The Biological Foundations of Virtual Realities and Their Implications for Human Existence

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► **Purpose** – Purpose: To consider the implications of the operation of the nervous system – and of the constitution of cultures as closed networks of languaging and emotioning – for how we understand and generate so-called "virtual realities." ► **Findings** – The nervous system operates as a detector of configurations of relations of activities within itself and thus cannot represent anything external to it. The distinction between virtual and non-virtual realities does not apply to the operation of the nervous system; rather it pertains to the operation of the observer as a languaging being. Our human existence has changed as virtual realities have become non-virtual through their systemic cultural inclusion in the realization of our biological human manner of living. ► **Implications** – Virtual realities are never trivial, because we always become transformed as we live them according to the emotioning of the psychic space that they bring about in our living, and this is so regardless of whether we like it or not. ► **Key words** – Behavior, dreaming, evolution, neural network, robots, self, reality, virtual reality, conversation, culture.

Introduction

One of the central features of our operation as living systems is that we cannot distinguish in our experience between what we call, in daily life, "perception" and "illusion." This is so because we, as living systems, are structure-determined systems, and all that happens in us or with us is determined in our structure and in our structural dynamics. Indeed, it is precisely because of this that virtual realities are possible. In the first part, I discuss the biological aspects of virtual realities; in the second, I discuss the implications for human existence.

Part I: Virtual realities and the nervous system

Here I wish to discuss what the experiential indistinguishability between what, in daily life, we call "perception" and "illusion" entails in relation to the nervous system, in relation to our existence as languaging beings, and in relation to virtual realities. This I shall do in a series of self-contained statements.

Sensors and effectors

The nervous system is, both anatomically and physiologically, a closed network of interacting neuronal elements. As such, the nervous system operates as a closed network of changing relations of activities between the neuronal elements that compose it, in the sense that any change of relations of activity in it leads to further changes in relations of activity in it. Sensors and effectors have a dual character since they operate as neuronal elements and participate in the composition of the nervous system through their structural intersection with some nerve cells. As sensors and effectors they are part of the organism and constitute the surface of encounter between the organism and the medium. So, the organism interacts with the medium through its sensors and effectors, not through the nervous system. What happens is that in their structural intersection with neuronal elements, sensors and effectors operate as components of the nervous system and participate as such in its closed dynamics of changing relations of activities. The nervous system, therefore, does not encounter the medium, and as it operates as a closed network of changing relations of activity between its neuronal components, it does not have input or output relations with the medium in its operation.

Neuronal dynamics

The structure of the nervous system is not fixed. It varies continuously in a network of intercrossing cyclic changes that take place in the structural dynamics of its components through many different cyclic processes with different time constants that result in different kinds of changes: changes in the regulation of the dendritic and axonal branching of the neuronal elements, in the metabolic dynamics, in the ionic channels, in the density of receptors – which in turn result in changes in the effectiveness of the synaptic relations – as well as many other changes of a cyclic nature. As a result of these structural changes, the operation of the nervous system as a closed network of changing relations of activities between its neuronal components is also in continuous cyclic change of long (sometimes permanent) and short time constants. In these circumstances, the course followed by the flow of changing relations of activities in the operation of the nervous system as a closed network arises moment by moment, determined by its structure at each moment in the flow of its continuous change.

The course followed by the structural changes of the neuronal elements that compose the nervous system is modulated in several ways:

1. through their own internal structural dynamics;
2. through structural changes triggered in them as a result of their interactions with other neuronal elements;
3. through structural changes that arise in them as a result of their structural intersec-

tion with other cells such as the internal and external sensory elements of the organism; and

4. through structural changes triggered in them by substances secreted by other cells of the same nervous system, cells of the rest of the organism, or substances that come from the medium in which the organism exists as it operates as a totality.

A basic consequence of this structural dynamics is that the structure of the nervous system as a closed network of interacting neuronal elements changes continuously through structural changes that arise in its components as a result: (1) of their own operation; (2) of the operation of the physiological dynamics of the organism; and (3) of the interactions of the organism in its domain of existence.

