

# Critical Thinking in the Context of Embodied Cognition: A Review of Research and its Pedagogical Potential

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The article presents an overview of current research on critical thinking based on the hypothesis of embodied cognition and representing the so-called non-Cartesian approach to thinking, in which the rational and the sensual do not act independently from each other, but as a closely related group of processes. Despite the fact that the topic of critical thinking is yet in the process of formation, the review is systematic and contains indications of two main directions, their theoretical guidelines and methodological guidelines. A comparison of the identified approaches makes it possible to identify the mechanisms that are key to any embodied version of the critical thinking model: an individual's sensitivity to his own explicit and implicit epistemic signals, or dispositional attentiveness, and emotional non-activity. It is shown that interdisciplinary transfer in this topic is problematic: knowledge produced in the psychological framework of embodied cognition research is inherently different from knowledge that allows improving the learning process of critical thinking. The results obtained open up prospects for further research and ways to reorganize pedagogical practice in the field of teaching critical thinking.

**Keywords:** critical thinking; critical thinking development; embodied cognition; somatic markers; non-Cartesian cognition; executive functions; micro-phenomenology; emotional reactivity; epistemic inhibition; metacognitive skills; metacognitive awareness.

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# Критическое мышление в контексте воплощенного познания: обзор исследований и их педагогический потенциал

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В статье представлен обзор современных исследований критического мышления, опирающихся на гипотезу воплощенного познания и представляющих собой так называемый некартезианский подход к мышлению, в котором рациональное и чувственное выступают не автономно друг от друга, а в виде тесно связанной группы процессов. Несмотря на то, что тема критического мышления в данном исследовательском направлении находится в стадии формирования, обзор носит систематический характер и содержит указания на два основных направления, их теоретические ориентиры и методологические установки. Сравнение выявленных подходов позволяет определить механизмы, являющиеся ключевыми для любой воплощенной версии модели критического мышления: чувствительность индивида к собственным явным и неявным эпистемическим сигналам, или диспозиционная внимательность, и эмоциональная нереактивность. Показано, что междисциплинарный перенос в данной теме является проблематичным: знание, произведенное в психологических рамках исследований воплощенного познания, по своей сути отличается от знаний, позволяющих усовершенствовать процесс обучения критическому мышлению. Полученные результаты открывают перспективы дальнейших исследований и способов реорганизации педагогической практики в сфере обучения критическому мышлению.

**Ключевые слова:** критическое мышление; развитие критического мышления; гипотеза воплощенного познания; гипотеза соматических маркеров; некартезианские модели познания; управляющие функции; микрофеноменология; эмоциональная реактивность; эпистемическое торможение; метакогнитивные навыки; метакогнитивная осознанность.

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## **Введение**

The influence of Descartes on the development of mind theory is difficult to overestimate. J. Searle notes that the cartesian tradition not only left a dualistic legacy for mind science, but also formed the basis of what opposes the dualistic worldview [57]. Contemporary models of cognitive architectures, which seem very far from Descartes' views, still retain references to him, at least in their name — non-cartesian architectures [21; 40; 60]. Non-cartesian models do not consider rationality the antithesis of materiality, so mind and body are not presented as separate entities (in contrast to the central thesis of cartesian theory). This term, non-cartesian mind, informally indicates a set of hypotheses that expand the concept of mind beyond internal cognitive processes. The embedded cognition hypothesis, that follows the ecological approach in psychology, suggests that the complexity of internal cognitive operations can be reduced by relying on appropriate structures in the environment. The extended cognition based on the idea that specific objects in the environment can function as a part of the human cognitive architecture. The hypothesis of enacted cognition interprets consciousness as a property of a living system that is formed at the boundaries between the body and the outside world due to the accumulation and configuration of individual experience. In this article, we consider the fourth of such hypotheses included in the corpus of concepts 4E, which has less externalism orientations and is associated with the inclusion of cognitive processes in the "body context". This is the hypothesis of embodied cognition [11; 20], which completely refutes the thesis of mind and body separability and asserts that at least some mental processes are consti-

tuted not only by brain processes, but by a combination of these and broader physical processes.

