

Memory And Self-Organization

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ABSTRACT: Based upon the paradigm of self-organization, the present paper investigates the concept of **cognitive memory** from a non-representationalist perspective. Basic principles of self-organization are presented to provide elements for an ecological approach to memory. This is contrasted with the traditional Cartesian notion of memory which is intrinsically connected to mental representation.

Leaving aside the notion of mental representation, we propose an analysis of memory in terms of **dispositional states**. These can be understood as states whose causal properties, when encountering adequate conditions, produce specific events. In this sense, dispositional states constitute causal propensities and, as we shall argue, they constitute the fundamental elements of memory.

KEY WORDS: self-organization, cognitive memory, dispositional states, cognitive science.

1. Self-organization and the mind/body problem

One of the most important (and also most criticised) aspects of the Cartesian system of ideas is the well known *substantial dualism*. According to this, the mind/body relationship is conceived as a metaphysical solution to the *problem of foundation of true knowledge* in so far as Descartes aimed to provide indubitable principles on which scientific knowledge could be based. He believed that in order to establish the foundations of true knowledge he should set aside all the information obtained from sensory experience of the world, since it cannot provide us with the required certainty that can stand beyond any possible metaphysical doubt. Only the abstract, rational, principles of reason can play such a role: the human body with its sensory experiences has no important role to play in such a project since it cannot not provide any secure source of knowledge.

In such a context, the mind/body division, established in order to provide foundations of true knowledge, imposes, as real, the existence of two distinct substances the **res cogitans** and the **res extensa**. However, it should be noticed that this division follows from a previously conceived metaphysical decision. Substantial dualism thus established gives place to the mind/body debate. This stands as a problem reinforced by the relationship that one establishes with his/her own subjective experience, which forces the classification of all phenomena related to consciousness as belonging to a category essentially distinct from that under which physical phenomena can be classified.

Without any intention of clarifying the existent hypothesis about the nature of consciousness, we suggest that by using the notion of **dispositional state**, in the context of the **self-organization** paradigm, it could be possible to understand the mind/body relationship without falling into the metaphysical traps of Cartesian dualism. If we conceive mental states as dispositional states of the organism that allow its adequate interaction with the environment, through self-organizing processes, then we can start thinking about how to understand cognitive memory from a naturalistic perspective.

2. Self-organization

Ashby (1962) introduced two basic notions of self-organization. The first refers to those processes in which elements initially separated (or with independent behaviours) evolve towards forming a system, whose parts are coordinated and interdependent, without the presence of a central control. Such a system is "...self-organizing in the sense that it changes from *separated parts* to parts *joined*" (Ashby, 1962, p.266).

Examples of self-organization, in this first sense, can be found in processes of pattern formation such as characterized in artificial neural networks (Gonzales, Alves & Sette, 1996). Initially, neural-like units can be seen as separated elements with little or no relevant interdependent relations. With training each unit is affected by other units, forming patterns of connectivity, as they interact amongst themselves and with invariants in the environment. These patterns of connectivity - formed exclusively due to the dynamics of interaction between neuron like units and the environment - are self-organizing in a *primary sense*. They constitute raw forms of organization emerged from self-connecting mechanisms.

The second sense of self-organization presented by Ashby includes the primary one, adding to it learning mechanisms and criteria of relevance for distinguishing between bad and good organizations (Gonzales, Alves & Sette, 1996). These allow organisms to act in order to further their own survival and examples can be seen in systems capable of learning from errors.

In both cases of self-organization a form of **conditionality**, which gives place to **dispositional states**, is established amongst elements without the influence of a central control. However, in the primary sense there is no guarantee that these dispositional states will produce stable forms of organization. When this happens and other dispositions are formed in order to assist the development of established organizations, then secondary self-organization applies.

With this notion of self-organization we can discuss its applications to cognitive memory.

3. Memory And Self-Organization

The history of philosophy has shown little progress in the understanding of memory. Classic rationalism, for example, proposed highly unsatisfactory answers to questions concerning the nature and structure of memory. In particular, the Cartesian notion of memory is a problematic one. For, even though in the fourth rule of the *Discours de la Méthode* Descartes conceives of the existence of some type of mnemonic activity, realized by the **res cogitans**, and in the *Méditations* he stresses the importance of remembering all the links of the **ordre des raisons**, he describes memory, in *Les Passions de l'Âme*, as a mechanical activity realized by the **res extensa**.

In the *Meditation* Descartes states: "... que la lumière naturelle me fait connaître évidemment que les idées sont en moi comme des tableaux, ou des images, qui peuvent à la vérité facilement déchoir de la perfection des choses dont elles ont été tirées..." (Descartes, 1978, p. 42).

He recognised that representations do not constitute clear and distinct ideas. As he pointed out such representations are "... comme le sujet de l'action de mon esprit..." (Descartes, 1978, p. 37). They are the

subject of true (or false) propositions but these *kinds of images* can only be precariously preserved by memory, which would be unable to reach the level of clarity and distinction necessary to produce indubitable knowledge required by the Cartesian method. For this reason, memory was excluded from the *cogito*'s activities, despite the problems involved with this division in the Cartesian paradigm.

We suggest that by changing our perspective in the analysis of memory, in such a way that the notion of representation is abandoned, these problems disappear. We propose an alternative approach to cognitive memory in terms of the dynamics of self-organizing systems that operate with dispositional states. From this perspective, an analysis of memory structures is developed:

1. **Physico-chemical memory:** constitutes a system of dispositions caused by the constitutive properties of existing elements. Under appropriate conditions this system of relations "remembers" the initial conditions that made possible its existence, in the sense that it may be capable of returning to its own origins.

2. **Biological memory:** includes the previous one adding to it a biological dimension which characterizes living beings. This kind of memory can be active or passive depending on its functional properties. The first happens when selective mechanisms are formed due to the organism's interaction with the environment. The second characterizes involuntary mechanisms for the registering of information independent of the organism's activities.

3. **Gregarious memory:** includes (1) and (2) and results from the collective action of organisms with learning abilities. These abilities are mainly acquired through perception-action and allow discrimination and discovery of informational patterns that are not immediately available to the organism.

4. **Socio-cultural memory:** includes (1), (2) and (3) above and the evolutionary history of specific types of organisms. In the case of humans the existence of language gives a new dimension to the self-organization of memory. This process has been investigated in depth by Vygotsky (1996), who conceived of memory in two distinct but complementary ways: a natural and a cultural one. The first is the most elementary, emerging as a consequence of the influence of external stimuli upon organisms. The second results from voluntary actions of organisms who operate using external information that helps them to remember specific contents.

The transition from natural to cultural forms of memory constitutes the development of cognitive memory. This substitutes forms of primitive organization by more elaborate ones that occur in the process of evolution. Here linguistic processes permit considerable development in memory evolution, working as instruments for the organization and documentation of different kinds of memory.

These four levels of memory allow us to conceive of cognitive memory as an emergent property of living organisms. This can be characterized as a type of dynamic network operating in and between the four levels. At levels (1) and (2) primary self-organization operates. At levels (3) and (4), secondary self-organization helps with learning and discovery of new forms of information. The results of such activities allow us to begin investigations, necessarily incomplete, of cognitive memory of organisms immersed in the informational flux of life.

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