UDC: 004.81; 159.92 https://doi.org/10.15407/jai2023.03.018

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THE NATURE OF THE PSYCHE AND CONSCIOUSNESS, QUANTUM COMPUTERS AND INFORMATION MODELS IN PSYCHOINFORMATICS (SOCIONICS)

Annotation. Modeling the psyche, consciousness and artificial intelligence have encountered conceptual difficulties in understanding real mental processes. Numerous modern studies and experiments presented in the review indicate the probable quantum nature of the psyche and consciousness. The analysis shows that a number of quantum processes are associated with known classical processes and structures, from a single cell to the brain. Therefore, adequate modeling of mental processes, including consciousness and intelligence, is possible only on multiprocessor quantum computers with a special architecture corresponding to the real structure of the psyche. This possible architecture is proposed by the theory of information metabolism - socionics (psychoinformatics), in which detailed holistic information models of the psyche have been developed, which have been used in practice for more than 30 years and have proven their effectiveness. These models represent a system of mental functions of information metabolism, which can be simulated by special quantum processors interacting with each other according to certain laws.

Keywords: psyche, consciousness, quantum system, quantum computer, living cell, type of information metabolism, modeling of psyche and consciousness, artificial intelligence.

Introduction

The nature and relationship between consciousness and matter, psyche and body are one of the most complex and intriguing mysteries not only of science, but also of human cognition in general.

The emergence of cybernetics in the 20th century as the science of control and communication, as well as computers, made it possible to simulate a range of information processes with the goal of creating artificial intelligence, even to attempts to imitate the functioning of the brain using computer models simulating millions of interacting neurons.

Existing systems are improving in pattern recognition or imitating some aspects of logical analysis, acting as a human assistant in information processing. However, nothing similar to manifestations of consciousness is observed in such systems and models, despite the continuous increase in computing power. At the same time, researchers in the field of creating artificial intelligence do not have a clear understanding of the nature of the processes and phenomena of the psyche, consciousness and mind, which are supposed to be reproduced in modeling.

Therefore, the question of the nature of consciousness and psyche cannot be considered resolved today, despite all the successes of neurophysiological and computational approaches. Moreover, the modern idea of the special nature of consciousness arose and is developing within the framework of quantum physics, the success of which, as we know, has revolutionized not only the scientific picture of the world, but also the flow of new technologies. Even Niels Bohr, the creator of the theory of the atom, considered obvious analogies between descriptions of quantum and mental processes.

Phenomenological description of mental processes as quantum

Quantum mental processes research is an area that uses the mathematics of quantum theory to model cognitive phenomena including information processing in the human brain, studies of language and speech, decision-making, memory, concept formation, judgment and perception. These studies do not depend on hypotheses about the nature of quantum phenomena in the brain, that is, they are also phenomenological and empirical, i.e., experimentally verifiable in psychological experiments.

Ideas for applying quantum formalisms

to mental processes first appeared in the 1980–1990s in the work of D. Aerts and his co-authors, E. Finkelstein, A. Bukalov, J. Broekaert, S. Smets, E. Atmanspacher, P. Bordley and A. Khrennikov. This direction has received particular development since the late 2000s as a result of a number of publications in well-known psychological journals, the publication of monographs and textbooks. Considering the functioning of the psyche at the system level as a macroquantum phenomenon, we can conclude that all the features of quantum laws necessarily arise in it, in including the fundamental complementarity of corpuscular and wave descriptions. This was noted by a number of authors: N. Bohr, D. Bohm, R. Feynman, I. Tsekhmistro, E. Finkelstein, A. Bukalov, etc. [9]. Consideration of the manifestation of quantum properties by the psyche automatically leads to the identification of corpuscular and wave components in it, which in humans can be considered as complementarity between the rational and irrational components of the psyche. Therefore, for example, the conclusions of mathematical logic that a formal description of an object is meaningless or a meaningful object is indescribable formally, represent extreme cases of the uncertainty principle for formal and semantic descriptions of a mathematical object, just as in quantum mechanics, with an infinitely accurate measurement of momentum of an elementary particle, its coordinate does not exist, and vice versa. This complementarity of form and semantics reflects the relationship between verbal, logical-formal and non-verbal, intuitive-semantic thinking. The incompatibility and complementarity of formal and semantic descriptions of objects constructed by the mind of a mathematician and the corresponding forms of thinking was reflected in the dispute between the formalistic (D. Hilbert) and intuitionistic (L. Brouwer) directions in the foundations of mathematics [11].