If the problem of critical thinking can be presented within the framework of a cartesian and non-cartesian approach, then the former is reflected in many publications [2; 5; 6; 7; 8; 11; 12; 13; 15 et al.], while the second is practically not represented in Russian literature. So, for example, a critical thinker is called someone who is focused on the search for truth and is able to "exclude the area of the irrational" [2, p. 128], who is familiar with the operation of methodical doubt [13, p. 1], who strives to "make their thinking more perfect" [15, p. 133]. As for the "embodied" mechanisms of critical thinking, mostly they are interpreted through the analysis of cognitive biases, that is, systematic deviations in reasoning that are natural for many people [3; 5]. This topic is wildly discussed in global academic literature [22; 32; 38]. On the one hand, attention to such deviations serves as a good reminder that the processes of reasoning are immersed in a body context. On the other hand, such an approach is not truly non-cartesian, and for an untrained reader it probably supports the dualistic worldview: the critical mind is opposed to the "uncritical" body, which, as it were, hinders thinking, distorting cognitive activity with various unconscious biases.

All this allows us to formulate several questions: is it possible to merge critical thinking and the non-cartesian paradigm? If so, how exactly can this help us strengthen or expand the understanding of critical thinking? If not, does this mean that critical thinking is out of current paradigm? In this article, we propose to focus on studies in which critical thinking is interpreted not through the opposition or hierarchy of ratio-

nal and sensual, but through their synthesis. On the one hand, there is a potential for such new theories. On the other hand, the development of such theories has practical relevance for improving teaching methods and critical thinking, which, as is known, is one of the goals of school education and constitutes the first universal competence in Russian higher education standards.

### **Non-cartesian models of cognition: historical background**

It is not difficult to find reflections of the cartesian worldview in the way humanity has organized traditional education processes. For example, this can be seen in the approach to learning, according to which knowledge is a prerequisite for practice, that is, mastering knowledge must precede its application. In this regard, D. Lorillard notes that in the UK the vast majority of academic time is spent not on activities in this field, but on working with analogies, historical reports, criticism, statistics, case studies, diagrams [39, p. 55]. It is this attitude that has been challenged by such pedagogical strategies as, for example, problem-oriented learning, in which the acquisition of knowledge occurs in the process of solving a specific problem, when the need for new information precedes its receipt. And yet, what D. Lorillard's remarks were aimed at is in some way consistent with the ideas of classical philosophy about the sublimity of theoretical knowledge in relation to everyday practical problems. However, what seems to be overlooked here is that in philosophy, formalized theoretical knowledge is the result of abstraction from a particular experiential manifestation, and not the initial condition of this experience. Criticism of D. Lorillard is not a problem of one author. For ex-

ample, M. Nathan designates the problem as FF-approach (formalism-first) [43; 44], and A. Glenberg, D. Schwartz, T. Martin and N. Nasir are opposing second-hand learning (description of experience) to first-hand learning (direct experience) [30; 56]. Regardless of the chosen vocabulary, the described approach illustrates how the mindset of dualism manifests itself in the separation of getting knowledge and applying of knowledge. This creates the illusion that one of these two processes is primary or more important in learning, while the fundamental assumption uniting the critics' comments is that these processes are fundamentally inseparable from each other.

A. Damasio devoted a significant part of his scientific career to refuting this assumption. In 1994, in *Descartes' Error* [23], he proposed to reconsider the relationship between mind and emotions basing on evolutionary neuropsychology. The hypothesized that emotions do not oppose thinking open up the very possibility of acting intelligently without thinking about it. The most famous example is fear, that is, a program of emotional actions that can quickly lead a person away from danger with little or no help from the mind. From Damasio's point of view, the reasoning system evolved as an extension of the automatic emotional system. This point of view is based on data from several years of studying people whose behavior was changed as a result of brain damage in a certain sector of the frontal lobe. Observations of these patients eventually led to another important idea, which is the notion that brain systems that are jointly involved in emotions and decision-making are constantly involved in the management of cognition and social behavior. Dama-

sio's concept has become the subject of a lengthy debate. One side made a rhetorical proposal to rename the publication the "Damasio's Error", and if it is impossible to ignore its results, then at least try to introduce experimental data into the Cartesian model. Such were the debates between A. Damasio and D. Kirkeben [24; 25; 35; 36]. Another part of the academic community, on the contrary, supported the revision of the idea of mutual autonomy of the sensual and rational [17; 52], as a result of which today in some areas of science, for example, in the economics of decision-making, statements about the connection of emotions with reasoning have generally ceased to be considered unusual. Among the supporters, fD. Dennett noted that Damasio does not reduce the human mind to flows of hormones and neuromodulators, but offers a model of mechanisms that support and implement this human activity, turn the "miracle" of thinking into an object of scientific knowledge [29, p. 4]. Then, in "Looking for Spinoza" [26], Damasio tried to revive the Spinosian doctrine of affects within the framework of neurobiology. Now not only emotions, but also feelings are an integral part of how we think. He believes that most ideas a person has are formed from messages coming from "his own body", and that the idea of himself is a combination of the perception of an object with the perception of own body. Already in 2018, when asked how the mind came about, A. Damasio gives this answer: we have a mind not only because we have a nervous system, but because everything else is there — from the skeleton to sensory experiences [27].

