for v > c to results measured by imaginary numbers. This circumstance greatly discouraged authors of the generally accepted version of the STR, since until very recently no one could explain physical sense of the results measured by imaginary numbers discovered 500 years ago. And no one would need a theory whose results could not be explained even by its creators. The fate of the generally accepted (but it's only now, not then) version of the STR hung in the balance in the early 20th century. It was saved by introducing a postulate, i.e. an unproven assumption, called the principle of light speed nonexceedance, the sense of which is clear from its name. The postulate looked quite acceptable, since in the early20th century physics knew no phenomenon, in which any physical entity would move with superluminal velocity. This is how the STR has begun to be studied and still been studied even in the most prestigious universities

But in 1934, Cherenkov radiation was discovered [33]. The radiation is emitted when electrically charged particles are moving at speeds faster than that of light. In 1958, Pavel Alekseevich Cherenkov, Igor Evgenievich Tamm and Ilya Mikhailovich Frank received

the Nobel Prize for the discovery and explanation of this radiation. The fate of the STR hung in the balance again. And the STR was saved once again. This time it was saved by making a clarification that the principle of light speed non-exceedance had implied the speed of light exclusively in a vacuum.

In the 21st century, one more attempt to refute the STR was undertaken. This time it was the OPERA experiment at the Large Hadron Collider. It was supposed to register superluminal neutrinos and thereby prove physical reality of imaginary numbers. A sensational report about successful completion of the very complex and expensive experiment was published on September 22, 2011. However, six months later, the OPERA experiment was refuted by the ICARUS experiment. Therefore, the STR again failed to be refuted.

Nevertheless, in 2008-2010, i.e. before publication of the OPERA experiment results, the results of alternative studies of special processes in linear electric circuits [34]-[38], were published. They proved that resonance, discovered by Galileo in 1602, occurs at complex frequencies, rather than at real ones, which has still been stated in textbooks on the theory of linear electric circuits. Thus, physical reality of imaginary numbers has been finally proved and the unsuccessful OPERA experiment has become useless. And since

mathematics is the language of all exact sciences, the principle of physical reality of imaginary numbers proven experimentally in the theory of linear electric circuits has become generally scientific. Therefore, this time the principle of light speed non-exceedance has been refuted.

At the same time, it has been also proved that if the outdated version of the STR presented in physics textbooks were true, then tsunami, bell ringing and music of piano or other musical instruments would be impossible; swings would not swing in a playground; Ohm's law as interpreted by Steinmetz used daily by millions of radio engineers all over the world would not work; and there would be no radio and electrical engineering at all. However, authors of the incorrect version of the STR did not know this when they created their theory at the beginning of the 20th century, but later physicists-relativists did not want to know this. Moreover, they did everything so that no one knew about it. For example, they staged a misleading and very expensive advertising action in the form of OPERA and ICARUS experiments at the Large Hadron Collider.

Nevertheless, physical reality of imaginary numbers has already been proven and the truth of this statement is beyond doubt. And therefore, in accordance with the relativistic formulas (1)-(3), something must exist in nature at . However, analysis of the formulas has shown that the universes corresponding to such a situation should be physically unstable and therefore self-liquidating, i.e. could not exist. Thus, the relativistic formulas (1)-(3) are incorrect as well as the generally accepted version of the STR.

The generally accepted version of the STR turned out to be incorrect because, due to the lack of necessary scientific knowledge in the early 20th century, relativistic formulas were derived incorrectly. Postulates were

used instead of missing scientific knowledge. However, the principle of light speed non-exceedance turned out to be wrong. Derivation errors were not timely detected and corrected. In subsequent years, following the inertia of competitive struggle (after all, within the framework of a market economy, science is a kind of business), the STR turned out to be so canonized that it became poorly receptive to new knowledge. As a result, the relativistic formulas have not yet been corrected.

3. Alternative version of the special theory of relativity

3.1. There is a hidden Multiverse in nature, not a Monoverse

Actually, relativistic formulas obtained in the generally accepted version of the STR not only were not, but could not be explained, because functions (1)-(3) vary in significantly different ways (see Fig. 1 a,b,c) in the subluminal (for v < c) and superluminal (for v > c) velocity ranges. As has been shown above, universes corresponding to the formulas (1)-(3) are physically unstable in the superluminal velocity range (for v > c) and, therefore, cannot even exist. That is why the formulas (1)-(3) are incorrect. In order for the same regularities to take place in the subluminal (for v < c) and superluminal (for v > c) velocity ranges and, therefore, formulas describing the corresponding processes could be explained, the graphs m(v), $\Delta t(v)$, l(v) should take the form shown in Fig. 1d,e,f. This requires introduction of the function i^q into the corrected relativistic formulas of the STR corresponding to them

$$m(q) = \frac{m_0 i^q}{\sqrt{1 - (\frac{v}{c} - q)^2}} = \frac{m_0 i^q}{\sqrt{1 - (\frac{w}{c})^2}}$$
(4)

$$\Delta t(q) = \Delta t_0 i^q \sqrt{1 - (\frac{v}{c} - q)^2} = \Delta t_0 i^q \sqrt{1 - (\frac{w}{c})^2}$$
 (5)

$$l(q) = l_0 i^q \sqrt{1 - (\frac{V}{C} - q)^2} = l_0 i^q \sqrt{1 - (\frac{W}{C})^2}$$
 (6)

where $q(v) = \lfloor v/c \rfloor$ – is the 'floor' function of discrete mathematics (Figure 2a);

w = v - qc is its own local velocity for each universe (Fig. 2b).

And the function i^q is the simple and clear function convenient for this situation, since, for integers of the argument q, it takes on only the proper values +1, +i, -1, -i and in the proper sequence.

These values correspond to four different universes alternating in space. However, its values are unknown for non-integers of the argument. This is not actually a problem, since we can replace the function i^q in the formulas (4)-(6) by the Euler's formula $e^{iq\pi/2}=\cos(q\pi/2)+i\sin(q\pi/2) \text{ that takes}$ on the same values +1, +i, -1, -i for integers of the argument q and, therefore, can completely replace it

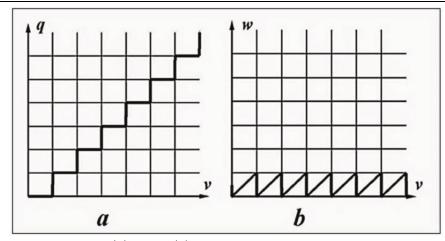


Fig. 2. Graphs of functions q(v) and w(v) illustrating the meaning of the 'floor' function of discrete mathematics

$$m(q) = \frac{m_0 e^{iq\pi/2}}{\sqrt{1 - (\frac{v}{c} - q)^2}} = \frac{m_0 [\cos(q\pi/2) + i\sin(q\pi/2)]}{\sqrt{1 - (\frac{w}{c})^2}}$$

$$\Delta t(q) = \Delta t_0 e^{iq\pi/2} \sqrt{1 - (\frac{v}{c} - q)^2} = \Delta t_0 [\cos(q\pi/2) + i\sin(q\pi/2)] \sqrt{1 - (\frac{w}{c})^2}$$
(8)

$$\Delta t(q) = \Delta t_0 e^{iq\pi/2} \sqrt{1 - (\frac{v}{c} - q)^2} = \Delta t_0 [\cos(q\pi/2) + i\sin(q\pi/2)] \sqrt{1 - (\frac{w}{c})^2}$$
 (8)

$$l(q) = l_0 e^{iq\pi/2} \sqrt{1 - (\frac{v}{c} - q)^2} = l_0 [\cos(q\pi/2) + \sin(q\pi/2)] \sqrt{1 - (\frac{w}{c})^2}$$
(9)

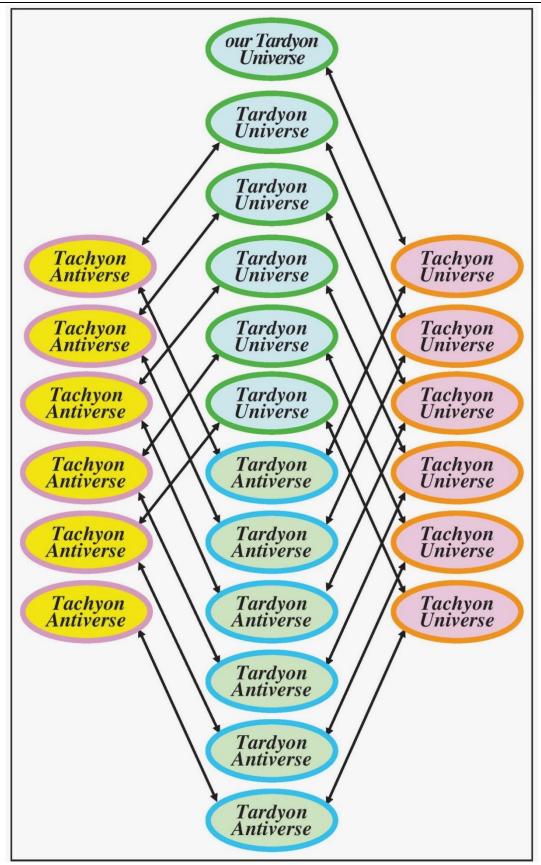


Fig. 3. Estimated helical structure of the hidden Multiverse

Thus the corrected relativistic formulas (4)-(6) and (7)-(9) imply that the quantity Q takes on integers² (see

physical factors that have not yet been studied, the value changes by on

² It takes non-integer values in the portals considered below, in which, from their entrance to exit, under the influence of

Fig. 2a), determined by the discrete 'floor' function $q(v) = \lfloor v/c \rfloor$. The integers correspond to different universes. Thus, the quantity q=0 corresponds to our visible universe (for which $i^0=1$) and the quantity q=1 corresponds to another universe (for which $i^1=i$) that is invisible for us by virtue of the condition v>c, because it is located beyond the event horizon. Stephen William Hawking wrote about imaginary time in such a Multiverse: "Imaginary time is a new dimension, at right angles to ordinary, real time". Thus, his research confirmed the validity of the hypothesis of the hidden Multiverse considered below.

Let us, for definiteness, call the universe corresponding to q=1 a tachyon universe, since it contains tachyons [39]-[40] that are understood to be subatomic particles moving at a speed faster than that of light. Therefore, many physicists believe that they should not exist in nature (by which they mean a Monoverse corresponding to the generally accepted interpretation of the STR), since they violate the principle of causality. However, since tachyons are actually in a tachyon universe (or antiverse), rather than in our universe, they do not violate the principle of causality.

For similar reasons, let us call our universe a tardyon universe. Then it would be logical to assert that the quantity q=2 corresponds to a tardyon antiverse (for which $i^2=-1$), the quantity q=3 corresponds to a tachyon antiverse (for which $i^3=-i$), the quantity q=4 corresponds to another tardyon universe (for which $i^4=1$), the quantity q=5 corresponds to another tachyon universe (for which $i^5=i$), etc.

Consequently, such a Multiverse has a helical structure (Fig. 3). Moreover, since v = w + qc follows from the formula w = v - qc, then v > c is for all universes, except for ours, and therefore they are beyond the event horizon, i.e. are invisible. The entire Multiverse is also invisible, which is why it is called hidden [41]-[47]. Universes of the hidden Multiverse do not intersect, which is why they can be called parallel. However, drifting in the fourth spatial dimension q they sometimes touch each other and even slightly penetrate into each other, forming some transitional zones called portals [48],[49] (they are shown by double-headed arrows in Fig. 3).

3.2 Dark matter and dark energy phenomena are generated by the existence of the Multiverse

But shown in Fig. 3 structure of the hidden Multiverse has the significant drawback that it does not take into account the existence of the phenomena of dark matter and dark energy, which are not explained. So what are dark matter and dark energy? And why is it so important to explain them? This is because,

according to the data obtained by the WMAP spacecraft, the entire universe (actually, the entire hidden Multiverse) consists of 22.4% of dark matter, 73.0% of dark energy and only 4.6% of baryonic matter [50]. And according to more recent data obtained by the Planck spacecraft, the entire universe (again, actually, the entire hidden Multiverse) consists of 26.8% of dark matter, 68.3% of dark energy and only 4.9% of baryonic substances [51]. That is, according to these data, almost the whole of nature is not at all what we have understood it to be in our visible universe. It is rather different. Thus, without understanding physical sense of dark matter and dark energy, understanding of our visible universe does not seem to be quite reliable. However, despite all the efforts of scientists to solve this important problem, dark matter and dark energy have been defied explanation for almost a hundred years. Michio Kaku wrote in this regard: "Of course, a whole bunch of Nobel Prizes is waiting for the scientists who can reveal the secrets of the 'dark energy' and 'dark matter'".

But all these efforts have actually so far been undertaken within the framework of the generally accepted version of the STR. Therefore, considering the remark of Albert Einstein "Insanity: doing the same thing over and over again and expecting different results", let us now try to seek for such an explanation within the framework of the alternative version of the STR. We should assume what could not be assumed within the framework of the generally accepted version of the STR - to seek for the explanation in the macrocosm, rather than in the microcosm. That is, we should assume that the phenomena of dark matter and dark energy are evoked in our visible universe by the rest of invisible universes of the hidden Multiverse. We should as well assume that the phenomena of dark matter and dark energy [52]-[60] are a kind of optical shadow of these invisible universes on our universe (however, it is gravitational or some other shadow, rather than an electromagnetic one). This will make it possible to understand why, until now, no material carriers of these phenomena have been found by research at the Large Hadron Collider. After all, no optical image (including a shadow) has ever contained any physical components of such an image.

Then, having made such an assumption, it might be argued that:

- the phenomenon of dark matter is evoked by invisible universes of the hidden Multiverse adjacent to our visible universe, and
- the phenomenon of dark energy is evoked by the rest of invisible universes of the hidden Multiverse, more distant from our visible universe.

Herewith, since these universes do not intersect anywhere, they are parallel. However, floating in space, they inevitably touch and even slightly penetrate into each other in many spots, generating portals. Adjacent universes exchange their material content through these portals. Therefore, over billions of years of their existence, parameters of all universes have substantially averaged. And this allows you to

determine the number of universes in the hidden Multiverse. Assuming that our visible universe has such averaged parameters, we can find the following:

- the total number of universes in the hidden Multiverse is 100% / 4.6% = 21.74 according to the above data obtained by the WMAP spacecraft, and 100% / 4.9% = 20.41 according to the data obtained by the Planck spacecraft. Consequently, their real number is supposedly equal to 20...22 universes.
- the number of universes in the hidden Multiverse that are adjacent to our universe and evoke the phenomenon of dark matter is 22.4% / 4.6% = 4.87 according to the above data obtained by the WMAP spacecraft, and 26.8% / 4.9% = 5.47 according to the data obtained by the Planck spacecraft. Consequently, their real number is supposedly equal to 5...6 universes.
- the number of universes in the hidden Multiverse that evoke the phenomenon of dark energy is 73.0% / 4.6% = 15.87 according to the above data obtained by the WMAP spacecraft, and 68.3 % / 4.9% = 13.94 according to the data obtained by the Planck spacecraft. Consequently, their real number is supposedly equal to 14...16 universes.