It is the observer who sees the inside and the outside of the organism and who makes the distinction "dreaming", not the operation of the nervous system

Not dreaming

The nervous system intersects structurally with the organism at different locations that are its internal and external sensory and effector surfaces, and does so through some neuronal elements that are components of both the nervous system and the organism. The cellular elements that in this intersection operate as sensors and effectors as components of the sensory and effector surfaces of the organism are elements of interactions of the organism, not of the nervous system. At the same time, those same elements, as they operate as neuronal elements, are components of the nervous system and not of the sensory and effector surfaces of the organism. As a closed neuronal network, the nervous system only operates by generating internal changing relations of activities between its components and does not interact with the medium. As such the nervous system does not operate with representations of the medium or of what happens to the organism in its interactions in the medium. One cannot even say that the closed operation of the nervous system is like dreaming, because dreaming pertains to the manner of being of the organism as a totality. It is the observer who sees the inside and the outside of the organism and who makes the distinction "dreaming," not the operation of the nervous system. The nervous system exists in its operation in its closed dynamics without any reference to what an observer may see as external to it.

Structural interaction

Due to the structural intersection of the neuronal elements of the nervous system with the sensory and effector elements of the organisms, the sensors and effectors participate in the structural dynamics of both the organism and the nervous system while the nervous system and the organism stay operationally independent. As a result, two things happen. One is that the structural changes that the sensors and effectors of the organism undergo in their encounters with the medium result in structural changes in the neuronal elements with which they intersect. The other is that the structurally changed neuronal elements that intersect with the sensory and effector elements of the organism change their manner of participation in the changing relations of activities of the neuronal network that they integrate. This is valid both for the external and the internal sensory and effector surfaces of the organism.

The general results are also twofold.

(1) The structure of the nervous system changes in a manner contingent to the structural changes triggered in the sensory surfaces of the organism during the flow of its interaction in the medium. The basic result of this is that the dynamics of the nervous system as a closed neuronal network, and the sensory effector correlations that it generates through its intersection with the sensory and effector surfaces of the organism, change in a manner contingent to the flow of the interactions of the organism.

The nervous system does not make the organism act on the medium

(2) The nervous system as a closed neuronal network continues generating an internal dynamics that gives origin to internal and external sensory and effector correlations in the organism that are proper to its manner of living its life, or the organism dies. So, although the operational domains in which the organism and the nervous system exist do not intersect, and remain independent as such, each modulates what happens in the other through the structural changes to which it gives rise. Finally, this occurs under circumstances in which the sensory and effector surfaces of the organism are operational and not necessarily anatomical in the classic sense.

While the nervous system operates in a flow of structural changes in its dynamic architecture, *sensory and effector surfaces* are notions that the observer introduces in order to refer to aspects of a systemic operation as components of a larger dynamic architecture. Thus, for example, in a pressure cooker, the cap that regulates the exit of water vapor can be said to operate both as a sensor and as an effector for the regulation of the temperature of the water in the pot, even though it is only an element of the dynamic architecture of the pot. Sensors and effectors are descriptive artifices to facilitate description and understanding of the dynamic architecture. While these artifices facilitate understanding, they also obscure the systemic operation of the architecture.

Behavior

In the structural intersection of the nervous system with the internal and external sensory and effector surfaces of the organism, the changes of activity in the neuronal elements trigger structural changes in the effector and sensory elements of the organism. As a result, the manner of incidence of the organism in its internal and external medium changes too. Nevertheless, the nervous system does not make the organism act on the medium; its activity only triggers structural changes in the sensory and effector surfaces of the organism, giving rise to the sensory effector correlations through the encounters of the latter with the medium. Those structural changes bring about change in the manner of incidence of the organism on the medium (internal and external) in a manner determined by the structure of the nervous system at every moment. However, as a result of such change, the manner of encountering the medium of the organism changes according to the structural changes that its nervous system undergoes along its internal and external relational living.