The birth of a thought, its awareness, can be described as a process of measurement in quantum mechanics. At the same time, the stream of consciousness described by a number of psychologists and philosophers (W. James, H. Bergson, etc.) can be easily compared with the description of the modern picture of a physical vacuum, consisting of virtual quanta of physical fields, particles, arising and disappearing semi-real formations. At the same time, thought, as an analogue of an elementary particle, has both “corpuscular” and “wave” properties. Measuring or fixing attention on one such “particle” - a thought - separates it from the vacuum continuum; it grows, becomes heavier, while, however, losing its previous features, especially when expressed verbally. In this case, the superposition of the states of the thought particle with all the states of the quantized virtual stream of consciousness disappears, and a certain state is allocated, which is one of its own states of consciousness, acting as a device. Here selectivity or predisposition of consciousness is manifested, an attitude towards choosing a solution (this is the reason for subjectivity). It turns out to be possible to introduce the concept of the wave function Ψ, which describes the psyche. Logical operations of consciousness, reducing the wave function of the psyche, cause compression of the wave packet of thought or its fixation. The isolation of some aspects of thought leads to the loss of others. This is the difficulty of self-observation - introspection. Therefore, from an evolutionary point of view, formally logical abstract thinking in its fully developed form arose in humans only when it could be afforded, since intellectual activity reduces and inhibits the instinctive, automatic work of the brain. The movement of a thought is not rectilinear; in its movement it interacts in an associative manner (or interferes) with other thoughts (analogues of interaction with vacuum virtual particles). At the same time, it is impossible to indicate the path of thought to the set goal; the trajectory of thought is confused, broken, “smeared” throughout the entire associative space of thoughts of the same dimension. This description directly corresponds to the quantum interference of alternatives described by the Feynman path integral. Verbal (corpuscular) components or phenomena of the psyche are necessarily discrete, in contrast to the integrity of gestalt images, the integrity of the mental act, its indivisibility and inseparability. This same statement about the integrity and indivisibility

of quantum phenomena is the central point of quantum mechanics. Thus, we can say that the recognition of the psyche as a quantum mechanical system explains many mental phenomena and paradoxes. The question of the quantum properties of the psyche can be considered from another point of view. Namely, from the recognition of the holographic principles of the brain according to K. Pribram and others, all of the above quantum mechanical properties automatically follow : superposition of mental and emotional states, interference of alternative amplitudes of the probability of thoughts or actions, etc. Moreover, in the interpretation under consideration, the mental unconscious as unobservable part of the psyche acts as a "quantum vacuum," but not structureless, but possessing a hierarchy of symmetries of "vacuum quantum fields" [9].

For any part of the psyche, there is a wave-particle dualism, and this dualism has a deep physical basis, since either the entire psyche or a significant part of it is a reflection of the Universe as reality, and to some extent its modeling, i.e. reproduction. Thus, the reflection of the phenomena of the external world also obeys quantum mechanical laws, reproducing the laws of nature. Therefore, the principles of the psyche reflect not only the phenomena of reality, but also the laws governing these phenomena, and this reflection, in turn, turns out to be isomorphic to the fundamental physical principles. Then the answer to the question about the reason for the emergence and existence of two different hemispheres of the brain is formulated as follows: the need to reflect the observed reality, which is additional at its core, necessitated the emergence of a quantum modeling mental substrate that uses the same laws. This is directly indicated by the holographic nature of information processing in brain structures.

Therefore, research in the field of Quantum Cognition are based on the quantum paradigm, which is that the mechanism of information processing using such a complex system as the brain, taking into account the contextual dependence of information and probabilistic reasoning, can be mathematically described within the framework of quantum information theory and quantum probability theory. In this field, researchers do not attempt to describe how the macroscopic and apparently non-quantum neural brain implements the observed quantum behavior. They are interested in the effects themselves, which consist in the fact that various cognitive phenomena are more adequately described by quantum information theory and quantum probability than by the corresponding classical theories. The quantum probability view developed by C.A. Fuchs et al. [18] also supports the quantum approach, especially for describing the decision-making process.

Here, contextuality is the key word, since quantum mechanics is fundamentally contextual [42], since quantum systems do not have objective properties that can be determined independently of the specific measurements of the context, as N. Bohr pointed out. Such contextuality implies the existence of incompatible mental variables, as well as a violation of the classical law of total probability and interference effects. Experiments with **player decision making** show that that when players are not told the results of the first round, most of them will not agree to play the second round, although previously, knowing the results, they were mostly ready to play regardless of whether they won or lost. This result violates the law of classical probability. However, it can be explained as a result of the quantum interference effect, similar to the explanation of the results in a double-slit experiment in quantum physics [16]. Such deviations from classical rational expectations of agents' decisions under conditions of uncertainty produce well-known paradoxes in behavioral economics, and human behavior under conditions of uncertainty is explained in terms of quantum aspects: superposition, interference, contextuality, and incompati–bility of noncommuting operators [1]. The use of quantum entanglement to model the semantics of combinations of various concepts has also been proposed [43].

Similar effects are associated with **memory** [7]. At the same time, quantum probability provides a new way to explain human **errors** in probability estimation, including conjunction and disjunction errors

[30]. The Liar Paradox is a contextual paradox. It can be shown that the true-false state in this paradox is described in a complex Hilbert space, and the oscillations between "true" and "false" are dynamically described by the quantum Schrödinger equation [40]. The use of quantum entanglement to model the semantics of combinations of various concepts has also been proposed [43]. The concept of quantum superposition is used to explain the emergence of a new concept when concepts are combined [41].

