

Comment by Humberto R. Maturana: The Mind is not in the head.

The essence of what Aboitiz says in his article, is that the syntax of the operation of the nervous system and the syntax of the operation of behavior, are different because the nervous system is a structure determined system, and as such it cannot and does not operate with representations of the external world where behavior takes place. He also says that in these circumstances a localized lesion in the nervous system, however discrete in its behavioral consequences, cannot be viewed as revealing a functional localization in terms of such behavioral consequences, but must be viewed as revealing a discrete interference with the production in the nervous system of some of the patterns of neuronal activity through which it generated the original behavior. As might have been expected I agree with this. However, I would like to add some reflexions that I cannot fully fundament here, but which I consider pertinent to the present discussion, and which

I shall present by referring to some conceptual mistakes that we neurobiologists frequently commit, and to some operational and conceptual consequences that we should admit if we did not commit such mistakes.

Mistakes that we frequently commit:

(a) We explicitly or implicitly operate conceptually as if in a scientific explanation we were doing a phenomonic reduction by expressing the phenomena of one domain as phenomena of another domain, and we do not see that scientific explanations are propositions of generative mechanisms that connect nonintersecting phenomenal domains by showing how the phenomena of one domain arise from the operation of the phenomena of the other. Through this mistake we confuse nonintersecting phenomenal domains that are bound by a generative relation, and treat them as if one were included in the other.

(b) Although as biologists we know that we must treat organism, nervous system and medium, as structure determined systems in order to explain scientifically the phenomena proper to them, we do not proceed conceptually according to all the consequences that this necessarily entails in the domains of operation of the nervous system and behavior. As a result we do not see that the nervous system and the organism, as any structure determined system, do not admit instructive interactions and are such that every thing that happens in them is determined in their structure.

(c) We usually, in our attempts to explain the operation of the nervous system, neglect the fact that we human beings cannot as individuals experientially distinguish between what we call perception and illusion. As a result, we do not see that the distinction that we make between perception and illusion in relation to any particular sensory experience, arises only as an after thought, either through reference to another equally doubtful sensory experience or through reference to other human beings equal to us in this respect, and continue trying to explain the operation of the nervous system and behavior as if such a distinction were possible.

(d) We use notions and concepts that entail the implicit or explicit assumption that the biological phenomena that we usually call higher mental functions, such as abstract thinking, self-consciousness, awareness and language, take place in the nervous system as features of the operation of its higher centers. As a result we confuse phenomenal domains, and we try to understand the contextual complexities of a particular behavior that as such are proper to the domain of interactions of the organism, as features of the neurophysiological processes that generate it.

Consequences that we must accept if we do not commit these mistakes:

(a) That what we as observers see as adequate behavior when observing a particular organism in a given environment, is an expression of the ongoing structural congruence (or structural coupling) that necessarily holds between an organism (with its nervous system if it has one) and the medium as a condition of existence that must be conserved through all the structural changes that the organism and the medium undergo together in their history of interactions while the organism is alive (Maturana, 1980).

(b) That behavior consists in the actions, and coordinations of actions, that an observer distinguishes as taking place when organisms interact with each other and/or the abiotic medium, and that he or she describes with reference to the ongoing history of these same actions and coordinations of actions, and not what takes place in the organisms themselves.

(c) That the nervous system, as a cellular system, is an internally closed network of interacting neuronal elements (sensors, neurons and effectors) that also closes upon itself externally through effector sensor interactions that take place across the medium as if this were only a synaptic gap (Maturana, 1983).

- (d) That the nervous system, as a closed network of interacting neuronal elements, operates as a network of recursive changes of relations to activity between neuronal elements that only give rise to further changes of relations of activity within itself, which, therefore, are its states as a dynamic system (Maturana, 1983).
- (e) That the dynamic structure of the nervous system as a cellular system (connectivity and structure of neuronal elements) determines at every moment the patterns of change of relations of activity that take place in it and constitute its dynamics of states.
- (f) That the dynamic structure of the nervous system as a cellular system component of an organism is undergoing a continuous change that follows a course contingent to the sequence of interactions of the organism.
- (g) That what an observer sees as the participation of the nervous system in the generation of behavior are changes of relations of activity between the effector and sensory surfaces of the organism in a domain of existence that he or she specifies for it through his or here observation.
- (h) That the participation of the nervous system in the generation of behavior is at every moment expression of the dynamic structural congruence that necessarily holds between organism, nervous system, and medium, in the domain of existence in which it is distinguished, and not expression of the operation of the nervous system with a representation of an environment. And, finally in this list:
- (i) The complexities that we observe in the behavior of an organism at any moment, and that we usually describe in terms of content and meaning, are contextual features of the particular historical circumstances that configure the behavior and not the operation of the nervous system.

The complexities of behavior and the complexities of the neurophysiological processes that generate it are of different kinds and take place in nonintersecting phenomenal domains, therefore they must be understood differently, each according to the syntax or coherence of the phenomenal domain in which it takes place, and regardless of the generative relation that we may see between them. To attain this understanding one must accept that through different features of its structure a system may exist in many nonintersecting phenomenal domains simultaneously. Indeed, scientific explanations by being nonreductionist validate the simultaneous existence of every structure-determined system in many nonintersecting phenomenal domains, and allow us to understand how we as human beings pertain operationally to many equally legitimate nonintersecting domains of existence.

Finally, if we accept that living systems as structure-determined systems can only exist in structural correspondence with a medium, then we must also accept that an observer will see that the dynamics of the states of a nervous system gives rise in an organism to a behavior adequate to the complexities of its circumstances only as a result of the dynamic structural correspondence that exists between it and the medium in the presence of the phylogenic and ontogenic history of conservation of dynamic structural correspondence between organism and medium to which it belongs in the domain in which it is distinguished (see Maturana, 1980). In these circumstances, any relation between a state of activity in a nervous system and what an observer sees as a feature of the environment of the organism to which it belongs, can be a relation of representation of the environment in the operation of such nervous system only in the description of the observer and for the observer, not in the operation or for the operation of the nervous system itself. Also in these circumstances, any lesion in a nervous system will necessarily interfere with some of its internal coherences, and will appear to an observer as altering some of the patterns of effector/sensor correlations of the organism in the domain of

existence in which it is observed. At the same time, this change in the effector/sensor correlations of the organism will necessarily appear to an observer as a changed behavior that he or she can always view as deficient in some of its usual features of content and meaning. Since all systems involved, organism, nervous system and medium, are structure determined systems, similar lesions in similar nervous systems will necessarily result in similar behavioral changes in similar organisms under similar circumstances, which is what one finds, anyway. It is this regularity what seduces us to believe that the behavioral consequences of a lesion in a nervous system reveal that the part of the nervous system that the lesion destroyed had been directly responsible of the content and meaning of the behaviour lost through it. To accept that this is not the case, to accept that constitutively there is no mapping possible between the syntax of the operation of the nervous system and the syntax of the content and meaning of the behaviour that it generates, is not easy, it requires a conceptual jump. It requires the acceptance that mental phenomena as phenomena of meaning, intention, language or self-consciousness, and physiological phenomena as phenomena of molecular, cellular or hormonal relations or interactions, take place in nonintersecting phenomenal domains, each defined by its own coherences or syntax, and that in general all living systems, and we human beings in particular, exist in each of them in different but legitimate manners. The mind is not in the head, the mind is in the behaviour.

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