The nervous system does not operate with representations of the medium, nor does it operate with symbols of the features of the medium, and it does not use in its operation dimensions proper to the description of the medium by the observer. The nervous system operates only as a closed network of changing relations of activities between its component neuronal elements in a continuous flow of changing relations of activity between them. It follows from all this that when the observer sees an organism performing a particular behavior as a dynamic interaction with the medium, the nervous system is only performing a dynamic correlation between the sensory and the effector surfaces of the organism according to its structure at that moment and is not generating any behavior. The behavior that the observer sees as he or she beholds the organism as a totality in a medium arises in the encounter of the organism with the medium in a manner in which both the organism and the medium participate. So behavior is not something that the organism does, but something that arises in the organism/medium encounter. This is why I said above that one cannot even say that the closed operation of the nervous system is like dreaming, since the notion of dreaming requires the distinction of inside and outside.

The working of neurons

Neurons operate as detectors of configurations of activities on their afferent surfaces. This is so because the nerve impulse begins at the origin of the axon (axon hillock) of any neuronal element as a result of a local composition of all the afferent activity from other neuronal elements impinging upon the collector surface of the neuronal element. As a result, not only single neuronal elements, but groups of neuronal elements and groups of groups of neuronal elements also operate as detectors of configurations of activity in the afferent activity impinging upon them. Indeed, the nervous system as a closed network of changing relations of activities between its component neuronal elements only operates as a detector of changing relations of activities in itself. As a consequence, as the activity of the nervous system gives rise to internal and external sensory effector correlations in the organism, it does so according to a closed internal dynamics of operational distinctions of recursive changing configurations of relations of activities in itself.

The evolution of the nervous system

The structure of the nervous system changes, through the various processes indicated above, following a course contingent to the course of the internal and external interactions of the organism that it integrates. Moreover, the structure with which any organism begins its individual life history is one that has been established along an evolutionary history in which the organisms of any given lineage and the medium in which they are realized have changed together congruently. As a result of this evolutionary history, the initial structure of the nervous system at the beginning of life of any organism with a nervous system, is one that gives rise in the organism to the external and internal sensory effector correlations adequate for the realization of the manner of living that defines the lineage.

Behavior is not something that the organism does, but something that arises in the organism/medium encounter

What makes a nervous system a nervous system is not the kind of elements that compose it, but rather – both in its manner of operation as a closed network of changing relations of activity between interacting plastic elements, and in its existence as a system in structural intersection with the sensory and effector surfaces of a larger system that operates as a totality in a relational space – that those very same sensory and effector surfaces contribute to define it. Thus, a protozoan such as a paramecium, for example, has a molecular nervous system in the form of a closed network of changing molecular relations in operational intersection with the closed autopoietic molecular system that the paramecium is as a living system, The operational intersection occurs at the sensory and effector surfaces that arise in the organism as it operates as a totality. Similarly, a mouse has a nervous system composed as a closed network of changing relations of cellular activities in operational intersection at the sensory and effector surfaces that the mouse has in the domain in which it operates as an organism. Indeed, it is because of the manner of the operational constitution of a nervous system that it is possible to design an artificial system that will, indeed, operate as a robot with a nervous system.

The nervous system operates as a closed network of changing relations of activities in intersection with the sensory and effector surfaces of an organism. Therefore, all that the nervous system does in relation to the organism as this operates as a totality in the medium, is to give rise to sensory effector correlations in the organism. These correlations constitute its behavior as the organism operates as a totality in dynamic structural coherences with the medium in which it exists in recursive interactions. Therefore, it is because of its manner of operation as a closed network of changing relations of activities in intersection with the organism, and because of its condition of being a structure-determined system, that the nervous system does not and cannot operate in a way that distinguishes the features of the medium as if these were independent entities. No doubt it appears to do so to an observer who sees it generating adequate behavior in its domain of existence. But organisms operate in a way that generates adequate behavior in their domain of living as they are alive as the result of the evolutionary and ontogenic history of structural coupling in the medium to which they belong.

Robots

In these circumstances, the difference between a robot and a living system resides in the different manner of origin of their operational and structural congruence with the medium in which they exist. Thus, the operational and structural congruence between a robot and the medium in which it exists is the result of an operation of design in which both the robot and the medium in which it operates have been made to fit dynamically with each other. So a robot and the medium in which it will operate arise as congruent through a human act of design. Contrary to this, the operational and structural congruence between a living system and the medium in which it operates, as I have already mentioned on several occasions, is the result of an evolutionary and an ontogenic history in which both the living systems and the medium have changed together congruently in structural coupling.