3.3 Dark matter and dark energy phenomena allow to determine the structure of the hidden Multiverse

And immediately striking is the discrepancy between the obtained calculation results and the one shown above in Fig. 3 supposed structures of the hidden Multiverse, which cannot be explained in any way by the inaccuracy of the measurements of the WMAP and Planck spacecraft, since the difference between the

results of calculations and experimental data is too large. There has been found to be five or six other parallel universes adjacent to our universe, rather than two. However, this number does not fit within the structure shown in Fig. 3.

Hence, it is logical to assume that there has been some mistake in the previous reasoning. This mistake, most likely, is that earlier, for simplicity, we have supposed the existence of only one extra dimension q in the hidden Multiverse, and, therefore, its correspondence to physically real complex numbers containing only one imaginary unit. In order for six other parallel universes to be adjacent to our universe (i.e. three tachyon universes and three tachyon antiverses), there should be three extra dimensions q, r, s, determining their position in space. Therefore, the structure of the hidden Multiverse should be described by quaternions $\sigma + i_1\omega_1 + i_2\omega_2 + i_3\omega_3$, i.e. hypercomplex numbers [61], containing three imaginary units i_1, i_2, i_3 connected by

the relations

$$i_1^2 = i_2^2 = i_3^2 = -1 \tag{10}$$

$$i_1 i_2 i_3 = i_2 i_3 i_1 = i_3 i_1 i_2 = -1$$
 (11)

$$i_1 i_2 i_2 = i_2 i_1 i_3 = i_3 i_2 i_1 = 1$$
 (12)

That is why, the relativistic formulas (4)-(6) and (7)-(9) must be corrected again as follows

$$m(q,r,s) = \frac{m_0 i_1^q i_2^r i_3^s}{\sqrt{1 - \left[\frac{v}{c} - (q+r+s)\right]^2}}$$
 (13)

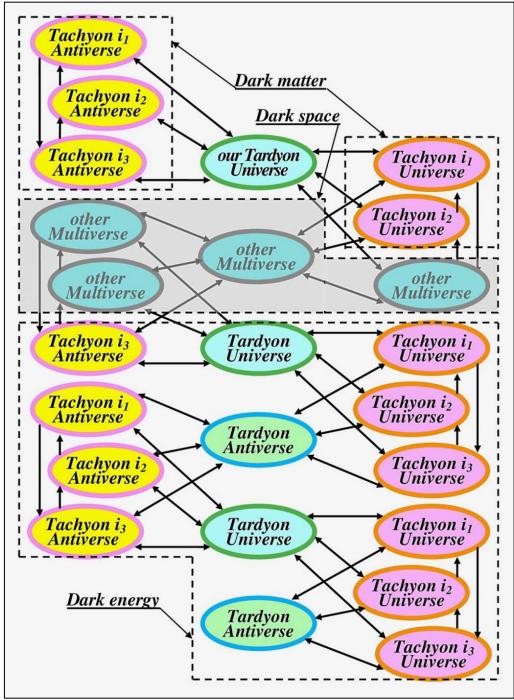


Fig. 4. Probable structure of the hidden Multiverse corresponding to the data obtained by the WMAP and Planck spacecraft

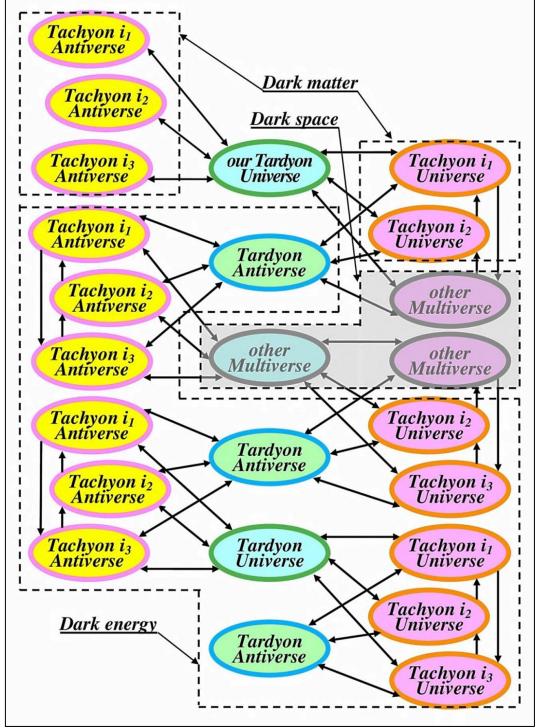


Fig. 5. Another probable structure of the hidden Multiverse corresponding to the data obtained by the WMAP and Planck spacecraft

$$\Delta t(q,r,s) = \Delta t_0 i_1^q i_2^r i_3^s \sqrt{1 - [\frac{v}{c} - (q+r+s)]^2}$$
(14)

$$l(q,r,s) = l_0 i_1^q i_2^r i_3^s \sqrt{1 - \left[\frac{v}{c} - (q+r+s)\right]^2}$$
(15)

or

$$m(q,r,s) = \frac{m_0 e^{iq\pi/2} e^{ir\pi/2} e^{is\pi/2}}{\sqrt{1 - \left[\frac{v}{c} - (q+r+s)\right]^2}}$$
(16)

$$\Delta t(q) = \Delta t_0 e^{iq\pi/2} e^{ir\pi/2} e^{is\pi/2} \sqrt{1 - \left[\frac{v}{c} - (q+r+s)\right]^2}$$
(17)

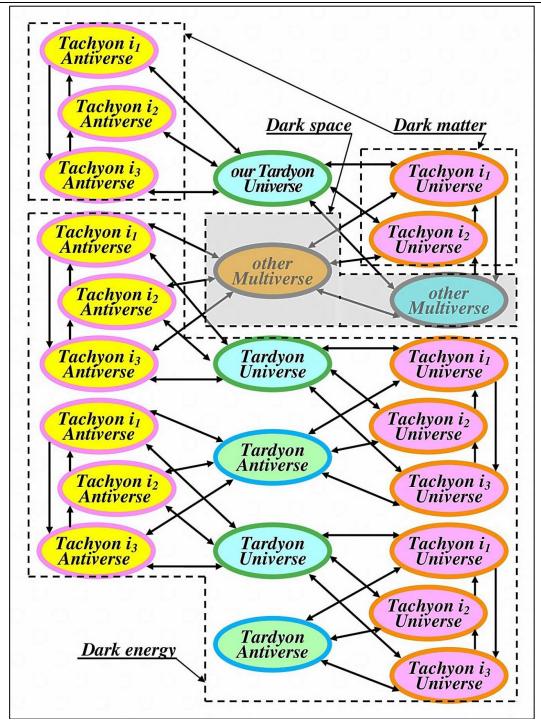


Fig. 6. One more probable structure of the hidden Multiverse corresponding to the data obtained by the WMAP and Planck spacecraft

$$l(q) = l_0 e^{iq\pi/2} e^{ir\pi/2} e^{is\pi/2} \sqrt{1 - \left[\frac{V}{C} - (q+r+s)\right]^2}$$
(18)

where m is the relativistic mass of a moving body;

 Δt is the relativistic time of a moving body;

l is the relativistic length of a moving body;

q, r, s are the coordinates of the universe in which a moving body is located.

These formulas implies that our Multiverse has a quaternion structure in six-dimensional space [62]-[64] and its structure is described by the function

 $f_{q,r,s}(x,y,z)+i_1q+i_2r+i_3s$, where the real summand $f_{q,r,s}(x,y,z)$ describes distribution of physical content in the universe with coordinates q,r,s, and the imaginary summand $i_1q+i_2r+i_3s$ describes the position of this universe in the space of the Multiverse.

According to the formulas (4)-(6), for integers³ of the coordinates of the universes q, r, s in the hidden Multiverse

- we get $i_1^q i_2^r i_3^s = 1$ for q + r + s = 0, which corresponds to our visible universe, which we shall call it a tardyon universe, since we have $0 \le v < c$ in this case;
- we get either $i_1^q i_2^r i_3^s = i_1$ or $i_1^q i_2^r i_3^s = i_2$ or $i_1^q i_2^r i_3^s = i_3$ for q + r + s = 1, which corresponds to one of the invisible universes adjacent to our universe; we shall call them tachyon universes, since we have v > c in this case;
- we get $i_1^q i_2^r i_3^s = -1$ for q + r + s = 2, which corresponds to an invisible tardyon antiverse that is not adjacent to our universe;
- we get either $i_1^q i_2^r i_3^s = -i_1$ or $i_1^q i_2^r i_3^s = -i_2$ or $i_1^q i_2^r i_3^s = -i_3$ for q+r+s=3, which corresponds to one of the invisible tachyon antiverses that is not adjacent to our universe;
- we get $i_1^q i_2^r i_3^s = 1$ for q + r + s = 4, which corresponds to another tardyon, but invisible, universe;

etc.

Examples of the structural diagrams of the hidden Multiverses corresponding to the calculations are shown in fig. 4-6. As can be seen, the universes contained in these Multiverses are interconnected not only by bidirectional portals corresponding to the formula

(10), but also by unidirectional portals corresponding to the formulas (11) and (12). Besides, some universes of the hidden Multiverse, including our visible universe, it appears, can be connected through portals with universes of other Multiverses that together form a Hyperuniverse⁴, generating the phenomenon of dark space [65], [66].

4. How to see invisible universes

So, the alternative version of the STR successfully solves the problems that turned out to

be unsolvable for the generally accepted version. Nevertheless, it will remain but a hypothesis until it finds experimental confirmation. What experimental confirmations of its truth will be authoritatively convincing and how can they be obtained?

Experimental confirmations of real physical existence of the hitherto undetected invisible universes would obviously be the most authoritative evidence. It turns out that one can see [67]-[71], or, in other words, discover them. This requires placing a telescope in a portal⁵ and comparing its observations of the starry sky with the observations of telescopes located outsidethe portals (Fig. 7). Constellations in the skies of other universes would actually be completely different. Therefore, once a hypothetical telescope is moved through a portal from our universe (i.e. from the earth's surface) to an adjacent universe invisible on Earth, all the known constellations in the starry sky would gradually be replaced by the constellations of the adjacent universe. This would be the most obvious and indisputable evidence of existence of other universes. And such an experiment will be much less expensive than a similar experiment a hundred years ago by the President of the Royal Astronomical Society, Sir Arthur Stanley Eddington [72], [73].

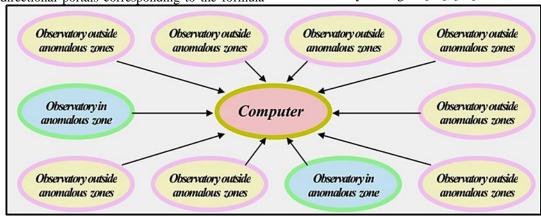


Fig. 7. Diagram of an astronomical experiment on invisible universe detection

³ And non-integer values q, r, s are taken in portals

⁴ By analogy with the term 'Multiverse', hereinafter, instead of 'Hyperuniverse', we will use the term 'Hyperverse'.

⁵ Similarly, to see the invisible neighbouring room of our dwelling, you need to look into it from the corridor connecting these rooms



Fig. 8. The Main Astronomical Observatory of the National Academy of Sciences of Ukraine located in an anomalous zone

Moreover, some observatories, such as, for example, the Main Astronomical Observatory of the National Academy of Sciences of Ukraine (Fig. 8) located in the Holosiivskyi forest, just 12 km from the centre of Kyiv, the capital of Ukraine, are already in anomalous zones, presumably being entrances to portals. Other observatories also located in anomalous zones can be identified by similar comparative studies of high-precision astronomical observations of all observatories. It is also desirable to subject all anomalous zones to such an examination so that to determine passport data of all portals available on Earth. Their comparative analysis will reveal how many adjacent invisible universes there are on the Earth and determine whether there are universes among these invisible universes that are not the part of the hidden Multiverse. Exploration of such universes would be the most interesting, as it makes possible to discover the Hyperverse.

In the future, when the portals are explored and people learn how to navigate through them safely, people can visit adjacent universes that are currently invisible. This would be another proof of their existence.

5. The relevance of geophysical researches of portals

At present, portals are absolutely unexplored. This even raises doubts as to their existence. Herewith, although there are a lot of anomalous zones supposedly being the entrances to portals, people avoid visiting them. And they are right. This is unsafe, because portals are a kind of invisible labyrinths, three-dimensional labyrinths. So, naturally, finding a way out of a portal is not easy without knowing this and taking special precautions in advance (for example, the Ariadne's thread mentioned in ancient Greek mythology). Even more difficult is to successfully move from entrance to exit through a portal (the Ariadne's thread would not help here) and get into an adjacent universe. To do this, you need to create special tools for orientation in the portals.

But all the means used for a serious portal research, including portal orientation tools, vehicles

(including unmanned vehicles), communications equipment and everything else, are much less expensive than people's flights to the Moon or Mars and much more effective in terms of quantity and quality of new expected knowledge, both astrophysical and geophysical. From the standpoint of scientific, as well as political and economic consequences for human civilization development this would appear to be much more crucial than, for example, the discovery of America by Columbus.

6. Conclusion

Thus, because the fallacybility of the universally recognized version of STR stated in physics textbooks, which asserts the existence in nature of our only visible universe, is experimentally proven in the most indisputable way, and the alternative version of this theory states that there are many parallel universes, it has also been proven that there are portals between these universes.

And these portals need to be explored. This is very important from a practical point of view, since one must know how one can safely visit neighboring universes. This is no less important from a scientific point of view, as it will prove the existence of anti-space and anti-time and the possibility of traveling through the hidden Multiverse not only in space, but also in time. Moreover, time travel can be not only in the past, but also in the future [74]-[78].

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PSYCHOLOGICAL SCIENCES

THE IMPACT OF VIRUSES AND THE TREATMENT PROCESS ON PSYCHOLOGICAL HUMAN CONDITION

Huseynov E.,

prof.

Department of General Psychology of the Azerbaijan State Pedagogical University (370000, Azerbaijan, Baku, U. Gadzhibekov st., 34) https://orcid.org/0000-0002-8373-5664

Huseynova F.

