Consciência quântica:

uma análise baseada na irreversibilidade

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Resumo: Nos últimos anos, com os avanços da Inteligência Artificial e do Machine Learning, tem havido um interesse renovado pelo tema da consciência. Nosso objetivo neste artigo é refletir sobre esse assunto a partir de uma perspectiva quântica. Assim, apoiados nas reflexões de Ilya Prigogine, Edgar Morin e Jorge de Albuquerque Vieira, juntamente com a Filosofia e Semiótica de Charles Sanders Peirce (1839-1914), pretende-se observar a consciência como fruto do não equilíbrio, da assimetria do tempo e, portanto, da irreversibilidade. Ao final, concluímos que é a partir das rupturas causadas pelas experiências da vida que a consciência se refaz em um continuum semiótico cuja finalidade é inerente à sua auto-feno-geno-organização, ou seja, encontrar sua nova estabilidade no não equilíbrio. Acima de tudo, em sua expressividade, a consciência nunca deixa de ser uma forma de arte.

Palavras-chave: consciência, quântico, irreversibilidade, semiótica, complexidade.

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Quantum consciousness: An analysis based on irreversibility

Abstract: In recent years, with the advances in artificial intelligence and machine learning, there has been a renewed interest in the subject of consciousness. Our aim in this article is to reflect on this subject from a quantum perspective. Based on the reflections by Ilya Prigogine, Edgar Morin and Jorge de Albuquerque Vieira, together with the philosophy and semiotics of Charles Sanders Peirce (1839-1914), the aim is to observe consciousness as the fruit of erraticism, non-equilibrium, the asymmetry of time and, there-fore, irreversibility. In the end, we conclude that it is from the ruptures caused by life's experiences that consciousness remakes itself in a semiotic continuum whose purpose is inherent to its self-pheno-geno-organization, that is, finding its new stability in nonequilibrium. Above all, in its expressiveness, consciousness never ceases to be a form of art.

Keywords: consciousness; quantum; irreversibility; semiotics; complexity.

In recent years, with advances in the field of artificial intelligence and machine learning (Russell, 2019; Wooldridge, 2021), there has been renewed interest in the subject of consciousness. With each advance in the development of these so-called 'intelligent' tools, there is always the question: when will we see these 'machines' become conscious? It seems natural to conclude that this path is becoming more tangible every day, closer to us, as if crossing this border between data processing – computing – and self-reflection – dialogue – were a path based on a coherent and orderly linearity.

In the recent book *Metazoa: Animal Life and the Birth of the Mind* (2020) by Peter Godfrey-Smith, the author surveys the species that, over time, have demonstrated degrees of intelligence in ways that are sometimes so specific to different environments that it is possible to say that the faculty of intelligence is something that is not exclusive to homo sapiens, but quite the opposite. This quality spreads throughout living systems, from bacteria to cephalopods to primates. So being intelligent is a quality of living and evolving also implies perfecting intelligence, given its biological and ecological conditions. In fact, intelligence is more connected to developing strategies, solving problems, recognizing obstacles and trying to overcome them, establishing cause and effect relationships, consolidating a pattern – or program – of decisions, behaviors and habits, in short, computing data and the ability of this computing – mediation – to coincide with reality in favor of the permanence and autonomy of the living system.

In this respect, both AI and ML are in full development mode and their results impress even the most skeptical. But what about consciousness? Does this capacity follow the same pragmatic path? Apparently not. For if it were, consciousness would have the same *feasible* generality and observability in various living systems around us as the faculty of intelligence. As such, consciousness seems to have a more, shall we say, particular nature, rather than something of a general nature. It is not surprising that autonomous systems achieve enormous computational interdependence if the growing volume of data that we supply to their micro- and macro-computing processes passes through them. Consciousness, however, seems to be organized along another path, beyond data processing: irreversibility.

This is where quantum, as a philosophical starting point, can offer us a way to discuss consciousness. Thus, supported by the reflections of Ilya Prigogine, Edgar Morin and Jorge de Albuquerque Vieira, together

with the Philosophy and Semiotics of Charles Sanders Peirce, we intend to observe consciousness as the fruit of erraticism, non-equilibrium, the asymmetry of time and, therefore, irreversibility.

