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Review article

The neuroscience of the future: What do we want?

La neurociencia del futuro ¿Qué es lo que queremos?

Hans Lenin Contreras-Pulache[1], *Palmer José Hernández-Yépez[1], Karina Jasmin Chicoma-Flores[2]*
[1]Facultad de Medicina Humana. Universidad Privada Norbert Wiener (Perú). [2]Centro de Documentación e Investigación Pedro Ortiz Cabanillas (Perú).

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Abstract

Since the origin of neuroscience as a discipline, great discoveries have been made in this area, but at the same time questions and problems arise that this science still cannot solve. Probably there is no consensus when defining what are the unsolved problems of neuroscience, but what most neuroscientist are sure about is recognizing that these problems exist. Is the neuroscience of future, with its achievements and unsolved problems, the neuroscience we want? In this document, a count of the so-called unsolved problems of neuroscience is elaborated, according to several authors who have analyzed the limits of this discipline in the future. Likewise, a summary of the itinerary of ideas of Pedro Ortiz Cabanillas' Sociobiological Informational Theory will be made as an alternative proposal in order to finally shape the neuroscience of the future, the neuroscience that we desire.

Keywords: Neuroscience; Information theory; Society; Sociobiology.

Resumen

Desde el origen de la neurociencia como disciplina se han realizado grandes descubrimientos en esta materia pero al mismo tiempo surgen interrogantes y problemas que esta ciencia todavía no puede resolver. Probablemente no exista consenso al momento de definir cuáles son los *unsolved problems* de la neurociencia, pero sobre lo que sí se está seguro es en reconocer que estos problemas existen. ¿La neurociencia del futuro, con sus logros y sus *unsolved problems*, es la neurociencia que queremos? En el presente documento se elaborará un recuento de los llamados *unsolved problems* de la neurociencia de acuerdo (según) varios autores que han analizado a futuro los límites de esta disciplina. Asimismo, se realizará una sumarización del itinerario de ideas de la Teoría Sociobiológica Informacional de Pedro Ortiz Cabanillas (1933-2011) como propuesta alternativa para así finalmente se perfile la neurociencia del futuro, la neurociencia que deseamos.

Palabras clave: Neurociencia; Teoría de la información; Sociedad; Sociobiología.

* Correspondencia: Hans L. Contreras-Pulache. Faculty of Health Sciences Norbert Wiener Private University, 440 Arequipa Avenue, Lima. School of Human Medicine. Phone +51 (01) 7065555, e-mail: hans.contreras@uwiener.edu.pe

1. Introduction

We will call "neuroscience of the future" to the scenario and context of neuroscience development in at least the next 30 years. Whatever happens within this discipline is what we will call "neuroscience of the future".

In order to imagine this context, first, we should recognize the development of neuroscience through time. The origin of neuroscience as a discipline was in the 1960s.[1] After half a century, it reached a hegemonic position in academia and culture. Nowadays, no one questions the importance or transcendence of neuroscience. At the same time, because this discipline is going through a development process, it is also urgent to envision its future. Regarding this, we could develop scenarios based on the future achievements of neuroscience. It does not seem wrong to us to carry out this exercise, even when we see in it a clear positivist exercise protected by a fallacious notion of "progress". Obviously, the development of a discipline includes a series of achievements; but in the same way there are also the proper limits of the discipline. In brief, enunciating positively all the future achievements of neuroscience does not downplay the fact of setting up its own limits. In this document, first, we will elaborate a recount of the "unsolved problems" of neuroscience. Hence, we will review the precedents and check how different authors have established the limits of neuroscience for the future. Then, we will outline the "neuroscience of the future" by highlighting the existence of the "unsolved problems" as an inherent part of its development. We will continue with a summary of ideas about the "Informational Sociobiological Theory" (IST) developed by Pedro Ortiz Cabanillas (1933-2011) as an alternative proposal (this could be named without using euphemisms: an informational neuroscience). Finally, we will outline for the neuroscience of the future, the neuroscience we desire.

