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Article

Modeling the Cognitive Activity of an Individual Based on the Mathematical Apparatus of Self-Oscillatory Quantum Mechanics

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Abstract: The goal of this research is to design a model of cognitive activity in the human brain. The fundamental component of such a model is the mathematical apparatus of self-oscillating quantum mechanics considered through the theory of information images/representations. Methods. This article provides a brief description of the proposed theory and highlights remarkable similarities between information images/representations and certain elementary particles, in particular—virtual Feynman particles. Following this principle, the human mind is considered as a one-dimensional potential hole with finite walls of different sizes. The internal potential barrier in this model represents the border between consciousness and subconsciousness. The authors carried out parametrization, taking into account the proposed theory. This allowed authors to lay down the foundations of the mathematical apparatus, viewing the proposed model both from the standpoint of classical quantum mechanics and through the mathematical apparatus of self-oscillatory quantum mechanics. The findings could open a way to the prediction of certain cognitive functions of the human brain. Additionally, the authors formulated the equation, which describes the state function of the information image during the cognitive activity of an individual. Conclusions. The key outcome of this research are the primary calculations of the state functions of information images/representations on the computer model, as well as the patterns of movement of the information image into and out of the human consciousness.

Keywords: cognitive activity; virtual particles; information images; representations; Schrodinger equation; potential hole; self-oscillating quantum mechanics

MSC: 91E10

Citation: Petukhov, A.Y.; Petukhov, Y.V. Modeling the Cognitive Activity of an Individual Based on the Mathematical Apparatus of Self-Oscillatory Quantum Mechanics. *Mathematics* **2022**, *10*, 4215. https://doi.org/10.3390/math10224215

Academic Editor: Eugene Postnikov

Received: 13 October 2022
Accepted: 9 November 2022
Published: 11 November 2022

1. Introduction

The impact of the environmental information factors on living systems remains relatively poorly studied by scholars [1]. There are multiple new electrophysiological method; first of all, for the registration of induced and event-related potentials recorded in experimental behavioral situations. These methods have paved the way for a closer study of the physiological mechanisms behind the individual stages of the information processing patterns: sensory analysis, mobilization of attention, image formation, extraction of memory standards, decision making, etc. The study of the time parameters of electrophysiological responses to stimuli of different types and in different conditions for the first time allowed for conducting chronometry, i.e., to assess the duration of individual stages of information processing directly at the level of the brain substrate [1,2]. Several fundamental discoveries in this field were made using classical methods of psychology, i.e., the analysis of the behavior of subjects in various social situations.

However, attempts to describe the processes of the transmission and processing of information by an individual raise a fundamental problem of contemporary cognitive science. The novel models of information transfer from an individual to an individual [2,3], processes of information processing in human memory [4,5], cognitive activity [6] based on stochastic equations [7], classic "predator–prey" models [8], perception models [9,10] and others [11–13] have been developed only recently. Nevertheless, many of the abovementioned models lack proper scalability or formalization and, therefore, are unable to provide a fundamental explanation of the processes of information transfer and its distortion caused by the interaction with the external communicative environment.

Moreover, a key feature of human cognitive activity is that a person does not think in code (like a computer). The process of thinking occurs through the interaction of multiple images/representations. Although a specific material foundation can be traced for these images (namely, electrical and chemical activity in the human brain), it is difficult to provide a proper description for them in the form of a conventional mathematical model [11].

This article proposes a new model of cognitive activity based on the theory of information images/representations and elements of the mathematical apparatus of quantum physics [14].

2. Brief Description of the Theory of Information Images/Representations

The proposed theory is based on the idea of a universal cognitive unit [11] of the information in the human mind—an information image (or representation)—and a space in which it exists, its topology, and its properties. Information images (hereinafter referred to as II) are the display of objects and events in any given feature space.

Accordingly, the theory of information images (hereinafter referred to as TII) can serve as a method to describe the exchange of information between individuals, as well as a number of cognitive functions of an individual.

The TII views the human mind as a large structured set of interacting images, which are constantly impacted by external factors.

Images with higher energy (here, we would like to introduce a concept of social energy (E) to describe the communicative activity of images and individuals) are positioned "higher" and closer to the boundaries of the space of information images (Figure 1). These images interact with each other and the external environment more often than their low-energy counterparts. The latter are located closer to the center of space and relatively more rarely enter into an active interaction with external stimuli.

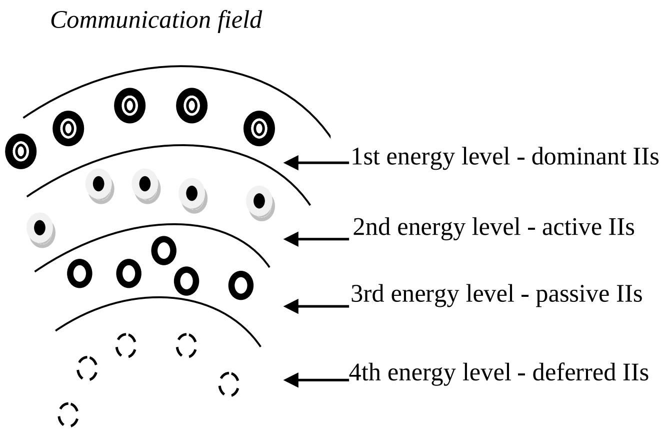


Figure 1. The energy levels in the individual's communication field.