The Time of Concepts: System, Organization and Complexity

Before we analyze the main topic of this article, consciousness, it is necessary to understand some concepts that will be used in our analysis. The first of these is the concept of a system. For Edgar Morin (2008a, p. 175), a system is everything that demonstrates emergence and autonomy in relation to the external environment. Emergence (Morin, 2008a, p. 136-142) can be seen as a creative capacity to evolve and find the means to remain. Jorge Vieira (2007, p. 34) distinguishes the following types of system:

(a) *open systems*, which are those that interact and exchange information with other systems and subsystems in such a way as to permeate their existence and permanence based on their ability to weave and/or build relationships, connections and integrations at different levels of associations, cooperations and mutual adjustments,

(b) *closed systems*, which exchange energy and information, but not matter, and

(c) *isolated systems*, which lose contact with their surroundings and tend to die.

According to Jorge Vieira (2007, p. 89), there are three fundamental classification parameters for analyzing a system: its capacity for permanence, its environment and its autonomy.

(a) *Permanence* has a temporal character embedded in its process and often, in biology, this parameter can be synonymized with the term survival, i.e. the ability to maintain its existence over time.

(b) *Environment* is a system that involves another system. In fact, the environment allows the system within it to find the necessary resources for its emergence, development and maintenance. Morin (2005, p. 64-68) warns us that in the same way that a system chooses its environment, or Oikos, the environment chooses the

systems that will develop through it. There is a co-evolutionary aspect to the process, as environments and species co-produce and co-operate mutually for the permanence and evolution of both.

(c) *Autonomy*, on the other hand, is related to the stock of information or systemic memory, i.e. the past connects the present, enabling possible futures. Thus, over time, in its process of permanence and exchanges with the environment, the system accumulates experience, evolves in mediation – or semiosis – internally – cells, organs, individuals – and externally – micro-systems, ecosystems and macro-systems – and transforms information into regularity, to the point of self-maintenance and self-generation: recursively (circuit) and retroactively (expansion). Maturana and Varela (2011) call this process autopoiesis.

But why is the accumulation of information important for open systems? Because every open system, which is non-linear and out of equilibrium, has to deal with entropy, i.e. the degeneration of itself and/or its surroundings. Thus, the stock of information guarantees that it can deal with crises, disturbances, hostilities, disputes, struggles, competition, etc. This is why Prigogine (2002, p. 29) warns us that entropy is the driving force behind evolution, as it causes systems to achieve what we call homeostasis, which, above all, means an intermittent action of overcoming entropy, transforming it into systemic memory and transmitting it to subsequent generations, recursively and retroactively. What Morin calls auto-pheno-geno-organization, in other words, a creative (emergent), phenomenal (existing), generative (self-reproducing) and organized (autonomous, permanent, continuous and intellectual) system.

Jorge Vieira (2007, p. 83) warns us that open, unstable and out-of-equilibrium systems are the great procedural matrix of the reality that surrounds us and that reversible and stable systems, such as those found in celestial mechanics, are exceptions. Thus, the degeneration of the system brings us face to face with the irreversibility of time, which drives the complexity of living organizations to find and build (Prigogine, 2011, p. 30) their permanence, autonomy and environment. This is because stable systems do not promote emergence or creativity in systems, on the contrary.

Following the concepts presented by Jorge Vieira (2007, p. 35-42), for a system to consolidate itself as such, it is necessary to observe certain so-called hierarchical or evolutionary parameters, i.e. those that de-

pend on the time factor to establish themselves, outlined as follows: composition, connectivity, structure, completeness, functionality and organization, all permeated by a parameter that can arise from the very first stage: complexity.

The first parameter called composition deals directly with diversity, i.e. the more diverse the system, the more information there is circulating, and the more information, the better the system will be able to deal with entropy. Therefore, information is difference and difference is autonomy. In this way, information density becomes the system's key to evolution.

In fact, many people confuse disorder with entropy, which is not correct. So, when we enter a forest, for example, that cacophonous disorder is not an index of entropy; on the contrary, everything that degrades there is driving a proportionally high volume of the possibility of life, it is driving a volume of correlations, complementarities and synergies promoting the evolution of all the species included in it.