III year of the Faculty of Pharmacy, Ankara University of the Republic of Turkey (06560, Turkey, Ankara, Emniyet, Dögol Cd. 6A) https://orcid.org/0000-0003-1647-0472 https://doi.org/10.5281/zenodo.7789455

Abstract

As many experts note, patients who survived outpatient treatment have depressed mood and anxiety, which are some of the symptoms of a post-traumatic state in the phase of intoxication that accompanies any disease, and even more so infectious diseases. After prolonged treatment, many people experience an acute disturbance of mental activity, and their perception of reality is disturbed. Behavior is concerned, and emotional reactions do not correspond to the actual situation. And there is also developmental coordination disorder, accompanied by a complete stupor or increased arousal.

Keywords: treatment, infections, viruses, psychology, influence, psychotherapy, behaviour, disorders, functions, application.

Recently, infections have been spread all over the world that no one heard about 20 years ago, which leads to intoxication, and oxygen starvation of the brain, which in turn causes an exacerbation of diseases of the neurological and psychiatric spectrum. And in older people, emotional and intellectual impairment is exacerbated. COVID-19, the more common infection of recent times in many infected and people with weak immune systems, requires long-term outpatient treatment, which itself causes a violation of a person's mental state. All this is accompanied by a violation of consciousness functions, hallucinogenic knowledge, and fear of the future. Anxiety-depressive behavior disorder, panic attacks, and obsessive-compulsive disorder are commonly manifested. [6].

A person suffering from an infectious disease experiences a mental breakdown due to long-term treatment, which can provoke a relapse and complicate the treatment process. For example, taking antibiotics and constant conditions in a hospital can cause psychosis in a patient with schizophrenia, manifested in hallucinations and inappropriate behavior, fears, and panic attacks. [2:5].

Any infection leads to the development of not only mental disorders but also the appearance of chronic diseases. With COVID-19, hypoxia, a lack of oxygen, occurs, which leads to a disruption in the nutritional function of the brain, a violation of behavior and self-control, and self-criticism. As history, which we all witness, has shown, the pandemic creates instability in society; this manifests itself in both economic and social factors. Mass illness, quarantine, social restrictions, and constant news about the death of loved ones and

relatives all lead to psychosis, which manifests itself depending on the state of the body in various forms, such as depression, anxiety, sleep disturbance, fear that never leaves you, and apathy.

Researchers state that the outbreak of any pandemic or epidemic affects not only the patients' mental state but also the people in their environment. Thus, approximately one in six, under the influence of the epidemic, developed symptoms of moderate and severe depression, and one in three showed signs of increased anxiety of varying severity. [3;5].

We, in turn, conducted a questionnaire survey of teachers and students on the topic: in your opinion, how much does the long-term treatment of infectious diseases negatively affects the human psyche? Teachers and students of higher educational institutions in Azerbaijan and Turkey took part in the survey. Survey participants did not unequivocally answer our questions; some (54%) note that the symptoms of post-traumatic stress disorder associated with long-term treatment lead to psychological depression, unwillingness to continue their work, study, etc. Another group of respondents (34%) believe that the pandemic worsens their mood, there is uncertainty about the future, and the course of mental disorders in such people leads to prolonged apathy. The next group of respondents (12%) note that the pandemic mentally affects not only the patients themself but also negatively on their environment. According to our interviewees, 65% of family members who lived with patients with COVID-19 can also observe symptoms of anxiety about their health and signs of developing apathy and depression.

From the above, we can conclude that the more difficult the treatment of infectious diseases, the greater the possibility of a future complication of mental disorders, and the degree of rapid recovery decreases. As a social survey of passers-by shows, in a third of people who have recovered after long-term treatment, changes in behavior and complications in the function of the psyche (apathy, deterioration of memory, thinking, etc.) can be observed.

Many people who have been ill with infectious diseases say that they experience the unwillingness to continue to fight, constant fatigue and malaise, difficulty in choosing words, memory impairment, decreased concentration, etc. They describe their condition after being treated for COVID-19 as a blur in relationships and the perception of everyday things. Experts studying this problem report that many people constantly experience headaches and dizziness, their sense of smell and taste deteriorates, and muscle weakness appears. [1;7].

Our research confirms that many COVID-19 survivors have post-traumatic stress disorder, and for many, this manifests itself in the form of depression and anxiety disorder, impaired self-esteem, and self-criticism, which leads to disruption of life in society. In addition, our survey shows that 49% of people develop behavioral inhibition and chronic fatigue as a result of long-term treatment.

Now I would like to note what is happening at the chemical level; this is a complex multi-level process of active interaction of infectious pathogenic agents with microorganisms, characterized by the development of the so-called complex of typical pathological reactions, meaning there are systemic functional shifts, resulting in a disorder of the hormonal status, specific immunological defense mechanisms and factors of nonspecific resistance of the body to the effects of various infections. There is a violation of the chemical nutrition of nerve cells which is very hard to recover from. The reason for everything is toxic damage to the central nervous system. The so-called damage to the nervous system, pathogenesis, - leads to molecular disorders and disruption of the activity of many body functions.

In such a situation, it is necessary to use drugs that improve the metabolism of the central nervous system and restore the nutrition of neurons; these are cerebrolysin, nootropic drugs, multivitamins, ATP, nicotinic acid, large doses of ascorbic acid.

In addition to pharmaceutical treatment, it is necessary to restore physical activity. Examples are primarily physical activity, training, and yoga. The rehabilitation process will certainly not be easy, but the positive effect will show its results. Those who have recovered from infectious diseases also need cognitive and psychological rehabilitation-the work of a clinical psychologist is necessary. The rehabilitation process

takes place after recovery; it is necessary to restore cognitive activity, behavior, and concentration, get rid of anxiety, depression, and post-traumatic stress disorders, restore sleep, and thereby get rid of chronic fatigue.

As we noted, practical cognitive-behavioral rehabilitation is necessary. It should include work on the correction of memory, and attention, solving logical problems, and psychotherapy to restore behavior. As a result, the emotional background will normalize, and the person will get rid of apathy, anxiety, stress, and, most importantly, depression. Psychotherapy will help people who have undergone long-term inpatient treatment reduce social isolation.

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TECHNICAL SCIENCES

ANALYSIS OF RESOURCE-CONSTRAINED IOT ENVIRONMENTS

Mammadov M.,

Azerbaijan State Agrarian University, associate professor of information technology departament Azerbaijan, Ganja

Taghiyeva Ye.,

Azerbaijan State Agrarian University, assistant of the department of in formation technologies Azerbaijan, Ganja

Aliyeva A.,

Azerbaijan State Agrarian University, assistant of the department of information technologies Azerbaijan, Ganja

Abdullayeva F.,

Azerbaijan State Agrarian University, assistant of the department of information technologies Azerbaijan, Ganja

Safarova U.,

Azerbaijan State Agrarian University, assistant of the department of information technologies

Seyidova A.

Azerbaijan State Agrarian University, master's student of the department of information technologies
Azerbaijan, Ganja
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Abstract

The Internet of Things (IoT) is a transformative approach that connects objects (things) of various natures with sensing, computing and communication capabilities. These objects are characterized by small size, less computing power, less memory and limited battery. This article first discusses the basic concepts of the Internet of Things and the hardware and software platforms needed to realize IoT environments.

Keywords: Internet of things, intelligent environment, limited resource, RDF, Hydra platform, A3-TAG platform, CoCaMAAL model.

One of the main results of the activities of creative, social and intellectual people is the creation of information resources to preserve them for future generations to use. It is no exaggeration to say that the level of development of the use of previously collected information and information protection technologies throughout the history of mankind has had a significant impact on the development of productive forces. The loss of information causes civilization to be pushed back centuries. However, in order to effectively use previously collected data, special tools and technologies are needed, with the help of which special methods for working with information can be implemented [17].

The Internet of Things (or briefly IoT) is a network environment in which arbitrary objects, whether human or animal, each have a unique identifier and can transmit information over the network. No human-human or human-computer interaction is needed for this information exchange. The Internet of Things is created by bringing together wireless networking technologies, micro-electronic systems and the Internet.

In the Internet of Things, an object is a pacemaker connected to a human heart, biological chips connected to animals and acting as a transmitter, a vehicle equipped with sensors and an on-board computer, or any human-made device with an IP address that can transmit information over a network. From this point of view, the concept of the Internet of things is understood mostly as device-to-device communication. Such relationships are widely used in the production of energy, oil and gas. Products with built-in device-device relationships are called smart (or intelligent) products. In short, we can understand the "internet of things" as the communication of smart devices.

In today's era, IoT technology has spread widely, from small appliances to big cities. Big data created here is widely used in the creation of other technological innovations. [3], [22], [20], [2]

A modern trend in IoT technologies is cloud computing, where computing is (partially) moved from the global cloud to localized environments (Internet periphery) using routers or gateways [9]. Most of the research conducted in this field is devoted to the collection and transmission of information from devices to gateways, its subsequent integration and sending to the cloud. Using the IP concept, it is possible to involve the devices in the environment in collaborative computing to build and provide information services. Separately,

resource-constrained IoT environments [19] are selected, which are characterized not by the number of participating SNGs, but by their heterogeneity and the variety of communication paths between them. The resource-constrained nature of such environments involves the use of limited communication networks (low data transfer rates) and SSC with limited computing resources [18].

As an example of an intelligent environment application deployed in a resource-constrained IoT environment, consider a portable version of a collaborative event system to be organized indoors. [5], [21]. Example 1. ("Joint Action System"). This system we are considering can be used for conferences, meetings, lectures, etc. this category is intended for information support in the conduct of public events (Figure 1.). For the

conference mode, software agents are allocated that implement the basic services for managing the conference, the program of the event, presentations of speakers and content. The computing environment of the system is localized in a room (eg, a conference room) equipped with computing and media equipment. To connect the main agents (participants) to the conference, it is possible to use other existing network computing devices (router, projector, etc.) instead of a traditional personal computer. Two projectors and screens can be installed in the room: one shows the speaker's slides, the other shows the program of the event. Many conference participants use a personal mobile network computing device (smartphones, tablets) working with a client agent to participate in the conference.

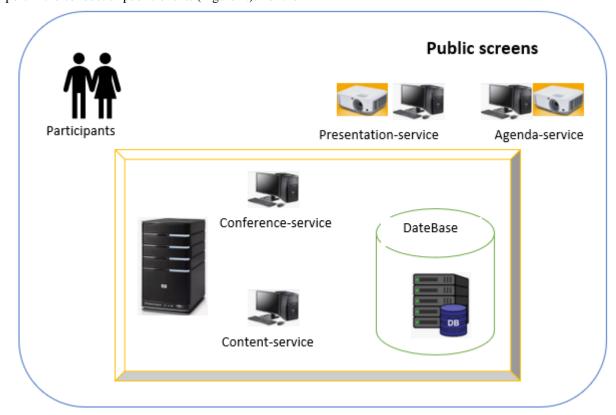


Figure 1. Architecture of the joint activities management system

There are various platforms for creating an intellectual space from the room (classroom) under review. Some of these platforms use distributed content provided by the Resource Description Framework (RDF) model to exchange information between agents. The JTangPS platform [6] implements a publish/subscribe model where tracked events are represented as an RDF graph. Presentation and inference mechanisms are used to search and interpret event materials. Users (agents) join the event by comparing templates in RDF graphs. An ontology-oriented approach is used to create a publish/subscribe model-based intellectual environment system. Here, the language understood by the subscriber (agent) and the ontological representation of events are used (the event is converted from the issuing agent into an RDF triple and delivered to the subscriber). According to the structure of events, systems are divided into two groups: image-based (many attribute/value pairs) and XML-based. Some researchers [14] present the infrastructure of the system as a "semantic knowledge space" to create an intellectual space. A special RDF data query language (RDQL) is used for knowledge query. Also, the platforms we have described are not designed to deploy intelligent space in the resource-constrained IoT environments that are currently in widespread use on the Internet. These platforms focus on traditional PCs (desktops, laptops) without supporting the existing variety of network computing devices in IoT-environments.

[12], [11], [10] and other sources reviewed various platforms that can be used to create an intelligent space in the IoT environment. It is concluded that platforms based on intellectual spaces are classified as event-oriented, service-oriented, virtual, multi-agent, multi-agent classes.

The Hydra platform [15] allows creating an intellectual space based on service-oriented architecture. The Hydra Platform is an open source model platform built for the purpose of information management in computer networks. Facilitates the creation of complex resource network models by providing a consistent storage facility for network topology and associated datasets. The Hydra Platform is built around a server that provides all functionality as a web service to which applications can connect to access data. This platform is composed of separate modules to manage the context and security of services, events, devices, information storage. Semantic, service, network levels and security levels are distinguished between these modules. The platform supports dynamic reconfiguration and selfprotection.

A3-TAG platform [16] creates a smart space based on the shared space of tuples. Many participants exchange information through this space. To enable the operation of a large number of devices in the platform, devices are combined into groups and further interaction is carried out between groups of devices.

From the point of view of ke, our platforms are used to create specific IoT environments - Wireless sensor network (WSN), which in turn do not allow creating an intelligent space for a wide variety of existing IoT circles.

Some classes of IoT environments are formed by platforms that support a wide variety of network computing devices, but are limited in their scope of application. An example of such platforms is the Co-CaMAAL platform. The CoCaMAAL platform represents a class of intelligent space for helping people in everyday life based on cloud technologies. By collecting data from many sensors and storing it in the cloud, the platform allows various applications to organize access to this information to build and provide information services. There is significant complexity in managing sensor data and retrieving personal data, as well as monitoring user activities and deploying relevant situational services. The CoCaMAAL model tries to solve such problems and implement a service-oriented architecture (SOA) to create a unified context. This is done by efficiently collecting raw sensor data and selecting relevant services in a timely manner using a context management system (CMS). Ambient Assisted Living (AAL) services are improved with a unified model that integrates patients, devices, computing servers into a single virtual community [1].

In an article titled "meSchup: A Platform for Programming Interconnected Smart Things," published in the November 2017 issue of Computer, the researchers describe an abstraction layer and a web-based integrated programming environment. "Developing software for the Internet of Things, programming the world around us, and creating innovative applications that affect our daily lives are big challenges. Current programming approaches, best practices, development environments, and tools are insufficient to efficiently support a network of managed smart devices. We believe it is important to build on existing skills (such as web development) and use online infrastructures (such as webbased IDEs) to lower the barrier to entry" [23].

Promising for creating intelligent space in various resource-limited IoT environments is the popular M3 Architecture, especially implemented in the form of the smart-M3 technology platform. The M3 architecture

supports the concept of Smart Spaces with the localization and interaction of existing resources, their semantics and information-based programming on this dynamic knowledge store (in the form of a semantic network). The M3 architecture was originally defined by a consortium participating in the SOFIA project (Smart Objects for Smart Applications) funded by Artemis JU and the Finnish nationally funded DIEM (Device Interoperability Ecosystem) program working in strong collaboration with Nokia Corporation. M3 stands for Multi-device, Multi-vendor and Multi-domain. [8].