The TII provides a new look at a number of typical patterns in the human mind, and contains tools for their proper interpretation and explanation.

Obviously, it is impossible to transmit one information image from one individual to another without any alterations. Each II is unique because each individual has their own specific set of individual experiences.

In addition, no one is capable of conveying an image that exists in their mind; their II space to another person "as it is", without any distortions. Such image transmission involves various communication devices which were shaped in our mind by a social superstructure of communication or the communication field (CF)—Figure 2. CF is the informational convergence of individual experience and collective unconscious formed as a result of an individual's immersion into the social medium. The communication devices include speech, various visual, tactile, symbolic methods, etc.

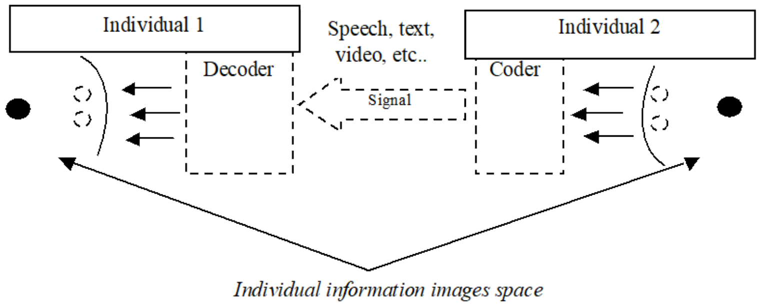


Figure 2. Schematic diagram of the interaction between the communicative fields of individuals.

Virtual Particle Theory and Its Comparison with TII

In previous works, the mathematical model of the interaction of information images was based on diffusion equations (primarily on the Langevin equation). This helped describe a number of particular cases of cognitive processes, but also created some limitations related to the specifics of the II. More information about the TII and its application to real cognitive processes and experimental approbation is available in [15].

What makes the theory of virtual particles so relevant for the description of the cognitive activity of the human brain? A virtual particle (VP) represents quanta of relativistic wave fields participating in vacuum fluctuations. From the point of view of general quantum mechanics, a VP can be considered as a particle arising in intermediate states of the processes of the transition and interaction of particles. VPs have the same quantum numbers as ordinary real particles, having quantum numbers of one of the real elementary particles (with mass m), for which, however, the usual relationship between energy (E) and pulse (p) is not fulfilled.

That is, for these particles:

$$E^2 \neq m^2c^4 + p^2c^2,$$

where c is the speed of light in the vacuum, and m is the mass of the particle.

Therefore, a measure of the "virtuality" of the particle was introduced, which is expressed by:

$$Q^2 = E^2 - m^2c^4 - p^2c^2, \tag{1}$$

Virtual particles cannot "fly away to infinity"; they are born and must either be absorbed by a particle or disintegrated [14]. In fact, virtual particles are a direct representation of an interaction.

This is very similar to the concept of VP for human interaction. These particles also exist only in the virtual world, but at the same time they have physical properties, can have a specific impact on matter (on the human body), and are created to describe the processes of exchange, generation, and processing of information by an individual. These particles also cannot "fly away to infinity"; they exist only in the presence of a perceiving individual (imagine a painting that no one can look at). Therefore, each information image must also be absorbed or materialized [15].

The VPs are also responsible for the quantum mechanism of particle interaction—they are the vectors of interactions. For example, the scattering of charged particles due to electromagnetic interaction between them according to quantum field representations is carried out through the exchange of virtual photons.

Virtual particles are particles existing in intermediate, short-duration states, for which the usual relationship between energy, pulse, and mass is not fulfilled. Other characteristics of virtual particles such as the presence of electric charge, spin, baryon charge, etc., are the same as those in real particles [14].

The concept of "virtual particles" and virtual processes is fundamental for modern quantum field theory. In this theory, the interactions of particles and their mutual transformations are considered as the birth or absorption of one free particle by other (virtual) particles. All the particles continuously emit and absorb VPs of different types. For example, the proton emits and absorbs virtual pie mesons (and other VPs), and gets surrounded by a cloud. At the same time, the number of VPs is uncertain.

This is very similar to an individual who also possesses a cloud of their information images, which, in fact, represent their mind and accumulated individual and social experiences [15].

In addition, in terms of classical physics, a free particle (a particle that is not affected by external forces, i.e., resting or moving uniformly and straightforwardly) can neither generate nor absorb another particle (for example, a free electron can neither emit nor absorb a photon), since this would either violate the energy conservation law or the momentum conservation law. Indeed, the resting electron has the lowest possible energy. Therefore, such an electron cannot emit a photon that always has energy—this would violate the energy conservation law. If the electron moves at a constant speed it also cannot (due to its kinetic energy) generate a photon, since it would violate the momentum conservation law: the loss of momentum by the electron due the loss of energy required for the birth of the photon would be greater than the momentum of the photon corresponding to its energy (due to the difference in the mass of these particles). The same applies to the process of absorption of a photon by a free electron.