A living organization, or a system out of equilibrium, demands not just an accumulation of information, systemic memory, but an intermittent exchange of information, that is, a diffusion and distribution (Prigogine, 2011, p. 45) of interpretants (Santaella, 2000a, p. 69) that resonates throughout the system, promoting its convergence or coupling (Prigogine, 2011, p. 47) of meaning, that is, homeostasis (Morin, 2008a, 240).

It is through these flows of correlations (Prigogine, 2011, p. 93) or semiosis that evolutionary parameters emerge as a constructive way of living (Prigogine, 2002, p. 27). Thus, when we talk about living systems we need to abandon the idea of trajectory, so common in stable systems, because unstable systems are permeated by sets (Prigogine, 2002, p. 51), that is, by a chain of multi-processual and complementary interactions that find stability precisely through an environment of sign exchange.

Thus, composition deals with this arrangement of informational diversity that takes place over time and is transformed into connectivity and connectivity, the second evolutionary parameter, means weaving links, relationships, strengthening the chain of complementary processes that are established to form a structure. The third evolutionary parameter, structure, is the configuration of the landscape or the design of the system. This is when the system takes on a form or Gestalt. It's as if we could 'photograph' it at a given moment in order to understand its topology.

Integrality, the fourth evolutionary parameter, means establishing systems within other systems, that is, forming subsystems that nourish each other through the links and connections established. Integrality therefore means fostering emergencies or synergistic co-stabilities, to the point where, if one part suffers damage, another part, in an interdependent way, co-operates and/or collaborates in maintaining the system as a whole. By stimulating such emergencies in the arranged elements, the system allows these parts to specialize. Therefore, integrality gives rise to functionality, the fifth evolutionary parameter, and functionality means providing the conditions for the properties of each element to act in such a way that everyone benefits.

Thus, the containment of degeneration or entropy reflects the organization of the system, since each part has a function in the whole, i.e. each element, with its specialty, complements each other in space and time. Diversity therefore favors this organic process, which is above all semantic, i.e. the system is cohesive and coherent. In fact, the parameters of cohesion and coherence are also parameters for consolidating a system. Cohesion deals with the syntax between elements in terms of their joint, complementary and interdependent actions. Coherence deals with semantic completeness or the convergence of meaning that resonates throughout the system. In fact, the last evolutionary parameter is organization, which means an elaborate form of complexity.

It seems clear that the constitutive link of living organization is the accumulation of information and its dispersion in a certain convergence of meaning or regularity. So, while the irreversibility of time drives the evolutionary stages of the system, expanding it in complementary synergies, the convergence of meaning seems to delineate the correlative flows or interpretants in a system closure.

This closure of the system is important for circumscribing what is internal from what is external. At the same time as organisms compute signs internally, there is also the mediation of external signs. The convergence of meaning implies that – internally – organisms have certain qualities, characteristics and behaviors, and at the same time they are able – externally – to mediate their surroundings using sensory and motor tools specific to each organism. What Jakob von Uexküll calls the "Umwelt", which translates as "the world around", would be a kind of "bubble" (Vieira, 2007, p. 24) or particular semiotic-perceptive-computational network through which each organism translates the information in the ecosystem in which it is inserted in accordance with its ability to interpret.

Intelligence seems to be the fruit of the characteristics that have moulded the convergence of meaning in each living organism. Evolutionarily, each organization has built a path or bifurcation, which could have been another (Prigogine, 2011, p. 75), but which, in the end, was established spontaneously from instability.

In fact, there is a tendency for stability to emerge from non-equilibrium (Prigogine, 2002, p. 27). Thus, a specific, defined, irreversible self-organization brings us face to face with the fact that time progressively leads us to homeostasis (*ibid.*, p. 78) or semantic regularity, in other words, to a tendency to acquire habits (Peirce, 1998, p. 33), habits that are satisfactory to the demands of reality, which requires us to have a certain interpretative-computational coherence or reasonableness (*ibid.*, 249) in relation to our surroundings, since the lack of this faculty implies the organism's own inadaptability to the environment, thus running the risk of not surviving the vicissitudes of life.

