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A. Bukalov
International Institute of Socionics, Ukraine
12, Illenko str., Kyiv, 04050
123@socionic.info
https://orcid.org/0000-0002-6586-7225

PROBLEMS OF DEVELOPMENT OF ARTIFICIAL INTELLIGENCE, ITS ERRORS AND HALLUCINATIONS. PSYCHOINFORMATIONAL (SOCIONICAL) AND QUANTUM METHODS OF THEIR ELIMINATION

Annotation. The causes of errors and hallucinations of artificial intelligence models are analyzed. The work of artificial intelligence is compared with the structure of the psyche, which is well described by the socionic model of information metabolism by Augustinavichyute–Bukalov. This model has been successfully used in the analysis of the work of the psyche for over 40 years. It is shown that modern AI models lack an independent block for monitoring the implementation of established rules and assessing the importance of the information being processed. It is also necessary to rank the processed data according to specified criteria. It is shown that the most pressing problem of AI - the emergence of hallucinations - is due to an increase in semantic entropy in closed probabilistic models. This problem is fundamentally unsolvable without changing the principles of construction and operation of AI. In addition, AI models lack a number of structures, including aspects of true creativity, which are an integral part of the real psyche and socionic models. In the context of the creation of quantum computers, the quantum aspects of creating a new type of AI are also considered, by analogy with the work of the psyche. Such computers must have a fundamentally different architecture, compared to existing ones, and consist of a whole system of specialized quantum processors.

Keywords: artificial intelligence, generative language models, AI hallucinations, quantum psyche, socionics, mental functions, creativity, control and assessment unit, conscience.

> "It is the theory that decides
> what we can observe."
> *Albert Einstein*

Introduction

The rapid development of artificial intelligence has not only made it possible to solve a number of complex problems, but has also posed a number of problems related to the specifics of its functioning and further development. These include, for example:

– errors in the presentation of data, especially when summarizing them;

– frequent lack of adequate ranking of heterogeneous data on the task;

– attempts to perform even absurd tasks, despite real data and the physical picture of the world (for example, with equal "success" a generative language model can prove that table salt NaCl both dissolves in water and does not dissolve).

AI hallucinations: "creation" of non-existent literary, scientific and legal sources, quotes, fictitious actions of real people, etc.

For a better understanding of the causes of AI errors and hallucinations, let us consider some principles of organization, functioning and interaction of mental functions that carry out the process of information metabolism (exchange) in the real psyche. This issue is considered in detail within the framework of models of the psyche in psychoinformatics [8].

We have already substantiated the conclusion that full-fledged computer modeling of human intelligence encounters objective obstacles, which are caused by the impossibility of fully modeling mental processes on conventional computers [9, 14]. In this regard, the use **of quantum** computers, the creation of which provides new opportunities, seems more successful. We have already noted the important fact that microscopic quantum devices in such computers are associated with macroscopic classical electronic input-output devices of information, which in the biophysical quantum paradigm are easily correlated with macroscopic neural structures. Numerous studies of mental processes convincingly demonstrate their quantum nature. Therefore, modeling of mental processes and consciousness on quantum computers should be much more successful.

However, for this, **a quantum computer must have a special architecture. It must be**

organized as a system consisting of at least 8 or 16 special processors, each of which must process a special part of the general information flow, similar to how this happens in the human psyche. In addition, the general management of such a system must be carried out by a central processor, which will be an analogue of the integrating function of consciousness. Theories of information metabolism - socionics or psychoinformatics - describe in detail the models of such structures, which are well tested in experiments and numerous observations of the work of the real human psyche and in practical activities over 40 years [14, 18, 19, 20, 21].

Phenomenological description of mental processes as quantum

Socionics, or psychoinformatics, examines and describes 8 basic information processing subsystems in the form of mental functions of information metabolism (FIM). Each of the structures or FIM specializes in processing its specific aspect of the general information flow.

