

# Dominance Concept by A.A. Ukhtomsky and Anticipation

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**Abstract.** This paper continues investigations of the theory of dominance by A.A. Ukhtomsky (1875-1942). This theory is one of the earliest attempts in the world to scientifically investigate the relationships of life and mind, and human behavior in particular. A.A. Ukhtomsky anteceded some ideas of cybernetics and synergetics, as it was shown in our previous works. On the other hand, one of main problems analyzed by A.A. Ukhtomsky is the ability to anticipate seen in the behavior of living beings. This work is devoted to the problem of anticipation from the viewpoint of the dominance concept.

**Keywords:** anticipation · behavior simulation · dominant theory by A.A. Ukhtomsky

*There is no such force, even within “positive science”,  
that could free man from the burden of moral freedom.*

*Alexey Ukhtomsky*

## 1 Introduction. Religious and Philosophical Basis of Ukhtomsky’s Theory.

While beginning to write this article, the authors are not sufficiently aware how well-known are the name and legacy of A.A. Ukhtomsky (1875-1942) abroad of Russia. In Russia, the popularity of Ukhtomsky during the post-Soviet period grew greatly due to the publication of previously unknown materials – letters and diaries that could not be published before due to the censorship of Soviet government [1-4]. Ukhtomsky is now popular among psychologists, since he formulated successfully the principle of Dominant as a common principle that allows to explain many psychological phenomena from a unitary perspective [5]. He also became an idol of the Orthodox community as a successful Christian scientist; this as well due to his brother – a bishop, prisoner and martyr of Stalin’s concentration camps. Still, we consider that Ukhtomsky is not completely understood in Russia, as various groups of supporters and critics see Ukhtomsky each in their own way. However, Ukhtomsky is interesting and powerful precisely because of his holistic aim – to create a comprehensive and complete theory about the behavior of living beings. “Science is in principle a cohesive world view... Thus it’s an offense against the basic principle of science when one tries to understand life from only one point of view. This is the sin of modern physiology, modern biology, and the sin of materialism at all times” [2, p.83]. Ukhtomsky was a highly educated man with three educations – an engineering-mathematical, a religious-philosophical, and a natural scientific one. In his views on the role and place of science in the whole cultural dynamics, Ukhtomsky was strongly based on Russian religious philosophers – the Slavophiles A.S. Homyakov and U.F. Samarin, and later – the great V.S. Solovyov. We should take note of several important moments here. Firstly – notwithstanding all the variety of its schools and theories, in Western philosophy there has been and continues to be a prevailing conception of the laws of nature as of something absolutely constant and immutable, and of man – as the neutral and objective observer of nature, as someone who tries to discern the laws behind natural phenomena. The Russian school of philosophy put in question the absolute objectiveness of the human observer, as well as the absolute constancy of the observed external environment as if independent of time. It doubted the very concept of “externality” itself, as the absolute separation of the observer from the observed. In other words, the Slavophiles did not consider the process of scientific creation to be absolutely objective, instead considering the significant influence of the subjective component – this particularly during the setting of goals and application of results. And where there is place for the subjective, ethical appraisal becomes possible. It is thus that Homyakov and Samarin could come to say – you can really get to know only that what you love. This implies “getting in tune with”, adjusting yourself to the object of cognition (Ukhtomsky can be considered as their follower namely in this sense). To what extent could such gneoseology be accepted by the objective and practical science? Naturally, it would not go without struggles – there were various objections, it was not always treated seriously. In the Russia of the 18-19<sup>th</sup> century, as well as everywhere else, the scientific approach was opposed to the religious one, so the disputes were rather offensive. Nevertheless the seeds were planted, and in

one way or another gave results, sometimes unexpected. All the more so as the 20<sup>th</sup> century provided strong scientific evidence that observation cannot be neutral, it always entails the interaction of the observer and the observable, during which neither can remain unaltered. Furthermore, based on new knowledge, human activity had led to significant and often irreversible changes in the object of study in a manner that was obvious to everyone (e.g., extinction of some animal and plant species). It became clear that we do not live in a static environment, but in an irreversible time, in a historical process. Not only representatives of humanities started to talk about irreversibility, ethics, and historical responsibility, but also leaders of natural and exact sciences – highly successful scholars in some fields of knowledge, such as the chemist and Noble prize laureate I.R. Prigogine [6-7], a European of Russian origins. Some thoughts of Prigozhin are in close agreement with Ukhtomsky's. Let's compare two quotes. "We are not observers, but participants of existence. Our behavior is labor" (Ukhtomsky, 1927) [10, p.149]; "The world is a construction, and we all can participate in building it" (I.R.Prigozhin, 1999) [7]. Prigozhin reminded the whole world about the forgotten medieval understanding of law as necessity, not only as applied to the moral and legal law, but also to the laws of nature, understood as the behest of God – they may one day be altered or canceled, but until then, living and inanimate nature must obey them (e.g. consider the famous tale of the chicken publically executed for not obeying the law and laying eggs).

Russian thinkers Alexey Homyakov [8] and Vladimir Solovyov [9] fearlessly introduced concepts of Christian love and human personality as philosophic terms into scientific consideration. Ukhtomsky set himself the task to integrate these concepts with the natural sciences, particularly with the physiology of higher nervous activity, and created the Dominant concept. In Russian language, the word "concept" differs somewhat from the word "theory" by the breadth of material it covers from a unitary position, and in the current case this extent is in fact staggering. At the same time, some of the details can remain incompletely investigated, stay in the form of hypotheses, requiring further specification or rejection. Ukhtomsky's concept is in this sense a challenge for all of us, and although it is almost 100 years old, it remains a challenge largely unmet. Ukhtomsky studied brain activity to the extent possible with the physiological methods available at the time, all the while giving a psychological interpretation to almost all of his observations. In perspective, he set the goal to describe the mechanisms of behavior with a degree of accuracy that would enable the use of mathematical methods in their study. All the while, he has in mind the complete pattern of behavior, the relation of people with one-another and the relation of man to the world, based on Christian ethics. All of this should be considered while analyzing anticipation as understood by Ukhtomsky. From his point of view, activity is always directed towards some kind of goals in the future, and it's success depends on the depth of comprehending reality, as gained through the whole of our past experience, the whole developmental history of the personality, and the biological inheritance history of the species. This adequacy and depth of understanding are, in turn, determined by our ability to constantly renounce our own prejudice and egoism, to look at reality as it is with empathic attentiveness. This is especially important in the social sphere, and particularly in interpersonal relationships, where the reality we encounter is the Personality of Another man. In the Dominant facing the Personality of Another lies the leitmotiv and pathos of Ukhtomsky's concept.