A. Damasio's concept was called the somatic markers hypothesis, that is, psychophysiological signals about the

work of the decision-making mechanism. However, the body context of rationality is not a problem of one author. Neuroscientists support this position, pointing out that emotions are part of reasoning, not a distraction that disrupts the "cold" rational process, and that the mechanisms of emotion and cognition are intertwined at all stages of stimulus processing, and their distinction may be difficult [47, p. 46]. Many works of recent decades show various aspects of the body (and in some versions even out-of-body [34; 50; 51]) contribution to cognitive processes. It is fair to note that Damasio was not the first defender of the hypothesis of embodied cognition. For example, the influence of body movement on the formation of abstract concepts expressed using metaphors was considered back in 1980 [37]. And yet, such works, unlike Damasio, to a lesser extent claimed the status of a fundamental concept of mind activity, taking into account the body contribution. Thanks to all these studies, we now know that cognitive processing of information about actions activates the same neural regions that are responsible for performing these same actions, and that understanding as an example of the highest function of thinking is not an out-of-body process [45; 48; 49; 59], and in 2023, a team of scientists from Germany, Italy, France and Russia presented a consensus report on when and how perceptual processes are involved in cognitive ones [18]. Affirming the importance of emotions does not mean that emotions are more important than analytical procedures in the process of thinking, or that emotions alone are the source of correct judgments, but it means that emotions play an important role in how critical thinking is implemented.

### **Critical thinking as an executive function**

Critical thinking can be considered as an executive function or a set of such functions [28; 41; 42]. The executive functions are cognitive processes that regulate, control and manage other cognitive processes: working memory, attention, cognitive flexibility, inhibitory control, planning, search and correction of errors [4, p. 22]. Unlike other terms through which different sciences refer to the idea of rationality, executive processes are not opposed to emotional regulation, and the relationship between them is widely studied in neuropsychology.

Based on modern research in this area, we can note that in some concepts, brain processes, including the ones that are related to emotions, set the conditions for the implementation of critical reasoning. Some researchers refer to such processes as dispositional mindfulness (or dispositional awareness) and non-reactivity [41]. Dispositional mindfulness is a term denoting a person's ability to focus on the present moment, momentary experiences, feelings and needs. Within the framework of research on critical thinking, it is important to assume that this process is responsible for detecting affective signals that are usually overlooked and which indicate that the current state of a person does not correspond to his target state [46]. This, in turn, allows to launch mechanisms for monitoring conflicts that arise in the process of information processing and signal the need for control and intervention in background cognitive processes [19; 58]. Non-reactivity, on the contrary, is a control aimed at suppressing affective signals, which allows you to start regulating emotions before the reaction becomes too intense [41; 46]. In some recent studies, the ability to update information stored in work-

ing memory and to intentionally suppress certain emotions are defined as neuropsychological predictors of critical thinking [41].

Thus, the involvement of emotions in the processes of critical thinking can be bidirectional: on the one hand, emotions allow us to fix conflicts that indicate the need to regulate reasoning, and on the other hand, the "inhibition" of affective reactions allows you to avoid quick conclusions and subject these conflicts to slow analysis. When viewed in this way, the rational and the sensual do not act independently of each other, but as a closely related group of processes that trigger critical thinking. Different combinations of these two functions can express a variety of critical thinking strategies due to several variables, the extremes of which are high or low sensitivity to epistemic conflicts, reactivity or non-reactivity.

From this point of view, the ideal critical thinker appears to be a person with a high sensitivity to conflicts and low reactivity, which suggests that the conditions for the implementation of acts of critical thinking are not the same for people with different levels of emotional reactivity.

### **Critical thinking as phenomenological awareness**

The ideas about the importance of dispositional mindfulness and non-reactivity for critical thinking largely echo the position presented by researchers at the ECT (Embodied Critical Thinking) Centre, which was opened in 2018 at the Institute of Philosophy of the University of Iceland. Defining the reinterpretation of critical thinking in terms of the hypothesis of embodied cognition as the main task of the Centre, the team addresses the question of how exactly ideas resonate in sensory experience and suggests several strategies.