The situation is different in quantum mechanics. According to the fundamental principle of quantum mechanics—the principle of uncertainty (see the ratio of uncertainties)—in any particle "living" for a short time Δt, the energy is not precisely fixed. Energy and momentum are continuously fluctuating, and over small periods of time, the energy conservation law may be "temporarily violated" (in the classical sense), and processes occurring within small volumes may be accompanied by "local violations" of the momentum conservation law [14].

It is also not very correct to talk about the conservation laws in the usual sense for IIs, which, of course, are limited by certain energy indicators based on their physical carriers, i.e., individuals. However, if we are not talking about the entire system of IIs, but about individual information images, then it is obvious that the classical relationship (1) will also not be fulfilled (in previous models, IIs were presented as a greater number of interacting particles [15]).

Sometimes, for the sake of clarity, the concept of "virtual particles" is explained somewhat differently. Namely, that in the process of interaction, the law of energy conservation is implemented with some error. This does not contradict quantum mechanics: according to the ratio of uncertainties, an event that lasts a finite period of time does not allow for determining the energy with accuracy above a certain limit. Roughly speaking, the intermediate particles "borrow energy" for a little while. In this case, in the process of interaction, ordinary particles can be born and disappear, with only a slight violation of the law of energy conservation.

The interaction of ordinary, real particles in the vast majority of cases occurs through the emission and absorption (exchange) of VP. The energy and momentum of the real particles before and after the reaction remain unchanged. During the reaction, the laws of conservation of these values are not fulfilled. The whole theory is built in such a way that any reaction can be presented as the result of various virtual processes that take place in a short time of reaction [16,17].

Additionally, the interaction of individuals is a process of emission and absorption (processing and perception) of IIs. In this way, we can describe any information interaction as the result of virtual processes associated with the IIs.

Thus, it is possible to find quite a few analogies between the processes of interaction of particles in quantum field theory and individuals in the theory of information images. Of course, such analogies cannot be interpreted as an unambiguous correspondence. However, it should be borne in mind that a human being is also a part of nature, and, therefore, the patterns, laws and phenomena that we find everywhere around us (not only phenomena associated with VP, but also diffusion, conservation laws, etc.) should somehow manifest themselves in relation to individuals and their cognitive activity.

However, this can only be verified reliably by using an appropriate mathematical apparatus to predict specific cognitive processes and verify the results in an experimental study.

3. Mathematical Apparatus

In the framework of the model, the interaction of two individuals is presented as the interaction of two systems using communication fields (which are quantized by means of the IIs—as an analogue of VP) in the information environment. Also of interest is the impact of a given information environment (for example, media, internet resources, social environment, etc.) on an individual.

Accordingly, it is necessary to record the interaction function for these two individuals or the individual and the external influence.

3.1. Mathematical Apparatus for the Ordinary Case

Since we are talking about the space of the IIs, it is obvious that this space will have certain coordinates, and the particles simulating the movement of the IIs in this space will also have a certain momentum, energy. Additionally, we should also mention the presence of a local minimum of potential energy of particles in this space. Thus, the mind of an individual can be represented in the form of a potential pit with oscillating information images in it. It is clear that physics usually solves the problem of quantizing the field inside a potential pit, finding energy levels (solving the stationary Schrodinger equation [18,19]). In this case, we also know about the presence of particles in advance.

The potential pit can be represented in the simplest form as shown in Figure 3. The function of the potential energy from the x coordinate will appear as shown in this figure.

$$U(x) = \begin{cases} 0, -\frac{a}{2} < x < \frac{a}{2},\ area\ 2 \\ U_0, \begin{matrix} x \geq \frac{a}{2},\ area\ 3 \\ x \leq -\frac{a}{2},\ area\ 1 \end{matrix} \end{cases}, \quad (2)$$

where U_0 is the energy level required to exit the pit.

The particle overcoming a potential barrier in the form of pit walls simulates the information interaction of an individual (i.e., the perturbation of the particle, the transition from one energy level to a higher one).

A more interesting case is a potential pit with unequal walls and an additional internal barrier. Such a barrier and the heterogeneity of the walls simulates certain specific properties of the human mind, in particular, the conditional division into consciousness/subconsciousness, the complexity of interaction with the external environment, etc. In theory, depending on the mental state of a simulated individual (or their individual cognitive function), such barriers can be more complex and occur multiple times (Figure 4).

$$U(x) = \begin{cases} U_1,\ x \geq \frac{a}{2} \\ 0,\ \varepsilon < x < \frac{a}{2} \\ U_2, -\varepsilon \leq x \leq \varepsilon \\ 0, -\frac{a}{2} < x < -\varepsilon \\ U_0,\ x \leq -\frac{a}{2} \end{cases}, \quad (3)$$