## **2 Dominance – Common Definition. Dominance in Physiology.**

The initial definition of dominance was developed by Ukhtomsky based on physiological material. At that time when the dominance theory was being created – the decades before and after 1920 – the main directions of physiological research included brain mapping (studying the correspondence between brain areas and types of peripheral effects) and reflexes (studying the correspondence between external stimuli and bodily reactions). Both of these directions were actively developed by Russian physiologists: it's sufficient to mention the Noble prize laureate Pavlov I.P. in this regard. But the scientific school where A.A. Ukhtomsky belonged to – the Sechenov-Wedenskiy school – was investigating also more complex phenomena, where the stimulus-reaction relations could not be seen as constant. The discovery of parabios by Wedenskiy marks one such phenomenon – an instance where the nervous tissue reacts to the same stimulus with either excitation or inhibition, depending on the phase of the underlying physiological process [10, p.92]. Ukhtomsky was interested in the possibility of using the phenomenon of parabios to explain functional coordination in the central nervous system. The discovery of the final common pathway as a physiological principle by the English physiologist C. Sherrington ("Sherrington's funnel") had raised the question – considering the vast amount of sensory and other nervous centers active at the same time, how are some of them selected to control the motor neurons and bodily movement? Sherrington himself offered the easiest explanation at hand, namely that the most excited nervous center gets the lead.

Ukhtomsky started to investigate the regularities of how such a “dominant” center is formed in 1904 after an unsuccessful laboratorial experiment, when the stimulation of a certain brain area of the animal didn’t give the expected motor reaction (limb movement), since the organism was preparing for another kind of reflex activity (defecation). Further excitation of the nervous center speeded up the defecation process, and only after that the expected movement reaction of the limb occurred. Ukhtomsky saw this not as a random experimental mistake, but as a manifestation of a common regularity of mutual influence of nervous centers on each other, requiring special investigation and respective description.

“When I assumed the position that this is not an anomaly but a rule, I started to think that we encounter here not only a rule, but *probably a highly important organ of vital functions in the central nervous system.*”

The concept of an “organ” is usually linked in our mind with something morphologically determinate and stable, with some static features. I consider it completely unnecessary, and it would in particular characterize the spirit of modern science not to see anything mandatory in it. *In my opinion and from my point of view, any combination of forces that is able to lead to the same results every time in otherwise equal conditions can serve as an organ.*

An organ is first of all a mechanism with a certain univocacy of action. This means that a set of tissues is turned into a mechanism by the virtue of their physiological resultant activity.

There was a time when in it was thought in mechanics that you need to understand the dynamics of a system on the basis of its static data. Mechanics was built from statics towards dynamics. ... The new science derives statics from dynamics” [10, p.124].

The main conclusion of Ukhtomsky was that during the excitation of nervous tissue (both in vitro and all the more in vivo) its reactions in fact do not show the stability expected from them. “Constant reactions in the same tissue can be obtained only under certain conditions in which we study the given physiological preparation. We also know that by altering the conditions of excitation in the same preparation we usually obtain, as an evident rule, completely different results, or even the opposite ones, for example when excitation turns into inhibition” [5, p.75]. Ukhtomsky lists these conditions: quantitative characteristics of the stimulus (frequency and strength), functional mobility of the reacting device, and the degree to which new central areas are drawn into the sphere of reaction. There can be many such centers influencing the reaction. The most active one among them is the dominant.

Let the ganglion S receive an impulse “r” from a receptor. In this case the effect is a function of the stimulus received from outside:  $E = f(r)$ . Now let’s consider that the ganglion S is not relaxed, but has its own degree of excitation, and that it is not isolated, but surrounded by another ganglia, each of which can be in a state of low excitation. An approaching excitation wave can influence any one of these ganglia to some degree, and they can have a reverse influence on the wave, although the ganglion S represents the most immediate recipient. In this case the effect is no longer the function of one variable. The equation can now be expressed as  $E = f(r, A, B, C, D \dots)$ . All of these represent excitation values and “their influence on the observable reaction process does not anyhow differ in principle from what we’ve seen in the first case” [5, 75]. The most important difference lies only in the fact that these factors are now *internal*. Let’s say that one of these factors D, which represents the “degree of excitation of a certain secondary center, not distant from the reflex arc you are investigating” [5, p.75], has decisive meaning in the sense of its influence on the result. It is this center that Ukhtomsky would call a dominant.

This leads to one of the definitions of dominance: “A leading focus of excitation, strongly predetermining the pattern of current reactions of centers at a given moment” [5,6] or just “a leading value in terms of its influence on the effect” [5, p.35]. Talking about a “center”, we need to take into consideration that this term is rather simplified, because even in a simple reflex, not to mention in a complex behavioral act, various brain areas and other systems of the body are involved. Ukhtomsky analyzes this problem on the example of the “speech center”. This “center figures not as a locally delineated area, but as an aggregate of areas that could be located rather far apart from each other and are united more by their common activity than by constant links. All data confirm that a fully expressed dominant is a complex of specific symptoms in the whole organism – in muscles, in secretory activity and vascular functions. It’s for this reason conceived as a constellation of centers with heightened excitability on different levels of the brain and the spinal cord, as well as the autonomic system” [10, p.50]. Thus, an effective dominant encompasses various subsystems while its active, in some cases extending to the whole organism. It is a temporal working organ that emerges for solving a certain task. The dominance is an “organ of behavior”, “although it is also mobile, like the vortical motion of Descartes” [5, p.80].

Ukhtomsky delineates “two basic moments of dominance as a working principle of nerve centers:

1. The dominating center reinforces its own excitation through collateral impulses
2. As excitation in the dominant develops, it inhibits other effective reflexes in the final common pathway” [5, p.120].

As already noted, dominance is a process. It has its beginning, main working phase and termination. The above referred features are related to the working phase, to dominance at the height of its activity.

The question how does a center become dominant is one of the essential questions of the concept. Ukhtomsky’s gives it an experimentally derived answer, although a qualitative, not a quantitative one. There are 4 features that characterize a potentially dominant center. (These principles are not yet formulated in terms of the theory of oscillations).

1. *Hightened excitability*. The excitation threshold of a dominant is low. An indifferent stimulus can evoke a dominant only in this condition.

2. *Excitation stability*. Excitation has already occurred, but it should “not be transient” in order to influence the course of reactions [5, p.52].

3. *Capacity to sum excitations*. The capacity of a center to become dominant depends on the “ability of a center to summate its own consequent excitations” [5, p.52]. This, in turn, depends on the relation of oscillation frequencies and phases in the center and the incoming excitation wave. “It’s not the “excitation strength” in a center, but the “ability for further summation” of excitation under the influence of an incoming impulse that can make a center dominant” [5, p.52].