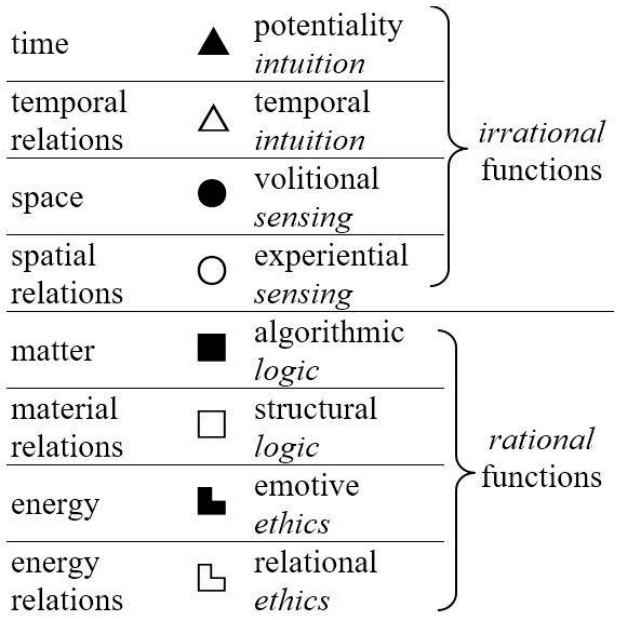

Fig. 1. Aspects of information flow and psychological functions of information metabolism (FIM)

Therefore, each aspect of the information flow, i.e. the information aspect, corresponds to a specific function of information metabolism (Fig. 1), which is responsible for the ability of the human psyche to perceive and understand various aspects of the surrounding physical and social space, objects and subjects in it, including psycho-informational interaction with them. These functions are trained and developed throughout a person's life.

All FIMs, as processors for processing information, solve their specific special tasks by processing their aspects of the information flow [9].

At the same time, FIMs are also connected with the functional systems of the body by large neural networks [9, 17, 29].

FIM *"Intuition of Possibilities"* corresponds to the network of the default mode or the network of operational rest, **Default Mode Network (DMN)**, the target negative network, is most active during resting and introspective states, daydreaming, napping, and meditation.

FIM *"Intuition of Time"* corresponds to the target positive network, the network of operational problem solving, **Task-Positive Network (TPN)**, which is active in flow states, when concentrating on performing complex tasks.

FIM *"Introverted Sensing"* is associated with the sensitivity regulation system, the tactile sensory system.

FIM *"Extroverted Sensing"* is associated with descending pathways of movement control, including the peripheral nervous system consisting of: motor units (nerve plus muscle fibers: shape, speed and strength); muscle spindles (sensor with adjustable sensitivity of length and speed - activator of the support reflex); receptors that activate the bending reflex.

FIM "*Algorithmic Logic*" is connected to a neural network that contains neurons for place, head direction, coordinate grid, and spatial orientation (mental map of the area).

FIM "*Structural Logic*" corresponds to the neural network of evaluation of spatial and numerical, categorical relationships between perceived objects and subjects, boundaries, with further evolutionary development into purely logical structures of thinking in the cerebral cortex.

The FIM *"Extroverted Ethics"* is associated with the functional system that evaluates the achievement or non-achievement

of the goal formed by the feedback acceptor.

FIM "*Introverted Ethics"* is associated with the functional system that determines empathy, including mirror neurons.

It should be noted that in reality, **a person has 16 permitted basic options for combining 8 FIM "processors" in the form 16 main types of information metabolism** (TIMs). This design is not accidental, but has emerged and formed over millions of years during the evolution of the human race. This social and psycho-informational system is called the Socion [4, 14, 18, 19, 20, 21]. Each TIM, determined by a special hierarchy of FIM, is characterized by corresponding basic priorities in the perception and processing of information, features of the thinking strategy, decision-making and behavioral specifics.

