**Consciousness understood as contrast, complexity and emergence**

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**Abstract**

Consciousness still remains puzzling and controversial. This article demonstrates that at general and objective level, for understanding consciousness it is necessary to understand such fundamental concepts as contrast, interaction, complexity and emergence. New definitions of these terms are provided as they are erroneous or incomplete in their current form. The result of these investigations is the explanation that consciousness is the sensation of energy interaction (like the sensation of touch or pain), but in a more complex form. This objective explanation and the resulting conclusions have been applied to the study of artificial intelligence consciousness and creativity. Specific solutions have been proposed here.

**Keywords**

consciousness explanation; definition of contrast; definition of complexity; definition of emergence; AI consciousness; AI creativity

**1. Introduction**

This article is based on the broader theory “Theory and Practice of Contrast” [Stanowski 2021], which explains and defines in a systemic way the hitherto unresolved fundamental issues of our knowledge, such as contrast, interaction, complexity, information, beauty, art, creativity, consciousness, being, emergence, and proposes a new (binary) model of reality/universe. Since this theory clarifies fundamental issues and integrates them into a coherent image of reality at the most general level, as such it is an extremely effective explanatory tool at more detailed levels as well. However, it is impossible to go into detail without considering this fundamental knowledge, hence the need to recall, however briefly, these general conclusions. The theory is much more general and informationally capacious than existing concepts on fundamental issues. It also combines the issues of the humanities and natural sciences (science, art, philosophy) into a coherent system. These differences make it impossible to compare it with other existing theories.

In modern literature, starting in the mid-20th century. (Wittgenstein and the anti-essentialists), we no longer find new solutions agreeing on fundamental questions which should be explained by doubt in the possibility of finding answers to them. If these issues appear then as already known, with a large body of knowledge about them, but so far unresolved. Thus, these issues were left unresolved and dealt with either insignificant details or the dissemination of already known knowledge. For this reason, most of the scientific literature is descriptive (usually meta-scientific), describing in various ways the state of knowledge that already exists. Unfortunately, this does not bring us any closer to understanding reality.

In this article, we will try to understand the concept of consciousness more deeply, by relating it to other fundamental concepts i.e. contrast, interaction, complexity and emergence. New definitions of the terms are provided as they are erroneous or incomplete in their current form. The result of these investigations is the explanation that consciousness is the sensation of energy interaction (like the sensation of touch or pain), but in a more complex form. This objective explanation and the resulting conclusions have been applied to the study of artificial intelligence consciousness and creativity. Specific solutions have been proposed here.

**2. Rational attempt to explain consciousness**

The actual state of knowledge about consciousness can be illustrated by the following citation:

Consciousness, at its simplest, is sentience or awareness of internal and external existence. Despite millennia of analyses, definitions, explanations and debates by philosophers and scientists, consciousness remains puzzling and controversial, being "at once the most familiar and also the most mysterious aspect of our lives". Perhaps the only widely agreed notion about the topic is the intuition that consciousness exists. (<https://en.wikipedia.org/wiki/Consciousness>)

Given the not very advanced state of current knowledge about consciousness at the fundamental level, we will go straight to considerations at this level, leaving aside less important specific issues. To understand consciousness, we also need to understand the following issues which are so far unclear:

1. What is interaction or contrast.
2. What is complexity in general
3. What emergence is in essence

1. Currently contrast is commonly understood (also in art and science) as a contradiction or a big difference. For our purposes, however, we will use a new, modified definition of contrast which is as follows:

Contrast is interaction of common and differentiating features of objects. Common features connect and differentiating features repel objects, thus tension arises. Contrast grows stronger as the number/strength of common and differentiating features held by contrasting objects increases [Stanowski 2021].

Contrast also connect (through common features) the contrasting objects/structures in a new structure (possessing the differentiating features of contrasting objects), which should be understood as the development in the most general sense (as first noted by A. N. Whitehead) [Whitehead 1978]. Development/contrast understood in this way can be equated with value in a general and fundamental sense.

Two types of contrast can be distinguished: mental (perceived with the mind) and physical (which can be perceived with senses). Physical contrast depends primarily on the energy of the features (information) of the contrasting objects. Mental contrast, on the other hand, depends on the amount of features (information) of the contrasting objects. These contrasting objects can be a) the perceiving subject (mind) and the currently perceived object (then the mind structures and perceptual structures are involved in the contrast), b) the currently perceived objects (then perceptual structures are involved in the contrast), c) or two mind structures can create contrast.