According to Hampton [25], the combination of the two concepts can be modeled in a specific quantum Fock space, where observed deviations from classical theory are explained in terms of contextual interaction, superposition, interference and entanglement [1, 2, 41]. At the same time, a cognitive test for the implementation of a specific combination of concepts shows that quantum entanglement arises between individual concepts, with violations of Bell's inequalities.

It is known in the field of **perception** that if a stimulus has an ambiguous interpretation, its interpretation tends to fluctuate over time. Quantum models have been developed to predict the time periods between oscillations, and how these periods vary with measurement frequency. Quantum theory was also used to model Gestalt perception, to take into account the interference effects obtained with measurements of ambiguous figures [4]. E. Conte obtained experimental confirmation of the quantum interference effect and the existence of a wave function at the perceptual-cognitive level by people using ambiguous figures, cognitive anomalies such as conjunctions of delusions, emotive-cognitive conflict, observation of ambiguous figures after a cognitive task, which indicates the quantum properties of consciousness , which manifest themselves based on the basic quantum principle of superposition of states of quantum mechanics [21].

In the field of **economics and finance**, there are also a number of works showing that information processing by market agents obeys the laws of quantum information theory and quantum probability (E. Haven , O. Shustova, A. Khrennikov [26]). This is, for example, Bohm's model of stock price dynamics, in which this price, as a quantum potential, is generated by the expectations of financial market agents.

A number of researchers apply the theory of open quantum systems to describe the **decision-making process** as a result of the dynamics of the mental states of a system interacting with the environment. The description of the decision-making process is mathematically equivalent to the description of the decoherence process [3].

Quantum aspects in the physics of the alive

In the 80s of the 20th century, in the works of prof. S.P. Sit'ko and his followers (Kyiv), a new direction arose. It is "physics of the alive" which developed in connection with the use of microwave resonance therapy (MRI) as part of quantum medicine. The physics of living things has been considered from a quantum perspective from the very beginning. The emergence of this direction was due to the fact that the reasons for the synchronization of processes that occur in billions of cells of the body, the nature of differentiation of tissue cells, and the mechanisms for the implementation of gene information during the development of the body were unclear. H. Fröhlich, one of the creators of the quantum theory of superconductivity, was the first to propose a solution to the problem of a physical explanation for the sustainable existence of macroscopic living organisms. He suggested the existence of a biological coherence effect that could create effective long-range action. H. Fröhlich was the first to draw attention to the fact that the natural vibrations of the protoplasmic membranes of cells, in accordance with their physical properties, are in the range (10-10 ÷10-11) Hz and, being energized, under any excitation they are sources of electromagnetic radiation precisely in range of millimeter electromagnetic waves [18]. The practical development of the concept of biological coherence began in 1982, when S.P. Sit'ko et al. discovered manifestations of the human body's own characteristic frequencies in the millimeter region of electromagnetic waves [37]. and experimental results were also obtained on restoring the

health status of patients when exposed to low-intensity electromagnetic radiation in the millimeter range, about 50 GHz, on human biologically active points (BAP). The researchers concluded that each cell can be considered as an active center in the potential for creating a coherent electromagnetic field of the entire organism. The physics of living things defines living things as the fourth level of quantum organization of nature (after nuclear, atomic and molecular), when a self-consistent potential, ensuring the existence of effective long-range forces, functions like a laser potential in the millimeter range of electromagnetic waves and provides the effect of biological coherence.

The very ability of a living thing to act as a quantum mechanical object is decisive for its very existence as a living thing, which is the physical difference between living and nonliving.

Other studies have also shown that even light quanta interacting with organic molecules even at room temperature under certain conditions can form a quantum hybrid superfluid liquid that moves without friction [24].

A biological cell is also considered as a system that carries out quantum information processing as a hypersonic molecular quantum phonon computer, and the brain is considered as a system of such quantum computers [31]. This concept was put forward and developed by E.A. Liberman et al. [31]. R. Penrose and S. Hameroff, developing the ideas of H. Fröhlich, independently also proposed a similar hypothesis about the connection between consciousness and quantum mechanical oscillations in micropipes cytoskeleton of the cell, creating the “theory of quantum neurocomputing”. But, as R. Penrose himself believes, this is not enough, since for global coordination of mental processes it is necessary that the collective quantum state covers large multicellular areas of the brain [33]. A generalization of the works of H. Fröhlich, E. Liberman, R. Penrose, S. Sitko and others allowed the author to conclude that we are talking about one complex phenomenon and the fundamental nature of coherent oscillations of various natures at frequencies of about 50–100 GHz in living cells and multicellular organisms [13].