However, with each self-organization that has been established on this planet, a break in the symmetry of time has been generated, because even if we were to go back to the initial conditions of each new organism, the possibility of a self-organization following in exactly the same footsteps is probably small. This is because open, out-of-equilibrium systems are eco-dependent on multiple factors. So a change in one of the evolutionary processes, whether in composition, connectivity and/or functionality, would mean that the organization would already have another type of convergence of meaning and/or closure. For, as Morin warns (2008, p. 188): "There is no linear development of complexity; complexity is evidently complex, that is, uneven and uncertain".

Finally, if everything around us is the result of instability and irreversibility, consciousness could have no other procedural matrix than that of a system out of equilibrium. We can see that there is self-organization in the construction of consciousness; however, unlike the faculty of intelligence, which demands a response to the challenges inherent in the permanence and autonomy of the organism, consciousness seems to have a different evolutionary path.

The Spiral of Consciousness: Duplicity, Resonance and Contemplation

Firstly, as observed by Edgar Morin (2008b, p. 209-221), consciousness is this 'double' that looks at itself and starts a dialogue, in various instances, with a system – itself (Morin, 2005, p. 181) – which is the ori-

gin and destination of its own reflections. It is therefore a circuit that circulates and evolves in a spiral, opening up to the horizon ahead to find its closed center in itself.

Primarily iconic in character (Peirce, 1998, p. 13), this double has its object within the sign itself, that is, its object of reflection is within the signs generated in the mind itself. Despite looking at the actions and conduct of the individual, the conscience only deals with the image, that is, with the reflection of this behavior that becomes its target for self-analysis. Hence its fragility and, at the same time, its plasticity, which is capable of both changing over time and being deceived by itself.

While reasonableness has its meaning pointing to an agreement between cognitive-computational representation and the surrounding reality, i.e. cognitive-perceptual-computational apparatuses are evolutionarily constituted to respond logically to the demands and vicissitudes of the environment, conscience has aesthetics as its locus, i.e. that which recommends itself as the ultimate or admirable end of behavior (*ibid.*, p. 142).

After years of studying logic – or self-controlled thought – Peirce realized that logic alone was not enough. In fact, he concludes that whether or not we approve of reasoning is dynamically connected to what we are deliberately ready to adopt (Peirce, 2000, p. 202). Thus, the logical good – or the sharpness with which we reason – depends on ethical approval, because while logic is the study of the means to achieve the goal of thought, ethics, on the other hand, is structured according to the definition of this goal (Santaella, 2000b, p. 121). However, the ethical good defines this ultimate end to be achieved or aimed for by what attracts it without any further consideration, by what arouses, enchants and recommends itself, therefore by what is admirable in itself. This means that the ethical good – the deliberate actions reasonably adopted – defines its goal by what is aesthetically good (Peirce, 2000, p. 202).

In its projection or dialogical reflexive duplicity, consciousness functions as a space or environment that is at the same time dual: aesthetic and intellective; in which the bonds of reasonableness are more tenuous and probabilistic processes become more likely to break the symmetry of time, in what we call 'awareness', that is, a new bifurcation opens up and a new process of self-organization of consciousness is restructured, dispersing a renewal of interpretants – diffusion – fostering a new organization of the self.

This doesn't mean that consciousness can evolve to a better or worse level, because what is admirable and aesthetically recommended for oneself doesn't always constitute something ethically approvable for everyone. Because it has a probabilistic character, this evolution can lead to either irrationality or rationality, in other words, either coherence with the environment or a lack of sense in relation to reality. Consciousness can therefore be as blind and deaf as it can be clear – 'enlightened' – and perceptive.

In this way, we conceive of consciousness not just as a system of itself, but as an ecosystem of itself or an environment or Oikos in which this self dwells and through which informational flows transit, circulate and reverberate. Thermodynamic in nature, this environment moves through time, co-evolving with logical thought, in an irreversible and undulating journey, in a spatialized time (Prigogine, 2011, p. 62) or image, transitory and plastic.

In this environment, internal informational flows circulate and resonate together, forming a kinetic structure whose stability or eco-homeostasis depends on the many undulations, reverberations and resonances (*ibid.*, p. 46) between various internal procedural matrices, creating couplings of internal events or signs, thus weaving a unity or Oikos through the fluidity of resonances. This means that without the intermittent and dialogical flows of signs, there is no self-organization such as consciousness, i.e. without the "effective gush of unpredictable novelty" (Bergson, *apud* Prigogine, 2011, p. 63) there is no consciousness.