2. The unsolved problems of neuroscience

The book "23 problems in Systems Neuroscience" was published in 2006. Through the development of their ideas, the authors propose that problems of neuroscience revolve around explaining the structure and activity of the human nervous system (some questions are raised: How is the brain structured? How is the cerebral cortex organized? And how do neurons interact?). Additionally, the authors consider that the nervous system is a system that processes information (an assumption that forces information to be thought in line with the classical approaches of Shannon's information theory: a message that is transmitted and processed). In that way, a question not solved yet in neuroscience is: How is information processed in the brain? Finally, there is an additional question: How are cognitive systems organized?[2] At the end of this book, as an epilogue, there is an article titled "What Are the Neuronal Correlates of Consciousness?". This article is a summary of all the "problems". The authors highlight the current absence of a global explanatory theory, not unique, but with enough explanatory capacity (in sum, a theory able to respond to all the questions). They suggest that this explanation (still pending what Koch and Crick call "the main problem" and which reflects the phenomenon of consciousness) could come from Information Theory, more specifically from an original reconsideration inside the Information Theory.[3]

"10 unsolved mysteries of the Brain" (2007) is probably the first disclosure article that popularized the topic about "the unsolved" in neuroscience. After this publication, the search criteria "*unsolved problems* of neuroscience" appeared for the first time in Wikipedia. For the author, the mysteries that cannot be solved about the brain (not about neuroscience as such, although it is understood that the discipline in charge of the understanding of the brain is neuroscience) are: i. How is information coded in neural activity? ii. How are memories stored and retrieved? iii. What does the baseline activity in the brain represent? iv. How do brains simulate the future; v. What are emotions? vi. What is intelligence? vii. How is time represented in the

brain? viii. Why do brains sleep and dream? ix. How do the specialized systems of the brain integrate with one another? and x. What is consciousness? What stands out about these unsolved questions is either they are applied to the structure of the nervous system (i, iii, ix); they are applied to the activity of the nervous system (ii, iv, vii, viii); or they mention attributes that are not about the nervous system itself (v,vi,x). However, it is feasible to notice that authors face something called "mereological fallacy".[4] For that reason, it is suggested in a disclosure that is the brain which not only simulates the future, but also represents time, sleeps and wakes up. Additionally, it does not seem clear what is the meaning of "brain" in the author's questions, in some parts it looks like as if the author is talking about the encephalon and, in other parts, about the cerebral cortex. Beyond these analyses, the programmatic value of the authors proposal is to put the "unsolved questions" as a topic at the center of the contemporary neuroscience agenda.

In "Seven challenges for neuroscience" (2013), it is proposed the discussion not at the level of unanswered questions or unsolved mysteries, but in terms of challenge. It is a *conference paper*, regarding the launching of the *Human Brain Project*, in which the author suggests as a "roadmap" the following challenges of neuroscience: i. Neuroscience has to become a "big science". ii. We need to create interlinked sets of data providing a complete picture of single areas of the brain at their different levels of organization with "rungs" linking the descriptions for humans and other species. iii. The development of efficient predictive tools, enabling us to drastically increase the information we can extract from expensive experiments. iv. We have to develop novel hardware and software sufficiently powerful to simulate the brain v. We need to develop new ways of classifying and simulating brain disease leading to better diagnosis and more effective drug discovery. vi. We have to exploit our knowledge to build new brain-inspired technologies with potentially huge benefits for industry and for society. And vii. We have to set goals for ourselves that the public can recognize and share.[5] Within these challenges we can clearly identify that except the second one (ii) the rest can be conceptualized as methodological issues (the need of technical innovation). The second challenge would be related to an unsolved question of neuroscience, this question would revolve around the explanation of the structure (and eventually the activity) of the nervous system. Additionally, the contribution of this author lies in revealing that neuroscience is in a transition, from being a "small data science" to become a "big data science".

"The unsolved problems of neuroscience" (2015), is probably the first document which positioned the term "*unsolved problems*" in an academic level. According to the author, we can group the unsolved problems as follows: "Problems already solved or that will be solved soon", "Problems that must be solved in the following 50 years", "Problems that must be solved (but we do not know when)"; and "Problems that will be never solved". The merit of this author lies in raising an issue from a perspective that allows differentiating "unsolved problems" that will eventually be solved (the ones that essentially depend on technological development) and unsolved problems that will not be solved (being categorical and imperative in his conceptual definition: for this author, there are unsolved problems that we will "never" solve).[6] When the author points these unsolvable problems that we will "never" solve (i. What counts as understanding the brain? ii. How can a brain be built? iii. What are the different ways of understanding the brain?), we can find that they refer to the activity and structure of the encephalon, to a parallel process about the brain (the cognition), and particularly, how to move from one to another.