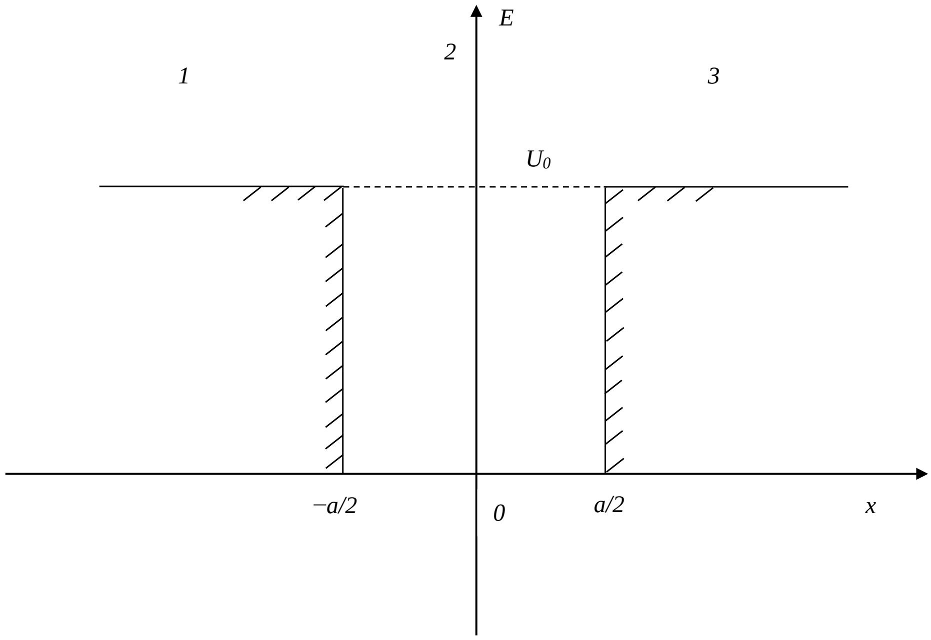


Figure 3. One-dimensional potential pit with finite walls. The simplest option.

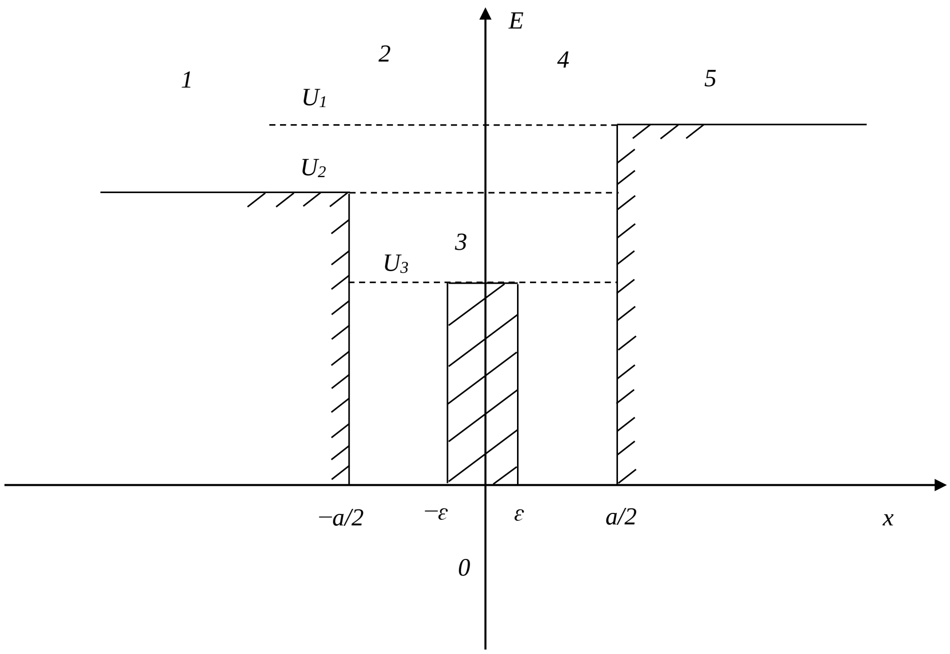


Figure 4. One-dimensional potential pit with finite walls. Variant with different walls and internal potential barrier.

Thus, the effect of the external information environment on the mind of an individual can be described as an effect on particles (modeling information images) in a potential pit. Initial reflections on the topic of such a model have already been given in earlier works [20]. However, these reflections never involved numerical calculations, self-oscillating mathematical apparatus, and attempts to correctly adapt the specific parametric apparatus of TII [21]. In this study, he will try to develop the ideas presented and carry out numerical calculations on the basis of the obtained model.

So, let us write the equations for the case in Figure 2.

The Schrodinger equation outside the potential pit for the particle/information image (II) will look like:

$$\frac{d^2\psi_{out}(x)}{dx^2} - \frac{2m}{\hbar^2}(U_0 - E)\psi_{out} = 0, \tag{4}$$

where

ψ_{out} is the wave function outside a potential pit;

E is the total energy of the II;

m is the mass (complexity) of II;

x is a conditional coordinate in the space of information images and $x \in \mathbb{R}$, as well as other parameters that we use in our study, since we assume analogues of real physical quantities;

$\hbar$ is the conditional constant replacing the Plank constant. Obviously, the meaning of this constant does not necessarily correlate with the physical concept of the Planck constant, since these are completely different situations and environments. However, using this model, it is possible to assume the presence of separate constant, which will be determined from the experimental data in the future.

By introducing the interaction coefficient k_1,

$$k_1 = \sqrt{\frac{2m}{\hbar^2}(U_0 - E)}\,,$$

we get

$$\frac{d^2\psi_{out}(x)}{dx^2} - {k_1}^2\psi_{out} = 0, \tag{5}$$

Solutions of this equation will have the form, for area 1:

$$\begin{aligned} \psi_1(x) &= A_1 e^{k_1 x} + B_1 e^{-k_1 x}, \\ \psi_3(x) &= A_3 e^{k_1 x} + B_3 e^{-k_1 x}, \end{aligned} \tag{6}$$

In order for the wave function to be limited (which is impossible otherwise for real information images), then B_1 and $A_3 = 0$.

