The Mental Mechanism of "Critical Thinking": Disciplined Doubt as the Foundation of Intellectual Autonomy

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Fractal Academy
Issue 5 (Autumn 2026), Article 5
Series: "Mental Mechanisms of the Communicative-Cognitive Framework of Personality: Structure, Foundations, and Pedagogy of Development"
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DOI: [to be assigned]
Publication date: 1.11.2026

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Title (English): «The Mental Mechanism of "Critical Thinking": Disciplined Doubt as the Foundation of Intellectual Autonomy»
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Annotation

In this article I disclose in detail such a mental mechanism as critical thinking, which is one of the key elements of the communicative-cognitive framework of the personality. Drawing on the philosophical tradition from Socrates to Karl Popper, on works in cognitive psychology (D. Kahneman, A. Tversky), as well as on contemporary research in the field of media literacy and argumentation theory, I show that critical thinking represents not simply a skill of working with information, but a fundamental intellectual virtue - the ability and readiness to call into question any assertions, including one's own. I pay special attention to why this mechanism is systematically presented in the modern school in a reduced form, how cognitive biases hinder its development, and in what way its purposeful formation is a necessary condition not only of personal autonomy, but also of the functioning of a democratic society.

Keywords: critical thinking, mental mechanisms, cognitive biases, intellectual virtues, Socratic dialogue, democracy, CCFP.

Doubt as a Craft

In contemporary pedagogical discussions critical thinking is often mentioned as one of the 21st-century skills alongside communication, collaboration and creativity. However, such an enumeration, in my view, is deeply mistaken. Critical thinking is not a skill in the same sense in which the ability to play the piano or to drive an automobile is a skill. It is an intellectual virtue, a mode of existence of the mind, an ethics of thinking. When I include critical thinking in the CCFP model, I have in mind something more than simply the ability to check facts. I have in mind the ability and, what is more important, the readiness to call into question any assertions - including one's own convictions, including authorities, including what is customarily considered obvious. This is not a destructive skepticism that denies everything indiscriminately. It is a disciplined doubt that seeks truth through verification.

In my CCFP model critical thinking occupies a special place. It is closely interwoven with other mental mechanisms: with the construction of cause-and-effect relationships - without critical thinking causal chains are built on unverified assumptions; with information search and analysis - without critical thinking search turns into confirmation of already existing convictions; with Socratic dialogue, which by its nature is critical; with constructive argument, which is impossible without the ability to critically evaluate both one's own and others' arguments [12].

But there is one more, perhaps the most important dimension of critical thinking. As I substantiated in the article on epistemological recursion [12], contemporary neuroscience is stuck in the correlation trap partly because researchers do not subject to critical revision the basic metaphors through which they think. The metaphor of the brain as a computer has become so habitual that it has ceased to be noticed. And what ceases to be noticed also ceases to be checked. Critical thinking is precisely the mechanism that allows the scientific community to break dogmas and give birth to new conceptual frameworks. Without it science turns into an endless solving of puzzles within an exhausted paradigm.

Before turning to the philosophical foundations, I must explicitly designate the place of this mechanism in my model. In the CCFP system, critical thinking is MM-6, and it belongs to the core [14; 15]. The distinction between core and support was introduced in the article on the structure of mental mechanisms [14] and substantiated in the article on epistemological recursion [15]. The core is six mechanisms that constitute the act of solving a difficult problem: MM-1, MM-3, MM-5, MM-6, MM-10, MM-11. Support is five mechanisms without which the core does not work, but which do not constitute the act of solution: MM-2, MM-4, MM-7, MM-8, MM-9. Critical thinking belongs to the

core, because without it the act of solving a difficult problem is logically incomplete: a researcher incapable of deconstructing the axioms of his own paradigm is doomed to normal science. He will brilliantly solve puzzles without noticing that the picture on the box has long ceased to correspond to what is being assembled on the table. Critical thinking is the ability to raise one's eyes from the puzzle and look at the box. And then - to doubt what is depicted on it.

