Edgar Morin: "Complex Thinking" Against Reductionism

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Abstract

In this article, I turn to the philosophical tradition that explains why the old tools of neuroscience do not work. If the hard problem of consciousness is a paradigmatic problem (Article 1), then its solution requires not just "more data," but a different way of thinking. Edgar Morin, the French philosopher and author of the concept of "complex thinking" (*pensée complexe*), shows that reductionism, which dominates modern science, is fundamentally incapable of understanding complex systems. He formulates three principles of complex thinking: the dialogic principle (holding contradictions), the principle of organizational recursion (when products and producers generate each other), and the holographic principle (when each part contains information about the whole). I show that these three principles serve as the philosophical justification for the six requirements (Article 1) and the six core mechanisms (Article 5) of my model. Without Morin, the requirements would be an arbitrary list; with him, they become a concretization of complex thinking applied to the task of solving the hard problem. Thus, Article 3 lays the groundwork for the transition to Article 4 (von Foerster), which will show that the observer is part of the observed system.

Keywords: complex thinking, reductionism, emergence, dialogic principle, organizational recursion, holographic principle, transdisciplinarity, Edgar Morin, communicative-cognitive framework of personality, mental mechanisms.

Introduction: Why Old Tools Do Not Work

In previous articles, I traced the path from the formulation of the problem (Article 1, Chalmers) through the response to pessimism (Articles 2 and 9, McGinn and Vygotsky) to the recognition of limits (Article 10, Chernigovskaya). Now I approach the question that has remained in the shadows until now: why can modern neuroscience not solve the hard problem, even if it has all the necessary data?

The answer is provided by Edgar Morin, the French philosopher and sociologist, born in 1921. At the time of writing this article, he is 105 years old and continues to be one of the most influential thinkers of our time. In 1977, he published the first volume of his magnum opus, *La Méthode* (The Method) [6], and in 1990, the book *Introduction à la pensée complexe* (Introduction to Complex Thinking) [1]. This relatively short work became a manifesto for an entire intellectual movement.

Morin grew up in an era when science was experiencing a period of triumphant reductionism. It seemed that any complex object could be understood by breaking it down into simple parts. Physics was reduced to particles, biology to molecules, psychology to neurons. Scientists believed: if we study the details in sufficient detail, we will understand the whole. Morin said: "No. This is an illusion." And he dedicated his life to proving that the complex cannot be understood through simplification. That the whole is not merely the sum of its parts. That understanding complexity requires a fundamentally different cognitive apparatus.

Here it is appropriate to recall the ancient parable of the blind men and the elephant. Several blind sages approached an elephant. One touched the trunk and said, "An elephant is a snake." Another touched the ear and said, "An elephant is a fan." A third touched the leg and said, "An elephant is a pillar." A fourth touched the tusk and said, "An elephant is a spear." Each was right in their own way, but no one saw the elephant as a whole. Morin says: modern science is a gathering of blind sages. The neurobiologist holds the trunk, the cognitive scientist holds the ear, the philosopher holds the tusk. Each sees their own part, but no one sees the whole. Moreover, they do not talk to each other because they speak different languages. It is precisely this fragmentation that Morin calls the main disease of modern science. And it is precisely this that he attempts to overcome through "complex thinking."

Reductionism: The Great Illusion of Science

To understand what Morin rebelled against, one must understand what reductionism is. Reductionism (from the Latin *reductio* - "returning, bringing back") is a methodological principle according to which a complex phenomenon can and should be explained through its simpler constituent parts. Imagine you want to understand how a car works. The reductionist approach says: disassemble the car into its parts - the engine, the wheels, the steering wheel, the brakes. Study each part separately. And then you will understand how the entire car works. This approach has brought enormous success to science. Thanks to it, we have split the atom, deciphered DNA, and created the periodic table. But Morin shows: at a certain point, reductionism stops working. It stops working where complexity appears.