D. Schoeller focuses on phenomenological awareness [53; 54; 55], that is, the ability to track a person's individual experience in the context of making a critical decision. The author notes that traditional approaches to critical thinking are based on a process of gradual detachment from subjective, sensual and emotional factors. The gap between a person's life experience and the expected "correct knowledge" seems to be a suitable explanation for the processes of opinions polarization in modern society. The tradition of dividing knowledge into "objective" and "subjective" has a long history, but in the modern world a person often has to process large amounts of information in a very limited time and rely on implicit meanings, images, intuitions. Hence, it arises a paradoxical tension: a person is tacitly asked to think without the participation of his life experience, feelings, situational context, which seem to be necessary for thinking. For example, we use conventional language to explain our unique experiences and our implicit knowledge, and notice that existing concepts do not fit. A state in which we understand that words do not quite correspond to what we want to say, and which is fundamentally important for a critical thinker, is also a sensual state. Thus, the development of critical thinking is not working with knowledge exclusively, but also with the experience of relevant others [31]. The point of view presented by the researchers shows the internal orientation of dispositional mindfulness in micro-phenomenological terms. Micro-phenomenology begins with the premise that attention to our experience and its formulation is an unusual action, prone to distraction and confusion, and therefore requires effort [31], and unlike other phenomenological approaches, it is aimed at very

short periods of experience. Directing our attention to our sense of situational context to how we *feel* the situation does not mean that the practice of such thinking implies unconditional trust in our own emotions, feelings and intuition. G.R. Johannesdotir, combining these commentaries, defines critical thinking as a transition from embodied perception to verbal thinking through analysis our reactions to current cognitive situations [33, p. 335].

### **"Embodied" Critical Thinking: the problem of interdisciplinary transfer**

The synthesis of the embodied cognition hypothesis and the critical thinking is possible, although the question of how exactly we should understand such integration remains unclear. For example, the claim that critical thinking control centres develop in the prefrontal cortex is not opposed by science today. However, by itself, the statement of scientific facts does not bring practical benefits for teachers engaged in the development of critical thinking. How exactly should knowledge of this fact be reflected in the programs of critical thinking classes? What can a teacher do with this statement, other than just to know it? In our understanding, interdisciplinarity does not consist in referring to theses from related disciplines, but in developing new theses that are equally useful in different sciences. Based on the presented results, it can be assumed that from the point of view of embodied cognition, the practice of developing critical thinking may be more effective if some additional factors are taken into account.

Firstly, if the acts of critical thinking are not universal, then their implementation requires the individuals to be aware of how their own reaction and sensitivity

systems are arranged, and this awareness is a condition of critical thinking, that is, it precedes it. In other words, the strategy for developing critical thinking skills may be different depending on the initial characteristics of the degree of emotional reactivity of students, which can be measured, for example, using the Perth scale [10]. From the standpoint of pedagogy, this assumption can be embedded in the idea of individual learning trajectories. The higher the reactivity, the more difficult it is to apply critical thinking skills, therefore, the longer and slower the learning process of these skills will be. However, it is premature to describe this assumption as a pattern, and the measure in which this indicator becomes significant for critical thinking requires preliminary research. Obviously, the lack of reactivity in general can weaken not only emotional reactions, but also the desire for critical analysis. This happened in 2016 with a study by K. Noone, B. Bunting and M.J. Hogan (reactivity was measured using the FFMQ-SF). Contrary to their hypothesis, the researchers found that lack of reactivity has a negative relationship with critical thinking. It is possible that the measure of non-activity used in the study reflects a tendency towards inoperable processing that goes beyond just emotional signals; the questionnaire questions used to assess non-activity focus on the ability to get rid of experiences, rather than persist in them [46, p. 11].

Secondly, the development of critical thinking can be combined with general training of emotional non-reactivity. It is believed that the latter depends on the quality of sleep and the level of anxiety, which are problematic for students, but it is also trained by mindfulness exercises, commonly used in stress therapy [61], and

meditative practices aimed at emotional and cognitive control. Currently, techniques for developing mindfulness in the framework of psychological support are widely discussed in Russia [8; 16], improving academic performance [1], developing creativity and creative potential [14], and it seems appropriate to expand these studies into the field of critical thinking.

Thirdly, the literature review does not allow us to answer the question whether such process as epistemic inhibition exists and what special properties it has. It is this kind of regulation that seems to be fundamentally important for building non-cartesian models of critical thinking. Learning how to formulate logical inference, one of the main skills of critical thinking, seems incomplete without reverse training in “inhibition”, or, to put it more academically, the practice of suspended judgment. This proposal follows from the analysis of the emotional contribution to the reasoning process, but it becomes especially relevant in the social context. The digital world contains more information than all the libraries in the world, and most of the information comes from unverified sources and is not reliable. A critical understanding of all the information and sources we come across would completely paralyse us, because we would never have time to really read valuable information. Investing critical thinking in sources that should have been ignored initially means that unscrupulous informants got exactly what they wanted, our attention. It is also known that the main tool of the information market is emotions, and therefore the practice of “epistemic inhibition” becomes significant.