In "Top mysteries of the mind" (2018), the authors put forward 5 mysteries or concerning questions about the mind which cannot be answered (their interest is not in fact the brain but the mind itself: the mind as a subjective phenomenon in contrast with the external world as a physical phenomenon). For these authors, the mind is the unified experience of sensations, the subjective experience. The "unsolved questions" (or in his own terms: mysteries) are: i. What is the relationship between subjective experience and the physical world? ii. How do we

so quickly process and interpret the external world? iii. How do all of our sensations unify into one experience seamlessly? iv. Why do we sleep? v. How and by what mechanisms can emotions be regulated?[7]

Finally, the book "The Future of the Brain" was published in 2014. In this book, different opinions of renowned scientists are detailed, concerning the expected evolution of both, the nervous system and the neuroscience as a science in development. The article at the end of the book, titled "Neuroscience in 2064" turns out to be meaningful for what we are mentioning here. We are going to close our report with this last reference (even when this is not the last one in terms of chronological order preceding here). This is one of the few essays written with the purpose to imagine the neuroscience of the future which sets as a goal to identify within fifty years the unsolved problems of neuroscience. Based on literature and philosophy, the authors prepared an argument according to which they could imagine the neuroscience scenario within 50 years (specifically by 2064). To begin with, they propose a chronological development of neuroscience, considering that from the 1960s to 2014 neuroscience had lived a "romantic era"; between 2014 and 2064, neuroscience is currently living the "big science era"; and, finally, by 2064, neuroscience is going to begin its "modern era". In this narrate, it is reviewed the achievements of neuroscience along its "second period" (essentially linked to the benefits provided by the technological development: the big science and the convergence of all exponential technologies: artificial intelligence, robotics, biopharmacology, machine learning, 3D print, and others). Finally, the authors propose that by 2064, the unanswered question (unsolved problem) of neuroscience will be: How does the brain establish mental functions, cognition and consciousness?[8]

In sum, the authors we have reviewed (Table 1), each time they have brought up some problems of neuroscience, they have generally identified, two types of problems: on the one hand, those associated to technological development (which have been recognized as eventually solvable); and, on the other hand, those associated to research questions with no answer ("unsolved problems"). As shown, there is not a consensus about what the unsolved problems of neuroscience are. Nevertheless, all the authors are in agreement when they recognize that these "unsolved problems" exist. We will get closer to this phenomenon in the following section.

3. The neuroscience of the future

The last decade of the 20th century will figure in world history as the moment in which neuroscience appeared on the world research agenda (not in vain it was proclaimed the "decade of the brain" in the country that boasts of having the world's greatest potential). Not surprisingly, there are those who propose the existence of a "neuroculture" in the contemporary world.[9] In its origins, neuroscience sought to understand the nervous system. This need of understanding enlightened the path of early neuroscience research plans (what Koch and Crick call: the "romantic era" of neuroscience).[3] However, by the second decade of this century, neuroscience has managed to organize itself around two axes, each one based on two research and development projects.[10] On the one hand, as shown in Figure 1, the "Human Brain Project", established in the European Union, has as its framework the development of digital technologies and promotes the simulation (it is understood simulating is not emulating) of the nervous system in activity.[11] On the other hand, the "BRAIN Initiative", based in the United States, which is about the technological development of images, seeks the representation of the nervous system, looking forward to have images with a real time resolution and at a microscopic level of the nervous system in activity.[12]