Let us return to the car. By disassembling it into parts, you will understand how the engine works. But you will not understand how movement works. Because movement is not a property of a single part. It is a property of the interaction of the parts. You will not find movement in the piston, in the crankshaft, or in the spark plug. It arises only when all these parts begin to work together. In exactly the same way, Morin asserts, one cannot understand the brain by studying individual neurons. One cannot understand consciousness by studying individual neural ensembles. One cannot understand thinking by studying individual cognitive operations. Because consciousness, thinking, and the brain are not the sum of their parts. They are emergent properties - that is, properties that arise only through the interaction of parts and cannot be reduced to them.

Imagine a soup. You can break it down into its ingredients: carrots, potatoes, onions, meat, spices. But the taste of the soup is not the sum of the tastes of the individual ingredients. The taste of the soup arises only when all the ingredients are cooked together. This is emergence. The distinction between "sum" and "emergence" is the key distinction for understanding complex systems. A sum is a property that can be calculated by adding the properties of the parts. Emergence is a property that arises through the interaction of parts and cannot be calculated from them. Consciousness is an emergent property: it cannot be found in a single neuron, but it arises when neurons interact in a specific way. This does not mean that consciousness is "supernatural"; it means that it cannot be explained by breaking the brain down into parts. A different way of thinking is needed - the one Morin calls "complex."

Three Principles of Complex Thinking

Morin proposes three principles that should form the basis of "complex thinking." These principles are not just philosophical ideas. They are cognitive tools that allow one to hold the multidimensionality of reality.

The first principle is the dialogic principle. Complex phenomena often consist of logically contradictory but inextricably linked elements. Imagine a pendulum. At one point, it possesses maximum kinetic energy and minimum potential energy. At another point, the opposite is true. These states contradict each other, but it is precisely their alternation that creates the movement of the pendulum. In exactly the same way, the brain is a dialogic system. Excitation and inhibition, order and chaos, stability and variability coexist within it simultaneously. These opposites do not cancel each other out; they generate the work of the brain. The reductionist's attempt to choose one side - "the brain is either order or chaos" - leads to simplification. Complex thinking requires holding both sides simultaneously: the brain is both order and chaos, and their inextricable unity.

The second principle is organizational recursion. In complex systems, products and consequences are simultaneously the causes and the products of what produces them. Imagine a cell. The cell produces proteins. But the proteins, in turn, produce the cell. This is not a vicious circle; it is recursion: products and producers constantly generate each other. In exactly the same way, the brain produces consciousness. But consciousness, in turn, produces the brain - through neuroplasticity, through purposeful activity, through culture. The brain and consciousness are not two separate phenomena where one is the cause of the other. They are a recursive system where cause and effect constantly change places. This principle is directly related to my concept of epistemological recursion (Article 1) [3]: the brain studying the brain is organizational recursion in its purest form.

The third principle is the holographic principle. Not only is the whole greater than the sum of its parts, but each part also contains information about the whole. Imagine a hologram. If you cut a holographic plate in half, each half will contain an image of the entire object, albeit with less clarity. Each part contains the whole. In exactly the same way,

in the brain, each neural ensemble, each functional zone contains information about the operation of the entire system. By studying a separate zone, we are not just studying a part; we are studying the whole, manifested in that part. This is like studying society through an individual person. A person is not just a "particle of society." Within them is contained the entire culture, the entire language, the entire history of society. By studying one person deeply, we study the whole society, manifested in them.

Morin's three principles correspond to three aspects of complexity. The dialogic principle answers the question: "How to hold a contradiction?" Organizational recursion answers the question: "How to hold circular causality?" The holographic principle answers the question: "How to see the whole in the part?" Together, they form a complete picture of complex thinking. It is important that these principles are not "rules" that can be mechanically applied. They are dispositions - inclinations to hold complexity, which are formed through practice. It is precisely for this reason that they have a direct relation to pedagogy: they can and must be developed. These ideas are developed in detail in the subsequent volumes of his magnum opus [7], [8], [9].