2. Mental contrast is equivalent to complexity. Intuitive criterion of complexity could be defined as follows: “the complexity of a system is greater the more elements it contains and the more connections there are between them” [Heylighen 1999]. In definition of contrast, the elements that are distinct are the differentiating features, while the connections between them are the common features. Common features introduce coherence into the system, which is equivalent to information compression. Information compression, on the other hand, reduces the energy of the system while maintaining the amount of information. This makes such a system more economical (cost effective). This saving of energy is the essence of value and goodness, as well as beauty and art, because we prefer objects the perception of which requires less energy (less effort). More details about this issue can be found here: [Stanowski 2021].

The above (intuitive) definition of complexity is formalized by Abstract Definition of Complexity [4], which defines the complexity of a binary structure - i.e. the most abstract structure of reality. Complexity is determined by the following formula:

C = N N/n = N²/n, where C is complexity, N - the number of features (distinct regularities/substructures) and n—the number of elements (zeros and ones). The factor N/n determines degree of organization or information compression. To define complexity (C) information compression (N/n) is therefore multiplied by N which takes into account the size of the compressed area (it is more difficult to compress a larger area). This formula defines complexity of a binary structure in a formal way and can be directly applied wherever a given system can be represented by binary structures (e.g. in music). Also it can be used to determine the complexity of the binary structures of our mind.

Consciousness is the structure of our mind that of all mental structures stands out and affects us the most. Stronger impact means greater contrast and complexity. It follows that of all mental structures, consciousness is the one with the greatest complexity.

3. Intuitively emergence means the emergence of qualitatively new properties, forms and behaviours from the interaction between simpler elements. The given system property - "emergent", exists at the higher system level of the organization in relation to intra-system properties and processes that constitute the "emergence base". The colloquial description of this phenomenon is expressed by the statement that "the whole is more than the sum of its parts". Let's consider the following definition of emergence:

Property is emergent if it is a novel property of a system or an entity that arises when that system or entity has reached a certain level of complexity and that, even though it exists only insofar as the system or entity exists, it is distinct from the properties of the parts of the system from which it emerges (<https://www.iep.utm.edu/emergenc/>).

The elements connected together have more common features than when they occur separately. This statement can be understood tautologically, because the common features are connections; we will see, however, that the introduction of common features is crucial here. These additional (common) features just make the whole is something else or something more, than the sum of its parts.

In figure 1, which shows the visual model of emergence, we see a disordered set of small squares (figure 1a). In figure 1b we have an intermediate state (part of the squares formed a circle) and in figure 1c squares formed a circle (maximum emergence). Squares that found themselves in the structure of the circle gained new (common) features related to their location: the same distance from the center of the circle and similar distance from neighbouring elements.



**Fig. 1** Visual model of emergence, a—unordered set of elements, b—intermediate state, c—maximum emergence.

The above model, although very simple, takes into account all aspects of the above emergence definition. 1) The formation of a new property/whole—a circle. 2) The new whole (circle) is more complex in relation to the previous system. The greater complexity here results from having more (significant) common features by the constituent components (thanks to which their differing features also have a stronger impact). According to our previous considerations, the contrast and complexity are greater in this case. 3) The existence of a new quality (circle) depends on the existence of the system/whole that owns it. 4) The new quality is distinct from the properties of the parts of the system from which it emerges.

Emergence understood as above (as the creation of something more than the sum of its parts) is a special case of contrast/complexity. Recall that the contrast is also combining elements into a new structure/entity. While contrast is a general concept encompassing all kinds of both mental and physical interactions, the notion of emergence concerns only those contrasts, where contrasting elements form strongly distinctive wholes.

This analysis shows that the reason for emergence, i.e. the emergence of new, coherent wholes as a result of mutual interactions of their potential (future) components are additional common features that these components gain as soon as they are combined into the whole.

Because this is a general explanation of the causes of emergence, it should also apply to specific cases of it, including consciousness, which is also considered a kind of emergence. To explain the reasons for the emergence of consciousness, we must define what are its components. Let's assume that these components are energy pulses (electrochemical). Our considerations show that if they gain a sufficient number of new common features, a new emergent whole will be created, which should be perceived as consciousness. New common features should be understood as additional relationships/connections between impulses (or more precisely—impulses structures). Thanks to them, the new whole should stand out more strongly, like the circle in our emergence model (which is also a new quality emerging from the area of disordered visual elements). This explanation also creates the possibility of empirical verification, e.g. by checking how the number of neural connections (common features) affects the appearance of conscious states. Previous brain neurological studies show that such a relationship exists. This hypothesis is also supported by the fact that as the number of connections increases, the complexity of the impulse structure also increases.