For area 2, which is in the pit (i.e., in the human mind), this will look like:

$$\frac{d^2\psi_{out}(x)}{dx^2} + \frac{2m}{\hbar^2}(E)\psi_{out} = 0, \tag{7}$$

Here, the interaction coefficient k_2 will be

$$k_2 = \sqrt{\frac{2m}{\hbar^2}E},$$

and the solution will look like this:

$$\psi_2(x) = C\sin(k_2 x + \propto) \tag{8}$$

Thus, wave functions for the information image in the mind of an individual will have the form:

$$\begin{aligned} \psi_1(x) &= A_1 e^{k_1 x} \\ \psi_2(x) &= C\sin(k_2 x + \propto) \\ \psi_3(x) &= B_3 e^{-k_1 x} \end{aligned} \tag{9}$$

The external influence will be recorded by the perturbation $V(x)$, which is added to the general form of the Schrodinger equation:

$$\frac{d^2\psi(x)}{dx^2} - \frac{2m}{\hbar^2}(U(x) + V(x) - E)\varphi = 0 \tag{10}$$

The perturbation can be set in different ways, depending on its type; for example, by the normal Gaussian distribution, or in other ways.

3.2. Self-Oscillation Model (SOM)

A separate direction in quantum mechanics is self-oscillations. It provides certain opportunities for solving problems that cannot be solved by conventional quantum mechanics [19]. One of the main properties of self-oscillating systems—a set of discrete energy states—is also a characteristic property of quantum systems. At the same time, conventional quantum mechanics does not consider the specific movement of an individual particle, so it cannot answer the question of whether it self-oscillates.

More information about this issue can be found in [19].

From the point of view of TII, the description of images/representations in the human mind in the form of an oscillatory system is quite convenient. It can reflect a number of characteristic properties of the studied effects and serve as an instrument for a more accurate study of the state of IIs as a result of internal interactions, movement, and overcoming barriers (i.e., information interaction with the environment). Oscillatory movements in the model for IIs and their frequency can characterize the degree of "activity", the impact on the human mind from within. This expands the possibilities of description of the model. In terms of the classical quantum mechanics, it can be viewed as simply an energy level. In addition, this approach can help study the constructed state functions of an individual II.

So, let us redraw Figure 3 with new zones. The kinetic energy of the particle inside the pit (Zone 1 in Figure 5):

$$E = \frac{mv_1^2}{2} \tag{11}$$

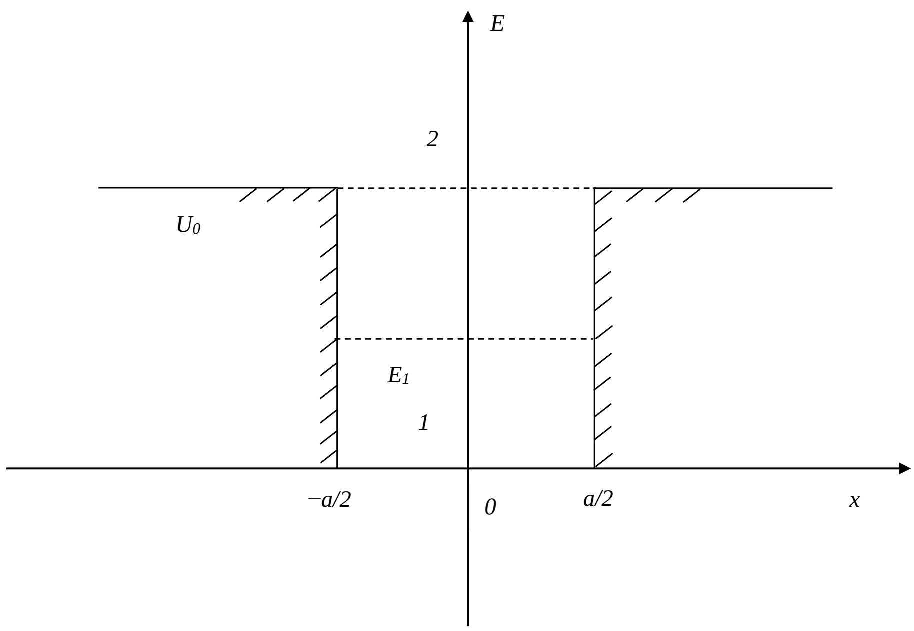


Figure 5. One-dimensional potential pit with finite walls for self-oscillating case. Zone 1—inside the pit, Zone 2—outside.