I Know That I Know Nothing

The origins of critical thinking go back to ancient philosophy. Socrates, as Plato describes him, was the embodiment of critical thinking. His famous "I know that I know nothing" is not coquetry and not a pose, but the expression of a fundamental intellectual position: the readiness to call into question any assertions, including one's own [4]. The Socratic method, the elenchus, is a method of critical questioning through which the interlocutor reveals contradictions in his own convictions. Socrates did not give ready-made answers - he asked questions that forced the interlocutor to critically reconsider his positions. This is precisely the essence of critical thinking: not the search for ready-made truths, but constant questioning. Socrates was an inconvenient person. His questions irritated, drove people out of patience, and reduced them to a dead end. And that is precisely why he was condemned. A society that does not love inconvenient questions will always reject critical thinking. This is worth remembering when we speak of the school.

Aristotle systematized critical thinking by creating formal logic. His *Organon* is a toolkit for the analysis of arguments, the identification of logical errors and the evaluation of the well-groundedness of assertions [5]. Aristotle showed that critical thinking is not simply intuition, but a discipline that can and must be studied. Especially important is his doctrine of syllogisms and logical errors, of sophisms. Aristotle showed that thinking can be formally correct but substantively erroneous, and vice versa. This understanding lies at the basis of contemporary critical thinking: what is important is not only what we think, but also how we think. A syllogism is a form into which any content can be poured. And if the form is correct but the content false, the result will be false, but will look convincing. It is precisely on this that all manipulations are built.

Francis Bacon in the *Novum Organum* (1620) formulated the doctrine of idols - systematic errors of thinking that hinder the cognition of truth [6]. He distinguished four types of idols: idols of the tribe, inherent in human nature as a whole (the inclination to see patterns where there are none, to confirm one's convictions); idols of the cave, conditioned by individual experience; idols of the marketplace, arising from the imprecision of language and communication; idols of the theater, imposed by authorities and traditional teachings. This doctrine of Bacon is a direct anticipation of contemporary research on cognitive biases. Bacon showed that critical thinking requires not only the analysis of external assertions, but also critical reflection on one's own thinking. We carry our idols with us, as a snail carries its shell. And in order to see them, one must make an effort - almost a physical one.

René Descartes in the *Meditations on First Philosophy* (1641) brought critical thinking to a radical limit - methodological doubt [7]. He decided to call into question everything that can be called into question, in order to find something absolutely certain. This led him to the famous *cogito ergo sum* - I think, therefore I am. Descartes showed that critical thinking can be not simply an instrument of analysis, but also a method of building knowledge. Through doubt one can arrive at new foundations, more reliable than those that are accepted on faith. It is as if you dismantled a house down to the foundation in order to check what it stands on. Frightening, but sometimes necessary.

John Dewey in his work *How We Think* (1910) formulated the conception of reflective thinking, which became the basis of the contemporary understanding of critical thinking [3]. Dewey defined critical thinking as the active, persistent and careful consideration of a belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends. Dewey emphasized that critical thinking is not simply an intellectual exercise, but a practical necessity. In a democratic society citizens must be able to critically evaluate political decisions, information in the media, and the arguments of politicians. Without critical thinking democracy degenerates into manipulation and populism [3]. Dewey wrote about this more than a century ago, but his words sound as if they were written yesterday.

Karl Popper in *The Logic of Scientific Discovery* (1934) formulated the principle of falsifiability as a criterion of the scientific character of a theory [2]. According to Popper, a scientific theory is not the one that is confirmed by facts, but the one that can be refuted by facts. Critical thinking, thus, is not the search for confirmations, but the search for

refutations. Popper showed that true critical thinking is directed not toward the defense of one's own convictions, but toward their critical verification. A scholar, and any thinking person, must not seek confirmation of his ideas, but actively seek ways of refuting them. Only those ideas that withstand such a verification deserve trust [2]. This sounds simple, but in practice proves almost unfeasible. We are so constituted that we seek confirmations, and not refutations. Popper proposed to go against one's nature. This is difficult. But it is precisely in this difficulty that critical thinking consists.

Two Minds Within One

Daniel Kahneman in his work *Thinking, Fast and Slow* (2011) showed that human thinking is carried out by two systems [1]. System 1 - fast, automatic, intuitive, emotional. It works without effort and constantly. System 2 - slow, analytical, logical, requiring effort. It is switched on only when System 1 encounters a difficulty. Critical thinking is the work of System 2. But Kahneman showed that people systematically prefer System 1, because it requires less effort. This explains why critical thinking is so rarely encountered: it requires a conscious effort that the majority of people are not ready to make [1]. System 1 is the autopilot. System 2 is manual control. Most of the time the autopilot copes. But when there is black ice on the road, the autopilot may drive into the ditch. Critical thinking is the ability to take the wheel in time.