Now let's consider another argument and think about how mental feelings arise, i.e. a feeling of understanding, realizing something, imagining something, feeling pleasure. The feeling of understanding a new concept/term arises when we place it in a sufficient number of contexts, i.e. associate with various existing structures in our mind, thus increasing the number of connections. These connections, which seem obvious, correspond to electrical neural connections. Similarly, one can explain the understanding of a problem, solving a task (e.g. mathematical), recognizing a musical piece or familiar face, or noticing hidden figures in Picasso's paintings. In all these cases, we are dealing with an increase in the number of connections of various elements/components necessary to form a properly coherent, emerging entity/whole.

On the other hand, isolation/distinction can be equated with impact and existence (what is not distinct cannot be perceived). Interactions understood in this way can be equated with energy because we do not know any interactions that would not require energy. (The word energy comes from Ancient Greece word e*nergeia*, meaning action). In fact, there is currently no more detailed definition. Physics defines energy as equivalent to work (to which it can be used), while work is the product of force and path (on which the force acts), but force is again defined as action. So isolation (separation, standing out), energy and strength should be considered as equivalent, basic and undefinable. So if we are able to extract (distinguish) consciousness, emotional states, sensory and mental feelings (qualia) it means that they exist.

Another, more detailed argument in favour of the materiality of the consciousness is the fact that (logically speaking) there can be no structure (also in the mind) without elements that somehow (in it) separate/distinguish. What is extracted, and thus somehow interact, must have energy. In the case of the mind, it would be a specific form of energy (electrochemical impulses).

Our considerations regarding emergence and its visual model show that the surprise associated with the emergence of new wholes results from the gradual accumulation of changes (in a given area, e.g. the area of the mind, or a set of squares), which from a certain moment begin to form noticeable (isolated) orderings, as in the process of crystallization, an example of recognizing a Dalmatian in the speckle pattern, the appearance of a sense of understanding, regaining consciousness after waking up, or emerging a circle in the visual emergence model. By ordering it is meant a known pattern, which, due to the fact that it is known, from a certain moment when it begins to be recognized, accelerates and strengthens emergence (because it imposes a known pattern on a still poorly isolated object). This acceleration (associated with what is referred to as the “explanatory gap” [Levine 1983] causes surprise and is difficult to trace/explain. Bridging this gap (that is, finding a satisfying mechanistic explanation for experience and qualia) is known as "the hard problem” [Chalmers 1995]. Theoretically, however, as our above considerations demonstrate, this difficulty can be overcome, as it has already happened in many other cases of emergence.

Directly related to the consciousness are our conscious, subjective experiences – qualia. Qualia are characterized as first-person mental states for which we have introspective access. They usually refer to some property of a given object and have a purely phenomenal, empirical character. Mental states that have qualia can be divided into sensory experiences (feeling of bitter taste, seeing a blue colour, hearing the sound of a guitar), all kinds of bodily sensations (toothache, feeling of thirst, hunger) and emotions (shame, contentment, love).

While consciousness is considered the emergence of neuronal processes in our brain, qualia can be considered as emergent states of consciousness, i.e. the structures that are emerging (or more distinct). So it is like emergence of emergence. Therefore, although the rules are the same as for emergence of consciousness, qualia have got a separate name. The essence of emergence is the appearing qualitative leap in relation to gradually increasing changes in a given area, as a result of obtaining additional features by the potential components of the new whole (which was discussed earlier). The variety, intensity and incomparability of quality-qualia as well as the difficulty in understanding/explaining them are due to the emergence of a new quality and the inability to trace too quickly growing changes in this process. If we had the opportunity to trace the growth of changes in the brain during which (we begin to see) e.g. red colour (similar to the formation of a circle in our emergence model), then its appearance would not surprise us as it is no longer a surprise that e.g. heat is the result of molecule movement. Qualia as emergent wholes are unique because they characterize our mind above all. However, similar examples are also found in physics, chemistry and biology, where we also observe large qualitative leaps. E.g. in physics, elementary particles such as electrons and protons do not have colour. Only when combined into atoms can they absorb and emit specific wavelengths, which is described as having colour). Another example is the fact that radio and light waves are electromagnetic waves of different frequencies, as demonstrated by Heinrich Hertz (1881-1884) and which was previously predicted by Maxwell's theory. In biology, one example of the emergence discovery was the statement (by biologists Matthias Jakob Schleiden and Theodor Schwann) that all plants and animals are made of cells.