In this movement permeated by signs, sometimes orderly, sometimes irregular, self-reflection seems to create as many roots below what we perceive internally as there are flourishes structuring a varied cognitive-reflexive canopy. In this iconic and quantum environment, there is as much diversity as unity, as much cacophony as harmony, however, it is possible to perceive a distinct volume of intellectual-computational temporalities travelling in varied instances, some incipient, others mature, some random, others regular, in their conclusions and/or unfoldings and stabilities or diffusion of interpretants.

This internal movement, out of equilibrium, seems to depend on a range of temporalities/information that would allow consciousness to self-organize, in other words, to 'see' itself, or duplicate itself. It's the gaze "that expands in many directions", as Davi Kopenawa observes (Kopenawa and Albert, 2015, p. 75), which sees the plateaus of our own landscapes, built/wrought over time in the clash with reality, by mediating/

computing: our experiences, concepts, desires, dreams, traumas, successes, disappointments, cultures, traditions, customs, etc., at different stages of life, which accumulate – storage – creating zones of information or spaces of contexts (Vieira, 2007, p. 51), full of past stories so intertwined and eco-dependent that the flutter of an idea – or a butterfly – at one point can generate a whirlwind at another.

On the other hand, stability doesn't mean the absence of conflict or contradictions. Much of what happens in this thermodynamic environment is not initially perceived, i.e. there are many unconscious processes involved in shaping this Oikos called consciousness. A trauma can be seen as if it were a black hole that, although it affects a person's behavior and actions, they are often unaware that it is there, gravitationally pulling on their behavior and thoughts. Because we have no way of looking at it directly, we can only analyze its action by its indices that emerge through dreams and/or in the observations of a good psychoanalyst during therapy sessions. However, once identified, this gravitational field is no longer an attractor (Vieira, 2007, p. 85) unknown to the mind.

So, unlike logical reasoning, whose trajectory can be observed and is reversible, as we see in Bárbara's syllogism, consciousness, on the other hand, is not expressed by trajectories, but by maps or topologies, in other words, it can only be measured diagrammatically, as if we could freeze that state-instant in an image representing all its complexity in movement.

This state-instant or map has the nature of what Charles Sanders Peirce called Existential Graphs (Peirce, 1998, p. 279). It is a spatio-temporal cut-out with a primarily iconic – double – and necessary – inter-relational – character, produced by the mind (*ibid.*, p. 21) in the face of the complexity in which it is immersed. In fact, graphs would have the same logical functions as close ups, medium shots, open shots, *plongées*, travelings, etc. in cinema.

As in a film, sometimes the mind dwells more closely on a diagram – a hypothesis, for example – and for this we need a close-up. However, at other times, the mind needs to see these hypothetical – and exploratory – interrelationships more comprehensively, as in an open shot. Thus, moving from one diagram to another, the mind sees (Peirce, 1998, p. 207) what is present, in general, in the correlations between the diagrams.

At this moment when we contemplate (*ibid.*, p. 247) the parade of images in the mind's eye and are so absorbed in their interrelationships, exchanges and informational complementation, it is notorious that we get lost in their topologies and landscapes, because we are completely immersed in

the horizon ahead to find our own gravitational center and don't even notice time and sometimes even the people and movements around us.

In this process, I see the image of my behavior (*ibid.*, p. 248) and self-analyze the ideals – aesthetics – that shape me, i.e. whether there is a semantic coherence between my actions and my ideals. Therefore, it is in this instant of self-reflection that awareness emerges as a rupture of time.

In this way, we can no longer go back to the way things were before, because the whole system (*self*) has been affected and it is from this break in time that consciousness irreversibly opens up to another self-reflexive path. Therefore, a bifurcation originates precisely at the moment when time is broken internally, and it is from this rupture that the reflexive flows – interpretants – are restructured – coupled – along other paths, finding a new active self-organization.

We are not far removed from the experiences practiced in meditation, whether in Zen Buddhism or yoga, because both lead us to exercise this breaking of time in and of consciousness, that is, from the 'pause' and/or 'rupture' of the flow of thought, the mind reeducates itself to self-organize. Thus, with each 'break', each rupture, consciousness restructures itself, evolutionarily restarts itself in composition, connectivity, structure, integrality, functionality, organization and complexity. In fact, consciousness rediscovers itself in the fluidity of each rupture in time.