4. *Inertia*, in which “the significance of distal waves is mainly expressed in the maintenance and acceleration of the established dominant reaction towards its completion” [10, p.102].

Inertia is the ability to maintain an already existing dominant in an effective state over a significant time period, an “ability to sustain and extend an already initiated excitation state even when the original stimulus has already faded” [5, p.52]. This feature is an obvious one in case the dominant is formed by a chain of reflexes (e.g., swallowing) or by self-enforcing reflexes like salivation, which can be evoked by the saliva that is already there in the mouth. However, the most important feature of a dominant is its ability to use extraneous stimuli for its own purposes, which is typical of any dominant during the height of its activity. “This inertia consists in the fact that an already evoked dominant is able to persist for some time in the centers and reinforce both its excitatory and inhibitory elements by various and distant stimuli” [5, p.38].

“While the dominant is bright and lively in the soul, it maintains the whole field of psychic life within its grip” [10, p.49].

How does a dominant fade? There are several ways for a dominant to terminate its work. This depends partially on the type of the dominant:

1. A dominant directed to achieving some concrete act, e.g., swallowing. In this case the dominant is a chain of reflexes, aimed at a concrete result, and its achievement will bring about the logical completion of the dominant. Such inhibition is called *endogenous* by Ukhtomsky.

2. The second way to extinguish dominance is *exogenous*. It consists in forming a dominant that is functionally incompatible with the currently active one.

3. The last means of dominant inhibition is by “straight” inhibition coming from the highest levels of the nervous system. Ukhtomsky compares such inhibition with the task “not to think about a white bull”, a task of theoretical moralization.

It should be noted that the feature of inertia – enabling the dominant to persist for significant periods and enforce itself through extraneous impulses –has also a second sense, allowing the dominant to fully reactivate itself with the help of fragmentary or external cues. “As the dominant fades, the sphere of stimuli capable of reenforcing it reduces” [5, p.46]. The receptive field gradually returns to its earlier borders. But “a once evoked dominant can occur again, even in an isolated spinal brain” [5, p.46]. This is even more typical of the nervous centers of the cerebral cortex. Generally: “a dominant is characterized by its *inertia* not only in the sense that if once evoked, it will persist in the centers, but also – it can reactivate itself after it has faded” [5, p.46]. “The dominant is characterized by its inertia, i.e., by its tendency to maintain and repeat itself entirely when this is possible, even if the environment has changed and previous reasons for reaction are gone. Dominants leave a solid, sometimes irreversible trace in the central nervous system” [5, p.13].

This extremely important feature of the dominant gives us the right to refer to it as a basis of memory. “Several potential dominants can live in the soul at the same time – traces of the past life activities” [5, p.13]. The organism develops during its whole life and each occurring event leaves a mark on its further life activity in the form of traces from experienced dominants. These realized dominants can fade and disappear later, or consolidate if similar circumstances reappear. This is how experience is acquired. The reactions of the organism to current environmental signals are mainly determined by which dominants possess the highest degree of readiness at the moment and can

emerge to the forefront. If a “suitable” dominant is not available, the signals can remain unnoticed or provoke an inadequate reaction. In various texts, Ukhtomsky compares dominance with a charged trigger, an explosion or catalytic process activated by an external signal. “Dominance: a large amount of potential energy in significant tension, easily discharged by different cues – a decelerated explosion, caused by detonation” [2, p.144].

A dominant appears for realizing a behavioral act. While it lasts it connects all the individual capacities and powers of the body to solve a given task. “Constantly differentiating, multiplying, and still not losing its unity; a preservation of this diverse unity through harmony – this is the organism in its developmental history, while this is achieved without disruption, defects, transgression” [10, p.426]. This is already a switch to the psychological level of description. It should be noted that Ukhtomsky always keeps this level in mind and often illustrates physiological conclusions with psychological examples.

### **3 Dominance in Psychology**

Ukhtomsky saw dominance as a universal mechanism. He compared dominance with the law of gravity, which is always effective, regardless of our understanding and evaluation. Dominance explains many aspects of behavior – perception in all modalities, motor control, and emotions. While it lasts, a dominant provides the integrity of perception – an “integral image”. Perception is not passive; it is subordinated to the current task through a dominant. We only notice things we currently need, everything else is ignored (and sometimes subjected to prejudicial interpretation). An integral image is stored by the organism and can be later reintegrated under other circumstances.

Emotions, controlled by subcortical structures, are linked with the images and motor skills of a given dominant and can then serve as a “flywheel”, facilitating memorization, providing continuity of behavior and connecting distant images and situations.

“An emotion, as a continuous state of the soul, is inert. Above all it deepens a dominant, giving it stability. That’s why it draws various contingent stimuli towards itself and “interprets them according to its disposition”.

It has an important biological role in the sense of a flywheel, consolidating the central nervous system in a certain direction of efforts, unabling to follow random side impulses and directing it towards certain achievements” [2, p.139].

“An emotional feeling underlines and reinforces the excitation (perception or action) which gives rise to it. It helps a perception or skill to consolidate itself in the soul and take the place of an independent agent in memory. An impression not related to an emotional tone in the soul is destined to be erased from the soul relatively fast!” [2, p.136].

“In the higher sphere of mind, emotions consolidate abstract conscious ideas as something living and concretely existing, making them the true “idees forces” – the creative basis of human life” [2, p.137].

The emotional component of a dominant links the conscious and the subconscious, the past and the future, and helps to understand the role of dominants in determining behavioral motives. The famous psychologist and historian of psychology M.G. Yaroshevsky has referred to dominance as the motivational potential of behavior [11]. Dominance enables to explain active behavior, as well as active relation towards the environment.

Let us once again underline the important idea that the mechanism of dominance allows to describe known psychological regularities in general terms. Not only motor control and skills, but also motivation, emotions, mechanisms of memory, attention, and objective thinking can be described in terms of the dominance concept. This circle of ideas ties together related terms in the psychology of motivation, cognition, communication and personality as they are considered in modern psychology. Mechanisms of dominance can also easily explain known pathological phenomena of psyche. The inertia of dominance can disturb normal behavioral regulation and become the source of obsessive images. If there is a malfunction in switching from one dominant to another, a conflict of reactions may occur. Thus, dominance mechanisms can evoke and reinforce pathological processes. Mechanisms of dominance can be useful also in the psychology of work and pedagogy, by explaining the processes lying at the base of learning, exercise, fatigue, the ability to concentrate attention, etc.