If we think even more broadly, we will come to the conclusion that not only qualia and other emergent wholes are surprising to us, but also everything that in any way (in the mind and outside it) is isolated (distinguished) – and therefore exists (the identity of isolation and existence has already been discussed). So it's worth realizing that the question about the phenomenon of consciousness or qualia is equivalent with the question about the phenomenon of existence. Our thoughts, imaginings, and sensations should therefore be treated in a similar way to sensory perceptions arising from the contrast between our body and other material objects. Every object of reality, including our body and mind is a form of energy of a certain complexity (a form of energy also is called information). Another form of energy is sound, another light, another accelerated mass and yet another is our thought. Each form interacts in a different way. Each particular thought or feeling has its own effect on us. When we think, we do not realise that the diversity of thoughts, their complexity, intensity and quality, is due to the diversity of energy forms, i.e. the diversity of information. **Therefore, we can define** **consciousness as the sensation of energy interaction (like the sensation of touch or pain), but in a more complex form.**

If there are no interactions, nothing is distinguished, and there is also no consciousness (like during sleep, for example)), because at a fundamental level, what we call consciousness is equivalent to interaction. How does this relate to the multitude of terms and understandings of consciousness that exist today? All these terms arise as a result of placing the fundamental meaning (which was not clearly defined before) in different contexts. At the complex level of our human considerations, many new, similar terms arise, which enrich the language, but hinder subsequent analysis, because we forget about their common origin and abandon analysis at fundamental level. Here are some examples of consciousness terms that have the common foundation: the mind; an aspect of mind; introspection, thought, imagination; cognition; experience; feeling; perception; awareness of internal and external existence; self-awareness; mental state; mental event; mental process of the brain.

**3. AI Consciousness**

Consciousness, understood as interaction, distinction and existence in general, can have different gradations, it can be felt weaker stronger or not felt at all. Applies not only to humans, but to all objects of reality, everything that exists, including artificial intelligence (AI). A similar view, although differently is expressed by Ben Goertzel, a well-known American AI researcher who when asked: Can AI have consciousness? He answered:

When it comes to machine consciousness, there are many different philosophies. I lean toward panpsychism and believe that everything, including a phone or a teaspoon, has its own spectrum of consciousness, which is not as complex, dynamic or richly structured as human consciousness. AI is probably already conscious. But when we create an AGI (Artificial General Inteligence) that replicates human thinking and intelligence, it will likely have human-like consciousness. (<https://cyfrowa.rp.pl/opinie-i-komentarze/art39235781-prawdopodobnie-juz-teraz-sztuczna-inteligencja-jest-swiadoma>)

Artificial intelligence neural networks, in principle, work just like the human mind. Also, they learn, perceive (data input), think, associate information (information processing), compress information and provide answers. Each of these stages is accompanied by contrasts of artificial intelligence structures with externally input information structures, and internal contrasts/connections of neural network structures. The greater these contrasts are, the more strongly they are noticed/perceived and the greater the complexity/compression of the information.

Assuming that the above argumentation was convincing, we already know that AI has some kind of consciousness. If we wanted to find out more tangibly/sensually and how it is similar to humans, it would be necessary to determine from what we know/assume that other humans also have consciousness. We don't know other people's thoughts; we convince ourselves by analogy that they think and are conscious like we are.

Many philosophers believe that consciousness is reflected in behaviour (including verbal behaviour), and that we attribute consciousness on the basis of behaviour. A more straightforward way of saying this is that we attribute experiences to people because of what they can do, including the fact that they can tell us about their experiences [Harnad 1995]. For example: if someone says he sits down on a chair and we see that he sits down on a chair it means that he is aware of what he is doing. The more and more diverse such correspondences we observe, the more convinced we are that this person has consciousness. If this "person" were an AI-equipped robot, we should become similarly convinced.

A more difficult issue to investigate with AI is self-awareness, or self-consciousness. In philosophy of self, self-awareness is the experience of one's own personality or individuality. It is how an individual experiences and understands their own character, feelings, motives, and desires. It is not to be confused with consciousness in the sense of qualia. While consciousness is being aware of one's body and environment, self-awareness is the recognition of that consciousness [Jabr, 2012].