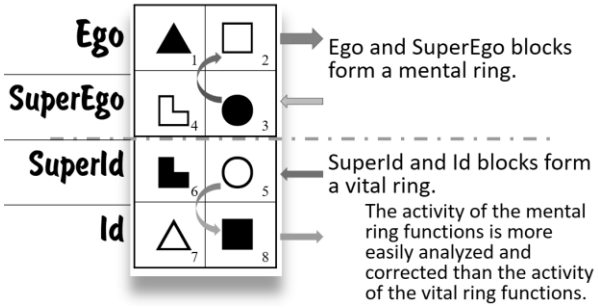

Fig. 2. Functions, blocks and rings
in model of TIM intuitive-logical extrovert (ILE)

Socionics, or psychoinformatics, as a science 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.

As we noted earlier, artificial intelligence systems and currently existing robotic systems are capable of modeling, and even then only partially, mainly only 3 subsystems out of 8 [9]:

– algorithmic and structural-logical (at the level of algorithms and programs);

– empirical probing (obtaining information from sensors) and pattern recognition;

– control of actuators.

But, as we have shown above, holistic intelligence is much more complex, and it consists of many subsystems. Therefore, a full-fledged artificial intelligence requires a whole series of fundamentally new processors as subsystems that must correspond to the real mental functions of information metabolism.

Dimensions of mental subspaces

Dimensions of mental subspaces discovered by the author [10], allows one to accurately describe the features of human thinking and behavior, the nuances of specific intertype relationships and has significant practical applications used in practice in expert-consulting work of both socionics employees and other socionics specialists.

The general structure of the functions of information metabolism, taking into account the graphically expressed vectors *of globality of dimensions* (*g*), *situation* (*s*), *norms* (*n*) and *personal experience* (*e*):

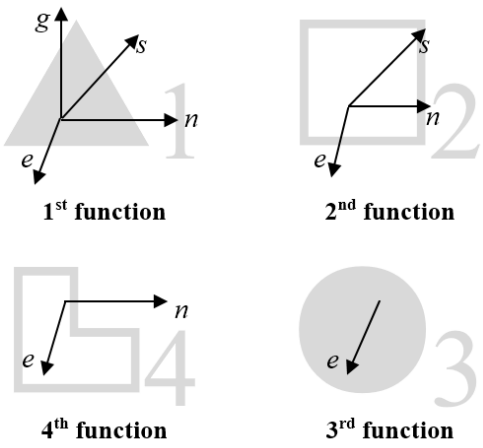

Fig. 3. Dimensions of the functions of the mental ring according to A.V. Bukalov [10, 14].
The background shows functions of the same TIM as in Fig. 2

A person of a certain socionic type knows and can do the least about the 1-dimensional function, which is in 4th place in model A, which has only a *personal vector experience* (*e*).

He/she knows more about the two-dimensional 3rd a function that contains, in addition to the vector of personal experience, also a vector (*n*) of social *norms* and patterns of behavior in relation to the corresponding information aspect.

According to the 2nd (3-dimensional) function, a person can act in an unconventional, creative manner based on a

real, developing situation, since the 2nd function, in addition to the vectors of personal experience and norms, has a creative vector *of the situation* (*s*).

Finally, on the 1st functions a person can evaluate information and think globally, holistically, since this function contains, in addition to the above-mentioned vectors, also the *globality vector* (*g*).

The mental development of a person is associated with the gradual, consistent development of the functions of information metabolism and their "switching on" or, more precisely, their transfer from a passive state to a more active one.

If we turn to the process of knowing any truth, we will easily discover these qualitative stages.

First of all, a phenomenon is learned through personal experience, for example the hardness of a stone or the burning effect of fire.

Then the rules for dealing with this phenomenon are studied and defined, which is transmitted through training in fire, interaction with it and precautions, methods of making fire, and so on.

It then becomes clear that fire can be effectively obtained and used in many ways, and this is already a 3-dimensional understanding of the essence of fire.

And finally, complete mastery of fire: understanding that fire is a special case of heated plasma. Here various plasma technologies arise, for example, for metal processing, the use of plasma in various fields; and a thermonuclear reactor can operate.

The same thing happens in scientific knowledge of the world as a whole. First, humanity, along the vector of personal experience, which is very conservative, acquires a lot of empirical knowledge about the surrounding world, which, accumulating and generalizing, leads to the formulation of the so-called "laws of nature", that is, those norms that God or Nature established for the manifestation of the properties of things or phenomena. They are certain formulations, which are sometimes called restrictions or prohibitions on certain arbitrary actions with objects, subjects, space. Support for these prohibitions or restrictions is based on explicit or implicit religious or cultural taboos.