The study of the optical characteristics of axons led to the conclusion that it is possible to transmit photons inside the brain over macroscopic (centimeter) distances. In this case, axons about 2 millimeters long can transmit from 46 to 96% of the biophotons entering them. At the same time, the brain can produce more than 10^9 biophotons per second, which allows us to talk about the possibilities of quantum entanglement of these photons, when implementing quantum communication [29]. But such quantum communication requires not only optical communication channels, but also mechanisms that encode, receive and process quantum information, that is, the desired quantum processors.

And analysis of the observation process in standard quantum mechanics led a number of outstanding physicists to the conclusion that it is impossible to exclude the consciousness of the observer from the measurement process. This, in particular, is evidenced by the position of quantum mechanics about the inseparability of the object and the device and the relativity of the boundaries between them, which is expressed in the well-known von Neumann theorem about the arbitrary transfer of the boundary between the object and the consciousness of the observer recording the readings of the measuring device. Indeed, even in the case of a measurement that turns a microscopic quantum event into a macroscopic one, it must be recorded by the consciousness of the observer, and the device itself must be continued to the retina and neural structures for processing incoming information. However, the process of quantum measurement is completed only after it is realized by the inner “Self”. It would seem that this can be dismissed, considering such a physical description a formal fiction, but the role of consciousness is also manifested in the fact that it is the observer who decides what he observes and how. This point of view was adhered to by a number of leading experts in the field of quantum mechanics: von Neumann, E. Schrödinger, F. London and E. Bauer, E. Wigner, R. Penrose, M. Mensky, etc., who considered the issue of reduction by the consciousness of the observer wave packet.

Direct experimental research has shown that the brain uses quantum computing. By measuring proton spins using magnetic resonance imaging (MRI), researchers from Trinity College (Dublin) found that the brain functions they measured were correlated with short-term memory performance and awareness, suggesting that quantum processes are also part of cognitive and conscious processes. brain functions [20]. They proceeded from the laws of quantum mechanics, in which if known systems that interact with an unknown system become entangled, then the unknown system must also be quantum. However, electrophysiological potentials, such as heart rate evoked potentials, are not detected by MRI, so they could only be observed due to the entanglement of proton spins in the brain fluid. It follows that brain functions must be quantum. The authors also concluded that "*our findings confirm that the mind operates non-classically, which seems like an obvious assumption considering what we know today about cognition and computing. However, our findings are standing against the unproven statement that quantum entanglement or coherence can't survive in the hot and wet environment of the brain long and far enough*" [20].

Note that the well-known Integrated Information Theory of Consciousness proposed by G. Tononi [39], based on the unconditional fact of its existence and observable properties, involves finding conditions and processes for the realization of consciousness. And if these properties, as a number of data show, are described by quantum mechanics, then the mechanisms for realizing consciousness must be of a quantum nature and must have a quantum material carrier.

Based on a number of facts, including research and modeling using a neural network of quite intelligent behavior of single-celled organisms, such as amoebas and ciliates, we have proposed a hypothesis about a unit or quantum of psyche and consciousness, which corresponds to the psyche and consciousness of a single cell as a unit of living [13]. The discovery of a neuron-like ribosomal r-protein network that functions as a "molecular brain" [38], and new research into a range of cognitive properties of prokaryotes, including associative learning and problem solving [32], also support this hypothesis.

The degree of consciousness of a living creature can be determined by the logarithm of the number of neurons in relation to a single cell, which corresponds to the general approach in information theory. At the same time, we found that the logarithm of the evolutionary increase in the number of neurons or brain mass in primates, that is, the increase in the amount of mentality and consciousness, is equal to the negative logarithm of the experimentally established frequency of neutral mutations in the genome of various organisms from Drosophila to primates and humans [12].

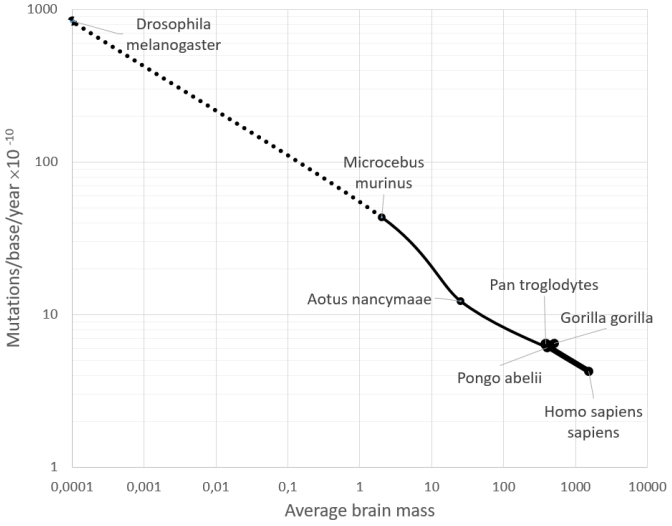

Fig. 1. Dependence of mutation rate on brain mass (logarithmic scales)

The resulting dependence (Fig. 1) shows that the evolutionarily increasing information orderliness of the psyche and consciousness reduces the growth of genome entropy at the quantum biochemical level.