Implications for the distinction of virtual/non virtual

The main consequence of the manner of operation of the nervous system, according to what I have said, is that as it does not operate with representations of entities that would exist as an external reality. As it operates as a closed network of changing relations of activities, it only generates sensory effector correlations in the organism that it integrates without acting by itself on an external world. It follows from this that the distinctions between inside and outside and between virtual and non-virtual realities that an observer may make do not apply to the operation of the nervous system. The distinctions between perception and illusion, or between virtual and non-virtual realities, pertain to the operation of the observer as a languaging being capable of operating in the distinction of the inside and outside of an organism as he or she beholds it as a totality in interactions in a medium.

It is possible to design an artificial system that will, indeed. operate as a robot with a nervous system

Part II: Virtual realities and human existence

The main difficulty that arises for us as observers with the aim of understanding the operation of the nervous system as a closed network of changing relations of activities between its component neuronal elements, has to do with understanding three experiential features of our humanness, namely:

1. the experience of the self;
2. the experience of the other as an independent being; and
3. the experience and understanding of what psychologists and philosophers call intersubjectivity.

Being in language

If we attend to what we do, and to what happens with us, when we engage in languaging, we see that we live together in a flow of coordinations of coordinations of doings or behaviors. Further, if we attend to what we do and to what happens with us when we participate in a conversation, we see that we live (dance) together in a flow of recursive coordinations of languaging and emotioning. Languaging is not a domain of abstractions or symbolizations, rather languaging occurs as a domain of concrete doings, whether these are things we do with our hands, or things we do in our thinking. Languaging takes place in the various domains of our doings in the continuous realization of all our doings. So, we human beings exist in the flow of our living in conversations, that is, in a flow of languaging and emotioning. Whatever we say happens to us that does not appear in the flow of our languaging or our conversations, does not happen to us as human beings. When one says, "I do not have words for what I see or feel," one is saying "I am living something that does not yet pertain to the recursive domain of coordinations of doings and emotionings in which I exist as a human being. I cannot say that what I feel is something that is some thing." We do not use language and conversations; rather, anything we distinguish, including ourselves (as when we say "we"), occurs as a flow of conversations in a relational domain with others like ourselves.

It is not that language is the home of the Dasein, as Heidegger says: our being as human beings occurs in languaging in the flow of our being in conversations. A human being is a dynamic manner of being in language, not a body, not an entity that has an existence that can be imagined independent of language and that can then use language as an instrument for communication.

The distinctions between perception and illusion, or between virtual and non-virtual realities, pertain to the operation of the observer

The *self* is a manner of explaining the experience of operating as a local relational identity as a human being that distinguishes (touches, senses) his or her operation as a body. Existence in language is required for the experience of the self to happen. Similarly, *subjectivity* is not an interior living, it is a manner of connoting how we are or feel in the distinction of the distinction of self as if this were an entity. Thus, subjectivity exists as a manner of living in the conversation that distinguishes the self.

At the same time, once we distinguish ourselves in languaging, we appear as languaging entities in the domain of distinctions in which we arise as selves. Henceforth we can speak as if we had an existence independent from the operation of distinction that brought us forth, and as if we could use language as an external instrument that is independent of our doings. So we find ourselves operating in unaware self-processes when we ask about ourselves, arise into "thingness" and become selves as discrete entities that obscure our being processes. This account, of course, does not replace the experience of self, nor does it intend to do so; it only describes what happens so that we have the experience we talk about as we talk of the self.

All that we do as human beings is possible precisely because the nervous system operates as a closed network of changing relations of activities between the elements that compose it, and because the elements that compose it have plastic structures. What happens is that the different circumstances of interactions of the organism in the medium give rise in its nervous system to two different kinds of interrelated processes, namely:

1. Different changes of relations of activity between the neuronal elements that compose it, and through the internal changes of configurations of relations of activity thus generated to different flows of sensory effector correlations in the organism; and

2. Structural changes in the neuronal components triggered through the changes of activity of the neuronal network in the contingencies of the interactions of the organism.