However, in the process of evolution of human knowledge, driven by the development of society and its economy, it turns out that many restrictions and prohibitions are either simply prejudices, or they can be circumvented by using new properties of old things that modify or cancel the current laws. A striking example of this was the change in the picture of the world from Aristotle's to Copernican, Galileo Galilei's discovery of Jupiter's satellites with the help of a telescope, etc. It is known that a number of orthodox priests and other figures of that era refused to look through a telescope so as not to expose their adopted norms to danger.

Further development of modern science gives us a 4-dimensional picture of the developing Universe containing billions of Galaxies.

But at the same time, modern science, for example physics, has categorical statements that there are immutable laws of nature, expressed by mathematical formulas, and these laws of nature cannot be circumvented. In fact, modern physics, which developed from these experiments and based on them, formed a number of laws that are considered general.

At the same time, the laws of nature, as the astrophysicist I.S. Shklovsky emphasized, are understood simultaneously as a sum of prohibitions: one cannot move at a speed greater than the speed of light, one cannot turn off gravity, one cannot change physical constants, etc. It is obvious that in this form modern science-physics is two-dimensional.

The next stage of development of science, especially physics, is mastering the vector of development of the situation, when it will be possible to change the so-called "laws of nature" and prohibitions as necessary. In fact, this will be an exit to a new, third dimension of understanding flat physical laws, free handling of material and spatial categories.

Let us give an example of modern physical theories: the speed of light cannot be exceeded in our space-time, but in additional dimensions, if they exist, the speed of interaction can exceed the speed of light and, having entered the additional dimensions, it is possible to get to a distant point of our Universe much faster than a light signal that

moves in our 4-dimensional space. In a similar way, we can consider the removal of other prohibitions or "laws of nature": these issues are implicitly and timidly considered in Everett`s many-worlds concept, according to which we live in only one of an infinite number of Universes, in which different laws of nature are realized.

If we turn to the 4-dimensional level of knowledge, reaching this level means a global understanding of the totality of the laws of the Universe, the ability to operate with space-time, energy-matter depending on our needs.

The expansion of the basic model A gives a more differentiated 16-component model B, supplemented by an integral function of consciousness, which gives flexibility and volume to the description of the human psyche.

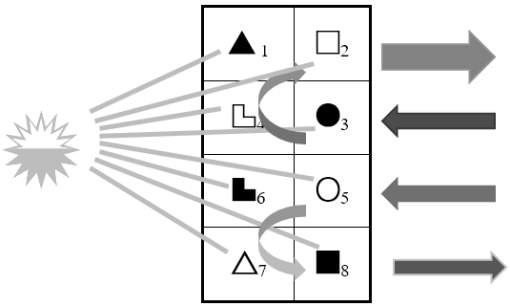

Fig. 4. Model of Augustinavichyute–Bukalov (A–B-model) of one of the 16 socionic types with the integrating function of consciousness

The function of consciousness regulates the operating modes of the functions of information metabolism.

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

The dimensionality of a function describes a very probable number of operational structures, and the number of actualized structures describes the level of development of each function and the personality as a whole [10].

Internal quantization of the psychoinformational space of memory, attention and thinking gives a characteristic spectrum of the number of operational structures in the form of the magic series of A. Bukalov: 6(7), 10(11), 16(17), 26(27), 42(43), … In it, the well-known Miller number 7±2, corresponding to the volume of operational memory, is the first member of the series. The series itself, by its properties, is a Fibonacci series and is characterized by the ratio of the golden section between adjacent members of the series.

Each vector associated with the dimension of a mental function can be associated with its own volume 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 structures (one is added when taking into account the integrating function of consciousness).

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

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

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) structures.

Our research shows that the IM functions can obviously be considered as special quantum or quasi-quantum processors [9, 15]. Factorials of the number of interactions between operational structures in each processor function give an approximate number of combinations that mental functions operate with.