At the same time, to understand the quantum properties of the psyche and consciousness, one electromagnetic structure discovered by S.P. Sit'ko is apparently not enough. It is too simple and cannot provide the described characteristics of consciousness, the processes of quantum computing and thinking. Therefore, despite the important role of the electromagnetic coherent framework, such a structure can be considered only as one of the substructures of the entire quantum system of the body, ensuring the interaction and coupling of this system with molecular biological structures. To implement a complete quantum system of an organism as a carrier of psyche and consciousness, the presence of another substrate is probably necessary, for example, a quantum condensate of light elementary particles [11]. The presence of a number of such particles ("dark matter", "dark energy", axions, sterile neutrinos, etc.) directly follows from the concepts and experimental data of modern physics and astrophysics. Therefore, the hypothesis about the existence of quantum structures from an unknown form of matter, additional to biological structures, but connected with them in a certain physical way, seems quite legitimate. According to our hypothesis, these structures are largely responsible for mental phenomena and consciousness, and are associated with biological processes.

This may also explain the existence of living and working people whose brains lack up to 90–95% of neurons [23]. In addition, using the "mirror test" method, self-awareness was experimentally discovered even in ants [17], which have only 250 thousand neurons versus 86 billion in humans. It turns out that the very fact of self-awareness depends little on the number of neurons. At the same time, artificial neuron-like systems with millions of elements are already working, but they lack self-awareness. At the same time, artificial neuron-like systems with millions of elements are already working, but they lack self-awareness.

Holographic model of consciousness

As the first non-mechanistic models, we can cite examples of holographic models of consciousness, starting with the model of K. Pribram [34], which demonstrate the role of wave processes in the formation of the phenomenon of consciousness and thinking. The author proposed a holographic model of the work of Jung-Augustinavichute mental functions as organs of thinking [10].

This model is based on the following. According to neurophysiology [19], information about external and internal reality enters the brain through two different systems: the so-called specific and nonspecific, which conduct excitation from receptors and from lower centers to the cerebral cortex. These systems provide the transmission of information, which includes an assessment of the physical parameters of the stimulus and its signal value. The synthesis of this information at the level of the cortex is considered one of the very first and most important stages of higher nervous activity.

The information that comes through a specific system is discrete and determined by sensory modalities. Moreover, its distribution throughout the cerebral cortex fully corresponds to the projection principle. A specific system perceives and transmits to the cortex information about the objective, physical properties of the stimulus, regardless of its biological significance. It provides the ability to accurately analyze stimuli according to their objective indicators. Therefore, such information is called specific.

In contrast, information entering the cerebral cortex through a nonspecific system has a different character and is called nonspecific. When passing through the structures of the brainstem, it loses its specificity, which is associated with its delocalization in the cerebral cortex and leaving the projection field of the corresponding analyzer. At the same time, passing through the emotional and motivational centers of the limbic system and hypothalamus, it acquires a new meaning, consisting in the assessment of stimuli according to their biological significance. Therefore, nonspecific information is nonspecific only from the point of view of the

sensory modality of the stimulus, but it is strictly specific in relation to its biological meaning, that is, in terms of its role for one or another activity of the organism.

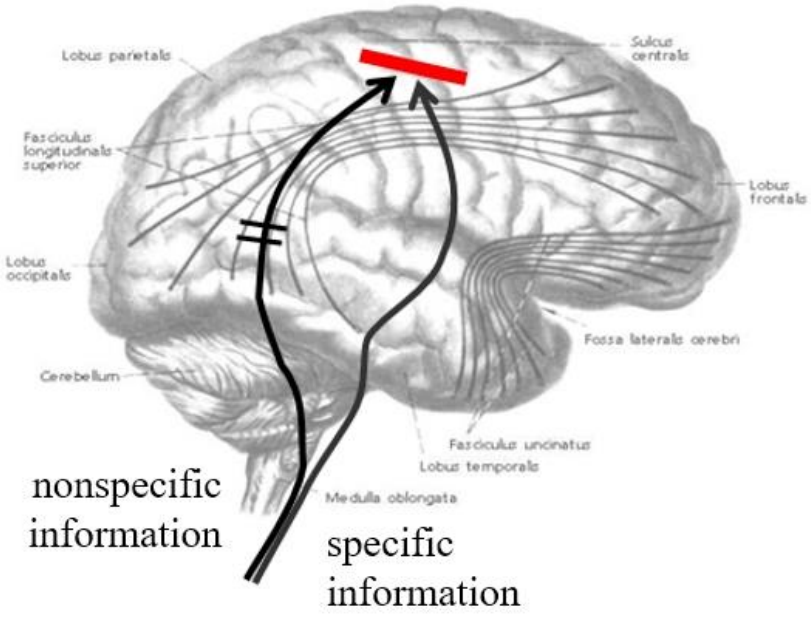

Fig. 2. Simplified holographic model of brain information processing
(A. Bukalov 1995, 2001) [10, 11, 14]