Outside the pit:

$$\frac{mv_2^2}{2} = E - U_0 = -(U_0 - E) \tag{12}$$

Hence,

$$v_2 = i|v_2|,\ |v_2| = \sqrt{\frac{2}{m}(U_0 - E)}$$

Next, we can write down the spatial parts of the wave equations for both zones, at the specified "quantum" frequency (in our case, it is the frequency of the oscillatory movements of the IIs in the human mind). This value is directly related to the "activity" of the II:

$$\omega_q = \frac{2\pi m v_1^2}{h} = \frac{4\pi E}{h}$$

In Zone 1

$$\frac{d^2\varphi_1}{dx^2} + \frac{\omega_q^2}{v_1^2}\varphi_1 = 0$$

or

$$\frac{d^2\varphi_1}{dx^2} + \frac{8\pi^2 m}{h^2}E\varphi_1 = 0 \tag{13}$$

In Zone 2

$$\frac{d^2\varphi_2}{dx^2} + \frac{\omega_q^2}{v_2^2}\varphi_2 = 0$$

or

$$\frac{d^2\varphi_2}{dx^2} - \frac{8\pi^2 m}{h^2(U_0 - E)}E\varphi_2 = 0 \tag{14}$$

$\varphi_{1,2}$ is a state function that satisfies the wave equation [19].

Accordingly, in Zone 1, the solution for the wave equation, and in our case, the equation describing the state of the II, will have the following form [19]:

$$\varphi_1 = A\sin\left(\frac{2\pi\sqrt{2mE}}{h}x\right) \tag{15}$$

In Zone 2 (outside the potential pit):

$$\varphi_2 = Be^{\frac{2\pi E\sqrt{2m}}{h\sqrt{U_0 - E}}x} + Ce^{-\frac{2\pi E\sqrt{2m}}{h\sqrt{U_0 - E}}x} \tag{16}$$

At $x > a/2$, the coefficient B will be taken as equal to 0 (since with the growth of x, it will increase to infinity, which is meaningless for the wave function), and at a drop of x below $-a/2$, C will already be 0 [19].

What will the processes of interaction of this representation of the cognitive system look like in this case? First, it is necessary to describe the II beyond the boundaries of the cognitive system (potential pit). From a physical point of view, this occurs when the kinetic energy exceeds the required potential barrier. From the point of view of psychophysiology, this means that the image was activated in the human brain through the necessary electrical and chemical connections, and was conditionally moved to the highest energy level corresponding to the current information activity.

Obviously, it will be possible to exit the II through the barrier if its energy exceeds the values of the barrier, i.e., from the point of view of the model, the velocity will look like this:

$$v^{out} = v_p + \varepsilon$$

v_p—the velocity corresponding to the threshold (i.e., at which the kinetic energy is equal to the energy required for the barrier).

ε—any small increment of this speed, if necessary. Let us write down the equation of motion for the oscillatory system. In general, it looks as follows:

$$\frac{d^2x}{dt^2} = -\frac{k}{m}x$$

where k is a certain coefficient characterizing the physical properties of the oscillatory system.

For a quantum system, this will look like this:

$$\frac{d^2x}{dt^2}m = \mp\frac{\partial\varphi}{\partial x}$$

Since, according to (15) and taking into account the self-oscillatory movement $\cos(\omega_q t)$:

$$\varphi_1 = A\sin\left(\frac{2\pi\sqrt{2mE}}{h}x\right)\cos(\omega_q t)$$

Then, adding the possibility of the II going beyond the barrier, we can derive the following form of the equation:

$$m\frac{d^2x_1^{out}}{dt^2} = A\omega_0\sin(\omega_0 x_1^{out})\cos(\omega_q t+\beta) + \frac{2U_0}{a}\delta\left(\frac{2x_1^{out}}{a}-1\right) \quad (17)$$

where ω_0 is the initial frequency of the oscillatory activity of the II.

β is the oscillatory motion phase.

δ is the Dirac function.

At values $-a/2 < x^{out} < a/2$,

$$m\frac{d^2x_2^{out}}{dt^2} = C\frac{\omega_q}{|v_2|}e^{-\frac{\omega_q}{|v_2|}x_2^{out}}\cos(\omega_q t+\beta) \quad (18)$$

At values $a/2 < x^{out}$,

$$m\frac{d^2x_3^{out}}{dt^2} = B\frac{\omega_q}{|v_3|}e^{-\frac{\omega_q}{|v_3|}x_3^{out}}\cos(\omega_q t+\beta) \quad (19)$$

At values $x_{out} < -\mathrm{a}/2$.

Then, the equation of II state will look as follows:

$$\varphi^{out} = \left(A\cos\left(\frac{\omega_q x}{\sqrt{\frac{2}{m}E}}\right)\Big|\frac{a}{2} > x_{out} + Ce^{-\frac{\omega_q}{|v_2|}x}\Big|\frac{a}{2} < x_{out}\right)\cos\omega_q t \quad (20)$$

Here, we need to make some changes to the mathematical apparatus, which, of course, uses physical parameterization. We attempted to bring this parametrization to a stricter concordance with our problems, but still to a limited extent. Let us exclude ω_q from the equations, keeping in mind that this is the "measure of activity" introduced by us for the II and that it directly depends on the energy of the individual IIs. So, let us rewrite:

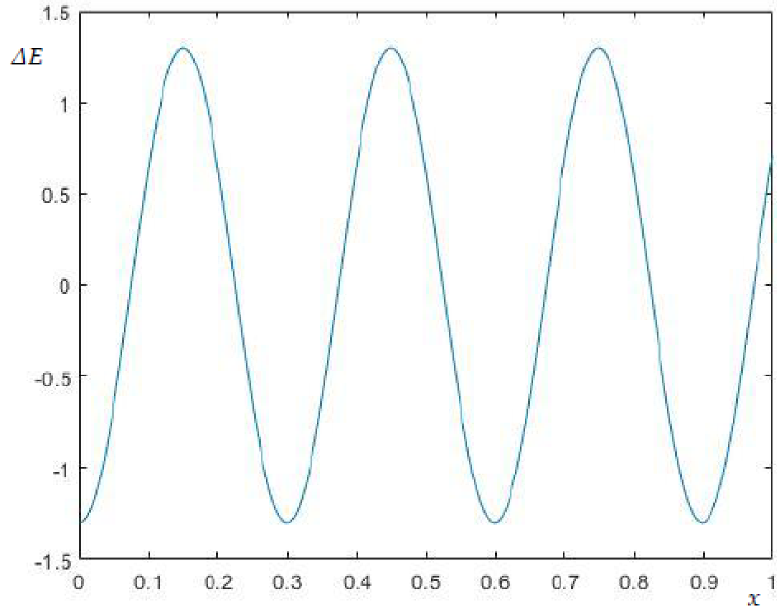
$$\varphi^{out} = \left(A\cos\left(\frac{2\pi x\sqrt{2Em}}{h}\right)\Big|\frac{a}{2} > x_{out} + Ce^{-\frac{4\pi E}{h|v_2|}x}\Big|\frac{a}{2} < x_{out}\right)\cos\left(\frac{4\pi E}{h}t\right) \quad (21)$$

4. Results and Discussion

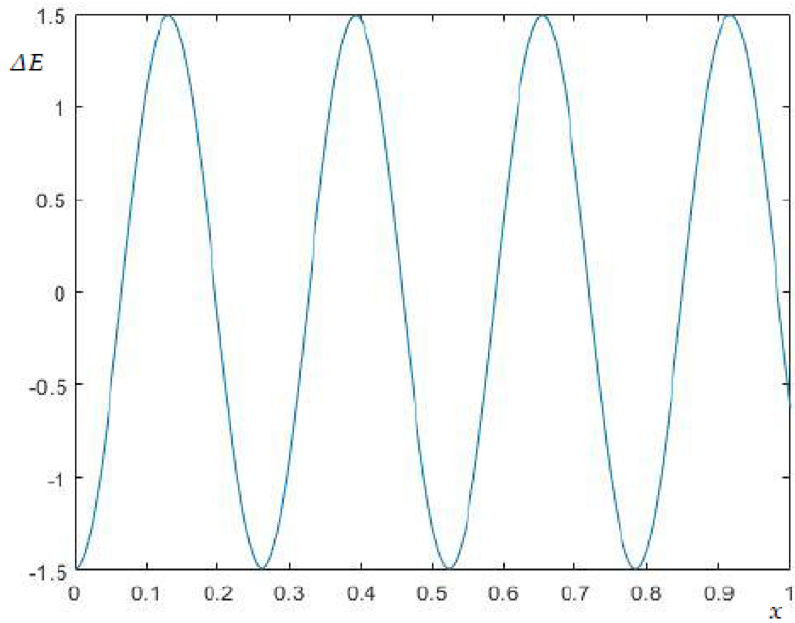
4.1. Simulation Results

Then, the equation of the II state when it is not activated (inside the "pit") will have the following form for the stationary case at different parameter values (Figure 6—built on the basis of a computer model in Matlab2017b).

To activate the II and, accordingly, to model the interaction process, the graph of the II state equation will be as follows (Figure 7).



(a)

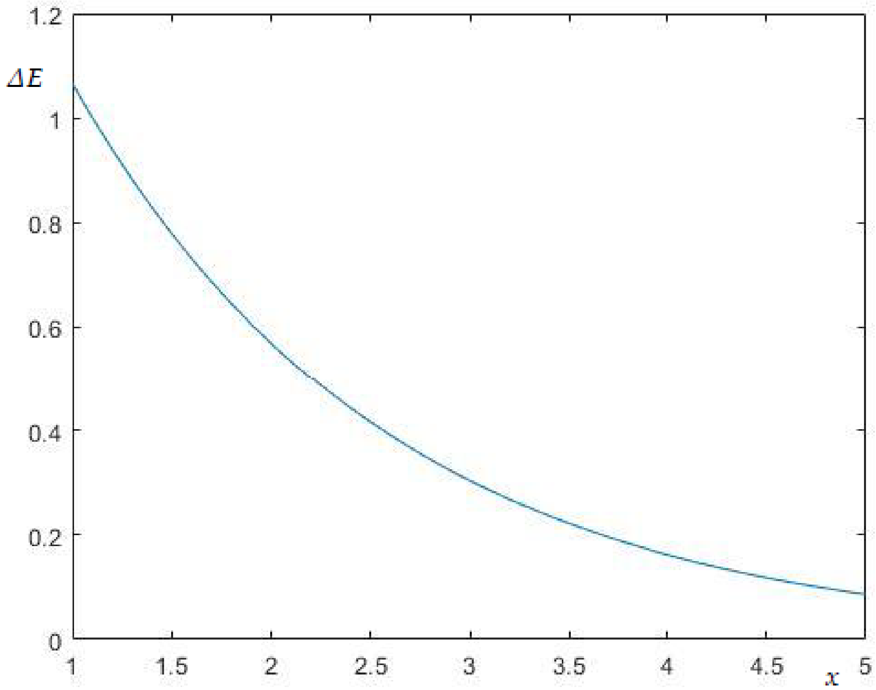


(b)