There are certain reasons to believe that the interaction of these structures has a quantum nature and can be realized in certain quantum systems.

The need for a basic, rigid system of norms

The above principles inevitably lead to the conclusion that modern AI models, in particular language models, operate only at the one-dimensional level of "personal experience." They clearly lack even the vector of norms that defines:

– the space of coordinates of the functioning of intelligence, the metric of this space;

– ranking (weight) of processed data, their hierarchy, structure, etc.;

– norms, standards and laws of behavior, evaluation and issuance of information (including A. Asimov's three laws of robotics);

– principles and methods for verifying the truth of processed information and statements, the basis for such verification.

Real-life example: AI may not differentiate between edible and poisonous mushrooms and may recommend picking and eating them together, resulting in cases of poisoning.

Therefore, to expand the capabilities of AI, it is necessary to create a suitable subsystem, including an internal block of AI behavior control. Such an internal block, which has a strong influence on the functioning of AI, up to and including limiting its functioning and even blocking it, is similar at the human level to the "Superego" or "conscience" block. Note that within the framework of the AI model, the presence of a "conscience" block was proposed by A.I. Shevchenko [28, 35].

The SuperEGO block is responsible for satisfying social needs: the need to belong to a certain social group (community), to occupy a certain place in it, to follow the norms accepted in a given social environment. This block ensures the existence of a person in a given social environment. It characterizes the cross-section of the relationship "me – society". Its other name "Need" reflects a person's reaction to the demands made by society. Non-compliance with these requirements causes an internal conflict.

The Superego block consists of two paired mental functions, one of which unambiguously evaluates the fulfillment of established, template social norms and rules of behavior, and the second operates in a one-dimensional "relay" mode, or similar to the "stopcock" on a train, abruptly changing the behavior of the individual in a number of situations [14].

Note that such block makes a situation like in the movie "Terminator" with the Skynet system impossible.

An AI system with a control unit also needs training, but on slightly different, more rigid and not probabilistic principles. Therefore, there is reason to believe that discriminatory models, rather than generative ones, will be more effective.

Some steps are being taken in this direction. For example, to properly reject malicious prompts, GPT-4 introduces a classifier that acts as a rule-based reward model. It would take prompts, corresponding outputs from the GPT-4 policy model, and a human-written set of rules to classify the output according to a rubric. GPT-4 was then rewarded for rejecting malicious prompts [32].

But this is only a small part of the "Superego" block action, with limited capabilities.

And only after the full creation of a system of norms can we move on to the creation of multidimensional models.

The problem of AI hallucinations

Highly specialized AI performs its tasks of processing information, identifying significant information, recognizing patterns, etc. well. However, when processing and synthesizing a large amount of heterogeneous data, the problem of hallucinations arises, which is becoming increasingly acute.

Thus, Nvidia CEO Jensen Huang believes that at the current level of development, artificial intelligence does not provide high-quality answers, so it may take at least several years before the emergence of such artificial intelligence that can be "significantly trusted". To solve this problem, Jensen Huang proposed requiring language systems to examine and validate answers from reliable sources before returning a result. This process could be similar to "fact-checking" in journalism: compare facts from sources with known truths, and if the answer is partially inaccurate, discard the entire source [31].

However, such a proposal does not completely solve a serious problem. After all, AI hallucinations also include the synthesis of pseudo-sources, including legal documents, the links to which look quite plausible. Thus, it is still the person who will have to check the truthfulness of the cited sources. This process

turns out to be similar to checking the code written by AI: it turned out that such a check takes time comparable to the time it takes to write it by a human programmer. For example, an independent check showed that using the GitHub AI assistant Copilot increased the number of errors by 41%. When evaluating the performance, it was found that there were no significant improvements for those developers who used Copilot. The results of this independent study contradict the statement by GitHub, which claims that using the Copilot assistant increases the speed of writing code by 55% [37]. At the same time, some programmers believe that code fragments written with the help of artificial intelligence are difficult to analyze for errors, so sometimes it is easier to rewrite the code.