Broker RedSIB is a platform designed for use on personal computers and offers an improved subscription processing algorithm. RedSIB is an evolution of the original Smart-M3 SIB implementation. The Redland library is used to maintain atriplestore and SPARQL support. The subscription mechanism has been redesigned for better performance. RedSIB (also Smart-M3 SIB) consists of two subsystems (sib-daemon and sib-tcp). D-BUS communication system is used for data exchange between these subsystems. Since D-BUS is not designed to transfer large amounts of data, the efficiency is mainly reduced. [13] authors present an OSGi SIB broker aimed at deployment in IoT environments with support for the Java language. Based on the OSGi platform, the broker is modular and extensible, which allows it to add new functionality. The PySIB broker implementation provides a "lightweight" modular broker designed to run on a resourceconstrained Python-enabled network computing device. At the same time, existing applications of these brokers have the status of research prototypes, which do not emphasize practically important features, such as customization, fault tolerance, and unitary programming capabilities, especially for the available resources of the IoT environment.

The diversity of existing platforms and systems for organizing the intelligent space is related to the hardware-network diversity of IoT environments themselves. The implementation of existing data warehouses is designed only for a narrow class of IoT environments. Thus, in the conditions of the diversity of the IoT-environment, the problem arises that the information service from one intellectual space cannot be transferred or integrated into the intellectual space of another IoT environment.

Another issue is the volatility of IoT environments and the dynamics of involving networked computing devices. Instability manifests itself in periodic interruptions (breaks) of the network connection between data storage and software agents. The number of participants (in the form of network computing devices) changes dynamically: mobile network computing devices can join (enter the environment) and disconnect (leave the environment). Thus, in the conditions of instability and dynamics of the IoT environment, the problem of various failures related to both data storage and software agents arises. The presence of a problem prevents the establishment and delivery of the service, which leads to the need to perform failure recovery while orchestrating the interactions of the agents. [7].

The diversity of IoT among existing applications of information warehousing has led to the emergence of different ways of programming the interaction of agents necessary for the co-construction of an information service. Due to the flexibility of the ontology-oriented representation of the content of the data store,

the methods of programming interaction when using a data store can also differ. Thus, in the context of different ways of interaction of programming, there are problems of integration of information services or the transfer of a service from one intellectual environment to another, which leads to the need to implement different methods of interaction between agents to support integration or transfer [4].

The above-mentioned problems related to the diversity, instability and dynamics of IoT environments have not been fully resolved in the existing platforms. The solution of these problems is possible at the level of the software infrastructure of the intellectual space, which includes information storage and software agents. Thus, it is necessary to create an infrastructure of such smart mwhits that will support various IoT environments as well as provide resilience to failures in the face of environment diversity, instability and dynamics.

RESULT

The article considers the problems of deploying intellectual space in IoT environments limited by intellectual spaces and resources. The definition of the software infrastructure of the intellectual space and its main tasks and platforms for organizing the activities of services in the intellectual space are considered.

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NATURAL LANGUAGE EFFECTS ON PARTNER COMMUNICATION IN A PAIR PROGRAMMING ENVIRONMENT: A QUALITATIVE ANALYSIS

Abasova N.,

Master Student of the Faculty of Computer Science of TU Chemnitz

Leipzig, Germany Rodtong N.

Master Student

of the Faculty of Computer Science of TU Chemnitz Chemnitz, Germany

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Abstract

This paper presents an empirical study on the impact of programming experience, sender-receiver roles, and role switching on sentiments and conversation during pair programming. The study was conducted with three groups of participants, with different levels of programming experience and using the Java programming language. The results showed that the number of times switching roles between sender and receiver in communication affected their sentiments in the direction of away from neutral sentiments that could be either positive or negative sentiments. However, the results also indicated that there is no correlation between programming experience and conversation sentiment. Moreover, the direction of sentiment could not be guaranteed by communication roles. Additionally, this research contributes to the study of natural language description by analyzing the effects of role switching, different communication roles, and programming experience on the language used during the pair programming technique.

Keywords: natural language, pair programming, communication, sentiment analysis

I. INTRODUCTION

Natural Language Description is a rapidly growing study area that seeks to understand how humans use language to describe and convey information. This field has different applications in various domains, including natural language processing, machine translation, and others. The aim of this study is to contribute to the field of Natural Language Description by analysing emotions and find out possible correlations between various factors.

To follow this, we focused one of the use cases for the development of NLP which is sentiment analysis. Sentiment Analysis deals with the identification and classification of emotions, opinions, and attitudes which are expressed in text. The main goal of this analysis is to determine the polarity of the text, that is whether it expresses a positive, negative, or neutral sentiment [1].

Pair programming is a software development technique where two developers work together on a single task, sharing a single keyboard and mouse and taking turns in writing code and providing feedback [2]. Despite the benefits of pair programming, such as productivity and improved code quality, only a little research has been conducted to understand the natural language effects on partner communication while using pair programming.

The purpose of this study is to investigate the impact of programming experience, sender-receiver roles, and role switching on sentiments and conversation during pair programming. The study was carried out with three groups of individuals, who had varying levels of programming experience and used the Java programming language during the experiment. The results of

this research are significant as they provide a comprehensive insight into the influence of natural language on communication between pair programming partners which can be used both for improvement of the effectiveness of the software development technique and to contribute to the generation of more accurate and nuanced natural language descriptions.

The study was conducted as a between-subject research design, with participants completing programming tasks in pairs, while their conversations were recorded and analyzed. The collected data were analyzed in order to assess the impact of programming experience, sender-receiver roles, and role switching on sentiments and conversation during pair programming

The structure of paper is divided into several sections and subsections. The Introduction section provides an overview of our study and research topic. Research Objective presents subsections namely: Hypotheses, Independent Variables, and Dependent Variables. The Study Design section consists of Confounding Factors, Participants, Survey, Material Creation, and Task. The Data Analysis Procedure section which describes the methods, and tools, are used for analyzing the collected data. The Results section presented the collected data, with a focus on the two subsections which are Presentation of the Collected Data and Descriptive Statistics. The Discussion section provides a discussion over the research question, and hypotheses. The Further Insights section provides additional findings and insights into the experiment result, and the Threats to Validity section discusses potential limitations and biases in the study. The Related Work section presents previous studies and literature related to this study. Finally, in the Conclusion and Future Work section, we have summarized the main findings, implications of the research, and potential areas of improvement in the future.

II. RESEARCH OBJECTIVE

There is a narrow, even fewer approach and articles regarding the natural language effects on communication between partners who do pair programming. This research paper aims to do qualitative analysis to reveal how sentiments change and correlate with programming experiences and role-switching (sender and receiver) during conversations between partners. We want to find correlations which can be helpful in future works to develop natural language.

For structured analysis, the following research question should be answered:

RQ: How does natural language affect sender-receiver communication pattern in terms of partner sentiments during pair programming between experienced and novice programmers?

A. Hypotheses

In terms of our research, it may have correlations between pairs' sentiments and different dimensions of pair programming (developer experience and roles), which can yield future development of natural language.

1) Programming experience

H10: Experienced programmers show more positive sentiments than novices sentiments.

H11: Experienced programmers do not consistently show more positive sentiments than novices sentiments.

According to our research, pair programming allowed for talks between developers. These contained explanations of general knowledge of software development and system-specific knowledge [3]. Thus, the sentiments of these dialogues might be positive, especially, when experienced developers' impart knowledge to novices. Additionally, experienced programmers' sentiments could also be more positive than novices' sentiments. In contrast, novices do interpretations regarding experienced programmers' explanations. Curiosity can cause more positive sentiments in novices [4]. This may lead to experienced programmers' sentiments not consistently showing more positive than novices' sentiments as a result.

2) Roles switching

H20: Partners who switched roles more are not near neutral sentiments or do not have neutral sentiments.

H21: Partners who switched roles more are near neutral sentiments than those who switch roles less.

Regarding our null hypothesis, switching roles may not affect pairs' sentiments. Meaning that changing roles may not reveal more neutral sentiments or even not have neutral emotions between partners.

However, during pair programming, changing roles is the behavior that may also significantly influence partners' sentiments. They share an understanding to arrive at the final code [5]. They attempt to transfer relatively to their roles their coding ideas, knowledge, and concepts for each idea. Therefore, depending on how many times the roles are switched between partners, this may significantly contribute to more near-

neutral sentiments than other pairs in which one switched roles less.

3) Individuals' roles

H30: Receiver sentiments express more negative than sender sentiments.

*H3*₁: Receiver sentiments do not consistently express more negative than sender sentiments.

Sentimental transmissions from one side to another during communication between pairs may also be affected by individuals' roles as well as programming experience and switching roles in between.

From the study, in email communication, the receivers interpret the sender's sentiment based on the received statement. Whereas senders demonstrate sentiment states, receivers judge the senders' emotions by themselves [6]. Therefore, receivers may express their sentiments more negatively than the receivers'. On the other hand, in their experiment, Y. Kato et al. reported that the emotional states that the sender gives and interprets by the receiver also correlate with the sender's emotional expectations [6]. The emotional interpretation of the receiver may not cause negative sentiments in comparison with the senders'.

B: Independent Variables:

This research has two independent variables: partners' roles (sender and receiver) during communication and participants' programming experience (novice and experienced programmers).

C: Dependent Variables:

To assess how the programming experience and roles of the sender-receiver communication model affect communication between pairs, we evaluate different sentiments, such as neutral, positive, and negative.

III. STUDY DESIGN

The aim of our experiment is to analyze conversations of pairs with different experiences working on programming tasks. We will spread a survey to find voluntary participants and conduct an online workshop to encourage participants to solve Java tasks using pair programming techniques. Our experiment is considered a between-subject research design. We will qualitatively analyze their communication in terms of sentiments they have used by recording their conversation and observe different correlations between their emotions, experiences, and roles. We will not inform participants that we will analyze their conversation to avoid confounding factors [7], such as they can imitate during the conversation.

In the next step, we plan to transcribe recordings and analyze them using sentiment analysis [8]. The recording collection will allow us to evaluate how pairs' sentiments correlated with their experiences and roles as sender and receiver. By analyzing recordings, we will extract how many times sender and receiver roles have switched between partners, which sentiments occur individually in the conversation of receivers and senders, and how the conversation affects partners' sentiments within the group after changing roles between receivers and senders.

A. Confounding Factors

Confounding factors resulted in the difference in research experiment outcomes that occur because of biased research participants selection in each research group. This study relates to communication between experienced and novice programmers during pair programming. To avoid between-group bias, communication ability, programming, and problem-solving skills are serious factors. Accordingly, age, gender, educational background, and programming experience are considered confounding variables in this study in which all volunteers are qualified before being admitted to the experiment. All participants in the 24-30 age range are chosen for both males and females as well as undergraduate and graduate students in computing-related fields for educational backgrounds, including Automotive Software Engineering, Computer Engineering, and Computer Science at Technische Universität Chemnitz. In terms of programming experience, participants who have less than a year of programming experience are considered a novice. Otherwise, participants are treated as experienced programmers during research experiments.

B. Participants

Participants are recruited from the Faculty of Computer Science at Technische Universität Chemnitz (TU Chemnitz) through an online survey. We recruit participants from Technische Universität Chemnitz (TU Chemnitz). We have prepared an online survey to select suitable voluntary participants for our experiment. We expect three novice and three experienced programmers to build 3 groups in total. Participants will have insights into the Java programming language. To avoid confounding factors, we keep similar age groups (between 24-30 years old), mixed gender, and similar programming experiences between each group.

There can be participants, both graduate, and undergraduate students. With this survey, we will also gather the demographics of the participants. Due to time limits, we recruit participants who have already worked with Visual Studio Code (VSCode) and ask them to choose one of the available time slots for the workshop. After completing the survey, to avoid confounding variables, we try to match participants by considering their experiences and defining participants. We would also form groups equally, with one experienced and one novice as partners. All participants offered a 10-Euro Amazon gift card after completing our workshop.

Participants hired via E-mail. The experiment began with 10 participants, of which 6 were able to complete the workshop successfully. Each group was given three tasks of different categories. However, technical challenges prevented four out of ten participants from fully participating in the workshop.

Volunteers are qualified and matched to a suitable partner as shown in Table I. In Group 1, a 29-year-old female programmer with more than 3 years of programming experience is considered an experienced programmer and is matched to a 27-year-old male novice programmer who has less than 1 year of programming experience, while Group 2 is 24-year-old male pair which an experience one is studying at the graduate level in Web Engineering and a novice is studying at undergraduate level in Computer Engineering. Lastly, Group 3, an over 3-year experienced programmer who is studying Automotive Software Engineering is matched with a less-than-1-year experienced programmer who is studying Web Engineering. However, both of them are female and stay at the graduate level.

Table I

Participants' Characteristics and Matched Pairs in the Study

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No	Group	Roles in Group	Education	Age	Gender	Major of Study	Year of Prog. Exp.	
1	1	experienced programmer	Graduate	29	Female	Web Engineering	Over 3 years	
2	1	novice programmer	Graduate	27	Male	Web Engineering	0-1 year	
3	2	experienced programmer	Graduate	24	Male	Web Engineering	1-3 year	
4	2	novice programmer	Undergraduate	24	Male	Computer Engineering	0-1 year	
5	3	experienced programmer	Graduate	30	Female	Automotive Software Engineering	Over 3 years	
6	3	novice programmer	Graduate	24	Female	Web Engineering	0-1 year	

Besides, it shows the education levels of the participants who took part in the survey. The table outlines that out of 6 total participants, only 1 participant was an undergraduate student, accounting for 16.67% of the participants. The remaining, 5 out of 6, equals 83.33% of the participants who are graduate students. The data gives an understanding of the educational background of the survey participants and helps us to understand the demographics of the group which we have studied, even though we choose mostly undergraduate students.

Additionally, in terms of the majors of the participants in this study, the majority of participants are Master of Web Engineering students, 4 out of 6 participants amounting to 66.67%. Meanwhile, another 2 participants, each of them consisting of students with a major in Computer Engineering and Automotive Software Engineering. The table provides an understanding of

the academic background of the participant and the fields they come from.

C. Survey

In this section, we will describe our survey that we used to collect information about volunteers and find potential participants for this study. The Survey was created using Google Forms and was distributed to students at Technische Universität Chemnitz via a digital poster that included a barcode linking to the survey. The survey consisted of several questions aimed at gathering information about the participant's background and experience with programming, as well as their availability for the workshop days.

We have designed survey to start by asking for the participants' name, surname, birthdate, and gender. Afterwards we asked about their education level (graduate or undergraduate) and major of study. Next, questions

was about their programming experience, including how many projects they had worked on and which programming languages they preferred to use. Participants were also asked if they had experience with pair programming techniques and which integrated development environments they have used such as MS Visual Studio Code, IntelliJ, and MS Visual Studio. Additionally, participants were asked about their operating system and available time slots for the workshop days. Finally, we asked for additional contact information and required from participants to give their consent for screen and voice recording during the workshop.