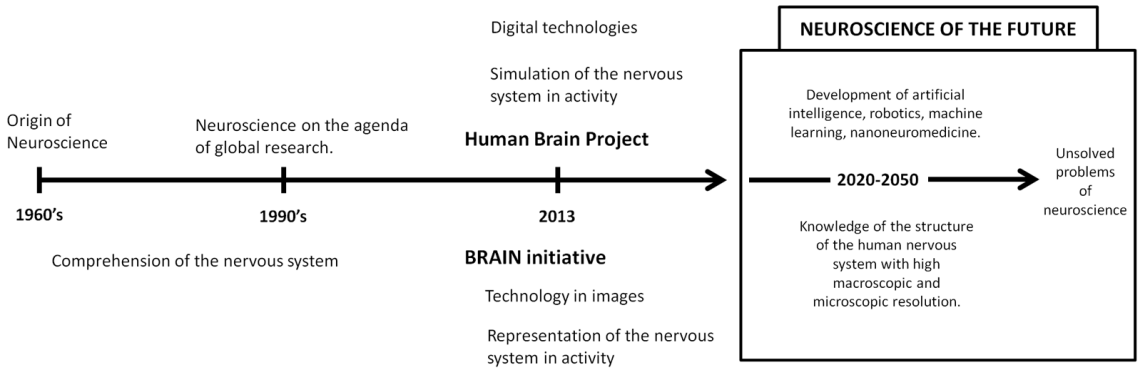
Table 1. The unsolved problems of neuroscience.

Author	Unsolved problem	
van Hemmen L. Sejnowski T. 2006	i. ii. iii. iv. v.	How is the brain structured? How is the cerebral cortex organized? How do neurons interact? How is information processed in the brain? How are cognitive systems organized?
Eagleman D. 2007	i. ii. iii. iv. v. vi. vii. viii. ix. x.	How is information coded in neural activity? How are memories stored and retrieved? What does the baseline activity in the brain represent? How do brains simulate the future? What are emotions? What is intelligence? How is the time represented in the brain? Why do brains sleep and dream? How do the specialized systems of the brain integrate with one another? What is consciousness?
Markram H. 2013	i. ii. iii. iv. v. vi. vii.	Neuroscience has to become a "big science" We need to create interlinked sets of data providing a complete picture of single areas of the brain at their different levels of organization with "rungs" linking the descriptions for humans and other species The development of efficient predictive tools, enabling us to drastically increase the information we can extract from expensive experiments We have to develop novel hardware and software sufficiently powerful to simulate the brain We need to develop new ways of classifying and simulating brain disease leading to better diagnosis and more effective drug discovery. We have to exploit our knowledge to build new brain-inspired technologies with potentially huge benefits for industry and for society We have to set goals for ourselves that the public can recognize and share
Adolphs R. 2015	Problems that are solved, or soon will be: i. ii. iii. iv. Problems that we should be able to solve in the next 50 years: i. ii. iii. iv. v. vi. vii. viii.	How do single neurons compute? What is the connectome of a small nervous system, like that of *Caenorhabitis elegans* (300 neurons)? How can we image a live brain of 100 000 neurons at cellular and millisecond resolution? How does sensory transduction work? How do circuits of neurons compute? What is the complete connectome of the mouse brain (70 000 000 neurons)? How can we image a live mouse brain at cellular and millisecond resolution? What causes psychiatric and neurological illness? How do learning and memory work? Why do we sleep and dream? How do we make decisions? How does the brain represent abstract ideas?

	Problems that we should be able to solve, but who knows when: i. How does the mouse brain compute? ii. What is the complete connectome of the human brain (80 000 000 000 neurons)? iii. How can we image a live human brain at cellular and millisecond resolution? iv. How could we cure psychiatric and neurological diseases? v. How could we make everybody's brain function best? Problems we may never solve: i. How does the human brain compute? ii. How can cognition be so flexible and generative? iii. How and why does conscious experience arise?
Jerath R. Beveridge C. (2018)	i. What is the relationship between subjective experience and the physical world? ii. How do we so quickly process and interpret the external world? iii. How do all of our sensations unify into one experience seamlessly? iv. Why do we sleep? v. How and by what mechanisms can emotions be regulated?
Koch C. Marcus G. (2014)	Unsolved problem in 2064: i. How does the brain establish mental functions, cognition and consciousness?

Source: Own elaboration.