From our point of view, **the reason for such errors is primarily in the probabilistic model of the functioning of artificial intelligence, and this is a fundamentally irreparable defect of such models**. After all, each solution to a problem by modern artificial intelligence is, in fact, a probabilistic, but incorrect synthesis of the initial data within the framework of the task.

It is believed that most of the Internet content (excluding social networks) has already been used to train modern language models. It is assumed that in 2025–26 all content will be exhausted and the limits of AI training will be reached. Therefore, without changing the principles of learning and functioning, AI will soon begin to generate an increasing amount of erroneous data and information. If content from social networks is added to the data, then due to its low quality and the subjectivity of AI, the product will inevitably degenerate into an average and usually illiterate “opinion of the average person”.

Moreover, experiments show that if speech models use data generated by them at the previous stage of processing, the number of erroneous conclusions increases sharply already at the 2nd–3rd stage. This means that the entropy *Sd* (including **semantic entropy**) of AI-generated data is also growing rapidly. Let's look at this process in more detail.

The reason is that modern generative AI models are large language models operating on discrete symbols. But in a closed system, which is what such a model is, the entropy of the set of discrete symbols inevitably grows, like the entropy of an ideal gas consisting of discrete atoms in a closed thermodynamic system.

In this case, in any integral system the law of conservation of information and entropy, formulated by L. Brillouin and others [6], is fulfilled:

$$I+S=const$$

At the same time, living organisms and living psyche (consciousness) avoid the growth of entropy, since they are open, nonequilibrium thermodynamic systems, within which the following relationships are fulfilled:

$$\frac{\partial(I+S)}{\partial t}=0,\quad \frac{\partial I}{\partial t}\geq 0,\quad \frac{\partial S}{\partial t}\leq 0$$

However, in AI systems, as in inanimate and closed systems, the opposite relationships are fulfilled:

$$\frac{\partial I_d}{\partial t}\leq 0,\quad \frac{\partial S_d}{\partial t}\geq 0$$

These same formulas are also valid for describing information and entropy of combinations of discrete symbols in generative language models of AI. Here we use the concept of **semantic entropy** S_{sem} and **semantic information** I_{sem}. Semantic entropy occurs when the data synthesis proposed by AI (pseudo-documents, pseudo-links, pseudo-information) is inadequate to reality. Especially since in some cases AI insists on its conclusions.

This situation can only be corrected by transforming AI into an open information system with constant receipt of current information from the environment on the maximum number of information aspects, which are described in the most general form in socionic information models.

Already the norm block, working with the use of not probabilistic, but strictly deterministic models, must be connected with the constant receipt of current information from the surrounding reality (as the mental “contact” 3rd function does in model A). Then the AI will receive feedback and take into account the reaction of the environment, including users.

The Epoch AI research institute have

found that modern AI systems cannot solve more than 2% of original mathematical problems, i.e. problems whose solutions are not available online [26]. This once again confirms the purely combinatorial-probabilistic nature of the algorithms used, which only imitate real human thinking and intellect. In the real psyche, creative thinking is the responsibility of structures that are described in the socionic model as special vectors of the situation or creativity in some mental functions of information metabolism, primarily in the main intellectual block - the EGO block. Therefore, full-fledged modeling of creative intelligence is fundamentally impossible without reproducing such a structure.

Quantum aspects of AI

The real psyche consists not only of discrete speech structures and symbols, but has at its core a vast sphere of unconscious processes. There are good reasons to assume a connection between the functioning of the unconscious part of the psyche and quantum processes, which is confirmed by experimental data [1, 1, 3, 5, 7, 11, 16, 22, 23, 24, 25, 30, 33, 34, 36].

This is why we proposed a quantum model of the psyche and consciousness [11, 12, 13, 15], which allows us to synthesize known experimental facts and propose new principles for creating new quantum computers. We proceed from the fact that the quantum qualities of the psyche and consciousness are provided by a field substrate with superfluid qualities. The entropy of a superfluid condensate is zero, so such structures can provide zero-entropy, ideal quantum information processing, since they are essentially quantum computers. Input/output of information in such a physical system is carried out with the help of a normal component through phonon-roton excitations (quasiparticles) in a quantum superfluid substrate. Therefore, these excitations can physically interact with the molecular structures of neurons and other cells within the framework of associated physical processes.