### **4 Ethics. Dominants Facing Another Personality.**

Ukhtomsky's vision of ethics is highly interesting. The importance of social components in all aspects of psychological activity is taken by him for granted. He wrote that we all are born, we live, and we die in a society, and a special language is needed for describing the social not to reduce it to biology. The life of society at large is subordinated to regularities that are similar to the regularities of dominance. For example, he wrote that the revolution had been growing for the long time and could be triggered by any concrete occasion. The events of 1917 were not the reason, but just an impetus for events that were already prepared. Yet, society consists of different people. Let us remind that Ukhtomsky created his concepts at the beginning of the Soviet period, when our country followed the motto that the "social is above the private". This was not true for Ukhtomsky. "Neither the common, nor the social can be set above personality, because it is made of personalities and for personalities; and a personality cannot be opposed to the common and the social, because a man becomes a personality only by devoting to other personalities and their society" [1, p.267].

The question of interpersonal relations is the most important and cherished one for Ukhtomsky. Based on the principles of dominance, he formulates the laws of the "double" and the "condign companion". "Our dominants stand between us and reality. The general tones in which we see the world and people around us depend to a vast extent on our dominants and who we are ourselves" [10, p.142]. If we are unable to overcome our egocentrism, then we will see our own limitations and flaws in our companion – we will see our own double, as Dostoyevsky said, instead of a companion. If we judge someone, it often turns out we judge the flaws we do not want to admit in ourselves. But if we idealize our companion, we raise the norm for both him and ourselves, acquiring an opportunity for moral development. The companion is for us who we deserve. Let's consider a quite long quote.

"According to the dominance principle, when meeting someone, we mainly see what this meeting arouses in ourselves, but not who that person is. How we interpret a person (by our own yardstick) that we come across predicts our behavior towards him and, in turn, his behavior towards us. In other words, we always find in our companion what we deserve. Meeting a person reveals and exposes everything that was hiding inside us; and we face the most truthful, realistic, objectively solidified trial over what we've secretly lived by and secretly thought of ourselves.

Thus in a social aspect, the principle of dominance turns into the law of condign companion. If a person you meet is bad for you, you deserve him as such – he could be good for others! And it is your own fault that the person has turned his worst sides to you. The most precious and essential in human life lies in the communication with other persons. However, the tragedy is that man actively approves and consolidates in others what he suspects of them; and what you suspect of others is usually what you carry inside yourself.

A malign person sees bad traits in others before anything else and thus provokes them to bad deeds, lowers them to his own level; this way we infect each other with what is bad and block the way for ourselves to grow and reach the beauty that can really hide in another person" [1, p.479].

Following this explanation is an idea for overcoming such lowering communication, recommendation for building truly human relations.

"An ability not to linger in your abstractions and at all times be ready to choose living reality instead, to know how to approach each person in his own right, to be able to enter his shell, share in his life, to understand his starting points, to understand his dominants, take his point of view – that's the task" [10, p.149].

"Infection with ignorance is something that happens very easily all by itself. Infection with the good is only possible by working with oneself, by actively not allowing oneself to see bad things in others and focusing only on the good. Here is the deep difference of whether we understand "equality" to mean that – see, both of us are unworthy, or in the sense that I can and try to become as noble as you.

We have to recognize that overcoming oneself and developing a bright creative dominant facing another personality come very easily and are granted anywhere where there is love: "he sold everything he had, and bought the village where the pearl is hidden" [1, p.479].

So the substance and the quintessence of Ukhtomsky's ethics lies in the development of *dominants facing another person*. The straightest and shortest way there is – love. "Only as much as we overcome ourselves and our

individualism, the leaning on our own selves – are we able to see another personality. From the moment the other personality reveals itself, a man deserves to be called a personality himself for the first time” [10, p.150].

An important case of the law of “condign companion” are the relations of grownup children and their parents. Ukhtomsky considers this problem in the form of commentaries to Blok’s poem “Revenge”. Children-revolutionaries that overturn and destroy the world of their parents simply bring to a logical close the contradictions and mistakes which their parents were once unable to overcome. Ukhtomsky considers the revolutionaries as the unhappy children of unexemplary parents. That’s why even in this case, the occurring tragedy is a moral-historical judgement, and the most appropriate, if not the only way to solve this problem is through love.

“As Blok thinks, and I highly empathize with this idea, the new generation is a consolidation, a realization and embodiment of the inclinations and unclear intentions that were secretly harbored by their fathers and forefathers! And whatever was hidden then, is now openly preached from the very cradle. What was barely thought of is now acted out in real history on the streets.

For the blind exchange of human generations, children are essentially the “condign companions” – the historical vengeance to their fathers. At the same time children are also an augmentation of love and the living realization of a future world to them.

The genealogy that Blok writes about in his poem is of a consecutive devouring of fathers by their children, just like in the genealogy of the Roman Caesars or of rats and rabbits. (Simplicity and extremes, yet they fit well!). A completely different legacy runs from the father of Abraham’s tribe through Isaac and Yaakov till Christ – a continuous evolution of love as principle of life” [1, p.480].

## 5 Hierarchy of Sciences

We can see that Ukhtomsky, starting with dominance as a physiological mechanism switched to a discourse on Christian love. After all, that was his main goal – to “justify” Christian belief with science. It’s namely due to this that various distortions in the interpretation of Ukhtomsky’s work have occurred on both sides of the debate. Depending on the reader’s viewpoint, the author’s belief either attracts or repels; in both cases, this leads to prejudiced opinions and superficial reading of his texts. At the same time Ukhtomsky’s thoughts deserve to be investigated closely and seriously, and to leave out the Christian aspect would be wrong, as without it the picture would remain incomplete. Of course, entirely physiological or psychological problems of applying dominance theory, as well as the question of mathematical description and modeling, can be successfully viewed separately from its philosophical basis – but this would not be the complete Ukhtomsky.

One of the milestones in Ukhtomsky’s concepts is the idea about a hierarchy of sciences, conceived by him already in youth. A.A. Ukhtomsky came out with a consistent and highly convincing rejection of reductionism. Reductionism is based on the possibility of explaining the behavior of a system based on the behavior of its elements or subsystems. Ukhtomsky took the opposite view– the behavior of a subsystem is determined not only by its own internal features, but by its place in the whole system. The elements and the system as a whole can require different levels of description. Various sciences differ in their language of description, which should be adequate to the level of observed phenomena. In Ukhtomsky’s view low level descriptions terms do not give us any knowledge about higher level phenomena and laws. For example, geometrical terms that allow describing the form of solid objects cannot explain the regularities of its motion. Although the laws of mechanics do not in the least contradict with the ones of geometry, and although the form of an object can be relevant and be considered when describing its motion, on the whole it’s still not geometry that defines motion, and it has to be described in terms of speed, acceleration, etc. and here it’s often possible to abstract away from the form. Attempts to describe something in lower level terms either fail, or lead to awkward and bulky constructions; the more complex regularities of higher levels cannot be captured in terms of lower level descriptions.