Figure 1. Neuroscience in the 20th and 21st century and neuroscience of the future



Source: Own elaboration

The validity of these neuroscience development projects of the 21st century is for the 2020-2030 decade, the aforementioned projects should be re-founded, without ruling out that in the new global socio-political orders, countries that have been relegated but clearly emerging (China, India, among others) will have a presence. Thus, in this new framework, it seems that the two axes drawn in the course of the second decade of the 21st century will remain (even when their players vary), this being one of the characteristics of the "neuroscience of the future". Here, in the "neuroscience of the future", neuroscientists will face a series of problems, which, in light of what was stated in the previous section, we can differentiate into (i) problems or questions with answers (from here will come the blossoming of neuroscience at this future time), and (ii) problems or questions with no answer (unsolved questions).

We do not believe we are undermining the greatness of the future of a discipline by highlighting its potential achievements as well as its challenges or shortcomings. More when these problems are already recognized in both academia and popular world (Wikipedia). There is no consensus when defining which are the unsolved problems of neuroscience, but there is, at least, relative consensus in recognizing that there are unsolved problems (either one or several). We believe that it is more honest and transparent when imagining the future of a discipline to keep in mind the limits of that discipline. For this reason: rather than focusing on the achievements of neuroscience -work that has been done quite well by the literature, sometimes sensationalist, of scientific dissemination- we want to focus the discussion around the unsolved problems, because they ultimately result not only in the pitfalls of a future science, but also in a fairly acritical contemporary attitude.[13,14] This neuroscience of the future, with its achievements and unsolved problems, is the neuroscience that we want?

How, knowing of the existence of unsolved problems, does one continue to insist on a discipline that is recognized as incomplete (epistemically) from the beginning? It seems that regarding this question modern neuroscience prefers to do nothing or pretends the question has never been asked. It seems that the contemporary attitude, once the unsolved problems of neuroscience were recognized, is to continue advancing without further protection on the basis of faith (and on an eventual resolution of the *unsolved*), always trusting that the achievements will be worth enough. It is as if quitting is the proper course of current neuroscience, the acceptance of acknowledging an *incomplete* science. Perhaps this explains why neuroscience initially sought to understand the human nervous system, and today what it seeks more than understanding is a simulation. It is obvious that saying to simulate the nervous system is not the same as emulating it, to emulate one would have to understand all the processes of the nervous system in order to replicate them, simulation is no longer seeking this understanding but rather a similar general approach (in response) to what the nervous system would do in a hypothetical situation. It does not stop oozing a certain behavioral paradigm in the ultimate claim of artificial intelligence, for example. Or, maybe, neuroscience is returning to its origins in cybernetics? To recognize the "unsolved" as an impossible topic, is the first step to the end of neuroscience as a modern science?

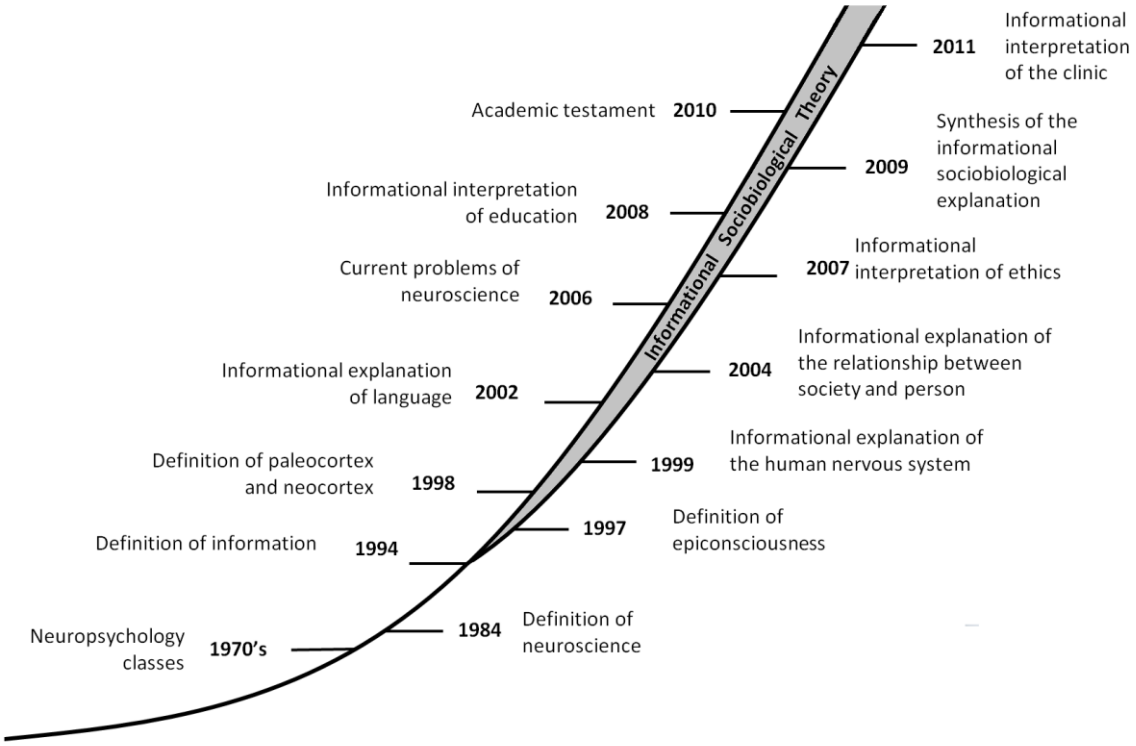
Why neuroscience gave up regarding not having a full explanation (as recognized by Koch and Crick) and simply accepts the *unsolved problems*? Why it quickly settles to acknowledge that a theory is necessary but does not make the elaboration or development of that theory as the first priority? Furthermore, is it true that this theory, which could come from information theory, has not been elaborated yet? What if we convinced ourselves that this theory has at least already been formulated? Neuroscience does not seem to contemplate that possibility. And simply accepts to being