Kahneman and Amos Tversky revealed a multitude of cognitive biases that systematically distort our thinking [10]. Confirmation bias - the tendency to seek, interpret and remember information in such a way that it confirms already existing convictions. This bias makes us blind to facts that contradict our convictions. The anchoring effect - the tendency to rely too strongly on the first information received when making decisions. This makes us vulnerable to manipulation, when the manipulator sets an anchor around which the further discussion is built [10]. The availability effect - the tendency to estimate the probability of events by how easily examples come to mind. We overestimate the probability of vivid but rare events and underestimate the probability of ordinary but statistically more probable ones. Survivorship bias - the tendency to draw conclusions on the basis of only the surviving, successful cases, ignoring those that did not survive [10]. The Dunning-Kruger effect - a cognitive bias in which people with low qualification tend to overestimate their abilities, and people with high qualification to underestimate them. This bias makes especially dangerous people who do not know that they do not know [10].

Contemporary research in the field of social psychology shows that critical thinking is often suppressed by motivated reasoning [11]. This is the tendency to use cognitive processes not for the search for truth, but for the defense of already existing convictions, identity or interests. When a person reasons in a motivated way, he uses all his cognitive abilities not for objective analysis, but in order to find justifications for his position. This makes him especially dangerous, because such a person can be very intelligent, but his intelligence works not for the truth, but for the defense of convictions [11]. Motivated reasoning is an advocate who pretends to be a judge. He knows all the rules, he masters all the procedures, but his goal is not justice, but victory. And the most frightening thing is that he himself may not notice this substitution.

A School That Fears Questions

Critical thinking is a potentially subversive ability. A person accustomed to thinking critically will not blindly submit to authorities, will not accept ideology on faith, will not carry out senseless orders. For the conveyor-belt school, created for the preparation of obedient executors, critical thinking is a threat. That is precisely why in the mass school critical thinking is either ignored or presented in a reduced form - as the skill of working with a text, and not as a mode of existence of the mind [13].

In contemporary educational standards critical thinking is often declared as a goal, but in practice is reduced to a set of formal devices: find the main idea, determine the author's position, adduce arguments for and against. This is not critical thinking - it is its imitation. As research conducted in Chile shows, critical thinking in the teacher-training system often turns out to be an instrumentalized vision, reduced to the level of discourse but not of action, which encourages naive thinking instead of critical, perpetuating the banking and uncritical model of education [11]. The school teaches children to answer questions. But it does not teach them to ask questions. And critical thinking begins precisely with a question. Not with an answer, but with a question. An answer can be learned. A question must be formulated by oneself. And this is far more difficult.

Critical thinking requires asking inconvenient questions - questions that may call into doubt the authority of the teacher, the textbook, the state ideology. In a system where the teacher is a transmitter of truth, and the textbook is a sacred book, such questions are undesirable. That is precisely why in the mass school what is encouraged is not questions, but answers. Not doubt, but confidence. Not criticism, but agreement. This kills critical thinking in the bud [13]. The school is like a person who teaches swimming without letting the child into the water. He shows pictures, explains the theory, requires memorizing the movements. But he does not let one feel the water. And without this the skill is not formed. One can know everything about swimming and not be able to swim. In exactly the same way one can know everything about critical thinking and not be able to think critically.

Cases Where Doubt Saves

One of the most vivid examples of the importance of critical thinking is the story with cold reading, a technique used by fortune-tellers, psychics and pseudo-psychologists. This technique is based on the use of cognitive biases (the Barnum effect, confirmation bias) to create the illusion that the test knows something supernatural about the person. A person with developed critical thinking notices how this technique works. He sees general phrases that can be applied to anyone. He sees how the fortune-teller catches his reactions and adapts to them. And he does not fall for it. Not because he is more intelligent than others. But because he is accustomed to checking.