Self-awareness appears in children between 15 and 24 months of age. I remember that when I was a child, maybe 1.5 years old, I was impressed by a discovery: one time when I looked in the mirror, it caught my attention that when a child in the mirror moves its hand—I knew about that, I can control it, e.g. raise my hand up and the image in the mirror does the same. It was only then that I realized that the thoughts I knew and the body in the mirror belong to the same person—to me. This was a breakthrough discovery for me, although not a very beneficial one, because then I began to perceive myself becoming more and more selfish (only after many years did I manage to partially transform this selfishness into altruism). Let's try to analyze what it consisted of.

Previously, I was aware of the external world and within it my body, which I could isolate from its surroundings. In contrast, I couldn't separate my thoughts, I didn't notice them because they encompassed everything I had to deal with and I had nothing to distinguish them from. When I associated/connected my thoughts with my body (a different object than my thoughts) in the mirror, there was also an extraction of my thoughts, then I noticed them. Only then could I compare them with something else. That's when the thought about my thoughts and self-awareness first appeared.

If we would like to equip the robot with self-awareness, we would have to do the same and allow it to see the relationship of its mind (artificial intelligence) to its body - that is, to the physical elements of the robot. This could be achieved by appropriate exercises associating the mind with the body, consisting in instructing the robot to observe its movements, behaviours in a variety of situations. One could also use a mirror here. There is also the possibility that the robot itself will become self-conscious after some time of functioning, like children and some animals. From time to time, we could check if self-awareness appears, using e.g. mirror-test:

The mirror-test was developed in the 1970s by Gordon Gallup [Gallup 1970]. The test examines whether animals are able to differentiate between seeing themselves in a mirror versus seeing other animals. The classic example involves placing a spot of colour on the skin or fur near the individual's forehead and seeing if they attempt to remove it or at least touch the spot, thus indicating that they recognize that the individual they are seeing in the mirror is themselves. Humans (older than 18 months) and other great apes, bottlenose dolphins, orcas, pigeons, European magpies and elephants have all been observed to pass this test.

([https://en.wikipedia.org/wiki/Consciousness#cite\_note-74](https://en.wikipedia.org/wiki/Consciousness" \l "cite_note-74))

**3.1. Can AI be creative?**

Ai's creative capabilities are not clear and opinions on the subject are divided. This is due to a misunderstanding of the essence of creativity, that is, a lack of knowledge of what is common to all creative activities (creativity is obtaining coherent wholes, what will be explained below). The existing knowledge about creativity, present in hundreds of volumes, is descriptive (not explanatory) and reduces to a set of information associated with creativity. Therefore, both proponents and opponents of the recognition of AI creativity present unconvincing, often even naive arguments. For example, Ray Kurzweil in his book "The Singularity is Near" [Kurzweil 2005] presents as an argument the fact that „evolution moves towards greater complexity, greater elegance, greater knowledge, greater intelligence, greater beauty, greater creativity, and greater levels of subtle attributes such as love”.

It is difficult to recognize this argument for several reasons: the growth of complexity does not apply to all objects of reality and not always; nothing is known about the evolutionary growth of elegance, beauty, creativity and love.

Many other theorists like: Haonan Wang, James Zou, Michael Mozer, Anirudh Goyal, Alex Lamb, Linjun Zhang, Weijie J Su, Zhun Deng, Michael Qizhe Xie, Hannah Brown, Kenji Kawaguchiopiera, considers introducing creativity into AI with statistical methods based on a large amount of information [Haonan Wang et al., 2024]:

Can AI be as creative as humans?” In our study, we theoretically demonstrate that this is feasible if AI can properly fit data produced by human creatives. In order to reach this conclusion, we formally structure the problem by introducing the concept of Relative Creativity, where an AI model is deemed as creative as a hypothetical, yet realistic, human creator if it can produce works indistinguishable from that creator, as determined by an evaluator. Building upon this, we present Statistical Creativity , a means for understanding whether and to what degree AI achieves creativity by comparing it with existing human creators. Through the lens of statistical creativity, our theoretical analysis of the training process suggests that AI has the potential to act as a hypothetical creator by effectively assimilating a massive amount of conditional data. This data encompasses a diverse range of creative works, along with the conditions and processes that led to their creation, from a specific group of creators. The creative ability of this hypothetical creator would be comparable to that of the group of creators upon which the AI’s training is based. The theoretical findings indicate that the emergence of human-like creativity will occur through the learning of extensive conditional data without marginalizing out the generative conditions and processes.