the center of deadly criticism: for example, that it lacks the necessary philosophical substrate, or that neuroscientists have not read or have misread philosophers, or that, to say of a modern philosopher: "[neuroscientists] are unable to demonstrate the status of their own theory", therefore, neuroscience is not ready to respond "impossible questions".[15,16] In short: are we willing to live with an explanation that is already announced as *incomplete*? Is this the neuroscience we desire?

4. Informational neuroscience

We are going to use as a point of reference the academical work done by Pedro Ortiz Cabanillas (1933-2011) who suggests that neuroscience does not have either solved problems, problems that it will solve or problems that it will not solve; but neuroscience itself is the problem.[17] According to Ortiz, the unsolved problems of neuroscience are not the questions that neuroscientists ask themselves and that they cannot answer, it is quite the opposite: they are the questions that neuroscientists never ask because they do not want to (it is easier to ignore the unsolved problems and keep entrenched in a stubborn bet driven by the achievements of their discipline) or because it is not enough for them to imagine and think the reality of the nervous system in a different way. Ortiz Cabanillas proposes the following essential problems of neuroscience: i. being stuck in the body-soul dualism (or in the brain-mind problem); ii. not differentiating between animal psyche and human psyche (being convinced that the human being is an animal); iii. not recognizing the historical condition of a person; iv. not differentiating between social interaction and society (and therefore speaking of a society of animals, for example); v. not having defined what consciousness is; vi. lagging behind the psychoanalytic knowledge of the unconscious (according to which the unconscious is what we do not realize about); and finally, vii. not being up to the task of giving an explanation about the moral condition of the person. Presented in this way, it seems that neuroscience has again been reduced to a fallible theoretical body.[18-21] This exercise has already been widely carried out: revealing the limits of neuroscience is almost an ordinary academic exercise. What is the difference between Ortiz Cabanillas' proposal and these other authors' proposal? It can be said that Ortiz is not the first to deal a mortal blow to neuroscience which forces us to turn the page of the "unsolved problems" and to consider, from the beginning, the necessity of an reinterpretation of the ideas (founding a new neuroscience radically different to the current one, trapped in the "unsolved"). As far as we know, Ortiz is the first who reviews and raises a totally different alternative proposal to contemporary neuroscience.[22,23] Ortiz began raising his work in the mid-1970s. In 1984 he argues in favor of the need to "go far back in time" to the definition of the origin of the universe.[24] He also, at this time, proposes a definition for neuroscience which remains the same even in one of his latest academic texts: "The Social Point of View of Neurosciences" (2011). Neuroscience is the integration of neurochemistry, neurohistology, neuroanatomy, and neurophysiology. He finally proposed his theory in 1994, since then until his death, he was dedicated to develop his theoretical proposal, named "Informational Sociobiological Theory" in his Academic testament, aiming to found a new neuroscience, and as much as to reinterpret universal phenomena such as language, society and others like social technologies (for this Ortiz considered education, medicine and ethics).[25,26] To summarize this theoretical development, Figure 2 is shown.