After the survey was completed, the collected data were analyzed in order to choose participants for the study. Measures were taken to eliminate any confounding variables, for example by selecting participants who had prior experience with Visual Studio Code and used

Windows operating systems. The sample consisted of a balance of both experienced and novice programmers, with 5 of each. The majority of the participants preferred the workshop to take place on the 2nd of January, and the study was conducted over the 3 days. Additionally, the majority of the chosen participants were familiar with the Java programming language and fell within the age range of 24-30.

In Fig. 1, represented the results of a survey that was conducted and we have visualized responses in a pie chart. Out of 37 total responses, 28 volunteers which were the percentage 75.68% were male, while 24.32% - 9 of them were female. This information provides an overview of the gender distribution of the survey participants and highlights the relative proportion of males and females who filled out the survey.

Percentage of Volunteer by Gender

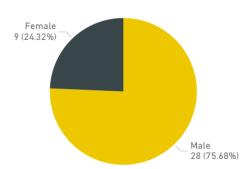


Fig. 1: Distribution of Volunteers by Gender in the Hiring Workshop Survey

Fig. 2, a pie chart shows the volunteers' education ratio of 37 responses that approximately 84%, 31 volunteers, are graduate students whereas roughly 16%,

amounting to 6 people, are undergraduate students. This information reveals that the majority of volunteers are graduate students.

Percentage of Volunteer by Education

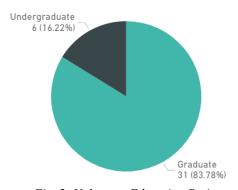


Fig. 2: Volunteer Education Ratio

The candidates who are interested in participating in our experiment are studying in various majors. Using Fig. 3, the largest proportion of them is Web Engineering which takes 13.51% - 5 people followed by Computer Engineering, Computer Science, Information Technology, and Engineering amounting to 10.81%,

10.81%, 10.81%, and 8.11% respectively. The other proportions share the same amount of 2.7% or 1 student such as Business, Chemical Engineering, Construction Management, Mathematics, and others. This can deduce that our experiment is attractive in the diversity of study areas.

Percentage of Volunteer by Major of Study

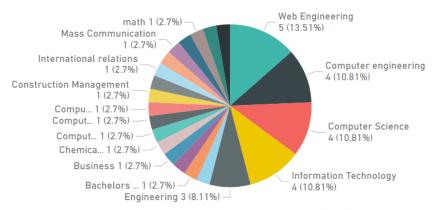


Fig. 3: Participants Proportions of Majors of Interested in the Experiment

The percentage of volunteers by year of programming experience is demonstrated in Fig. 4. About 41% of volunteers, 15 out of 37 people, have 1-3 years of programming experience. Equally, another 41% of can-

didates have more than 3 years of programming experience. Lastly, the residual part takes 18.92%, 7 people, indicating 0-1 year programming experience participants.

Percentage of Volunteer by Year of Programming Experience

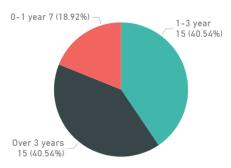


Fig. 4: Pie Chart of Volunteers' Programming Experience

In conclusion, this survey ensured that a diverse and representative group of participants were chosen for the study and that confounding factors were minimized.

D. Material Creation

We designed a survey in order to reach the right participants for our experiment. We have asked questions on different categories such as education and programming experience. After completion of the survey, to find voluntary participants regarding chosen time slots, we will define the workshop day which is planned to be conducted in the first week of January 2023.

On workshop day, pairs will be provided with introductory materials about pair programming techniques, Test-Driven Development (TDD) methodology, and instructions for how they can use Visual Studio Code (VSCode) with Live Share extension to be able to work with pair programming. Then, we will give participants 1 hour to solve 3 different types of Java programming language tasks which will be on the same difficulty levels from Codewars.com [9] [10]. This website is a developer community sharing the problems which all developers practice and challenge their programming skills in various programming languages. The problems on this website are divided into 8 levels, the easiest one is 8 kyu and the hardest one is 1 kyu. In order to examine different situations between pairs

which will consist of experienced and novice programmers, we have designed tasks at the same levels, but on different topics. As our participant groups consist of 1 experienced and 1 novice programmer, we only select the famous verified 6 kyu level ones for those 3 workshop tasks. Because the experienced ones may solo complete 8 kyu and 7 kyu problems by themselves. Participants should use pair programming techniques during solving tasks in a group and also may or may not use test-driven development iterative methodology which embraces them knowing when they should swap their roles.

We also considered the possibility of the learning experience of participants during the workshop with the same task topics and choosing different ones. One task is about converting string to camel case whereas another task is about fundamental algorithms and the last task is related to arrays. And, we will see how they behave while solving the tasks, especially, after they have experience from the previous tasks.

All pairs invited to the online meetings, Zoom, on the workshop day. Each pair broken into separate rooms and they worked as a group. After completion of workshops, participants asked to put their codes into Google Drive. During the workshop, we record screen and audio. We store and transcribe the recordings so that we can study their dialogue. All the information participants provide is treated as confidential and only be used for our research. They can request deletion at any time beforehand. Collected data will not be shared with anyone not involved in this study. In a possible publication of the result of this survey and workshop, the data will be anonymous.

E. Task

In order to observe the impact of pair programming on sentiments, programming experiences, and the role of the sender-receiver during the collaboration, three tasks were assigned to the participants during the workshop. These tasks were designed to test the participants' understanding of programming concepts and their ability to collaborate effectively. The tasks were as follows:

Task 1: Convert dash/underscore delimited words into camel casing. The first word within the output should be capitalized only if the original word was capitalized (known as Upper Camel Case, also often referred to as Pascal case). The next words should always be capitalized [10].

Task 2: Write a function, persistence, that takes in a positive parameter number and returns its multiplicative persistence, which is the number of times you must multiply the digits in number until you reach a single digit [10].

Task 3: Given an array of integers, find an index N where the sum of the integers to the left of N is equal to the sum of the integers to the right of N. If there is no index that would make this happen, return -1 [10].

We created separate folders for each group in Google Drive and provided each group with a unique link to access their respective folder. This allowed each group to upload their task solutions, as well as access the materials (such as instructions for the tasks, examples, and any necessary resources) provided for each task. This helped to streamline the process of collecting and evaluating the task solutions and results. The results of the tasks were analyzed to determine the impact of pair programming on sentiments, programming experiences, and the role of the sender-receiver during the collaboration.

During the workshop, we allocated specific time slots for each task. For Task 1 and Task 2, participants were given 15 minutes each to complete the task. Task 3 was given a longer time slot of 25 minutes. Participants were required to complete the tasks within the allocated time frame, and no additional time was given. This was done to simulate a real-world scenario where time constraints are often a factor in completing tasks. Additionally, the limited time frame also helped to assess the participants' ability to work under pressure and manage their time effectively.

IV. DATA ANALYSIS PROCEDURE

After successful completion of the workshop, we have followed several procedures in this study to analyze the data collected. We transcribed all 3 sessions of 6 participants and performed our analysis based on text material. To achieve the goals of our study, we utilized a range of tools, technologies, and techniques. For example, we used Microsoft Word to transcribe the data, Google Natural Language AI for sentiment analysis, JupyterNotebook for processing files, and Microsoft Power BI for visualizing and summarizing the data in different forms. The steps and procedures of this study include the following:

- 1) **Transcription:** Source data is screen recordings with paired programmers' conversation voices. Transcription is needed to convert our data for further analysis. Microsoft Word [11] is used to transcribe all 3 group conversations.
- 2) Correction: Albeit reliable automation tools, mistakes still occur in the transcription process. Manually correction is applied for higher accuracy.
- 3) Complementation: Plain text is produced from the previous steps. Defining the speaker's name for each sentence is the responsibility of humans. Moreover, the interpretation of each sentence is handled manually to identify sender-receiver roles based on the Shannon-Weaver Model of Communication. The model states that communication consists of the sender, message, encoder, channel with noise, decoder, receiver, and feedback [12]. The cycle of communication shows in Fig.5.

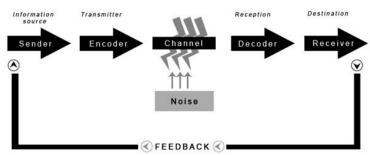


Fig. 5: Shannon-Weaver Model of Communication [12]

As a result of this step, sender and receiver roles are marked to speakers and sentences. Afterwards, changing roles can immediately actuate by comparing with their previous roles. In other words, in the case that a sender receives a message and answers back followed by a new question which unrelated to the question, we count this situation as a 1-time changing role. Otherwise, a question that is related to a sender question is not defined as role-changed, but feedback by question

instead, and also does not count as a changing role because the sender's question is still open.

4) Execution: Sentiment analysis is a natural language processing (NLP) aiming to extract emotion from input text [13]. Regarding a trusted provider, Google, we selected Google NLP named Google Natural Language AI [14] to determine our data. Notwithstanding, in order to effectively analyze data, we have

-H "Content-Type: application/json; charset=utf-

'content': 'OK, let's start with the first task!'

"https://language.googleapis.com/v1/docu-

Listing 1: A Curl Post request to Google Natu-

5) Transformation: Sentiment analysis results

are responded in JSON. The transformation from JSON

curl -X POST

'document': {

'language': 'en',

'encodingType': 'UTF8',

'type': 'PLAIN_TEXT',

ments:analyzeSentiment?key=[api-key]"

--data "{

}"

ral Language AI

8"\

to perform a cleansing of data then followed by an operation process as follows.

- a) **Pre-processing:** In NLP, it recognizes that text will be analyzed by sentence. But, our data is real-life conversation. Many times, humans continue speaking long sentences, especially when implementing programs, for example, "we can add a data type and we can declare a function... and... and... ". On that occasion, adding proper sentence ending punctuations is significant. Then we manually determine suitable positions and punctuations including a period (.), question mark, and exclamation point [15].
- **b) Processing:** With cleaned conversation text, requests are separately made to Google Natural Language AI by the dimension of our analysis aspect comprising the whole conversation, speakers, senders, and receivers, in each workshop using Listing 1. JSON format will be responded from the endpoint.

```
into CSV has been done using JupyterNotebook [16].
                                            The result is shown in Fig. 6.
                                             group, seq, dimension, content, score, magnitude
"documentSentiment": {
                                             1,1,experience,You and me.,0,0
    "magnitude": 147.4,
                                             1,2,experience, "uh what is your name Tmusal
   "score": 0
                                             1,3,experience,OK.,0.5,0.5
                                             1,4,experience,Thank you.,0.8,0.8
"language": "en",
                                             1,5,experience, "as far as I know , uh you a
"sentences": [
                                             1,6,experience,OK.,0.5,0.5
                                             1,7,experience, "so, for today, we will be a
        "text": {
                                             1,8,experience,let me share my screen.,-0.3
            "content": "You and me.'
                                             1,9,experience,OK.,0.5,0.5
            "beginOffset": 0
                                             1,10, experience, "so, let's just get started
                                             1,11,experience, "With uh I am a driver and
        sentiment": {
                                             1,12,experience,OK.,0.5,0.5
            "magnitude": 0,
                                             1,13, experience, let me check it out., -0.2,0
            "score": 0
                                             1,14,experience,I'm not sure.,-0.1,0.1
                                             1,15,experience,OK.,0.5,0.5
                                             1,16,experience,I already encouraged and L
```

Fig. 6: Sentiment Analysis Results in CSV Format, Transformed from JSON Using JupyterNotebook [16]

6) Visualization:

All charts are created by Microsoft Power BI [17] which is a powerful visualization tool allowing us both to manipulate data and create astonishing visualizations.

As a result of the processed data, the communication between paired programmers is promptly visualized. Then we can figure out insight for our hypotheses and the research question, for example, Fig. 7 is describing a data visualization that shows three columns: speakers (A and B), conversation, and score for each of them. The conversation column includes sentences that we have extracted from workshop recordings and the

score column includes the sentiment scores of each sentence. The example presented a conversation between two speakers, where the first sentence by speaker A has a positive sentiment score of 0.50, and the second sentence of this participant has a neutral sentiment score of 0.00. The third and fourth sentences have negative sentiment scores of -0.30 and -0.40 respectively. Additionally, sender and receiver roles have been defined at the end of rows indicating what is the current role of that sentence. With the first row, speaker A is a receiver. Then (s)he starts new content and questions in the 2nd - 4th row. In this circumstance, we counted as a 1-time changing role.

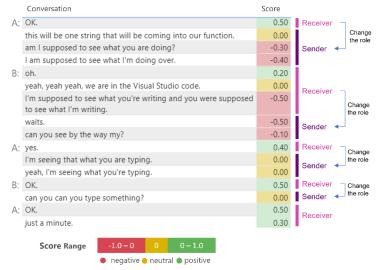


Fig. 7: Sentiment Analysis Results of Speakers' Sentences, Showing Role Changes and Sentiment Scores for Each Sentence

V. RESULTS

In this section, we present the findings of our sentiment analysis. To evaluate the sentiment, different dimensions were used for data analysis: groups, different roles, and programmers with different experiences.

Our analysis of the transcriptions revealed insights that helped formulate answers related to this study's hypotheses. In total, we spent 30 hours analyzing our data. The tasks are shown in Table II.

Data Analysis Task Details in Research

Table II

No.	Time Spent (hrs)	Tasks			
1	4	transcribes process by Microsoft Words			
2	8	corrects transcribed scripts			
3	4	defines speakers and sender-receiver			
4	4	adds proper sentence ending punctuations			
5	3	requests for sentiment analysis by Google Natural Language AI API			
6	3	transforms sentiment analysis results from JSON into CSV using JupyterNotebook			
7	4	visualizes results by Microsoft Power BI			
Total	30				

A. Presentation of the Collected Data

In this part, we will provide an overview of the data that we have collected and describe the format in which it will be presented for qualitative analysis.

We organized and distributed the data based on factors such as programming experience, communication roles, and group. To reveal comparisons between groups and individuals, we have used tables, bar graphs, and text as methods for presenting our findings.

Table III, for example, shows extracted sentences from the workshop transcription, illustrating the different types of sentiment, namely positive, negative, and neutral, referred to as polarity. Additionally, the table presents the sentiment score of the polarity of each sentence. Using Google API, sentences have been scored from -1 to 1, less than 0 indicates negative sentiment, 0 means neutral, and above 0 is positive sentiment. For instance, "Yeah, we can do it." has been determined to a 0.5 score which implies moderately positive sentiment whereas "I pressed enter, but it is not recognized." has been evaluated with a -0.9 score indicating strongly negative sentiment.