Ukhtomsky sees the hierarchy of his contemporary sciences as branching in the following way:

“Real physical world is a pure accident from the point of view of geometry, the world of real chemistry is an accident from the point of view of physics, life is a pure accident from the point of view of chemistry; the law of good and evil (law of retribution) is a pure accident from the point of view of biology. That is a typical chain of rising links, when it’s constructed from below. But if you move downwards from above, the place of each lower link in the life of the higher unit is obvious! [3, p.224].

With regard to the problem we're currently interested in, the question is whether psychological phenomena can be described in physiological terms. Ukhtomsky considers that all psychological laws should be described in their own psychological terms. Talking about physiology, its laws do not contradict the psychological ones, but also do not explain them – just like the laws of geometry do not contradict those of mechanics but also cannot pretend to explain them, as the former are a “provincialism” in Ukhtomsky's expression in relation to the latter.

We should stress once more that dominance in physiology results from physiological experiments and physiological observation – yet the description of dominance as a process has some analogies with the psychological level. Based on the mechanisms of dominance, Ukhtomsky formulates several laws pertaining to the psychological level and which can already be attributed to the moral sphere – the law of “condign companion”, the “law of retribution”. They do not contradict psychology, but from the point of view of pure psychology they are not necessary, they are “accidental”. And such matters as overcoming the “law of retribution” with a higher “law of love” already belong to moral or religious levels.

The originality of Ukhtomsky as a thinker – either we agree with him or not – lies first of all in his ability to see everything as one whole. Higher level laws exist on exactly this level. The lower level cannot dictate them, it is neutral in relation to them. In some sense the possibilities of a lower level are wider, they are redundant, whereas the higher levels constrain them, draw some kind of borders. “Out of the law of love and mercy, out of the law of good and evil, as the most concrete and substantial ones, we can – with various degrees of abstraction – deduce the laws of history, sociology, biology, chemistry, and mechanics” [3, p.233]. This is a view of principle for Ukhtomsky, as it reflects the relation between his scientific views and moral and ethical beliefs.

We consider the aforesaid to be very important for understanding the scientific position of Ukhtomsky, though it's hardly accepted by the majority of modern scientific community.

## **6 Approaches and Attempts at Formal Description**

Due to the pronounced ethical-religious direction of Ukhtomsky works, one may think (and this happens quite often) that it is a “humanitarian” line of study, containing very little concreteness and too much “verbalism”. We consider Ukhtomsky's legacy is not researched enough in terms of “positive science” not because of its humanitarian dimension, but because its “positive-scientific” component is rather difficult and currently there is no worthy successor, able and ready to carry this heritage forward. Let us illustrate this statement firstly with an enumeration of approaches which Ukhtomsky overgrew and rejected, though many of them still exist and we only begin to realize their limitations. Secondly, let us recall the similarity of Ukhtomsky's ideas [12-15] with the ideas of modern post-non-classic science, or synergetics [16]. And at last let us discuss the attempt made by Ukhtomsky at the very end of his life to apply mathematics to the description of nervous centers' functioning, where an equation of nonlinear oscillations was used.

Dominance seems to be a simple and self-evident principle, as there certainly should be a united control center for holistic actions and behavioral acts. By observing which modern approaches Ukhtomsky rejected, we see to what extent the concept is not self-evident. Above all, this is the reflex theory. Within reflex theory, the organism is considered simply as an aggregate, set of reflex arcs. Instincts were similarly considered as fixed structures with invariable reactions to external stimuli. I.P. Pavlov introduced time-dependence into reflex reactions, but this dependence was a superstructure added to a constant set of reactions. On the contrary, Ukhtomsky considered constancy as a special case of variability. “A reflex is not an element, but a fragment of motion. And the whole is not the result of compounding reflexes, but an integration of action moments” [3, p.228]. These are two opposite theoretical approaches. “Reflection, of course, is reflection, not a passive and instant given, but a historical achievement as the ability to capture, perceive, attend, and reflect new sides of existence develops” [2, p.246]. It is not passive because it is determined by internal adjustments no less than by external stimuli. The aforementioned definition of an organ as a temporal structure is in line with this approach. Rejecting the reversibility of time also corresponds to it. Studying the laws of nature as constant leads to the use of a mathematical apparatus where time can be reversed, i.e. flow backwards. Such are the laws of classical celestial mechanics, for example. In historical sciences, time is fundamentally irreversible. After a certain events has occurred, for example, the victory of Russia over Napoleon, everything follows a different path. That's why, unlike in mechanics, where time is a feature of motion in three-dimensional space, and all motions are equal, in history “the frame of reference” is a consequence of consecutive events, and you can't move backwards in it. Studying living systems – animals and man –Ukhtomsky does not refrain from considering their natural, material basis, but he places them in a historical coordinate system.

And this approach is indisputable, as the life of any living being from conception till death consists of unique, unrepeatable events.

In analyzing the organism's energetic exchange with environment, Ukhtomsky decisively rejects the principle of least action and the mathematical optimization mechanisms corresponding to it. Ukhtomsky considered the goal of any living creature to be the unleashing of its own potential possibilities as much as possible, and not in the limitation of environmental effects. "In the sense of least required actions, let us consider the most successful organism that has gained a lucky opportunity to produce minimum work in the environment. What examples from biology do we have? First of all, these are immobile parasitic forms" [10, p.136]. During its activity, an organism "extracts" energy from its environment. The more active the work is, the more intense the energetic exchange. That is an open system, a nonequilibrium process.

"In case of a regular relation to the environment, the organism is bound to it in the most intimate way: the more it works, the more energy it extracts from the environment, the more energy it captures and incorporates in its own processes; it's obvious then that the strongest actor with powerful central nervous system functions and dependent devices can take and process the largest amount of energy during its life and involve it in the sphere of its work to achieve the most powerful working results and the longest aftereffects of his work, that will make us remember this nervous system and this individuality even when it is already long gone" [10, p.135].

The energetic exchange properties of living beings were studied on the cellular level only after the death of Ukhtomsky, including by his students and followers. I.A. Arshavsky showed that during the work of skeletal muscles, i.e., during organisms' motor activity, a surplus of free or structural energy is generated, raising the efficiency of the developing organism. This is the difference between the "functioning" of non-living systems and the development of living organisms. The irreversibility of time for living systems consists here in the conversion to a higher energetic level during muscular work. If we consider the organism-environment system, the overall amount of energy received from the environment and used for work – i.e., accumulated in the organism and dissipated in the form of heat – stays the same, only performance efficiency is increased and heat losses reduced [17]. M.N. Kondrashova discovered the surplus effect related to action also in its biochemical aspect [18].