History knows many examples when the absence of critical thinking led to catastrophes. One of the most tragic is the story with thalidomide in the 1950s-60s. The drug, which was supposed to prevent toxemia in pregnant women, caused thousands of congenital deformities in children. This happened because doctors and regulators did not subject to critical verification the data presented by the manufacturer. They accepted them on faith, because the manufacturer was an authority [13]. Authority is not an argument. It is a label that we attach to a person or institution in order not to check what they say. But authorities make mistakes. Sometimes - catastrophically.

In everyday life critical thinking saves us from a multitude of traps: from financial pyramids, from false advertising, from manipulation in relationships, from false medical advice. A person with developed critical thinking will not believe in a miracle cure for all diseases, will not invest money in a guaranteed profitable scheme, and will not spread fake news [13]. This does not mean that he is a cynic. It means that he checks. And this makes his life calmer and safer.

The Craft of Doubt

The first and main principle of the development of critical thinking is the habit of always asking "why." Why is this assertion true? On what grounds is it based? What alternative explanations are there? Who asserts this, and what is his interest? This does not mean being cynical or distrustful of everything. It means not accepting anything on faith without verification [9].

The second principle is the habit of seeking refutations, and not confirmations. As Karl Popper showed, a scientific theory is the one that can be refuted [2]. Critical thinking requires not seeking confirmation of one's convictions, but actively seeking ways of refuting them. This is especially important for overcoming confirmation bias. When we seek refutations, we become less blind to facts that contradict our convictions [2].

The third principle is the habit of checking sources. Who asserts this? What is his qualification? Does he have a conflict of interest? What other sources are there, and what do they say? In the era of the internet, when anyone can publish anything, this principle becomes especially important [9]. Formerly information was filtered by editorial boards and publishing houses. Now there is no filter. Everyone is his own editor. And everyone is his own censor. But not everyone knows how to be a censor.

The fourth principle is the habit of distinguishing facts and interpretations. A fact is what can be checked and confirmed. An interpretation is how we understand this fact. Critical thinking requires a clear distinction of these two levels. This is especially important for overcoming confirmation bias and the anchoring effect [10]. A fact is a brick. An interpretation is a building. From the same bricks different buildings can be built. And the question is not only which bricks we use, but also what form we give them.

The fifth, and perhaps the most difficult, principle is the habit of calling into question one's own convictions. This requires intellectual modesty and courage. But it is precisely this principle that distinguishes true critical thinking

from pseudo-skepticism [9]. A pseudo-skeptic calls into question everything except his own convictions. A true critical thinker calls into question everything - including himself. This is like trying to look at yourself without a mirror. Difficult, almost impossible. But necessary. Because without this we remain blind to our own idols.

Critical thinking must be integrated into subject instruction. In history lessons - through the analysis of sources and interpretations [13]. In logic lessons - through the study of the formal rules of reasoning [16]. In extracurricular activity - through debates and discussion clubs [17]. Critical thinking is not a separate subject. It is a way of thinking about any subject. It is like salt, which does not replace food but makes it tasty. Without salt food is insipid. Without critical thinking knowledge is dead.

From Faith to Verification

For pedagogical diagnostics it is important to distinguish the levels of development of critical thinking [13]. At the initial level the student accepts information on faith, does not ask questions, and does not distinguish facts from interpretations. Example: this is true because it is written on the internet. At the basic level the student asks questions, but only about others' assertions, not about his own; he distinguishes facts from interpretations, but does not always check sources. Example: this may be untrue, because the source is unknown. At the developed level the student calls into question both others' and his own assertions; actively seeks alternative explanations; checks sources; distinguishes facts, interpretations and opinions. Example: this assertion may be true, but I need to check other sources and consider alternative explanations. Also I must acknowledge that I have my own prejudices that may influence my evaluation. At the expert level the student systematically subjects to critical verification all assertions, including his own; identifies hidden assumptions, logical errors and cognitive biases; is able to change his convictions under the pressure of arguments; uses critical thinking as a mode of existence of the mind. Example: the ability to conduct a complex interdisciplinary analysis, to identify hidden ideological presuppositions in scientific theories, to participate constructively in scientific discussions, and to acknowledge one's errors and change position.