Table III

Sentences and Their Corresponding Sentiment Scores for Each					
Polarity (Positive, Neutral, and Negative)					

Sentences	Score	Sentiment
Yeah, we can do it.	0.5	Positive
Let's understand how to set the environment.	0.0	Neutral
I pressed enter but it is not recognized.	-0.9	Negative

Table IV presents data on different groups of participants, organized by their programming experience, roles during conversations, and average scores for the whole conversation. The group column represents the group number in which 2 participants are divided. Roles during conversation represent the role of participants during conversation divided into Receiver and Sender. Decimal numbers represent the scores, positive

numbers (0 - 1.0] indicate a positive sentiment, negative numbers indicate a negative sentiment [-1.0 - 0), and zero indicates neutral sentiment [0.0]. For example, Group 1 has a 0.06 score for experienced participants, which is positive polarity, a -0.04 score for novice participants is a negative one, a 0.01 score for a receiver, a 0.03 score for a sender who both represents positive sentiments, and an overall score of 0.02 for the whole conversation is also evaluated as positive sentiment.

Table IV

Sentiment Scores of Sender, Receiver, Experienced, and Novice programmers by Groups

	Programming experience		Roles d	•	NAME OF THE OWNER OWNER OF THE OWNER OWNE	
Group	Experienced	Novice	Receiver	Sender	Whole conversation	
Group 1	0.06	-0.04	0.01	0.03	0.02	
Group 2	0.09	0.17	0.19	0.07	0.12	
Group 3	-0.03	-0.05	-0.02	-0.05	-0.04	
	Score Range	_	10-0	0 0-	1.0	

neutral

positive

negative

In Fig. 8, the number of sentiments during conversation is calculated in percentage by group. For each bar, three sentiment percentages are stacked, including negative, neutral, and positive sentiment. For example, Group 1 has 44.13% of a negative element while neutral and positive ones present 18.26% and 37.61%, respectively.

On another aspect, the elements' size of each group can be compared to the other groups due to the same sequence stacks. The collected data show that all groups conducted approximately 37%-44% negative sentiment, 16%-25% neutral sentiment, and 32%-47% positive sentiment.

Percentage of Sentiment by Group

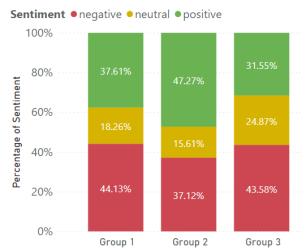


Fig. 8: Percentage of Sentiments by Group

In conclusion, we have presented the collected data in various ways to provide an understanding of the sentiment analysis results. Overall, the data we have provided insight into the sentiment scores of experienced and novice programmers, the impact of role switching on sentiment, and the sentiment scores of senders and receivers. The data support the study's hypotheses and serve as the foundation for our analysis and conclusion in the following section of this study.

B. Descriptive Statistics

In this section, we will be evaluating the results of our study in relation to our hypotheses. By analyzing the descriptive statistics of the data collected, we aim to identify patterns and correlations within the data and determine whether or not our hypotheses are supported by evidence. This will allow us to gain a deeper understanding of the impact of natural language on communication patterns and sentiments during pair programming between experienced and novice programmers.

1) Programming experience

In Fig. 9 bar graph is showing the average sentiment scores of experienced and novice programmers in three different groups. The x-axis of the graph displays the different groups and the distinction between experienced and novice programmers, while the y-axis shows the average score of sentiment. In Group 1, the sentiment score for experienced programmers is 0.06, which is positive, and the sentiment score for novice programmers is -0.04, which is negative.

In Group 2, the sentiment score for experienced programmers is 0.09, which is positive, and the sentiment score for novice programmers is 0.17, which is positive as well. In Group 3, the sentiment score for experienced programmers is -0.03, which is negative, and the sentiment score for novice programmers is -0.05, which is also negative.

Overall Sentiment Score of Experienced and Novice Programmers

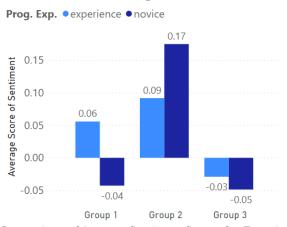


Fig. 9: Comparison of Average Sentiment Scores for Experienced and Novice Programmers in Group 1, 2, and 3.

Also, Fig. 10 illustrated as a bar graph suggest that the average sentiment scores for only positive sentiments during the whole conversation were relatively similar across all groups and experience levels, with Group 1 experienced having a score of 0.46, novice having a score of 0.45, Group 2 experienced having a score of 0.57, novice having a score of 0.56, and Group 3 experienced having a score of 0.40, novice having a score of 0.39. Overall, all groups, senders and receivers show no significantly different scores, a difference of only 0.1 scores.

2) Roles switching

As a result, we found that the number of switching roles between a sender and a receiver is related to the sentiment of the conversation. Considering Table V, groups 1, 2, and 3 show average scores of conversation, 0.02, 0.12, and -0.04, respectively, while the numbers of switching roles are 21, 35, and 86 times throughout the workshop. This reveals that the number of changing roles influences the average score of participants' sentiment. The more they change positions, the more an average sentiment is away from a neutral score (0.0). Nonetheless, according to the result, groups 2 and 3 indicate positive and negative sentiments. This means that we cannot guarantee their sentiment direction, whether it is positive or negative.

Summary of Switching Roles and Average Conversation Scores by Group

	Group 1	Group 2	Group 3
Average Score of Conversation	0.02	0.12	-0.04
Sum of switching roles	21	35	86

Table V

With Fig. 11, participants consistently demonstrate the lowest number of neutral sentiments in all groups. On the one hand, participants present more negative than positive sentiments in Group 1 and 3. On the

other hand, Group 2 indicates positive more than negative sentiment during the workshop. In a nutshell, the correlation between the number of changing roles and the number of both positive and negative sentiments is invisible.

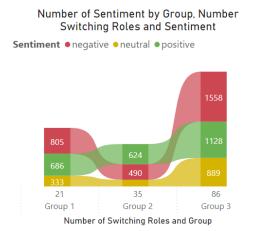


Fig. 11: Distribution of Sentiments by Group and Role Switching

3) Individuals' roles

Fig. 12 illustrates the overall sentiment scores of senders and receivers. The x-axis represents different groups divided based on the receiver and sender roles, while the y-axis represents the average sentiment score.

During the workshop, Group 1's data shows that the receiver has a sentiment score of 0.01, and the sender has a sentiment score of 0.03, which indicates that the sender has slightly more positive sentiment than the receiver. In the second group, the receiver has a sentiment score of 0.19, and the sender has a score of 0.07, which means that the receiver has a more positive sentiment than the sender. In Group 3, the receiver has a sentiment score of -0.02, and the sender has a sentiment score of -0.05, while both the receiver and sender have negative sentiment scores.



Overall Sentiment Score of Senders and

Fig. 12: Comparison of Average Sentiment Scores for Senders and Receivers in Group 1, 2, and 3

Also, we have considered the average score of the negative sentiments used by receivers and senders, which are visualized in Fig. 13. In Group 1, the receiver has a score of -0.36, and the sender has a score of -0.33. Similarly, in Group 2, the receiver has a score of -0.39, and the sender has a score of -0.36, a difference score

of -0.03. In Group 3, the receiver has a score of -0.41, and the sender has a score of -0.36. These results provide that the receiver and sender sentiments are relatively equal in terms of negative sentiment. On the whole results show similar differences between the receivers' and the senders' scores.

Overall Negative Sentiment Score of Senders and Receivers

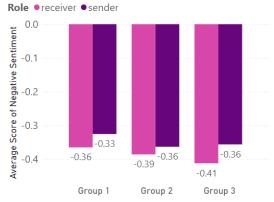


Fig. 13: Negative Sentiment Scores of Senders and Receivers by Group

VI. DISCUSSION

In this section, we will discuss the results by answering our research question, and research hypotheses. We will conclude with discussion over further questions and further insights.

A. Research Question

In this research, investigating the impacts of natural language on the communication between experienced and novice programmers is the main objective. To answer this research question, three groups of paired participants were shaped based on their programming experiences and assigned 3 different programming tasks which requirement was to use only Java programming language.

The results of the experiment, which aimed to answer the research question of "How does natural language affect sender-receiver communication patterns in terms of partner sentiments during pair programming between experienced and novice programmers?", have provided insights into the nature of communication between experienced and novice programmers during pair programming. The results showed that the sentiment expressed during pair programming is not solely determined by the experience level of the programmer. Rather, it may be due to a complex interaction between the individual characteristics of both the sender and the receiver, as well as the roles they adopt during the conversation.

One surprising finding was that experienced programmers did not always express positive sentiments. This suggests that the experience level of a programmer does not necessarily correspond with positive sentiments during pair programming. Moreover, the receivers in the experiment were not always more likely to express negative sentiments than the senders. This also contributes to highlight the importance of considering the individual characteristics of both partners in the pair, as well as the dynamics of their interaction, when assessing the sentiment expressed during pair programming.

Additionally, the results indicated that pairs with highly switched roles tend to have average sentiments far from neutral. This finding highlights the importance of considering the dynamic nature of communication during pair programming. It suggests that the sentiment expressed during pair programming depends on their

interaction and the roles they adopt during the conversation. As well, it may be supported by the individual characteristics of the partners

In conclusion, the results of this experiment suggest that natural language can affect the sender-receiver communication patterns during pair programming between experienced and novice programmers. Further research could explore the individual and situational factors that contribute to the sentiment expressed during pair programming and how these factors can be optimized to improve the effectiveness and efficiency of the pair programming process.

B. Hypotheses

1) Programming experience

Regarding the first hypothesis, data shows that experienced programmers do not consistently show more positive sentiments than novice programmers in all groups in Fig. 9. Therefore, we may conclude that the null hypothesis H1₀ should be rejected and H1₁ should be accepted instead. However, as Fig. 10 provided, the result shows that the average positive sentiment scores for experienced and novice programmers are similar across all groups, with no significant difference between the two.

Overall, these results suggest that while there may be some correlation between experience level and sentiment, it is not as straightforward as initially assumed, and other elements like group interactions, and participants' traits might also affect the sentiments. Likely, that experience level does not significantly impact the positive sentiments expressed during pair programming.

2) Roles switching

The second hypothesis's result in Fig. 11, which explored the relationship between receiver-sender roles and sentiments, was supported by our findings. We can say that the number of changing roles directly affects the average score of participants' sentiment. In other words, an increase in changing roles leads to an increase or decrease in the average sentiment score. Hence, the null hypothesis $H2_0$ can be accepted.

3) Individuals' roles

Finally for the third hypothesis, in terms of the null hypothesis, which states that receiver sentiments express more negative than sender sentiments, the results do not support this claim because of the result in Fig. 12. The data shows that in Group 2 and Group 3, the sentiment scores of the receivers are more positive than those of the senders. Contrastingly, the receiver in Group 1 shows more negative sentiment than the sender. Consequently, the alternative hypothesis, which states that receiver sentiments do not consistently express more negative than sender, is supported by the data. This resulted in a rejection of H3₀.We may also need to do further analysis over more data which can help to draw more definitive conclusions.

VII. FURTHER INSIGHTS

Further questions that arose from this study can be: Are there other factors that may influence the sentiments of programmers during pair programming? How can we further investigate the impact of natural language on communication patterns and sentiments during pair programming? Also, it may be interesting to research how other variables, such as task complexity, may affect conversation during pair programming. It may also be valuable to explore the changes in sentiments throughout pair programming sessions and to see how communication may impact task performance.

1) Result of tasks

The results of the tasks conducted during the workshop provide valuable insights into the impact of pair programming on sentiments, programming experiences, and the role of sender-receiver during collaboration. These insights can be leveraged to enhance the efficiency and effectiveness of the pair programming approach in software development.

Task results can be divided into 2 aspects including task completion and task correctness. All tasks are carefully examined for completeness and are tested with 2 possible test cases provided in Codewars [10]. Table VI shows the task completion of all groups. After finishing the experiment, Task 1 was completed by Group 1 only, Task 2 was completed by Group 3 only, and Task 3 was completed by Group 1 and 2. In the other words, Group 1 and Group 3 came with 2 completed out of 3 tasks while Group 2 could not complete all provided tasks.

Table VI

Results of Task Completion By Group

Group Name	Task 1	Task 2	Task 3
Group 1	completed	not completed	completed
Group 2	not completed	not completed	not completed
Group 3	not completed	completed	completed

Moving to task correctness, with Table VII, Group 1 passed Task 1 and all groups failed for Task 2. In Task 3, Group 1 failed, Group 2 partly failed, and Group 3 passed. In the other words, Group 1 and Group 3 resulted in 1 completely correct task. Surprisingly, one of

Group 2's tasks passed 1 out of 2 test cases. This means that they produced 1 partially completed task, even though they could not complete any given tasks.

Table VII

Results of Task Correction By Group

Group Name	Task 1	Task 2	Task 3
Group 1	pass 2	fail 2	fail 2
Group 2	fail 2	fail 2	pass 1, fail 1
Group 3	fail 2	fail 2	pass 2

The average conversation score for Group 1, Group 2, and Group 3, as shown in the Summary of Switching Roles and Average Conversation Scores by Group Table (Table V) in the Result section, was 0.02, 0.12, and -0.04 respectively. The results imply that Group 1 produced near-neutral sentiment with 1 completed task. Interestingly, Group 2 showed the highest positive sentiment score with a partially completed task. And, even Group 3 showed negative sentiment, but they still came up with a successful task. Consequently, all groups show appealing outcomes and all of them tend to be diverse. Hence, research is needed to conduct in-depth to show a correlation between task completion and correctness in order to contribute the pair-programming productivity in the future.

2) Content of the conversation

Fig. 14 illustrates the count of content in the conversations of Group 1, 2, and 3. A total of 2249 sentences were analyzed and the word "OK" was used 186 times, which suggests that the participants were generally in agreement with each other during the conversations. The word "yeah" was used 81 times, indicating a sense of affirmation or agreement among the participants. The word "yes" was used 52 times, which further supports the idea of agreement among the group members. The use of "hmm" 31 times and "oh" 30 times suggests moments of contemplation or surprise during the conversations. The use of "uh" 12 times and "right" 11 times may indicate moments of hesitation or confusion. Lastly, the word "no" was used 9 times, indicating instances of disagreement or dissent among group members.

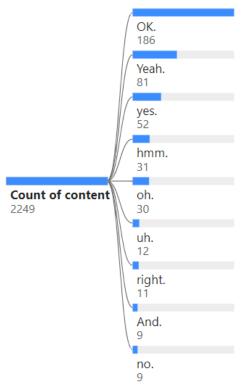


Fig. 14: Count of Conversation Content in Group 1, 2, and 3

Overall, this tree diagram provides insights into the general sentiment and dynamics of the conversations among the groups during the workshop. The use of specific words and phrases can indicate moments of agreement, disagreement, contemplation, hesitation, and surprise among partners during pair programming which means the analysis of conversation content can be used to understand the impact of natural language on group communication.