Why the Brain is a "Complex Object" in Morin's Sense

Morin identifies several characteristics of complex systems. The brain possesses all of them. First, the brain is a gigantic system. It contains about 86 billion neurons, each of which is connected to thousands of other neurons. The total number of connections exceeds 100 trillion. This is a system that surpasses in complexity any other known structure in the Universe. Second, the brain is a non-linear system. In it, small causes can produce large effects, and large causes can produce small ones. A neuron that "fails to fire" can change the entire trajectory of a thought. Third, the brain is a self-organizing system. It is not controlled from the outside; it organizes itself. There is no "master neuron" that commands the rest. Order emerges from the bottom up, through the interaction of millions of elements. Fourth, the brain is an open system. It constantly exchanges information, energy, and matter with the environment. It is not closed; it exists only through interaction with the world. And finally, the brain is an emergent system. Its properties (consciousness, thinking, language) cannot be reduced to the properties of individual neurons. They arise only at the level of the whole.

Attempting to explain the workings of such a system through linear, reductionist thinking is like trying to describe a Beethoven symphony by listing the notes. You will get a list, but not the music. Morin's five characteristics of complex systems are not just a "list." They are criteria by which one can determine whether a system is complex. If a system possesses all five characteristics, then a reductionist approach to it is fundamentally insufficient. The brain possesses all five; therefore, to understand it, we must use tools adequate to its complexity. This is not a "philosophical assertion," but a methodological conclusion: if we want to understand the brain, we must use tools adequate to its complexity.

Crisis of Disciplinary Fragmentation

Morin does not just criticize reductionism. He criticizes disciplinary fragmentation - the habit of science dividing reality into isolated domains: physics, chemistry, biology, psychology, sociology. Imagine you are studying an elephant. One scientist studies its trunk, another its legs, a third its ears, a fourth its tusks. Each of them is an expert in their field. But none of them sees the elephant as a whole. Moreover, they often do not talk to each other because they speak different "scientific languages." In exactly the same way, Morin asserts, modern neuroscience is fragmented into narrow specializations. Neurobiologists do not talk to phenomenologists. Cognitive scientists do not talk to philosophers of consciousness. Researchers of emotion do not talk to researchers of memory. Each studies their own "part of the elephant," but no one sees the whole.

Morin calls for transdisciplinarity - not just cooperation between disciplines, but the creation of a new type of thinking capable of holding the connection between them. This is like learning to see not individual trees, but the forest. Not individual notes, but the symphony. Not individual cells, but the organism. Here it is appropriate to recall Hermann Hesse's *The Glass Bead Game*. In this novel, a secret society of intellectuals is described, playing a game that connects all human knowledge - mathematics, music, philosophy, history - into a single whole. The game requires not just erudition, but the ability to see the connections between different fields. Morin calls for something similar: to "complex thinking," which connects rather than separates. To thinking that sees the forest behind the trees.

Disciplinary fragmentation is not just an "organizational problem." It is an epistemological problem. When science is divided into disciplines, each discipline creates its own "language" and its own "standards of proof." As a result, a situation arises that Kuhn (Article 14) [5] would call "incommensurability": representatives of different disciplines cannot even discuss a problem because they do not agree on what constitutes a "problem." Overcoming this fragmentation requires not just "interdisciplinary conferences," but a new type of thinking - the one Morin calls "complex."

"The Observer Must Modernize Their Cognitive Apparatus"

This is, perhaps, the most important thesis of Morin for my hypothesis. Morin asserts: the problem is not that the world is too complex. The problem is that our cognitive apparatus is inadequate to this complexity. We try to understand the complex through simplified tools - and therefore inevitably fail. Imagine trying to measure temperature with a ruler. A ruler is a good tool for measuring length. But it is fundamentally unsuitable for measuring temperature. The problem is not that temperature is "unmeasurable." The problem is that you are using the wrong tool. In exactly the same way, Morin asserts, linear, reductionist thinking is a good tool for studying simple systems. But it is fundamentally unsuitable for studying complex systems, such as the brain. The problem is not that the brain is "unknowable." The problem is that we are using the wrong cognitive tool.