Critical thinking is connected with each of the other mental mechanisms [12]. With the construction of cause-and-effect relationships - without critical thinking cause-and-effect chains are built on unverified assumptions. With information search and analysis - without critical thinking the search for information turns into confirmation of already existing convictions. With Socratic dialogue - which by its nature is critical. With constructive argument - which is impossible without the ability to critically evaluate both one's own and others' arguments. With emotional intelligence - critical thinking requires the ability to separate emotions from arguments. With forecasting - forecasting requires a critical evaluation of the assumptions on which forecasts are based. Critical thinking is not a separate muscle. It is a joint that connects different movements. Without it there are movements, but they do not add up into a dance.

How to Measure Progress

To assess a student's progress in the development of critical thinking, I propose to use dynamic diagnostics - an assessment not of a static level of knowledge, but of progress in the development of a skill. The principle of dynamic diagnostics, substantiated in a separate article [18], means that we assess not whether the student is able to think critically, but how his ability to call assertions into question and to check sources has changed over the past six months. This requires the fixing of reference points and regular comparison - which can be done with the help of specially designed tasks and, in perspective, with the use of artificial intelligence.

An example of a diagnostic task: the analysis of an assertion. The student is offered an assertion (for example, vitamin C prevents colds) and is asked to determine whether it is a fact, an interpretation or an opinion; to find sources confirming and refuting this assertion; to evaluate the reliability of the sources; to formulate his own conclusion with an indication of the grounds. What is assessed is not the correctness of the answer, but the depth of analysis, the taking into account of alternative points of view, the checking of sources, and the distinction of facts and interpretations [9]. A second task: the identification of logical errors. The student is offered a text with logical errors (for example, all politicians lie; Ivan is a politician; therefore, Ivan lies). The student must find the logical errors, explain why they are errors, and propose how a better-grounded reasoning could be constructed [5]. A third task: the critical analysis of one's own position. The student is asked to choose his own conviction (for example, the death penalty should be abolished) and to formulate arguments against this position, to evaluate how well-grounded these arguments are, and to determine whether he is ready to change his position under the pressure of arguments. This

task is especially important, because it trains intellectual modesty and the readiness to change one's convictions - the key virtues of critical thinking [9].

For the collection and analysis of data on the development of critical thinking, I propose to use artificial intelligence [18]. AI could analyze students' answers, identify patterns, track dynamics and propose individual recommendations. This is especially important for the individualization of learning. Each student develops in his own way, and AI could help the teacher understand which particular aspects of critical thinking need to be developed in each specific student [18]. But here I must make a caveat. Artificial intelligence will not replace the teacher. It can help to see patterns, but it cannot replace the living person who asks questions. Critical thinking is formed in dialogue. And dialogue is what the machine does not yet know how to do. At least, for now.

Freedom from One's Own Prejudices

Critical thinking is not simply a skill or a competence. It is the path to freedom - to freedom from manipulation, from dogmas, from cognitive biases, from one's own prejudices. A person with developed critical thinking is not a cynic or a skeptic. He is a free thinker - one who is able to independently evaluate information, make well-grounded decisions, and change his convictions under the pressure of arguments. That is precisely why the development of critical thinking is one of the key tasks of my pedagogical model [12]. It is not an additional skill, but a necessary part of the communicative-cognitive framework of the personality.

It is important to connect the development of critical thinking with democratic culture. Democracy requires citizens capable of analyzing political decisions, understanding their causes and consequences, and critically evaluating information. Without this democracy degenerates into manipulation and populism [3]. John Dewey, one of the greatest philosophers of education, wrote that democracy is not simply a form of government, but a way of life requiring educated, thinking citizens. It is precisely such citizens that the CCFP model prepares. In the era of post-truth, when facts lose their significance and emotions and convictions become the main driving forces of politics, critical thinking becomes not simply a desirable quality, but a necessary condition of the survival of democracy [3].

Critical thinking is not only the foundation of democracy, but also the foundation of science. Science moves not by the accumulation of facts, but by the critical verification of hypotheses. As Karl Popper showed, a scientific theory is the one that can be refuted [2]. Critical thinking is precisely the mechanism that allows science to move forward, rejecting false hypotheses and accepting those that withstand verification. Critical thinking is especially important for overcoming the reproducibility crisis in contemporary science. Many scientific results cannot be reproduced, because researchers do not subject to critical verification their methods, data and interpretations. The development of critical thinking in future scholars is a necessary condition for overcoming this crisis [12]. Science without critical thinking turns into a collection of sacred texts. And sacred texts are not checked. They are interpreted. And the interpretation can be any. Critical thinking is what keeps science from turning into religion.