VIII. THREATS TO VALIDITY

In the context of our qualitative analysis, there are several potential threats to validity that should be considered in future studies.

A. Internal Validity

One potential threat is that participants' mood and personality traits, as well as an understanding of the workshop materials, may have affected the quality of the conversations and emotions during pair programming. These factors were not measured but could have impacted the results.

Additionally, the limited types and complexity of given tasks used in this experiment may have biased the results, leading to inaccurate conclusions about the relationship between the independent and dependent variables and can lead to biased communication sentiments.

B. External Validity

External validity refers to the generalizability of the result. In the context of our qualitative analysis, there are several potential threats to validity that should be considered in future studies.

One threat to validity is the sample size. Low population validity was shown in our because of only 6 participants, and this may not be large enough to be representative of the entire population of programmers. Similarly, low population validity was also shown in terms of participants' age range, only participants the 24-30 were admitted to this research experiment.

Java programming language was also another treat that we embraced for the experiment to research natural language on communication during pair programming. However, Java is widely used in the industrial world. Furthermore, it's strongly typed and object-oriented programming. So, it's an excellent choice for this research. Besides, the environment was similar to real-world development in that all participants were not allowed to ask anything after pair-programming sessions began, and they also were not interrupted by investigators.

IX. RELATED WORK

The impact of natural language on partners' communications in pair programming environments has received limited attention in the different literature. However, some studies have investigated the role of communication in pair programming and its effects on programming tasks.

Some studies focus on the effective communication role in the success of pair programming. For instance, researchers have investigated the impact of gender and cultural differences on communication during pair programming [18].

Additionally, studies have also shown that the use of natural language and nonverbal, play a significant role in effective communication during pair programming [19].

Another research focuses on the high level of communication during pair programming. In that study, they investigated that levels of compatibility and confidence between pairs did not positively influence the partners' conversation [5].

However, there is limited research on the impact of programming experience, sender-receiver roles, and role-switching on sentiments during conversation using the pair programming technique. This study adds to the existing knowledge by conducting a qualitative analysis of the impact of programming experience, senderreceiver pattern on conversation, and role-switching on sentiments and conversation during pair programming.

X. CONCLUSION AND FUTURE WORK

Working with a partner using a pair-programming technique relies on communication and then natural language occurs and directly affects the interlocutor's sentiment. Nonetheless, it probably additionally influences the quality of work. Regarding the widely used, experienced-novice pair is fascinating and worthwhile to investigate in order to contribute their natural language.

The results of this experiment reveal that experienced and novice programmers could show either positive, negative, or neutral sentiments during pair programming that resulted from the interpretation of natural language. Moreover, the direction of sentiment could not be guaranteed by communication roles. In the other words, both senders and receivers can express positive, negative, or neutral sentiments as well. However, the number of times switching roles between sender and receiver roles in communication during working as a pair affected their sentiments in the direction of away from neutral sentiments that could be positive or negative sentiment.

To continue this research, we can experiment with a large group of participants to confirm the results and clearly observe the trend of pairs' sentiments. Furthermore, we may also ask them for feedback on how they feel after the experiment ends. Afterwards, evaluation sentiment results can be compared with their feedback. We may see other insights. If the trend is obvious, we can improve the productivity of pair-programming easily by putting a potentially positive environment and seeing the productivity of their works. A good mood which developers are looking for and high productivity which is a company's need can be produced perfectly.

Additionally, tasks that are assigned to participants during the experiment can be changed to other popular programming languages such as Python, GO, then analyze and compare the result for each programming language whether it goes in the same direction or not. This can also improve the productivity of workers in the future.

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METHOD FOR SYNTHESIS OF MATCHING DEVICES IN A DISTRIBUTED ELEMENT BASIS FOR BROADBAND RADIO SYSTEMS WITH UNSTABLE LOAD IMPEDANCE

Boykachev P.,

Candidate of Technical Sciences, Associate Professor, Educational Institution
"Military Academy of the Republic of Belarus", Republic of Belarus

Vvrko S.

adjunct, educational institution "Military Academy of the Republic of Belarus", Republic of Belarus

МЕТОДИКА СИНТЕЗА СОГЛАСУЮЩИХ УСТРОЙСТВ В РАСПРЕДЕЛЕННОМ ЭЛЕМЕНТНОМ БАЗИСЕ ДЛЯ ШИРОКОПОЛОСНЫХ РАДИОТЕХНИЧЕСКИХ СИСТЕМ С НЕСТАБИЛЬНЫМ ИМПЕДАНСОМ НАГРУЗКИ

Бойкачев П.В.

кандидат технических наук, доцент, учреждение образования «Военная академия Республики Беларусь», Республика Беларусь

Вырко С.Н.

адъюнкт, учреждение образования «Военная академия Республики Беларусь», Республика Беларусь https://doi.org/10.5281/zenodo.7789622

Abstract

To solve the problem of synthesizing load matching circuits in a distributed elemental basis, the complex resistance of which has a non-stationary character in a wide operating frequency band, a new matching technique has been developed based on the sensitivity invariant apparatus in combination with the Richards and Kuroda transformation. Verification of the technique was carried out on the example of matching the active element with the output and input loads in Mitsubishi LD-MOSRD07 power amplifiers.

Аннотапия

Для решения задачи синтеза цепей согласования нагрузок в распределенном элементном базисе, комплексное сопротивление которых имеет нестационарных характер в широкой полосе рабочих частот, разработана новая методика согласования на основе аппарата инварианта чувствительности в комбинации с преобразованием Ричардса и Куроды. Верификация методики произведена на примере согласования активного элемента с выходной и входной нагрузкой в усилители мощности LD-MOSRD07 компании Mitsubishi.

Введение

Радиотехнические устройства (РТУ) широко используются практически во всех сферах жизнедеятельности человека. Для того, чтобы РТУ обеспечивало максимальную энергетическую эффективность, а как следствие максимальную дальность радиолинии в различных условиях эксплуатации, необходимо, чтобы элементы радиотехнических трактов как передающего, так и приемного устройств, обладающие своим комплексным сопротивлением (изменяющимся во времени), были согласованы друг с другом. Для выполнения данной задачи используют широкополосные согласующие устройства (ШСУ), методы синтеза которых не учитывают непостоянство импеданса нагрузки, вызванное изменением условий эксплуатации (температура, вибрация, различные режимы работы активных элементов и т.д.). В следствии чего возникает необходимость в разработке метода синтеза ШСУ, обеспечивающего устойчивый уровень передачи мощности в условиях изменяющегося импеданса нагрузки. Такая необходимость актуальна для РТУ как в сосредоточенном, так и в распределённом элементном базисе. В работе предложена методика синтеза согласующих устройств для распределенного элементного базиса.

Методика синтеза согласующих цепей для широкополосных радиотехнических устройств в распределенном элементном базисе с изменяющимся импедансом нагрузки

Обзор и анализ методов широкополосного согласования показали, что в качестве математического аппарата для синтеза согласующей цепи (СЦ) с изменяющимся импедансом нагрузки целесообразно использовать метод вещественных частот [1]. Предлагается разработать методику синтеза ШСУ, обеспечивающих требуемый уровень передачи мощности в условиях изменяющегося импеданса нагрузки для РТУ в распределённом элементном базисе на основе метода вещественных частот в комбинации с преобразованием Ричардса и Куроды.

Следует заметить, что разброс номиналов элементов РТУ (в распределенном элементном базисе размеры, магнитная и диэлектрическая проницаемости подложек и т.д.) и подключенной к нему нагрузки негативно сказываются на функционировании РТУ в различных условиях эксплуатации. Связь между пространством параметров цепи, анализом и оптимизацией, в том числе с регулируемыми (управляемыми) параметрами, может осуществляться с помощью функции чувствительности. Данная функция может способствовать

решению широкого круга задач, связанных с анализом влияния малых изменений конструктивных параметров и внешних условий на работу РТУ.

Для синтеза ШСУ, позволяющего обеспечить уровень коэффициента передачи по мощности (КПМ) не хуже требуемого, при наличии изменяющегося импеданса нагрузки в первую очередь необходимо оценить степень влияния вариации импеданса нагрузки на уровень КПМ. Представим комплексное сопротивление нагрузки $Z_{\rm H}(f)$ в качестве ряда параметров $\left\{ x_{i}\right\} \ (i=1,2\dots \, {
m M}),$ от которого зависит некоторая функция $D(x_i)$ описывающая частотную характеристику ШСУ (КПМ, групповое время запаздывания и др.). Отклонение функции номинального значения $\Delta D = D(x_i + \Delta x_i) - D(x_i)$, вызванное изменением параметра $\Delta x_1, \Delta x_2...\Delta x_M$, определяется соответствующим разложением в ряд Тейлора. Для линеаризованного случая (пренебрегаем производными второго и более высоких порядков) разложение имеет вид

$$\Delta D = \sum_{i=1}^{N} S_{x_i}^D \Delta x_i, \qquad (1)$$

где
$$S_{x_i}^D = S\{D(x_i), x_i\} = \sum_{i=1}^N \frac{\partial D(x_i)}{\partial x_i}$$
 – чув-

ствительность функции D(x) к изменению параметров x_i ;

$$R\left\{S_{in}(f, Z_{H}, Z_{CII})\right\} = \frac{2 \operatorname{Re}\left\{Z_{CII}(f)\right\} Z_{H}(f)}{\left(Z_{H}(f) + Z_{CII}(f)\right) \left(Z_{H}(f) - Z_{CII}(-f)\right)}$$

— инвариант чувствительности функции коэффициента отражения к изменению параметров нагрузки; $S_{in}ig(f,Z_{\rm H},Z_{\rm CII}ig) = rac{Z_{
m H}ig(fig) - Z_{
m CII}ig(-fig)}{Z_{
m H}ig(fig) + Z_{
m CII}ig(fig)}$ —

функция коэффициента отражения (коэффициент

$$\delta = \int_{f_B}^{f_H} \frac{\Delta \left| S_{in} \left(f, Z_H, Z_{CII} \right) \right|}{\left| S_{in} \left(f, Z_H, Z_{CII} \right) \right|} \left| \frac{Z_H}{\left(\Delta \operatorname{Re} \left\{ Z_H \right\} + i \Delta \operatorname{Im} \left\{ Z_H \right\} \right)} \right| df, \tag{3}$$

где $\Delta \left| S_{in} \left(f, Z_{\rm H}, Z_{\rm CLL} \right) \right|$ — допустимое отклонение модуля функции коэффициента отражения;

 $\Delta {
m Re}\{Z_{
m H}\}, i \Delta {
m Im}\{Z_{
m H}\}$ – допустимое отклонение реальной, мнимой части функции коэффициента отражения.

Таким образом, система уравнение преобразуется к виду

$$\begin{cases} \int_{f_{B}}^{f_{H}} \left(K_{\text{Tpe6}} - \left(1 - \left| S_{in} \left(f, Z_{\text{H}}, Z_{\text{CII}} \right) \right|^{2} \right) \right)^{2} df \leq \varepsilon \\ \int_{f_{H}}^{f_{B}} \left| \text{Re} \left\{ R \left\{ S_{in} \left(f, Z_{\text{H}}, Z_{\text{CII}} \right) \right\} \right\} \right|^{2} df \leq \delta \end{cases} , (4)$$

N – количество параметров x_i ;

 ΔD – отклонение функции.

Выражение (1) используется для описания влияния малых отклонений, и оно основано на математическом анализе. Особый интерес в данном выражении представляет чувствительность характеристики ШСУ, так как уменьшение значения данного параметра приводит к уменьшению отклонения характеристики ШСУ, а при ее фиксированном (допустимом) значении увеличивает отклонение Δx_i , при котором сохраняется требуемые значения характеристики ШСУ.

Для обеспечения требуемого уровня КПМ при наличии изменяющегося импеданса нагрузки необходимо, чтобы синтезируемое ШСУ обладало свойством минимальной чувствительности функции коэффициента отражения к изменению параметров нагрузки. Для этого необходимо решить систему уравнений

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$$\int_{f_B}^{f_H} \left(K_{\text{треб}} - \left(1 - \left| S_{in} \left(f, Z_{\text{H}}, Z_{\text{СЦ}} \right) \right|^2 \right) \right)^2 df \le \varepsilon$$

(1)

$$\int_{f_B}^{f_B} \left| \text{Re} \left\{ R \left\{ S_{in} \left(f, Z_{\text{H}}, Z_{\text{СЦ}} \right) \right\} \right\} \right|^2 df \le \min$$

где $K_{\text{треб}}$ – требуемый уровень КПМ; $Z_{\text{H}}(f)$ – комплексное сопротивление нагрузки;

 $Z_{\text{CЦ}} ig(f ig)$ – комплексное сопротивление согласующей цепи;

рассогласования); ε — допустимое отклонение уровня КПМ в рабочем диапазоне частот.

Для определения минимального значения инварианта чувствительности предлагается использовать выражение 3.

где в качестве исходных данных задаётся: требуемое отклонение уровня КПМ ϵ , допустимые отклонение модуля функции коэффициента отражения, отклонение комплексного сопротивления нагрузки ($\Delta \text{Re}\{Z_{\text{H}}\}$, $\Delta \text{Im}\{Z_{\text{H}}\}$).

Систему уравнений можно использовать в качестве целевой функции (комплексного критерия) в сочетании с одним из существующих численных методов синтеза ШСУ. В качестве метода синтеза ШСУ предлагается использовать метод вещественных частот [2]. Основное преимущество данного метода состоит в том, что он не требует аппроксимации импеданса нагрузки, а также в том, что функция КПМ представляется в виде аналитического выражения, при этом ШСУ лестничной структуры

синтезируется с помощью итеративных подходов поиска вещественной составляющей функции сопротивления ШСУ.

Таким образом сочетания комплексного критерия с методом вещественных частот вид реальной составляющей функции сопротивления позволило разработать методику синтеза согласующих устройств для широкополосных радиотехнических устройств к изменяющемуся импедансу нагрузки в распределенном элементном базисе, которая представлена на рис. 1.