The solution, according to Morin, is to modernize the observer's cognitive apparatus. To develop the ability for complex thinking. To learn to hold contradictions, see recursions, and grasp holographic connections. And it is precisely here that my hypothesis takes the next step. I show: Morin's "complex thinking" is not an abstract philosophical idea. It is a concrete pedagogical project. The eleven mental mechanisms of the CCFP [2] are precisely that toolkit that allows one to develop "complex thinking" in a specific person.

Morin's thesis about "modernizing the cognitive apparatus" is a direct challenge to all classical epistemology. Classical epistemology assumes that the observer is a "neutral instrument" that does not affect the result of observation. Morin says: this is an illusion. The observer always affects the result, because their cognitive apparatus determines what they can see. This is close to what von Foerster (Article 4) [4] calls "second-order cybernetics": the observer is part of the observed system. Morin and von Foerster arrive at the same conclusion by different paths: Morin through the critique of reductionism, von Foerster through the critique of "naive realism." Both point to the necessity of modernizing the observer as a condition for adequate cognition.

Connection to CCFP: Complex Thinking as the Foundation of Six Requirements

Now I can explain why Morin's three principles are the philosophical foundation of the six requirements (Article 1) [3] and the six core mechanisms (Article 5) [2]. The dialogic principle corresponds to Requirement 2b (holding the tension between perspectives). Morin says: complex phenomena consist of contradictory elements that must be held together. My Requirement 2b says: solving the hard problem requires holding the first-person and third-person perspectives simultaneously, without reducing one to the other. This is the same requirement, expressed in different languages. The mechanism that implements it is MM-5 (Socratic dialogue). The principle of organizational recursion corresponds to Requirement 1 (distinguishing correlation from causality). Morin says: in complex systems, cause and effect constantly change places. My Requirement 1 says: solving the hard problem requires seeing not just correlations, but causal mechanisms. This is the same requirement: both Morin and I speak of the necessity to see circular causality, not linear causality. The mechanism that implements it is MM-1 (cause-and-effect relationships). The holographic principle corresponds to Requirement 4 (holding a multidimensional model). Morin says: each part contains information about the whole. My Requirement 4 says: solving the hard problem requires holding multidimensional models in which part and whole are interconnected. This is the same requirement. The mechanism that implements it is MM-10 (spatial imagination). Complex thinking as a whole corresponds to Requirement 3 (deconstruction of axioms). Morin says: to understand complexity, one must step outside the reductionist paradigm. My Requirement 3 says: solving the hard problem requires deconstructing the basic axioms of one's own paradigm. This is the same requirement. The mechanism that implements it is MM-6 (critical thinking).

Thus, Morin's three principles and the six requirements of my model are not two different lists, but two descriptions of the same thing. Morin describes the philosophical principles of complex thinking. I describe the specific

requirements that these principles impose on the researcher's cognitive apparatus. Without Morin, my requirements would be an arbitrary list; with him, they become a concretization of complex thinking applied to the task of solving the hard problem. The correspondence between Morin's principles and the requirements of my model can be represented as follows. Dialogic principle → Requirement 2b → MM-5. Organizational recursion → Requirement 1 → MM-1. Holographic principle → Requirement 4 → MM-10. Complex thinking as a whole → Requirement 3 → MM-6. This correspondence is not a "coincidence." It reflects the fact that both Morin and I are answering the same question: "What must the cognitive apparatus be able to do in order to understand a complex system?" Morin answers at the philosophical level; I answer at the pedagogical level. Both answers are compatible and complement each other.