As Immanuel Kant precisely formulated it in his famous essay *What Is Enlightenment?*: Enlightenment is man's emergence from his self-incurred immaturity. Immaturity is the inability to use one's own understanding without the guidance of another [8]. Critical thinking is precisely the instrument that allows us to emerge from this immaturity and to become truly free. Kant wrote this in 1784, but his words sound as if they were written yesterday. Because the problem is not in the epoch. The problem is in us. We voluntarily give our understanding over to another's guidance. We prefer ready-made answers to difficult questions. We choose convenience instead of freedom. Critical thinking is a reminder that freedom is possible. But it requires effort. And this effort must be made every day. Like exercise for the mind. Like the hygiene of thought. Without this the mind atrophies. And then we become what Kant warned about: immature by our own fault.

References to Primary Sources

1. Kahneman D. Thinking, Fast and Slow. - Moscow: AST, 2014.
2. Popper K. The Logic of Scientific Discovery. - Moscow: Progress, 1983.
3. Dewey J. How We Think. - Moscow: Pedagogika-Press, 2000.

4. Plato. Apology of Socrates // Collected Works in Four Volumes. Volume 1. - Moscow: Mysl, 1990.
5. Aristotle. Organon. - Moscow: Mysl, 1978.
6. Bacon F. Novum Organum. - Moscow: Mysl, 1978.
7. Descartes R. Meditations on First Philosophy. - Moscow: Mysl, 1989.
8. Kant I. What Is Enlightenment? // Collected Works in Eight Volumes. Volume 8. - Moscow: Mysl, 1994.
9. Paul R., Elder L. Critical Thinking: Tools for Taking Charge of Your Professional and Personal Life. - FT Press, 2006.
10. Tversky A., Kahneman D. Judgment under Uncertainty: Heuristics and Biases // Science. - 1974. - Vol. 185, No. 4157. - P. 1124-1131.
11. Valenzuela Baeza C. Suppress to oppress: Critical thinking and its presence in a competency-based curriculum // Revista de la educación superior. - 2024. - Vol. 53, No. 210. - P. 23-36.
12. Kleymenov A. Epistemological Recursion in Cognitive Science: Mental Mechanisms as an Instrument for Overcoming the "Hard Problem" of Consciousness // Fractal Academy. - 2026. - Issue 3. - Art. 1. https://fractal-academy.com/articles/article-3-1/
13. Kleymenov A. History: Causality, Multiplicity of Interpretations and Strategic Thinking // Fractal Academy. - 2026. - Issue 4. - Art. 10. https://fractal-academy.com/articles/article-4-10/
14. Kleymenov A. Basic Mental Mechanisms: The Structure of the Communicative-Cognitive Framework of the Personality // Fractal Academy. - 2026. - Issue 1. - Art. 5. https://fractal-academy.com/articles/article-1-5/
15. Kleymenov A. New Subjects: Logic, Rhetoric, Psychology, Project Activity // Fractal Academy. - 2026. - Issue 4. - Art. 15. https://fractal-academy.com/articles/article-4-15/
16. Kleymenov A. Extracurricular Activity as a Space for the Development of Mental Mechanisms // Fractal Academy. - 2026. - Issue 4. - Art. 16. https://fractal-academy.com/articles/article-4-16/
17. Kleymenov A. Diagnostics and Development of Mental Mechanisms: From Theory to Pedagogical Practice // Fractal Academy. - 2026. - Issue 1. - Art. 6. https://fractal-academy.com/articles/article-1-6/
18. Kleymenov A. The Reasons for the Viability of Contemporary Pedagogical Practice: Institutional Inertia and Conservative Stability // Fractal Academy. - 2026. - Issue 1. - Art. 2. https://fractal-academy.com/articles/article-1-2/

Conflict of Interest
The author declares no conflict of interest related to the publication of this article.

Funding
The research was conducted without external funding.

Data Availability Statement
The data discussed in the article are contained in the text of the publication. Additional materials can be requested from the author.

Author Contributions
Aleksandr Kleymenov - concept, research, text writing, final editing.

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