On the other hand, both the Aristotelian catharsis (Aristoteles, 2005, p. 35), or the experience of the sublime observed by Longinus (2005, p. 185), or even the aesthetic experience according to F. Schiller (Schiller, 2002), are equally responsible for this rupture in the time of consciousness, to the point where we lose ourselves in the work and, from this rapture, change the way we reflect on our surroundings and ourselves. Therefore, the asymmetry of time seems to be an important factor in the self-organization of consciousness, which opens up to new possibilities in a *continuum* of renewal – generalities – self-reflection.

Of a probabilistic nature, consciousness self-organizes in countless ways and in new couplings suggested aesthetically to itself in a projection based on the new diffusions of information – interpretants – constructed by the rupture of time. Whether through a playful rapture, a meditative practice, or an event/experience so striking to the mind that it prompts a semantic renewal, consciousness reorganizes itself in a unique and singular way, because any evolutionary change, be it in the new recomposition, in the new reconnectivity and/or in the new semantic re-functional-

ities found in this new bifurcation of consciousness, can generate another environment, not previously foreseen.

After the rupture of time, while logical reasonableness weaves the paths to realign the edges of this new internal architecture of consciousness, aesthetics takes care of the Gestalt of the self, the form of this double – iconic – that looks at us from a distance while being umbilically connected to ourselves. In fact, consciousness is qualitative and can only be measured by the topological totality of its parts. Thus "an object, in order to be aesthetically good, must have a number of parts so related to each other as to give a positive, simple and immediate quality to the totality of these parts" (Peirce, 1998, p. 201).

However, these edges can only be built from spaces in previous contexts (Vieira, 2007, p. 97), that is, from our own systemic memory, because life experience is continually contributing more or less to illuminating (Peirce, 1998, p. 248) our own consciousness. Even if it takes a while to realize it.

Thus, like a clearing that opens up in a forest and covers the soil with organic matter, the rupture in the time of consciousness takes as its semiotic nourishment the very forest that preceded it. Thus, from this *humus* that now spreads through the soil of the mind, a new self-reflexive forest – *Oikos* – is reconfigured, connecting the past to the present and making possible futures.

Conclusion

As a result of erraticism, consciousness is rooted in the irreversibility of time. Thus, it is from the ruptures caused by life's experiences that self-understanding is rebuilt in a semiotic continuum whose purpose is inherent to its self-pheno-geno-organization, that is, finding its new stability in non-equilibrium (Prigogine, 2002, p. 44).

With the contours of aesthetic reasonableness, consciousness has a unique plasticity that allows its self-organization to be flexible and moldable over time. On the other hand, it is fragile, open to chance, fallibilism, probabilities, in other words, error and illusion. This is because its object is within itself. It is, therefore, the reflection of oneself that we contemplate from a distance and within ourselves. In this way, it is capable of both wisdom and madness, both enlightenment and blindness (Morin, 2007, p. 123).

Unlike logical reasonableness, which is constituted by the conformity between representation and reality (Peirce, 1998, p. 380), consciousness is information that is geometrized (Vieira, 2007, p. 97), that is, in its data processing, information becomes a landscape that we can dwell on by looking at it from different angles. Through its iconicity, we expand our understanding and through its circularity we make it three-dimensional. We walk through it because it is an irreversible, singular and self-poetic reflexive construct.

In this Oikos of the self, consciousness and intelligence compete, complement and adjust to each other. Consciousness chooses and, at the same time, is chosen by the logical reasonableness that travels through it, so both co-evolve in time and space. On the other hand, it is in its kinetic movement – of interpretants – that consciousness acquires life, and at the same time, it is in its rupture that it renews itself in an unpredictable gush of novelty. Finally, consciousness has its expressiveness (Peirce, *ibid.*, p. 203) which can be seen in the quality of its reflections. This leads us to say that consciousness is a form of art (Peirce, *ibid.*, p. 10), because through it we can open up new semiotic horizons.

If in the near future we want to promote autonomous and self-aware machines, we need to ask ourselves if we are prepared for their idiosyncrasies, because there will no longer be replicas, but open works (Eco, 2008).

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