Connection to Kuhn: Complex Thinking as a Condition for Paradigm Shift

Morin's three principles have a direct relation to Kuhn's concept (Article 14) [5]. Kuhn showed that a paradigm shift is not just a "new idea," but a revolution that requires stepping outside the old paradigm. But what makes such an exit possible? Morin answers: complex thinking. The reductionist paradigm cannot be overcome by reductionist means. To step outside its limits, one must think complexly - to hold contradictions, see recursions, and grasp holographic connections. Without this, the researcher remains locked in the old paradigm, even if they "want" to leave it.

This explains why a paradigm shift is so difficult. It requires not just "new data" or "new theories," but a new way of thinking. And a new way of thinking does not arise on its own; it is formed through pedagogy. This is precisely why CCFP pedagogy is a condition of possibility for a paradigm shift: it forms the very cognitive apparatus without which a paradigm shift is impossible. The connection between Morin and Kuhn can be formulated as follows. Kuhn describes the structure of scientific revolutions: normal science → anomalies → crisis → revolution → new normal science. Morin describes the cognitive conditions necessary for a revolution: complex thinking capable of stepping outside the reductionist paradigm. Without Morin, Kuhn's concept would be "sociological": it would describe how revolutions happen, but not explain how to accomplish them. With Morin, it becomes pedagogical: it shows what cognitive abilities must be formed to make a revolution possible.

Criticism and Boundaries of the Theory

Morin's concept is not free from criticism. I want to outline three main objections. The first objection: the vagueness of the concept of "complex thinking." Critics note that "complex thinking" is a broad concept that can include anything from a systems approach to a holistic worldview. Without a more precise definition, it is difficult to understand what exactly is being formed and how to measure it. The second objection: the risk of anti-scientism. Morin criticizes reductionism, but some interpreters understand this as a critique of science as a whole. If reductionism is "bad," should we not abandon the scientific method? Morin answers: no. He does not reject science; he calls for the expansion of the scientific method, for the inclusion of complex thinking within it. The third objection: the difficulty of operationalization. If complex thinking is a "disposition," how can it be measured? Morin does not provide specific methods of diagnostics. This creates a problem for pedagogy: how do we know if complex thinking has been formed in a student?

These objections are important because they show that Morin's concept is not a dogma, but a research program. In my model, these boundaries are taken into account. I do not claim that "complex thinking" is "everything that is needed." I claim that it is a necessary component, without which solving the hard problem is impossible. The operationalization of complex thinking is the task that I solve through the six requirements and the six core mechanisms. Each requirement is a specific aspect of complex thinking that can be diagnosed and developed.

Conclusion: From Complexity to Pedagogy

Morin showed that the complex cannot be understood through simplification. He formulated three principles of complex thinking - the dialogic, organizational recursion, and the holographic - and called for the modernization of the observer's cognitive apparatus. For my model, this means the following. The CCFP is not just a set of dispositions, but a set of dispositions that implement complex thinking. Mental mechanisms are the specific tools of complex

thinking, each of which corresponds to one of Morin's principles. Pedagogy is the practice of forming complex thinking, not the "transmission of knowledge."

And here we approach the question that will become central to the next article (Article 4, von Foerster): what happens when the observer tries to apply complex thinking to themselves? Morin showed that to know complexity, one must modernize the cognitive apparatus. von Foerster will show that the observer is part of the system being observed - and that this creates a paradox that cannot be resolved without increasing the complexity of the observer. This is the next step in constructing the answer to McGinn's challenge. The conclusion links Article 3 to Article 4. Morin showed that to know a complex system, a "complex" cognitive apparatus is needed. von Foerster will show that this apparatus is part of the very system it is trying to know. This creates a recursion: to know a complex system, one must modernize the observer; but the observer is themselves part of the complex system they are trying to know. The way out of this recursion is not to "abandon observation," but to increase the complexity of the observer. This is exactly what CCFP pedagogy does: it increases the complexity of the observer, making them capable of holding recursion.

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