Ukhtomsky rejects reductionism in all its forms. He considers that the whole is not the sum of its elements. On the contrary, an "element" is always dependant on its place in the whole system. For example, in the context of visual perception this means that a whole image is not conjoined out of elementary sensations, on the opposite – the incoming sensations are perceived based on the general anticipated image. "Of course, the truth is revealed to man through "sense organs", and not by them! The presence of real living truth won't give anything if man is not internally prepared to perceive it! An adequate preparation of the whole person in his ongoing history is needed to notice the truth" [3, p.254]. And further:

"Here we have a much more principled question of the whole-part relation, after all! Sensation is considered as a part of whole perception. So can we say that perception is composed of sensations and represents a secondary product of primary sensations (psychological atoms), or is perception the primary integral, and senses only exist as derivate abstract elements, artificial analytical functions of thought!" [3, p.265]. If we compare these viewpoints with existing approaches in computer modeling of visual perception, we are able to see similarities with, for example, M. Minsky's "frames". The entire sphere of visual perception based on a priori models belongs here.

When Ukhtomsky discussed neural networks models he opposed viewing them as switching schemes, where single neurons act according to the "all or none" principle. Understanding the convenience of such a simple scheme for the construction of numerical models, he nevertheless listed the experimental facts which cannot be explained by this scheme. These include decremental decay, deceleration of rhythmic conduction in inhibited nerve regions, the possibility of group excitatory discharge in response to a strong impulse, etc.

"No doubt we are to welcome the time when the physiology of excitation will become a mathematical science. It's in this regard necessary to say in advance, however, that the mathematical construction of a theory of excitation on the basis of the "all or none" postulate will remain a particular and exceptional theory, similar to Euclidian geometry. The future methemathical physiology can not avoid the task of measurements within an "elementary excitation" [19, p.32].

At the very end of his work, in 1940, Ukhtomsky took a step towards building a mathematical model of excitation in the nervous tissue. He followed here, as usual, the holistic principle, and considered that the regularities that govern the whole system require separate investigation, while the features of single waves would be determined by these general regularities. On these bases, Ukhtomsky proposed the concept of physiological excitation as an

oscillatory ensemble. Referring to the results of Van der Pol, who successfully applied a nonlinear equation of relaxation oscillations for explaining heart rate, Ukhtomsky suggests following the same idea to explain the set of facts gathered on nervous tissue excitation.

“We bear in mind the following set of phenomena:

- a) existence of a lower and upper threshold of frequency and power of external effects on the oscillatory system necessary to produce an effect in it;
- b) prolongation of effect frequency, akin to an inertial lag of the oscillatory system behind rhythmic impulses;
- c) phenomena similar to single tetanic excitation (combined resonance);
- d) phenomena of forced synchronization, equivalent in content to the assimilation of rhythm;
- e) phenomena of frequency division, conversion of impulse rhythm into an aliquot of effect rhythm;
- f) «autoparametric filter», matching the selective conduction of oscillations through a parabolic area;
- g) dampening influence of one oscillation sequence with a certain amplitude and frequency on another oscillation sequence with a different amplitude and frequency.

In the general equation of relaxation oscillations of Van der Pol

$$u'' - a(1 - u^2)u' + \omega_0 u = \omega_1 E \sin \omega_1 t$$

a continuous change in the value of  $a$  leads to a transition from continuous Thompson type oscillations to discrete relaxation type oscillations. At this point, the regularities of ongoing oscillations change – the system acquires new features, and diminishes previous ones. By  $a < 1$  we obtain complete isochronism and independence of amplitude from frequency, at the same time by  $a > 1$  there appears a significant dependence of frequency from amplitude. By  $a < 1$  resonance is a main feature, and by  $a > 1$  it is almost absent. By  $a < 1$  the system is easily disturbed by external influences in terms of changing its amplitude, yet its “own rhythm” is maintained steadily. By  $a > 1$  its frequency changes easily, but the amplitude is steadily maintained. The principle of superposition is applicable to  $a < 1$ , but not at all applicable to  $a > 1$ .

In non-linear systems a low amplitude rhythm can be imposed by a strong device, and the key to domination is created through tactically selected and persistently maintained rhythmic influence from a “weak” component on a “strong” one [19, p.163].

We have provided such an extensive quote from Ukhtomsky’s work as it’s the only attempt, as much as we know, to mathematically describe physiological experimental material made by Ukhtomsky himself and his followers when he still lived. We are talking about a single nervous center here that can be in a dominant state. In the general framework multiple centers must be considered, and the theory must explain how and why only one of them becomes dominant in the process of their interaction.

Ukhtomsky’s followers continued to study the possibilities of applying the theory of non-linear oscillations to physiological processes, and created a system of equations not for a single, but for a group of interacting oscillators [20, p.80]. But, as far as we know, none of these mathematical models have been studied in sufficient detail to compare them with the results of physiological experiments.

We should also note that the processes of dominance studied by Ukhtomsky and the various processes of nature discussed in synergetics are analogical not only because of the features we have already talked about (irreversibility of time, openness, and nonequilibrium) but also due to the presence of 2 stages in the process of dominance – stability and bifurcation. The stable stage – the dominant at its height – is deterministic, allowing to predict in the near future the course and result of an already started process. The stage of switching from one dominant to another allows multiple options for further events to develop, and even very weak additional influences can significantly change the course of the process.

For many years, there were very few known attempts to model different aspects of the dominance mathematically. The work of the academician N.M. Amosov was one of the earliest among them, famous in the 1970s for the inhibition reinforcement system [21]. The neural network is presented here in the form of interconnected ganglia, and the excitation level of a ganglion is determined by the overall summation of the excitation received from other ganglia. As seen below, the model is highly simplified and does not take several

important aspects of the dominance theory into consideration. Another model was developed much later by V.I. Kryukov (Father Superior Feofan) and was dedicated to attention modeling [22]. Beginning with 1990-s, oscillatory neural network models were successfully applied to modeling attention, memory, visual and auditory perception [23]. These studies have continued to the present day. They usually do not consider problems of energetic exchange with the environment, as well as the problems of motivation and transition from one activity to another, which are central in the dominance theory. From this point of view, we can compare and find analogies of Ukhtomsky theory with genetic algorithms, scenario modeling etc. Attempts to apply oscillatory network models to solve such problems are still unknown.