As a result of these two processes, the structure of the nervous system changes in a manner that continues to generate sensory effector correlations in the organism that are coherent with its manner of interacting in the medium in which it exists. In the case of organisms such as human beings who live in language, the main consequence is that the structural changes of the nervous system are such that they continue to give rise to sensory effector correlations proper to the operation of an organism that exists in language.

Experience of the other

We human beings live the experience of distinguishing other human beings. As we attempt to explain such experience, we ascribe a self to each of them in the same terms that we claim for ourselves – that is, as an entity. As we do this, subjectivity arises as the experience in which we distinguish the difference between distinguishing oneself and distinguishing an other self.

In order to account for the harmonization of the coexistence of two or more individual selves, the notion of inter-subjectivity is proposed in psychological and philosophical reflections as an explanatory notion that suggests the possibility that otherwise independent selves may be able to interconnect in ways that transcend their boundaries. In our culture we describe the experience of harmony with others as an expression of some sort of interconnectedness, and we live it as such. However, as we are structure-determined systems, this cannot occur. What happens is that all experiences have the character of something lived that we can talk about only as they arise as distinctions in a conversation, either with oneself or with another. That is, an experience appears in our living only as we distinguish what happens to us or in us, and the experience appears to us with an evocation of what we distinguish in the culture to which we belong.

Since experiences are distinctions that we make of what happens in us or to us as languaging beings, and since all that we live has recursive consequences in our living, nothing that we distinguish as happening to us, be this the experience of self or the experience of inter-subjectivity, is trivial for our living as languaging beings. Furthermore, and since a culture is a closed network of conversations, we necessarily live the consequences of these experiences in our living according to the culture in which we live them, which is where they are features of the world that we live. Thus, for example, sorcery is effective in a culture that accepts sorcery as a feature of its living, and it is lived in the form proper to that culture.

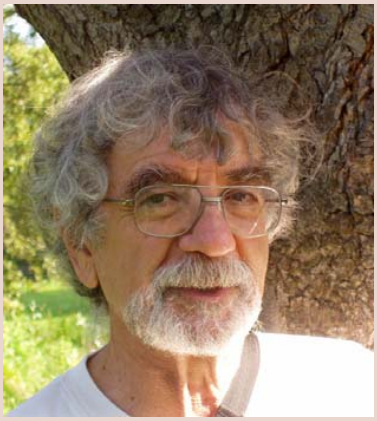
Intersubjectivity

In these circumstances, since (a) the notion of reality is an explanatory notion (b) the notion of structural determinism is an abstraction from the coherences of our experience, and (c) we explain experience rather than an objective independent reality by using the coherences of our experiences to explain our experiences, the other arises as an experience to be explained in terms of the conditions that give rise to him or her in the distinction of an observer. Accordingly, the other is to be explained as an experience of the observer, and not as if the other existed independently of being distinguished by the observer. In these circumstances, the notions of *inter-subjectivity* and *self* become explanatory notions for manners of living that arise as we live the experience of interacting with other human beings in conversations that deal with the ease or difficulty with which we coordinate our behaviors with each other. Difficulties arise, though, when we do not fully see that the effectiveness of our coordinations of behavior is the simple result of our operation in reciprocal structural coupling, and we insist on accepting the presence of the other as an independent entity as a primary condition – this is what we cannot do, due to our condition as structure-determined systems.

Virtual realities as domains of coexistence

From all that I have said above, it is apparent that for the operation of the nervous system as a closed neuronal network, all that happens in or with it are phenomena (processes) of the same kind – namely, changes of relations of activities in its neuronal components. And this is so for all cases, even when, to the observer, the organism appears to be realizing different behaviors. This means that waking, mating, eating, breathing, emotioning, reflecting, thinking, or talking are different phenomena only in the relational domain in which the organism operates as a historical whole, and not in the operation of the actual nervous system as a closed neuronal network. No doubt the different relational circumstances that an animal lives involve different neuronal dynamics in the operation of its nervous system. However, what gives them their different characters is what happens in the relation between the organism and the medium, and not what happens in the nervous system itself. The normal manner of operating of living systems as systems that do not distinguish in the experience between perception and illusion is what makes possible what are now called "virtual realities."