Hence the existence of two types of signals: one of them carries “objective” information, the other “subjective”, colored by the internal desires, motivation, and biological needs of a person [19]. In this regard, it is appropriate to note that C.G. Jung identified extraversion as the property of perceiving objective data of the surrounding world with the subordination of subjective aspects to this, as opposed to introversion as the property of relying on the inner world, thoughts, desires, etc. with the subordination of objective data to this [27]. Therefore, we proposed to correlate the neurophysiological mechanism of transmission and processing of specific information with the mental process of extraversion, and the mechanism of transmission and processing of nonspecific information with the mental process of introversion within the framework of a new holographic model (Fig. 2) [10, 11].

An important aspect of this model, which includes, as a special case, the holographic memory model of G.I. Shulgina [35], was confirmed by neurophysiological studies of the mechanisms of extraversion and introversion [14]. Such holographic models describe the observed phenomena well, but the ability of one neural substrate to actually ensure the occurrence of holographic processes is questionable. After all, these processes are associated with ensuring quantum coherence, and they require an appropriate quantum substrate. Neural structures are macroscopic non-quantum structures and have significant entropy. They are, of course, associated with wave quantum holographic processes, but how many can ensure their occurrence. They can rather be considered as classical transition devices for input-output of information in relation to quantum processes and quantum substrate. Therefore, the holographic model we described can be called phenomenological, reflecting the physiological projection of the work of more fundamental quantum structures that determine the specifics of mental processes.

Due to this feature, modeling thinking processes on ordinary computers has encountered difficulties associated with the objective impossibility of realizing the specific features of consciousness on ordinary computers. However, quantum computers are now being developed, in which calculations are carried out using qubits in quantum cells containing tens or hundreds of quantum

correlated particles. Microscopic quantum systems in such computers are interfaced with macroscopic classical information input-output devices, which in the biophysical quantum paradigm can be compared with macroscopic neural structures. Therefore, modeling a number of aspects of the psyche and consciousness on quantum computers will be much more successful. However, for this, a quantum computer as an analogue of the brain must form a system of at least 8 specialized processors, each of which will process its own special part of the general information flow, as happens in the human psyche. The entire system is controlled by a central processor, which can be considered as an analogue of the integrating function of consciousness. In **socionics**, or psychoinformatics, as the theory of information metabolism of the psyche models of such structures [10, 15] are well developed. Their use can help in the development and creation of future full-fledged quantum computers.

Models of information metabolism in socionics (psychoinformatics)

Socionics, or psychoinformatics, as the theory of informational metabolism and informational structure of psyche, makes it possible to look at these problems from a different conceptual base [5, 10].

A feature of socionics (or psychoinformatics) is the **presence of well-developed and testable information models of the psyche**, which describe how the psyche perceives various types of information, processes it and makes decisions. Therefore, socionics methods are used to train pilots and civil aviation dispatchers [36], astronauts, to create more productive and effective teams in management, psychotherapy, practical psychology, sports, modeling mental processes, and in other areas [10, 11, 15]. Socionics conclusions have been tested in experiments and in practice for more than 30 years.

When constructing information models of the psyche, socionics distinguishes 8 basic information processing subsystems, each of which processes its own aspect of the information flow in a certain way. These 8 subsystems, which carry out the mental functions of exchanging and processing information, are described in the language of psychology as mental functions. In socionics they are defined as functions of information metabolism (FIM).

Each aspect of the information flow has its own function of information metabolism (Fig. 3), which determines a person's ability to perceive and understand certain aspects of the world. FIMs provide specific images and ideas that form a certain "grammar" of a person's relationship with the world, including with other people. Nature allows everyone to develop these functions, along with receiving and producing information.

Each of these FIMs as information processing subsystems is a specific processor that solves a problem of a certain kind. At the same time, depending on the structure of the problem, different schemes for combining all 8 processors into a single information processing system are possible, which makes it possible to solve multidimensional problems at high speed.

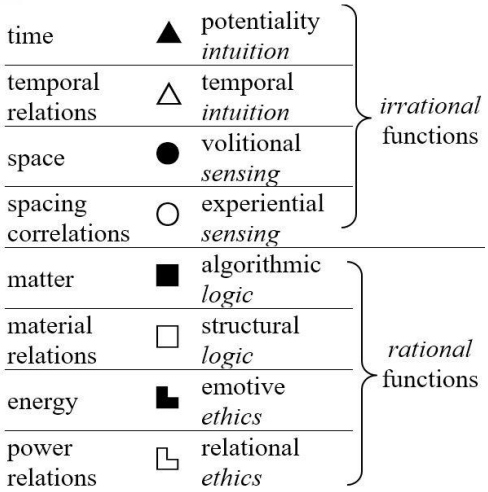

Fig. 3. Aspects of informational flow in socionics and functions of information metabolism

Each FIM also correlates with a specific functional system of the body and with large neural networks.