## Conclusions

Our review of the highlighted topic shows that critical thinking can be de-



scribed as embodied cognitive activity. The results of the analysis make it possible to assert that the emotional and sensual contribution to the reasoning process can be considered as part of the mechanism of critical thinking, and not its antithesis. The materials indicate that it is premature to talk about an accurate description of embodied critical thinking, but some of its features are already beginning to manifest themselves.

These transformations are of particular importance for the practice of teaching critical thinking. If the traditional focus on logical analysis skills is shifting towards reflexive analysis of sensory experiences and emotional self-regulation, then the pedagogical technique is also changing. This means that in the future, critical thinking classes may include, for example, measurements of emotional reactivity, and training programs will be adapted to the individual characteristics of students.

From the point of view of the concept of executive functions, these processes can take place in the background, while the concept of critical thinking as phenomenological awareness comes from the idea of their reflexive accessibility. Regardless of the orientation of the concept, as shown in this article, emotions are involved in critical thinking in two directions. On the one hand, they are active when they allow you to fix conflicts that indicate the need to regulate the ongoing reasoning process. On the other hand, they are passive when affective reactions are “inhibited”, and passivity in this case does not mean the absence of emotions as such, but their specific state.

As a conclusion, it is possible to clarify the concepts that in this study were identified as significant for further research of embodied models of critical thinking. Dis-

positional mindfulness is a form of reflection characterized by a purposeful concentration of attention on the experience received at the current moment. The dispositionality component clearly indicates that such reflection is related to a person's predispositions to distribute attention and refers to “higher dispositions” related to the value orientations of an individual. This does not mean that attentiveness to the present is not trainable, but both the terminological and substantive aspects of mindfulness, essential for critical thinking, have yet to be determined in further research.

Dispositional mindfulness is a general psychological term, not a term specifically for theories of critical thinking. For this area, attention to epistemic conflicts will be more specific, that is, the ability to recognize the signals of the current situation indicating the need for critical intervention. Unlike other forms of metacognitive regulation, epistemic processes are associated with solving only one group of tasks, namely, establishing the degree of reliability of information (attribution of truth, falsity, uncertainty, fixation of ignorance or recognition of delusion). If we consider critical thinking as a method by which such tasks are solved, then dispositional attention can be expressed by such questions as “Why does this seem convincing to me now?”, “What in the current environment pushes me to this decision?”, “Is my decision justified by current experience or is it more familiar, what is the reason?”. The ability of an individual to postpone making a decision, even when it seems obvious, and to dwell on such issues has been designated by the term “non-activity”. The hypothesis of embodied cognition asserts that such an epistemic process is not always con-

scious, and therefore some of these signals remain implicit. Explicit signals (for example, the apparent inconsistency of a message or the expectation of bias from an informant) are much more studied in both pedagogical and psychological concepts of critical thinking. The training of recognizing such signals involves critical thinking. However, non-cartesian models of critical thinking admit that implicit signals can also be useful for critical thinking. This thesis is generally accepted in relation to expert thinking, and by analogy it can be assumed that implicit signals are associated with critical intuition — a concept that is also of interest for future research in this direction. It can be said, so far as a preliminary assumption, that the higher the sensitivity to such signals, the more implicit signals become explicit, as they move from the field of intuition to the field of dispositional attention.

The research questions that were indicated at the beginning of the article, can be answered now. There is definitely a point of contact between critical thinking and the non-cartesian mind paradigm, although this scientific direction is only forming currently. This direction complements the

interpretation of critical thinking with reflection on sensory experience and expands the practice of teaching critical thinking through ideas about training different ways of emotional response. The very fact that the concept of critical thinking can be formulated based on different foundations of psychological knowledge means that the scientific problem is not alien to the current paradigm.

The question of whether critical thinking turns into an extra-paradigm problem disappears, but the question of how exactly the hypothesis of embodied cognition can improve our practice of teaching critical thinking remains. The considerations on the transfer of the results of psychological research into the field of pedagogical practice, proposed in the article, serve rather as an illustration of the fact that such a conceptual synthesis is not fundamentally impossible. However, the boundaries of such a transfer are not currently defined. All this indicates that the development and further empirical verification of “embodied” models of critical thinking is not a solution to a scientific question, but a way to pose new and correct existing issues in the field of education.

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