ABOUT THE AUTHOR



Humberto Maturana was born in Santiago Chile in 1928. Starting with biological research on perception, he has developed the Biology of Cognition and the Biology of Love. Several threads are intertwined through the development of his body of work. For one, he notes that in any relation where something, including an explanation, is offered it is the person who accepts who determines the truth, value, or adequacy of the offering. Maturana retains an awareness throughout his work that it is the observer who determines the validity of what he or she accepts as valid. In his works he shows that we do not know, and constitutively cannot ever know, if what we live as valid at any instant is something that we shall later treat as a mistake, as an illusion or as a perception. In noting that we live our lives trusting the repetitiveness of the manner in which things appear to operate, he developed the notion of structural determinism. As we too are structure determined systems so that external agents do not specify what happens in us, then nothing external can tell us anything about itself. Thus instead of asking how things are, he began following a path of asking for the processes that gave rise to them, and for the criteria used to accept the answers he considered valid. Thus in all his writings one may find the proposition of generative mechanism that give rise to the phenomena he explains, along with the criteria he uses to claim that something is as he says it is. (Photo: Pille Punnell)

Virtual realities are illusions – that is, experiences that we call "virtual" in relation to some other experiences that we call "real." According to all that I have said about scientific explanations, the nervous system, and structural determinism, the only experiences that can possibly be called *real* as a reference that permits us to call all others *virtual*, are those that we live in the realization of our biological living in structural coupling with the medium in which we exist.

As humanness arose with language, humanness arose in a historical path open to the possibility of endless generation of virtual realities through the open-ended possibility of recursion in the consensual coordinations of consensual coordinations of behavior of languaging. Moreover, as actual living in language expanded, the possibility of recursions in the inner dynamics of the nervous system expanded too, and with that came the possibility for the recursive generation of more domains of virtual realities. Indeed, virtual realities in the domain of conversations have been with us from the very beginning of our human existence. Our human existence has changed as virtual realities have become non-virtual through their systemic cultural inclusion in the realization of our biological human manner of living.

Conclusion:
Virtual realities are never trivial

Yet virtual realities, as we have distinguished them in our technological culture, should not by themselves be a source of serious concern. What should call us to reflect, though, if we do have ethical concerns, is what happens to our psychic existence as we manipulate the domains of virtual realities to which we expose one another. No matter whether we are aware or not of what kind of reality we live at any instant, all the realities that we live affect us in the same way in the emotional dimensions of our psychic existence, because there is no virtual emotional life. Indeed, it is precisely because of this that all that we live in our psychic existence is non-virtual. Indeed, it is the absence of any "virtual" psychic existence that allows virtual realities to become, first, cultural manners of being and, eventually, features of our non-virtual living in the realization of our biological living.

Let me expand on this idea. Our nervous system is continuously changing along the flow of our living, and it does so in a manner that is moment by moment contingent on the course of our living, both in our conscious and unconscious, external and internal, relational psychic space. As a result, all that we live, regardless of what kind of living we live, arises in us modulated by the history of our psychic existence regardless of whether this takes place through our living in what an observer might call a *virtual* or a *non-virtual* reality. In these circumstances, and since our structure and the structure of the medium that we bring about systemically in our living change together congruently as we live, our living becomes dependent on the virtual realities that we live as they become systemic factors in the cultural realization of our living. In other words, as we live them repeatedly, realities that were initially virtual progressively stop being virtual. As features of our culture, they become part of our biological manner of living and, hence, of the non-virtual reality that we live.

The problem with virtual realities, then, if there is any, is not how they occur, or if they occur at all, but whether we do or do not like the psychic manners of existence and the cultural transformations that we generate through them. Virtual realities are never trivial, because we always become transformed as we live them according to the emotioning of the psychic space that they bring about in our living, and this is so regardless of whether we like it or not. If we care about what happens to us and to other human beings through what we do through virtual realities, then it is our responsibility to act accordingly.

Note

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