Figure 2. Development of the ideas of Pedro Ortiz Cabanillas (1970's-2011)



Source: Own elaboration

This is not the place to contrast informational neuroscience (by Pedro Ortiz Cabanillas) and traditional neuroscience (stuck in unsolved problems), it will be enough to specify the following: Pedro Ortiz Cabanillas' theory is a conceptual elaboration within information theory, specifically Ortiz reworks the definition of information (in a qualitative perspective, not in the classical mathematical and quantitative perspective developed by Norbert Wiener and Claude Shannon at the 1940s) and spreads a different method to work in information theory. For Ortiz, information is a property of matter that allows organizing different levels of increasing complexity (product of which varied biological systems are established). If Koch and Crick had known this fact in 2006 (at the moment that Ortiz had spent almost 30 years developing the dimensionality of his theory), probably others would have been the antecedents described in this document. The fact is that Koch and Crick did not know Pedro Ortiz's work, so, at most, they managed to augur the generating potentiality of Information Theory and resigned themselves to a neuroscience condemned to live along with unsolved problems as an *ad infinitum* shadow.

So, just stating that Pedro Ortiz Cabanillas developed his own "theory of information" is not enough to explain in itself the essential achievement of informational explanation (which, in summary, is the resolution of the mind-brain problem). It is urgent to explain how this informational theory achieves what it claims. In this sense, it will suffice to say that the IST is not in the strict sense a neuroscience, in the theoretical body it offers a neuroscience, but at the same time it goes beyond the epistemic limits of neuroscience. In other words, it reaches neuroscience, however, it does not start or limit itself to it. For example, Eric Kandel elaborates an explanation starting from within neuroscience (and resorting to psychoanalysis for when neuroscience does

not reach him as an explanatory framework). Nowhere in the book "Principles of Neural Science" is there a need for a theory of the universe, a theory of society, a theory of history or a theory of culture.[27] It seems that Kandel wants to explain the human being stripped of all its unique attributes (perhaps because it is more familiar to him in terms of an *Aplysia californica*). On the other hand, the IST is essentially based on the need for an explanation of the universe, an original explanation of society (related to Niklas Luhmann's "General Theory of Society") and, finally, an interpretation of the brain.[28] It is precisely this epistemic difference between Ortiz's informational neuroscience and Kandel's cognitive neuroscience that positions the IST in better conditions when trying to solve the mind-brain problem. If the following question were asked: "How is thought, love, hatred, reason, goodness and evil (among other things that "emanate" from the brain) measured in the IST?" The answer would be: in the IST, thought, love, hate, reason, goodness, evil, among other things, are not measured; informationally all these phenomena are reinterpreted. Furthermore, from the IST, it is not correct to say that these phenomena "emanate" from the brain, firstly because centering everything on the "brain" is a *mereological fallacy*; second, because only those who do not have an explanation of the structure and activity of the human nervous system (not even the brain, but the entire nervous system) resort to the idea of "emanating", it is precisely the IST that enables this double explanation of the nervous system: it performs as a structure, it performs as an activity.[29,30] And we repeat: to achieve this, the IST necessarily avoids the epistemic framework (reductionist, inductive, mechanistic, dualistic and scientistic) that sustains cognitive neuroscience (such as Eric Kandel's neuroscience).

Along the same lines, but with the intention of describing the IST more organically, it should be mentioned that between 1973 and 1993, Pedro Ortiz Cabanillas, rather than giving an explanation of the nervous system, was interested in the search for a natural philosophy (or philosophy of nature) that allow the integration, within the same explanatory framework, of the universe, society and people (with their nervous systems, and in particular with their brains). From 1994 to 2011, Pedro Ortiz added on his natural philosophy (dialectical sociobiological) a theory of life (or what is the same: he proposed his own theory of information), which makes him rethink not only the definition of what people are but what all living beings are.[31] One of the essential lessons of Ortiz is never to be interested in believing that the human being is an animal, or that he belongs to the animal kingdom. The real magnitude of Ortiz's contribution; it is the affirmation, and repeats it throughout the last 17 years of life, that the human being has already transcended the level of animality when society emerged (in the course, at least, of the last 30 thousand years).