For example, the default mode network, the operational rest network, Default Mode Network, the target negative network is active in a state of rest and self-absorption, dreams and dozes, meditation, corresponds to the "*intuition of possibilities*", and the target positive network, the network of operational

problem solving, Task-Positive Network, which is active in flow states, when concentrating on completing complex tasks, corresponds to the "*intuition of time*"

"*Sensing*" is the most studied by physiologists aspect of socionics, ensuring the vital activity of the body and interaction with others. These are sensitivity regulation systems ("*experiential sensing*") and descending pathways for controlling movements ("*volitional sensing*"), including the peripheral nervous system (anatomical) consisting of: motor units (nerve plus muscle fibers: shape, speed and strength); muscle spindles (sensor with adjustable length and speed sensitivity – support reflex activator); receptors that activate the bending reflex, etc.

Aspect "*logic*" at the basic level, a functional system is responsible, including neural networks with the participation of neurons of place, head direction, coordinate grid, border, with the further development of purely logical structures in the cerebral cortex.

Aspect of "*emotive ethics*", or feeling, corresponds to the activity of the functional system associated with the assessment of the achievement or non-achievement of the goal formed by the feedback acceptor.

Mirror neurons that determine empathy have also been studied. The FIM corresponding to this functional system is "*relational ethics*" [28].

In nature, at the level of the human psyche, 16 basic options for combining 8 "processors" are implemented in the form of 16 types of information metabolism (TIM) as integral types of intelligence. They were formed evolutionarily and collectively constitute a psycho-informational social system; it is called the **Socion** [5, 10]. Each TIM is characterized by its own specific perception and processing of information, strategy of behavior and decision-making.

Socionics also studies the **types of information interactions** between types of information metabolism (predicts and describes intertype relationships), as well as their interaction with the outside world.

Optimal interaction between the operator and the technical system is especially important in control systems for complex technical processes, nuclear power plants, and transport systems. Considering the interaction of a person with any system, it is possible to describe the information type of such a system and highlight one of the many possible interactions with the type of person. The range of these interactions is very wide, from resonant to conflicting. Taking this into account, it is possible to create systems that are as human-friendly as possible and that will interact optimally with the operator. Such a system can be restructured for interaction with a specific person [8, 10].

Artificial intelligence systems and currently existing robotic systems are capable of modeling, and then partially, mainly only 3 subsystems out of 8:

- ✓ algorithmic and structural-logical (at the level of algorithms and programs)
- ✓ empirical sensing (obtaining information from sensors) and pattern recognition,
- ✓ control of actuators.

However, since holistic intelligence consists of at least 8 subsystems, it is obvious that real artificial intelligence needs at least 5 more information processing subsystems, that is, analogues of the corresponding functions of information metabolism (Fig. 4).

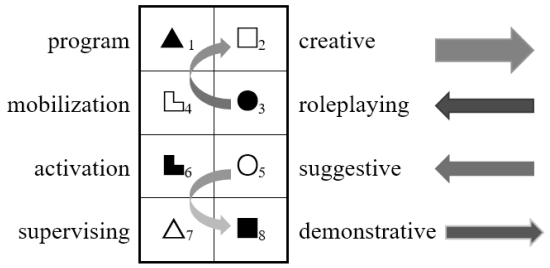

Fig. 4. A-model (A. Augustinavichute [5, 10]) of TIM *intuitive logical extravert* with names of functions and indication of information flow directions

Our research shows that IM functions can apparently be considered as special quantum or quasi-quantum processors [10].

This consideration is also in accordance with the description of the psyche in Quantum Cognition. R. Blutner and. E. Hochnadel showed that the formalization of the theory of psychological types by C.G. Jung, Myers-Briggs and A. Augustinavichute using the mathematical apparatus of quantum mechanics allows us to deduce the existence of 16 personality types. These types correspond to

the types of information metabolism in socionics [6].

The development of A-model gives 8-component A–B model (Augustinavichute-Bukalov) with an integrating function of consciousness.

Function of consciousness (Fig. 5) regulates the activity of all FIMs, including them in various operating modes as needed when solving various problems, especially non-standard ones in the surrounding world.

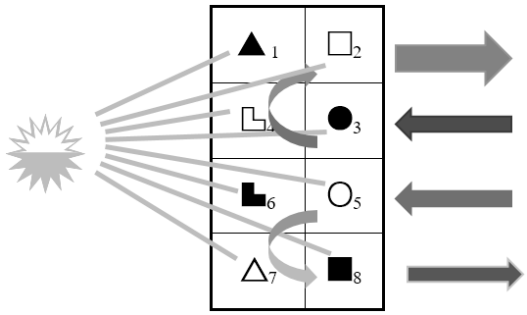

Fig. 5. The controlling role of the consciousness function consists in switching FIM modes (A. Bukalov [10])

Dimension of FIM, hierarchy of volumes of attention, memory and thinking

The dimension of a function determines the maximum possible number of operational cells, and the number of actualized cells determines the level of development of each function and personality as a whole.