## **7 Cognition as an Aspect of Activity. Experience – Hypothesis – Experience. Chronotope. Intuition.**

Let us now discuss the ways a dominant can serve as an organ of anticipatory cognition from Ukhtomsky's point of view. We should underline once more that anticipation is considered by Ukhtomsky not as a separate kind of intellectual activity, but as an inherent attribute of any activity. Not only the organism, but reality itself is considered by Ukhtomsky in a historical manner, within time, understood as an irreversible process. That's why cognition is also understood not as the discovery of static, everlasting regularities, but as an increasing involvement in the surrounding life that is acquired and developed over the period of one's own life. Man becomes aware of the reality surrounding him, acts within it, changes it and changes himself – all of these are different aspects of one process. "A man is active in forming the integrals of his experience and his truths" [1, p.363].

*"Man's thought – it is his action.* Talking about man: if he thinks about the world in one way, than how he acts in the world is the same. Also among people he acts the way he thinks about the world and people" [1, p.465]. This idea was later developed by N.A. Bernstein, who suggested that any thought has a muscular expression, and only through this can it become known to others – through action, speech, written speech, mimics.

From Ukhtomsky's point of view, the ability of increasingly precise anticipation is determined by how deeply one is tied with reality. To anticipate – this is not only to set a goal and lay down a plan of actions towards it in some formal or mathematical language, as it is often considered in artificial systems. Neither is it for Ukhtomsky the principle of feedback as understood by Wiener, although the idea of action correction in the course of goal achievement is naturally also present in his work. In artificial systems it is usually assumed that the model of the environment can be described in formal terms, and the goal state is one of the possible states in this model. Accordingly – it's in principle possible to realize the plan, and hinderances and unwanted side effects exist in the form of limitations in terms of the same formal language. However, in real life we have to form our behavior within informal reality, sometimes totally unpredictable, and always wider than our data about it. Moreover, after Freud's discovery of the subconscious (a theory that Ukhtomsky admitted and used with some important reservations), it became obvious that even with adequate understanding of the task and its solutions, and we cannot always predict and control our own behavior.

According to Ukhtomsky, when a new situation appears, we think and act based on the experience we have encoded in the form of dominants that are ready to work. The organism reacts and behaves in the way it is ready to react. Instances of inadequate reaction are not infrequent, for example, when a person is angry or obsessed with something, and a completely accidental occasion can provoke the prepared action. But even in most adequate reactions, a dominant is an "experience in action" – it never wholly covers the new situation, and therefore necessarily contains a prediction, anticipation of new experience, and it is checked and reinforces only through new experience.

"A hypothesis is an anticipation of experience. Psychologically it always has its bases for appearing, thus it has psychological relevance. But its true goal consists in verifying to what extent anticipation matches real experience" [2, p.130].

"Based on already known facts, the synthesizing thought creates a model of reality. Only future confrontation with still not investigated and unaccounted facts can evaluate this model. But if the model is complete, this means it had sufficient basis, and the dominant underlying it had its sources for itself. Building a model (integral image of reality), man won his fight for the model's existence, i.e. he was able to build a future. Through man, existence is building its own future, since man's share is not only to build models by drawing on the past, but also to fight to include them in the future" [...].

The historical approach consistently applied by Ukhtomsky leads him to several basic postulates and concepts. Definition of the “chronotope” is one of them. In linking time and space, Ukhtomsky followed the theory of H. Minkowsky, which confirmed that ideas of separate space and separate time – are but shades of reality. The actual measure is an interval between events, where time and space are united and interchangeable. The distance to a nearby city can be measured in kilometers, or hours spent for travel by car or by foot. From the viewpoint of the model that anticipates reality, these are complementary descriptions. Ukhtomsky uses the concept of chronotope also in another sense. This is related to the ability of harmonization and synchronization of events. This was already seen with reference to dominance. “The imposition of rhythm”, the coordination of time, speed, and rhythms is a precondition for forming a functionally unified system out of spatially segregated elements. This relates to the human brain, but also to social and natural phenomena. However, for Ukhtomsky the concept of chronotope found its main meaning as an analogue of dominance, not with reference to neurophysiological processes, but to external and mostly social processes. “World lines”, chains of events in space-time reveal historical regularities where what passes never disappears without a trace, and the future is never strictly determined by the past, though it arises from past events.

“Nothing passes without leaving a trace. All foregone is accounted for. What comes to light is only what was hidden inside. What is gone, but requires external conditions and time to grow in order to open and reveal itself – that is the dominant in man, and the chronotope of Existence!” [3, p.380].

An event is a meeting in a person’s life, an interception of his inner dominants and the world lines of external reality, a practical verification of his truths.

“While a dominant is at its height, the internal chronotope and the external chronotope develop in direct correspondance for a period of time. This is truly visionary understanding and sagacity.” [3, p.269]. “A dominant becomes coupled to the chronotope and adequately perceives its content at a given moment. And this is of no surprise, as the dominant is a part of it! And a fully adequate relationship is obtained now between what is sought and what is realized” [3, p.269].

After an act is performed, its adequacy can be experimentally verified. In this case, we can only speak of a very limited anticipation in time and space. An action with instant feedback, usually, does not require and does not interact with complex dominants and large segments of memory. Ukhtomsky compares such actions with touch. It does not require, or almost don’t need a priori information and hypotheses. It can be a “blindfold” move.

As opposed to such actions, anticipation over significant time-space intervals is compared by A.A. Ukhtomsky with visual perception. Vision is in principle impossible without hypotheses, a priori information, models, as available information is never sufficient to see everything. That’s why illusions and mistakes are possible in visual perception. The verification of visual hypotheses can be deferred in time or distant in space (for example, you might need to move towards the object to see it from the other side or to touch it). Touch allows more close verification and more precise reproduction, but in much smaller range. Alexey Alexeyevich loves this analogy and often applies it to higher level of consciousness – interpersonal relations, comprehension of historical regularities, etc. Visual perception always supposes faith as a hypothesis and a plan of action.

“Building a tactile model based on visual experience; building visual model based on auditory experience; building a visual auditory model on the basis of any new experience – these are constant *physiological facts*. *The anticipation of distant reality and the preliminary construction of a likely reality are typical facts of brain activity*, which spread and grow in their movement towards reality.

Thus idealism, the constant building of ideal models, belief in an ideal future reality as an already manifesting fact – although these anticipatory visual models seem phantasmal and deceptive at least for the near-sighted touch, they are a direct consequence of our physiological *modus operandi*! The near-sighted “truth” of the closest tactile experience can devalue and even deem illusory the distant visual foresights of an astronomer or a prophet.

But for a whole-hearted, active and developing person there is no absolutism of tactile presence when he foresees a new, distant visual image of future experience!” [10, p.312].