5. Conclusion

What does it mean what we have argued so far? This means that the informational explanation represents an alternative to the traditional explanation of neuroscience, which, for the future, has a list of "unsolved problems". In addition, which are the implications of knowing that the informational perspective represents an alternative explanation? To begin with, it must be recognized that the scientific revolution of the last 5 centuries has its own course. Ortiz is like a sinking island in the sea, or more precisely: the stone on a sinking island (using Cesar Moro's metaphor).[32] The neuroscience of the future will not be affected by the presence of the informational explanation. The neuroscience of the future will keep asking itself the same essential questions over and over again with no answers and the flow of its no-answers will fuel all who practice neuroscience now and in the coming years. Ortiz Cabanillas' contribution lies in presenting a testing tool that enables the approaches of neuroscience

to be placed on judgement. The explanation, strictly speaking, does not solve the mind-brain problem, quite the opposite, is useful to evidence this problem in the neuroscience approaches (neuroscience has problems, but Ortiz problematizes not these problems but the neuroscience as a problem itself). Ortiz Cabanillas in his original explanation completely omits all disquisitions on the "mind", in other words: "mind" does not exist in his vocabulary. Thereby, the theory, without having any intention to give a solution (according Ortiz, the theory was not developed to answer the mind-body problem but to help physicians, educators, psychologist, and leaderships, among others, to understand the nature of the subject that is the center of their job), solves the mind-brain problem in two ways: revealing the entrapment of an explanation; and proposing an elucidation that omits any allusion to mental when is time to illuminate how the brain is integrating in a singular, personal, particular experience. Ortiz, and for this is that he has titled of "hard to understand", uses his own definitions, has his own vocabulary; we are not facing only with singular ideas, we are in front of a man with an architectonic *modus* of think.

With an eye towards the future, the informational sociobiological explanation represents a way to contrast the hypotheses and approaches of neuroscience. This, on the other hand, allows to get a better way to imagine the future, low in dystopic futures (that is what we get when only focusses in the achievements of a discipline), and without blinding ourselves regarding the science's limits. In this respect, in the following decades, neuroscience will have huge improvements, the barrier between machines and nervous system will break; and the knowledge of the microscopic level, robotics and artificial intelligence will bring great progress for the control, detection, treatment of illnesses and strengthening of human capacities. In this field, pharmaceutical progress will join and go on the vanguard, in parallel with the technology improvements of the fifth industrial revolution. The human being who comes closer to neuroscience of the future, will live in a chaotic world, of an inherently unequal socio-political order, this inequality will be similar to the present (maybe more or, hopefully, less, but always there: like something unwaivable): a daily occurrence in order to hold the technological progress in a globalized world. In fact, it will matter little whether we have or not an explanation that solves the mind-brain problem; the contemporary agenda will always be about getting closer to the mind from the brain and on the basis of technology. The brain-mind disunion will remain, the technological development will sustain this division (in short: persisting in a real dualism). The digital technology of the future will allow several modified experience options, but, in essence, the human experience will be the same: the human being sensing, the human being thinking, the human being imagining and the human being acting. In 30 years or more, whether neuroscience exists or is already out of fashion, the human being will continue pondering as he did 3 thousand years ago, about the intelligible nature of the nervous system. The soul, the spirit, the "nous", the being, these concepts all together make us what we are. We are satisfied to know, from the informational explanation, that it is not necessary to wait decades for keeping questioning the same, this is the neuroscience we desire: an alternative explanation that would allow us celebrate each technological advance like an incurable firework that is approaching to illuminate the night but which is not the light of dawn yet. Explaining what we are, as the Post-Socratic philosophers already knew, does not make things seem less special. Quite the opposite, it is totally different asking for the sake of asking rather than asking but following a conceptual framework, this exercise extends according to the autopoietic capacity of the conceptual framework. In this way, the Informational Sociobiological Theory transcends what neuroscience pretends to explain. That means that the informational explanation gets to describe what

neuroscience wants to describe, but neuroscience is not enough to imagine what informationally it is possible to think.

6. Conflict of interests

No conflict of interest.

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