Internal quantization of the psycho-informational space of memory, attention and thinking gives a characteristic spectrum of the number of operational cells in the form of A. Bukalov's magic row 6(7), 10(11), 16(17), 26(27), 42(43)…, in which the well-known Miller number 7±2, corresponding to the volume of random access memory (RAM) is the first member of this row, whose properties are close to the Fibonacci sequence with golden ratios between neighboring members of the series. And the expansion of the basic A–model gives a more differentiated 16-component B–model, supplemented by the integral function of consciousness, which gives flexibility and volume to the description of the human psyche.

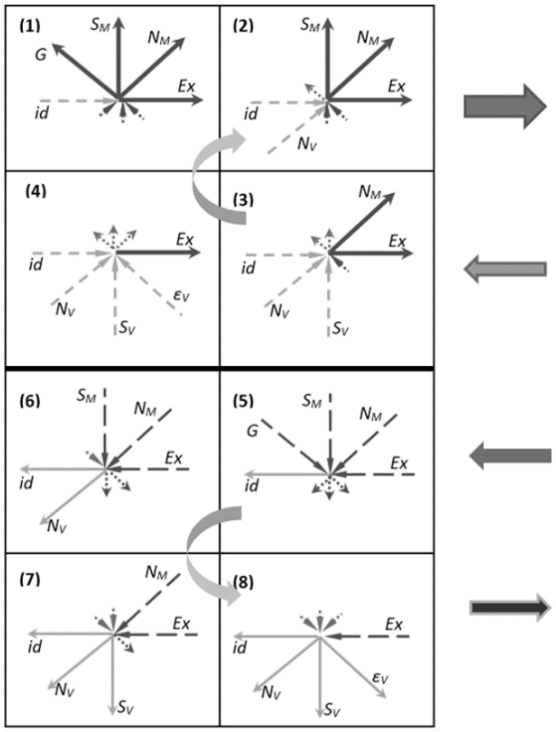

Fig. 5. FIM dimensions and information input/output channels

Each vector (Fig. 5) associated with the dimension of mental function can be associated with its own amount of attention, thinking and memory. Thus, the one-dimensional fourth function contains only the vector of personal experience. Its volume is N_4 = **6 (7)** operational cells (a unit is added when taking into account the integrating function of consciousness).

The two-dimensional *third* function, determined by the vectors of personal experience and learned norms (rules of behavior), is characterized by a volume of N_3 = **10 (11)** cells.

The three-dimensional *second* function is determined by the vectors of personal experience, norms, situation and is characterized by a volume of N_2 = **16 (17)** cells.

The four-dimensional *first* function is determined by the vectors of personal experience, norms, situation and globality. Therefore, its maximum volume is N_1 = **26 (27)** cells.

Factorials of operating cells interacting with each other in each function-processor give the approximate number of combinations with which mental functions operate. So, for *the first* function, the number of combinations with which it operates is

$$W_1 = N_1! = 27! \approx 10^{28}.$$

For *the second* function

$$W_2 = N_2! = 17! \approx \approx 3.6 \cdot 10^{14}.$$

For *the third* function

$$W_3 = N_3! = 17! \approx 4 \cdot 10^7.$$

For *the fourth* function

$$W_4 = N_4! = 7! = 5040.$$

For real people, not all operating cells may be fully active. Such differences in the number of active cells in different FIMs correspond to differences in the degree of mental development, in the abilities, talents and skills of different people. In apes, the number of operating cells is 2–3 times less than in humans. This determines the difference in cognitive abilities between humans and apes [10].

Conclusions

A conceptual and theoretical analysis of the nature of the psyche, consciousness and thinking shows the quantum nature of these phenomena and their processes. This conclusion is confirmed by direct experimental data. Therefore, adequate modeling of mental processes, including consciousness, seems to be possible only on quantum computers, in which quantum structures and processes are coupled with classical, macroscopic structures and processes. But such computers must have a structure close to natural. At the same time, information models of the psyche, developed in socionics, well describe many observable aspects of human thinking and behavior. Therefore, these models can become the basis for building the architecture of complex quantum multiprocessor computers that reproduce the structure of mental functions of information metabolism, which process various aspects of the incoming information flow. The power and degree of development of each function is determined by the parametric dimension of its operational space and the number of operational cells. There is reason to believe that the interaction of these cells is of a quantum nature and can be realized in certain quantum systems. Modern technologies apparently make it possible to implement such systems, which will allow us to get closer to modeling human thinking.

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The article has been sent to the editors 20.10.23.
After processing 23.10.23.
Submitted for printing 30.11.23.