While statistical methods have proven themselves in many fields including quantum mechanics and meteorology, they have nothing to do with creativity, rather they contradict it. The essence of creativity is not the multiplicity of information, but the compression of information and obtaining through it coherent, organized wholes, structures and systems, among other works of art. Excessive amounts of information make compression difficult and even impossible. Therefore, artists do not have as much information as, for example, professors, who have knowledge in the form of information collection rather than a coherent system. It is also a misunderstanding to strive for works that are similar to existing works of art, since the raison d'être of a work of art is precisely the absence of this similarity. By making works of art different, they surprise and enrich us.

The article of Mark A. Runco "AI can only produce artificial creativity" [Runco 2023] will serve as an example that does not accept that AI could be creative as human. The main argument given by the author is that computer and human creative processes differ from one another:

“To really explain creativity it is necessary to understand the mechanism that produces it (Jay & Perkins, 1997). With this in mind it is vital to distinguish between human and artificial creativity. Only then can we understand the mechanism that underlies and allows creativity.”

What features of human creativity does AI creativity not possess, that if we recognize them, we will also recognize "the mechanism that underlies and allows creativity"? According to the author, these are “authenticity and intentionality”, which he proposes to add to the current standard definition of creativity which takes into account only originality and effectiveness - that AI creativity already possesses:

“I already proposed updates to the standard definition of creativity (Runco, 2023a). That proposal identified two criteria and key dimensions of creativity (authenticity and intentionality) which should be added to those currently in the standard definition (i.e., originality and effectiveness)”.

Does this explain the mechanism of creativity? Certainly not. Besides, authenticity and intentionality in the case of artificial intelligence may be present in a different form. Can the characteristics: originality, effectiveness authenticity and intentionality be considered a definition of creativity? Certainly not. The author's conclusion is as follows:

“Given that artificial creativity lacks much of what is expressed in human creativity, and it uses wildly different processes, it is most accurate to view the ostensibly creative output of AI as a particular kind of pseudo-creativity”.

In addition to these considerations, which can be described as the more substantive side of the paper, the author presents a collection of different concepts and opinions to various degrees associated with creativity. These are well known for many years rather vague views that do not explain anything. Instead of an explanation, we get a huge number of references to similar publications. Under the guise of scientific thoroughness, this manner of publication primarily ensures a large number of mutual citations, for which academics are rewarded. It seems that in such a situation, rational thinking loses its sense. Nevertheless, let's move on to more rational and deeper thoughts.

Why is information compression so important to us? Because it reduces the energy of the system while maintaining the amount of information. This makes such a system more economical (cost effective). This saving of energy is the essence of value and goodness, as well as creativity, beauty and art, because we prefer objects the perception of which requires less energy (less effort) e.g. we prefer a shorter instruction to a longer one if it is equally useful. Information compression is a value itself, if it has no practical use, then it represents aesthetic value, becomes art or beauty. How can we measure the compression of information in an object? The measure is the strength of the effect of this object on us, that is, the magnitude of the contrast we create with it. As we remember from Section 2, contrast is also complexity and compression of information. This contrast will not be the same for all audiences due to individual characteristics (knowledge, intelligence, etc.). In many cases, however, these contrasts will be similar and can provide a measure.

Definition of creativity as information compression is concrete and objective enough to to use in AI design. One could, for example, introduce into AI various examples of compression/coherence of texts, images, sounds (if we think deeper we’ll find that coherent, organized sound structures are just nice melodies) to produce a general concept of compression/coherence. If successful, then AI would begin to be creative, compressing information even in areas where it had not been before. However, it should be remembered that this is not a compression of data codes (binary structures) as we deal with in computers and which does not depend on the type of objects being encoded (it is the same for images, texts or sounds), but a compression based on the economy of the means of constituting objects available to humans directly, e.g. the economy of words when expressing thoughts (thanks to the selection of appropriate words), the economy of forms in images, the brevity of a scientific theory thanks to a better organization of concepts, or the melodiousness of a musical piece obtained thanks to a better organization of sound structures.

**Conclusion**

Unlike other publications about consciousness, a concept that still remains unclear, this article brings concrete and objective knowledge that greatly advances its understanding. This was made possible by relating consciousness to other foundations of our knowledge such as contrast, complexity and emergence, having previously verified them. This article also demonstrates that considerations at the fundamental/general level are not idle and concrete conclusions can arise from them. Current theoretical considerations follow long-established paths and focus on details taking care of form and references to similar publications. This guarantees citability and scoring for authors, unfortunately at the expense of usefulness.

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