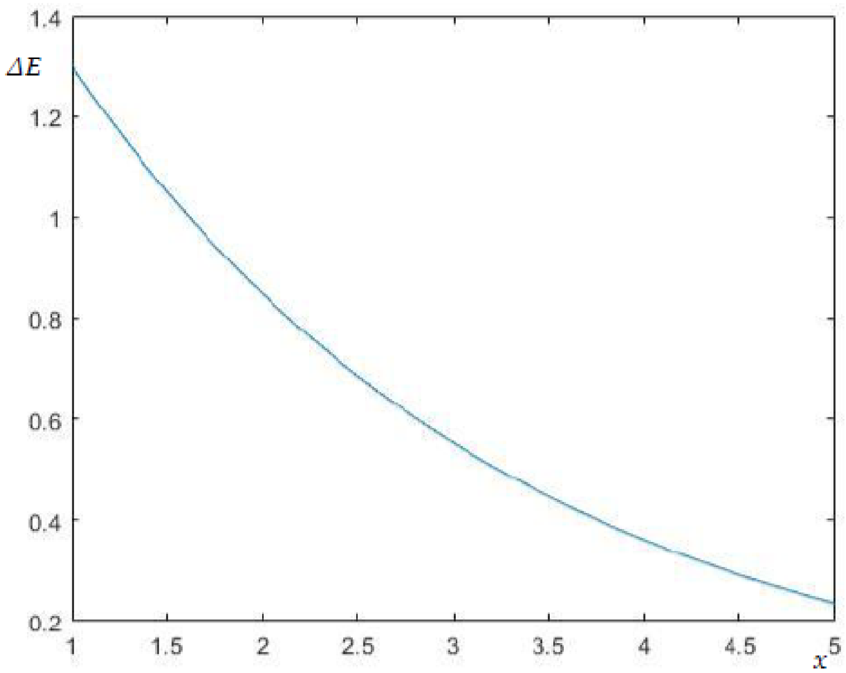
Figure 6. Graph of the equation of the II state in the inactivated state with different parameters (**a**,**b**). Stable self-oscillating process at a certain level of activity/energy. The Y axis represents the change in potential energy/activity (ΔE) of the II, X axis is x—a conditional coordinate in the space of information images.

4.2. Discussion of Results

In Figure 6 we observe a classic self-oscillatory process for the image/representation within the human mind near its level of activity (energy). The measure of activity of the investigated image directly influences the amplitude of its oscillatory movement and stability. The activity/energy level of the II grows and exceeds the threshold—its state changes, and the II goes beyond the boundaries of the human mind (modeled by the potential pit), which corresponds to the process of informational activity (see Figure 2).



(a)



(b)

Figure 7. Graph of the equation of the II state in the inactivated state with different parameters (**a**,**b**). The II goes beyond the boundaries of the human mind/potential pit. The Y axis represents the change in potential energy/activity (ΔE) of the II, the X axis is x—a conditional coordinate in the space of information images.

When the barrier is passed (Figure 7), the activity of the II fades, which simulates a decrease in the communicative capabilities of the individual as the social and physical distance between the objects grows.

5. Conclusions

In this paper, we present the foundations of a mathematical model of the human mind based on the mathematical apparatus of self-oscillatory quantum mechanics.

The theory of information images/representations and its foundations are briefly presented.

The authors have analyzed general laws and phenomena related to peculiarities of human thinking and a number of quantum effects, in particular, virtual particles. The analysis led to the assumption that the similarities between informational images and quantum virtual particles make the corresponding mathematical apparatus applicable in this case too.

Variants of potential pits for modeling cognitive functions of the brain have been proposed.

The authors have developed a mathematical model based on the apparatus of standard and self-oscillatory quantum mechanics. The equations of state for information images/representations for different modes of functioning (inside/outside the potential simulation of the human mind) were formulated analytically. The authors conducted computer simulations of the state in different points for two versions of parameter values. The results of the simulation are presented graphically.

The results allow for using the developed model for forecasting an individual's state under conditions of external information influence and during communication processes with other individuals (or socio-technical systems, such as social networks). In addition, such models can be used for diagnosing the state of an individual because their characteristic modes of functioning and communication will change depending on the parameters (which can describe deviant states, stress, etc.).

The next stage in the development of the model involves conducting an experimental study to register the activation of information images/representations in a psychophysiological experiment and comparing the obtained data with qualitative conclusions and patterns based on the presented model.

Author Contributions: Development of the theory and foundations of the idea—A.Y.P. and Y.V.P. Adaptation and development of the mathematical apparatus—A.Y.P. and Y.V.P. Calculations based on a computer model—A.Y.P. Analysis of the results— A.Y.P. and Y.V.P. All authors have read and agreed to the published version of the manuscript.

Funding: This work was carried out with the financial support of the Ministry of Education and Science of Russia: Grant No. 075-11-2020-011 (13.1902.21.0040).

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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