There is a “law of relations, according to which the truth is anticipated and preliminarily given long before there is a 1) direct contact with it and 2) it unfolds on the historical plane. That’s why preliminary statements about it are

always in the form of “beliefs”, “convictions”, “models”. Truth for the participants of this unfolding is “faith” [3, p.269].

An analogy between visual perception and anticipatory cognitive activity helps to understand another important aspect of Ukhtomsky’s ideas. In itself the ability to perceive the response to our actions, to realize if we are correct in our insights and deeds is also not constant. It exists in time and changes with us and with the surrounding reality. Understanding the results of our activity, is, by itself, a cognitive activity, based on our dominants. Growth is necessary to attaining proper understanding, and it will never be complete. In this sense man learns his entire life, as Ukhtomsky said, always reintegrates his world view. Truth is always ahead; it obliges us. We are able to assimilate only a small part of something that always remains bigger than who we are.

“Its natural for one’s own realizations to subside and crystallize into certain constants, as they are created in your soul. But this is also what turns them into artefacts and fragments of life, different from living life in its wholeness. Be sure that the living life from which they crystallize is wider, and cannot be contained by them, can never be exhausted by them, and will always yield new contents, since “experience is always new” – as Goethe rightly said. We need to be wider than our crystallizations!

Living life always escapes the net of your realizations, charges ahead of them, grows, draws you along, calls you to become higher than you are” [10, p.330].

The wider the field of activity related to the deed, the longer it takes for consequences to appear, the harder and more responsible the anticipation becomes.

Here Ukhtomsky talks not only about eternal approximation towards the truth, but also about the judgement – the objective trial, the reaction of reality to our actions, based on our hypotheses and understanding.

“Truth is given to us through experience, in the form of uncertain and for some time “vexing experience”; so when the Truth presents itself, the human mind cannot be satisfied, what to speak about total satisfaction! It’s an old and very harmful prejudice that Truth is human satisfaction and exists to satisfy man! It’s a trial – and a dreadful judgement. It is recognized and revealed in experience if man has developed appropriate receptiveness, and to the extent such receptiveness towards oneself is developed in man – it raises him higher and higher. Here, the path to the raising the man ever higher lies in his progress and work!” [1, p.462].

In the same way, scientific cognition is understood as an unlimited pursuit of understanding the truth, leaning on all former experience. Based on the dominance principle, the principle of dynamic development, – and from a mistrust towards constancy and dogma – Ukhtomsky considers the influence of the subconscious and confirms the leading role of intuition in scientific cognition. Talent is seen as a special gift for profound intuition.

“Science is called science because we learn through it something that is bigger than us, something that we don’t know and could not know by our own, something which we see as being above ourselves, as given by someone who is much greater and from a place much greater than us. Given by the tradition of history; the sprouts of humanity lie in history; and in what is waiting ahead. The role of science isn’t of course to insist on what it prefers at all costs, but to reach out in pursuit of the future” [1, p.457].

As already noted, explanations of cause-effect relationships are, according to Ukhtomsky, sufficient only for systemizing already occurred events, for the past, but not for the future.

“When thinking about the past, about what has already happened, the leading category is the *causal one*. The category of goal is expressed in thoughts about the future and what is anticipated. Full-fledged human thought is always directed towards the future, it is always pragmatic and purposeful – man can devote himself to an exclusively causal description of reality only in abstraction and reduction, when you can turn your attention completely to past events and when present reality is just a repetition of the past.

Full-fledged human thought always tries to project new realities. And all knowledge about the past, from the perspective of the causal category, plays only a subservant role to better project a new reality” [10, p.294].

In line with the above, Ukhtomsky sees the role of logics, verbal argumentation, and formal methods in science as completely subservant – designed to explain, verify, and systematize already present knowledge post factum. Dividing cognitive activity into levels and treating it as a hierarchic structure (an approach accepted by most modern psychologists in Russia) isn't very characteristic of Ukhtomsky. However, the logical, formal, and theoretical levels are not the highest ones for him, since this is the level of simplification and reductionism, often distorting real life in favor of a convenient scheme. Formal structures often cannot bear experiential verification. "It was conceived so well, yet experience says something else! That's the tragedy of abstract theory. And that's because objective experience is always new!" [1, p.458].

Abstract theorization, based on a logical scheme, is the opposite of intuitive cognition, based on the play of dominants.

"Intuition or "clairvoyance of reality" is this: there is no discursive justification of truth, but an empirical justification is lies well ahead, i.e. in the present moment, willpower, decisiveness, action, determination, and "undertaking" are required" [3, p.269].

"We call "intuition" the elusive thought in its natural state that passes even before words. It is always the first inside us. Our further task is to embody, reveal this intuitive thought – coming from the unknown and returning to unknown, almost always "wise as a cat" – into the slow and inert speech symbols with its "logics", "argumentation", "conscious estimate".

However, logics and argumentation only following the intuition, attempting to rebuild, verify and justify its meaning.

However, its meaning and wisdom aren't in its logic, argumentation, nor in its further explanation; it lies instead in preconscious experience, in the play of dominants granted by the legacy of tradition!" [10, p.332]

Talking about the legacy of tradition, Ukhtomsky was sure that certain traits of worldview and behavior are brought and accumulated from generation to generation, and are thus national. In the sense of cultural continuity this is beyond doubt. Alexey Alexeyevich believed that physiological dominants also can be inherited and compose the historical basis of morality. "Conscience is really an inherited, organic, preconscious legacy of evaluation" [3, p.269].

According to Ukhtomsky, talent in science consists in deepened intuition. It depends on the richness of dominants and their speed of transition, and accordingly on inborn abilities and their correct development.

"Talent is the ability to clearly see the complex dependants and architectonics of thought at once as a whole structure. Suddenly, perspectives open up in thought for linking chains of phenomena and ideas into a single entity, into an integrated image of reality. In further discourse one only needs to lay out, reveal, and provide a clear and compelling explanation to everyone of what was presented to him in the initial integral form. This is the same in mathematics, music, poetry, and any science: philosophy is no exception. This is the "original synthesis" which so surprisingly anticipates links with reality, it's a model of reality about which we can only say whether a given person possesses it or not – as it's an ability of individual nature, and question of giftedness – just like the individual abilities of vision, hearing, and association!" [2, p.139].

## Conclusion

The creative legacy of Ukhtomsky has not yet been exhausted. It must be investigated by the united efforts of psychologists, philosophers, physiologists, mathematicians. The psychologist V.P. Zinchenko persistently insisted on this [25]. As an epigraph to one of his articles on Ukhtomsky, he chose this line from the poet O. Mandelstam: "Yesterday is not yet born".

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