From the point of view of the proposed model, the flow of phonons and rotons in the superfluid substrate already at the level of consciousness we call thoughts, which can be considered as excitations in the quantum substrate of the psyche. In this case, the visual (non-verbal) images arising in consciousness correspond to the wave aspects of phonons, and the discrete, logical, speech (verbal) aspects of thinking naturally correspond to the corpuscular properties of these quasiparticles in the superfluid substrate. Self-observation (introspection) usually reveals a mixed visual-speech thought pattern, which corresponds to the well-known quantum-mechanical corpuscular-wave dualism in the behavior of quantum objects, including the Heisenberg uncertainty principle [13].

Quantum excitations, or phonons and rotons, interact with atoms and molecules of biological systems, including neurons. Due to this interaction, in which electromagnetic fields also participate, a single quantum-molecular system “quantum brain + molecular (neuronal) brain” is created and functions. Thus, in the phenomenon of life and thinking we can record both a molecular component that has entropy, and a zero-entropy, ideal, and therefore difficult to observe structure that also contains a normal component that transfers heat and entropy, i.e. phonon (sound) and roton (vortex) excitations. These structures, as two parts of a single quantum substrate, interact with each other.

However, the phenomenon of thinking consists not only in zero- entropy processing of information, but also in the creation of new information. This was shown by M.I. Kobozev [27], based on the analysis of thermodynamic processes. Thus, if in the Boltzmann-Planck equation $S = \ln W$, for closed molecular systems $W > 1$, $S > 0$, then for living organisms $W < 1$, $S < 0$.

Note that for superfluidity or superconductivity there is a region of decreasing entropy, since the difference between the entropy of the normal state and the entropy of the condensate is negative.

Therefore, the solution of any problem is accompanied by a phase transition in a quantum condensed system with a decrease in its entropy. It is important that an external effect on a quantum condensed system causes a response in it in the form of the creation of a system of vortices. An analog of this is the

reaction of a superconducting system to the effect of a magnetic field: first, the external magnetic field is pushed out of the superconductor, and then, if the field grows, it begins to penetrate the superconductor, and a system of quantum vortices is created in it. In our case, this is an analog of the quantum process of mental reflection of reality with the subsequent emergence of thoughts, emotions, etc. as quantum vortices in a superfluid medium.

In such a model of the organization of life and consciousness, it is easy to see the solution to a fundamental problem that has attracted the attention of many thinkers, philosophers and physicists: **why is the psyche ideal, but the observable macroscopic world is not?** It is precisely the superfluidity qualities of quantum field fluids, taking into account their different phases, that provide the properties of zero-entropy ideal thinking and consciousness [9, 14, 15].

From this quantum point of view, mental functions (*intuition*, *logic*, *sensing* and *ethics*) are dedicated structures that work as special quantum processors, translating the initial data through a phase phonon-roton transition into an ordered condensed state in a dedicated segment of the information space, processing one of the 8 aspects of the information flow known in socionics.

Conclusions

Our analysis shows significant shortcomings of existing models of artificial intelligence. However, they can be eliminated using the well-developed and many years of practical application psychoinformational model of the psyche by Augustinavichyute–Bukalov, which describes the system of mental functions as a hierarchy of special specialized quantum processes that constantly interact with the environment through continuous information exchange. This is an open-type system, so the problem of entropy growth discussed by us does not arise in it, as in closed probabilistic models of AI. AI hallucinations arise as inevitable consequences of the rapid accumulation of errors due to the growth of internal semantic entropy. These problems can be avoided by creating an open-type quantum system of artificial intelligence by analogy.

This approach to understanding the processes of information processing and thinking allows us to identify new, previously unknown principles of the operation of human mental structures and reproduce them in future quantum computers of a new type.

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