Разработанная методика состоит из семи этапов:

- 1) Для упрощения последующих расчетов выполняется нормировка входных данных (комплексного сопротивления нагрузки и частоты), представленных в виде дискретных отсчетов. Исходя из требуемого уровня КПМ и допустимого отклонения импеданса нагрузки в рабочем диапазоне частот, а также порядок электрической цепи;
- 2) Процедура формирования вида вещественной составляющей функции сопротивления СЦ и алгоритма формирования;
- 3) Формирование комплексного представления функции;

- 4) Расчет уровня КПМ с учетом функции сопротивления согласующей цепи;
- 5) Расчет инварианта чувствительности модуля функции коэффициента отражения, а также минимально возможное значение инварианта чувствительности в рабочей полосе частот;
- 6) В зависимости от типа задачи согласования рассчитывается один из критериев оптимальности, по значению которого принимается решение на пересчет коэффициентов вспомогательного полинома. В случае выполнения критерия оптимальности переходим к седьмому этапу синтеза;
- 7) Формирование функция комплексного сопротивления СЦ с последующим переносом ее в пространство Ричардса [3] и синтезом микрополосковых линий из формируемой функции;
- 8) Замена элементов физически нереализуемых на элементы Куроды [4].

Достоинство данного подхода заключается в отсутствии дифференцирования функции коэффициента отражения для поиска значения чувствительности. Достаточно лишь знать значение импеданса АУ на дискретном ряде частот, чтобы синтезировать ШСУ, обладающее минимальной чувствительностью к изменению импеданса нагрузки в распределенном элементном базисе.

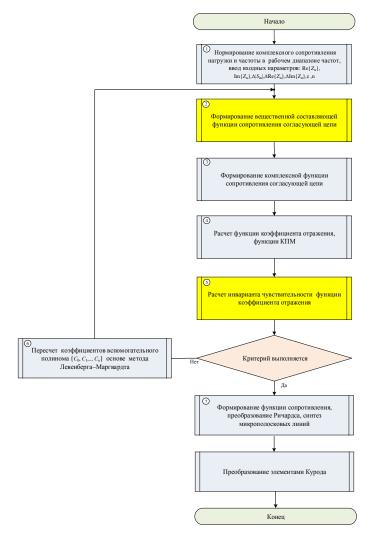


Рис. 1 Блок-схема методики синтеза согласующих цепей для широкополосных радиотехнических устройств с изменяющимся импедансом нагрузки СВЧ диапазона частот

Анализ показателей качества полученной математической модели адаптивного согласующего устройства

После разработки методики синтеза ШСУ с последующим синтезом согласующей цепи в комбинации RFPA, преобразования Ричардса и Куроды необходимо проверить работоспособность данной методики. Для верификации представленной методики предлагается на ее основе разработать широ-

кополосный трансформатор импеданса, предназначенный для усилителя мощности LD-MOSRD07 компании Mitsubishi.

Синтез СЦ для усилителя мощности LD-MOSRD07 компании Mitsubishi

Ссылаясь на рис. 2, фильтр преобразования импеданса построен между генератором RG = 12 Ом (выход ВЧ усилителя мощности, который разработан с использованием LD-MOSRD07 компании Mitsubishi).

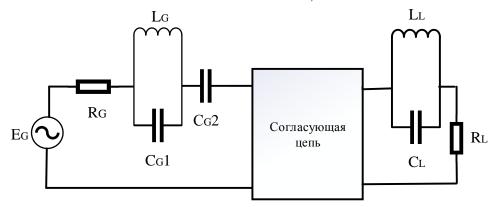


Рис. 2 Задача двойного согласования усилителя мощности LD-MOSRD07

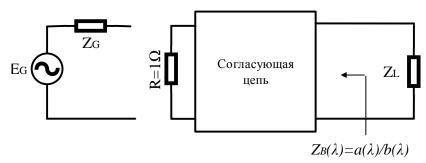


Рис. 3 Описание согласующей сети с помощью входного сопротивления со стороны ZB(λ)

Стандартная нагрузка RL = 50 Ом в диапазоне $850{\text -}2100$ МГц. На стороне генератора (12 Ом) резонансный контур LG//CG1 вводит ноль передачи на частоте 4200 ГГц, что является второй гармоникой на верхнем конце полосы пропускания. Кроме того, CG2 вводит ноль передачи на постоянном токе. Точно так же на стороне нагрузки колебательный контур LL//CL вводит нулевую передачу на третьей гармонике (6300 МГц). Таким образом, на рис. 3 показана проблема двойного согласования (с обеих сторон комплексное сопротивление). Согласующую цепь должна обеспечить согласование между комплексным генератором ZG и комплексной нагрузкой ZL.

Зададимся исходными параметрами нагрузок RG=12 Ом, LG=0.947 нГн, CG1=1.515 пФ, CG2=3.4 пФ, CL=1.515 пФ, LL=0.412 нГн, RL=50 Ом

нечности. $\{c_i; i=1,2,\ldots,6\} \}_{\text{вспомо-}}$ гательного полинома $c(\Omega)$ инициализируются. Кроме того, с0 фиксируется равным единице (с0 = 1), так что нормализованное оконечное сопротивление R устанавливается равным единице. Таким образом, дробно рациональная функция, описываю-

щая сопротивление ZB(\(\lambda\)) полученная по представ-

(5)

ленной методике будет иметь вид:

Согласующая цепь синтезируется, обеспечи-

вая согласованием сопротивления со стороны

ΖВ(λ) с использованием шести соизмеримых линий

передачи (n = 6). В ходе проектирования выбира-

ются k = 4 (общее количество каскадов) и q = 0 (без

нуля передачи постоянного тока), что, в свою очередь, дает n ∞ = k - q = 2 нуля передачи на беско-

$$Z_B(\lambda) = \frac{a(\lambda)}{b(\lambda)} =$$

 $=\frac{0\lambda^{6}+0.62\lambda^{5}+0.7259\lambda^{4}+0.2427\lambda^{3}+0.1717\lambda^{2}+0.0169\lambda+0.0036}{2.1530\lambda^{6}+2.5204\lambda^{5}+1.1745\lambda^{4}+0.9848\lambda^{3}+0.1634\lambda^{2}+0.0754\lambda+0.0036}$

Коэффициенты $c(\Omega)$ получаются в результате оптимизации, а коэффициенты полинома чистимизации.

 $a(\lambda)$ и полинома знаменателя $b(\lambda)$ получаются с использованием метода Левенберга - Марквардта [5].

Таблица 1

Результаты расчетов $c(\Omega)$

№ п/п	$c(\Omega)_{,*100}$	$a(\lambda)$	$b(\lambda)$				
1.	5,9257	0	2,1529				
2.	6,0851	0,6200	2,5204				
3.	-2,2964	0,7258	1,1744				
4.	-2,3805	0,2426	0,9844				
5.	0,1579	0,1717	0,1634				
6.	0,1757	0,0168	0,0753				
7.	0,010	0,0036	0,0036				

После нахождения функции $ZB(\lambda)$ с нормализованными параметрами R0=1 , $f0=1/(2\pi)$, выполняем преобразование Ричардса [3].

Список выходных векторов показан в таблице 2, а окончательный синтез $ZB(\lambda)$ показан на рис. 4

Таблица 2

Результаты синтеза по преобразованию Ричардса

№ п/п	Z_new	a_new	b_new	CT	CV
1.	0.2517	0	1.0000	8	7.5637
2.	1.8721	0.1322	1.1706	1	0.8542
3.	0.1245	0.1547	0.1547	9	0.9999
4.	1.536	-	_	_	=

где Z_{new} – нормированное волновое сопротивление; a_new, b_new – пересчитанные значения коэффициентов числителя, знаменателя функции сопротивления; CT – тип соединения каскада CII и

тип радиоэлемента (CT = 1 -последовательный индуктивность Ричардса, 8 -параллельная емкость Ричардса, 9 - резистор); CV - остаток от деления.

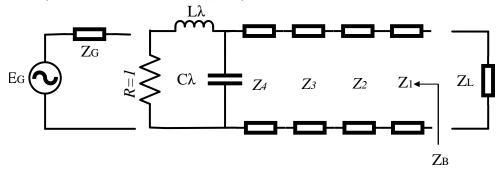


Рис. 4 Результаты синтеза СЦ из ZB(λ)

Таким образом, волновое сопротивление на рис. 4 определяется выражением

$$Z_1 = 0,2517; \ Z_2 = 1,8721; \ Z_3 = 0,1246; \ Z_4 = 1,5364,$$
 и компоненты Ричардса указаны как: $C = 7,5637; \ L = 0,8542.$

При выборе числа нормализации сопротивления R0 = 50 Ом фактические значения элементов определяются как

$$Z_new = [12,5850 \quad 93,6052 \quad 6,2297 \quad 76,8177];$$

Конденсатор Ричардса С выполнен в виде шунтирующего открытого шлейфа с приведенным характеристическим сопротивлением Zcap = 1/C или с фактическим волновым сопротивлением Zcap = R0/C. Точно так же индуктор Ричардса L реализован в виде последовательного короткого шлейфа

с нормированным характеристическим сопротивлением ZInd = L или с фактическим характеристическим сопротивлением Zind = R0L. Таким образом, получается, что Zcap = R0/C = 50/7, 5 = 6,6105 Ом и Zind = R0L = 42,7106 Ом. Для рассматриваемого случая Z3-act = 6,2297 Ом и Zcap-act = 6,6 Ом трудно реализовать. Что касается практической реализации, мы можем предпочесть использовать микрополосковую технологию для реализации идеальных соизмеримых линий передачи. Шунтирующие конденсаторы Ричардса (т.е. открытые шлейфы в шунтирующей конфигурации) могут быть легко реализованы, но реализация последовательных катушек индуктивности Ричардса (т.е. коротких шлейфов в последовательной конфигура-

ции) представляет серьезные трудности. Тем не менее, проблемы физической реализации можно обойти, используя тождества Куроды [4]. В связи с этим последовательное применение тождеств Куроды удаляет последовательные короткие шлейфы с шунтирующими открытыми шлейфами.

Идентификация Куроды 1:

Согласно рис. 5, линия передачи с емкостной нагрузкой может быть заменена эквивалентной линией с индуктивной нагрузкой, используя следующий набор уравнений:

$$Z_{\rm B} = \frac{Z_{\rm A}}{C_{\rm A}Z_{\rm A} + 1} \tag{6}$$

$$L_{\rm B} = \frac{C_A Z_A^2}{C_A Z_A + 1} \tag{7}$$

В нашем случае конденсатор Ричардса и пара линий передачи $\{C\lambda, Z4\} = \{C\lambda = 7,5637\lambda, Z4 = 1,5364\}$ могут быть заменены парой линий передачи и индукторов Ричардса $\{ZB1, LB1\lambda\}$ так, что

$$Z_{\rm B1} = \frac{Z_A}{C_A Z_A + 1} = 0,1217 \tag{8}$$

$$L_{\rm B1} = \frac{C_A Z_A^2}{C_A Z_A + 1} = 1,4146 \tag{9}$$

Таким образом, на первом этапе мы воспользовались тождеством Куроды I и получили следующую топологию цепи.

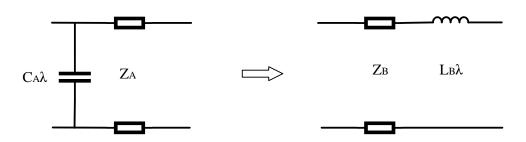


Рис. 5 Идентификация индуктивности с помощью тождеств Куроды

Идентификация Куроды 2:

Ссылаясь на рис. 5, пары $\{L\lambda, ZB1\}$ и $\{LB1, Z3\}$ можно заменить их идентичными парами, используя тождество Куроды II, как показано на рис. 6. Набор уравнений замены задается выражением

$$Z_{\rm B} = Z_A + L_A \tag{10}$$

$$C_{\rm B} = \frac{L_{\rm A}}{Z_{\rm A} \left(Z_{\rm A} + L_{\rm A}\right)} \tag{11}$$

На втором этапе тождество Куроды II применяется дважды. Сначала пара $\{\lambda\ LB1,\ Z3\}$ заменяется на

$$Z_{B3} = Z_3 + L_{B1} = 1,5393$$
 (12)

или фактическое значение ZB3 равно ZB3-act = 76 Ом.

$$C_{\rm B3} = \frac{L_{\rm B1}}{Z_{\rm B1}(Z_{\rm B1} + L_{\rm B1})} = 7,37 \tag{13}$$

Аналогично пара $\{L\lambda, ZB1\}$ заменяется новой $\{ZB2, CB2\}$ такой, что

$$Z_{B2} = Z_{B1} + L = 0,9759$$
 (14)

или фактическое значение ZB2 равно ZB2-act =48,7974 Ом.

$$C_{\text{B3}} = \frac{L}{Z_{B1}(Z_{B1} + L)} = 7,1899$$
 (15)

Следовательно, мы получаем рис. 6 как окончательный синтез $ZB2(\lambda)$

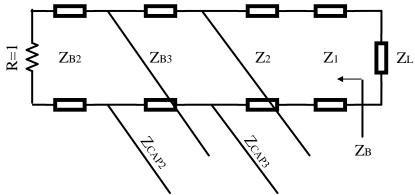


Рис. 6 Согласующая цепь для усилителя мощности LD-MOSRD07

Согласующее устройство выполнено на FR-4 с диэлектрической проницаемостью 4.3. Характеристики согласованной системы показаны на рис. 7.

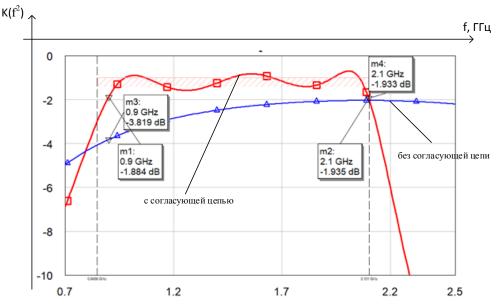


Рис. 7 Зависимость КПМ с согласующей цепью и без нее

В случаи нестабильности параметров усилителя, вызванной различного рода дестабилизирующими факторами, приведшему к изменению параметров нагрузки до 25% от номинального значения, приводит к изменению КПМ в полосе пропускания

незначительно при использовании синтезированной согласующей цепи (рис. 8 – сплошные линии), в отличии зависимости без нее (рис. 8 – штриховые линии).

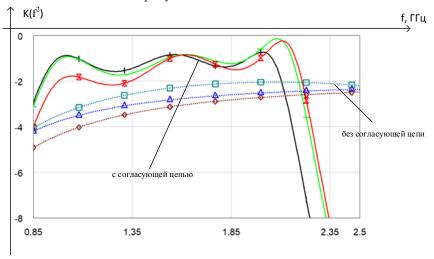


Рис. 8 Зависимость КПМ от частоты усилителя с согласующей цепью и без нее

Исходя из полученных результатов следует, что СУ обеспечивает не только улучшение КПМ в диапазоне частот от 0,9 до 2,1 ГГц, но так же обладает и повышенной избирательностью за полосой пропускания. Таким образом полученная методика может применятся для синтеза СУ как в сосредоточенном элементном базисе так и в СВЧ диапазоне частот.

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