

RESEARCH NOTES

THE NEED FOR AN ECOLOGICAL APPROACH WITHIN THE STUDY AND COMPREHENSION OF COGNITIVE PROCESSES

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Resumen

Los *procesos cognitivos* organizan y transforman inferencialmente la información sensorio-perceptiva del medio. La base de dichos procesos es ecológica. Se entiende como *ecológica* toda relación entre un organismo viviente y su medio para alcanzar los balances entre su medio interno y externo. Esas relaciones permiten explicar las funciones preservadoras de la vida. La representación mental es una función preservadora de la vida. Cada especie desarrolla (como requisito de supervivencia) su propia representación holográfica del medio ambiente, pero esta representación adquiere la máxima complejidad cognitiva en la especie humana. Si un desbalance se perpetúa, lleva a la muerte del organismo y a la extinción de la especie. En esto reside la importancia del *enfoque ecológico* y la profundización del mismo. La explicación de los procesos cognitivos ha avanzado a través de un esquema ecológico tipo abajo/arriba, *bottom-up*, más que a través de esquemas formales - proposicionales de tipo teoricista arriba / abajo o *top-down*.

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Palabras clave: Epistemología ecológica - Enfoque ecológico - Procesos cognitivos - Representación social.

Abstract

Cognitive processes are information, meaning, structure organization and transformation processes, most of which are inferential. Then, an important question about cognitive processes is: What is their deepest basis? Where, when, how and at what level do they originate? Here, it is proposed that the original and deepest basis of cognitive processes is essentially ecological and sustained on the permanent unity and relationship between the living organism and its environment. We understand as ecological the undecomposable union between a living organism and its environment, as well as every kind of immediate and stepwise relationship between them. The relationships between a living organism and its environment is held everyday and continuously in order to get its life-preserving resources and to adopt their adequate, best or most successful actions and reactions over the environment, as well as to reach its necessary internal and external balances with and within it. In these terms, the elementary perception and categorization are seen as basic cognitive processes originated in that permanent and whole ecological relationship. This way, representation systems and information processes as developed by each species are seen as basic preservation functions (life-preservation functions) in the teleonomic sense given by Pittendrigh (1958) and later used by Lorenz (1986) within his ethological approach. These arguments support the idea that any species, whatever simpler or complex it may be, whenever it is endowed of minimal sensors (elementary sensory perceptive receptors) for light (sight), odor (olfaction), sound (hearing), taste and tactile stimuli, etc., can form and must have a minimal representation of its immediate surroundings; and so that those living organisms can then count on or have at their own's disposal a minimal mental representation of the immediate and customary environment in which they live and survive along all their lifetime. Otherwise these living organisms will soon and easily die, and its species will be exposed

to be extinguished soon too. So, all these argumentations are required and provided in order to analyze and explain the origin of cognitive processes within an ecological bottom-up direction. The main approaches adopted to sustain this ecological view originate in Gibson's (1979) studies on direct perception, in Rosch's (1978) approaches to natural and prototypical categorization of concept-formation, and, finally, it is also found in different attempts by Schank and Abelson (1977) and other authors to describe, for example, the formation of semantic primitives, or of schemata and scripts on alternative and ever changing areas of commonplace social experience and representations. One cue is to easily differentiate between the role and definition between defined attributes and characteristic or prototypical attributes when referring to concepts and their schemes or networks of relationships. There may be many others authors and examples that could be given to prove this *ecological approach*, however the above mentioned seemed to us prototypical and sufficient as to be especially included and treated.

Key words: Ecological Epistemology - Ecological approach - Cognitive processes - Social representations.

There are many important cognitive processes, such as perception and concept categorization that were formulated under theorist top-down models, while other models were ecological, natural and bottom-up.

As an example to this topic, Gibson's (1979) theoretical approach to perception can be regarded as a bottom-up theory, in that he claimed that there is much more information potentially available in sensory stimulation than it is generally realized. He emphasized the role played in perception by movement and action of the individual within his or her environment. Indeed, Gibson (1979) called his theory an *ecological approach* to emphasize that the primary function of perception is to facilitate interactions between the individual and his or her environment.

Concerning the second topic, concept categorization, there is a considerable body of empirical evidence that supports the prototype view including research on color, natural, and artificial categories. There is also work on the nature of conceptual hierarchies in human categorization that has grown out

from the prototype view. This view is properly a natural, ecological and bottom-up approach that emerged in critical opposition to severe misstatements of the classical theorist, top-down approach, based in the biased determination role of the so-called *defining-attributes* (Eysenck, & Keane, 1997). However, two main models characterize prototypes differentially. In some models, the prototype is a set of characteristic attributes; that is not of defining-attributes but rather only characteristic attributes which have differential importance within the concept (Hampton, 1979; Posner, & Keele, 1968; Rosch, 1978). While in other prototype theories, the prototype is literally the best example of the concept (Brooks, 1978; Estes, 1994; Hintzman, & Ludlam, 1980). In both ways, however, concepts have a prototype structure, which is considered to be of natural-ecological origin. Advantageously, this approach has usefully simplified the theory of concepts' hierarchies (that is the superordinate and subordinate relationships between concepts). That is, the ecological approach implicit in the prototype theories of concept formation has allowed that these theories could solve and simplify easier the superordinate and subordinate structures of relationships between concept terms; it was reached by only reducing the open and unlimited net of classical defining-concept theories to a simpler three levels system, which are: (1) superordinate, (2) basic, and (3) subordinate. Within these three levels the fundamental properties concerning the organization of knowledge, such as cognitive economy, informativeness, and natural coherence, are better balanced and understood (Eysenck, & Keane, 1997).

It is also another important topic to consider the differential characteristics between the two basic human representational systems: images (non-verbal) and propositions (verbal-linguistic). *Images* are somehow analogical, while *verbal propositions* arise from an arbitrary and conventional linguistic base. However, this makes a notorious difference concerning the natural and ecological universality of each code. Images and analogies are always more directly related to the basic structure of ecological representations of the perceived physical world, while words and propositions are arbitrary names, indirect, abstract and finally the most formal codes of the representation systems.

This matter gets also into special significance questions, when we enter upon the problem of the structures of concepts relations and schemata concerning the representation of contingent events and situations happening in the real, observable world, which specially cannot be logically inferred. In this concern, Schank (1972) for example, has proposed a *conceptual dependency theory* on one hand, and later on, in collaboration with Abelson, has proposed a *script theory* (Schank, & Abelson, 1977) as a second attempt. Both

attempts are directed to explain high level complex cognitive processes such as the formation of schematic concepts representations of meanings, actions and relationships concerning the real world. But, really, there is a different implicit approach in each of both attempts. The first one (*conceptual dependency theory*) is an attempt to explain how the core of meaning of a whole set of action verbs could be captured by twelve to fifteen primitive actions. These primitives were called *acts* and the main ones were described as a kind of super-verbs (such as ATRANS, PTRANS, MTRANS, MBUILD, etc.) where each one implied an abstract and vague commonplace action as *transfer of possession*, for example, as assignable to sample verbs, such as *give, lend, take* in the case of ATRANS, and alike with the other ones. This first attempt really was an intent to encode a high level of complex meaning cognitive process in terms of a hard propositional and formal system of representation, whose approach was abstract, theorist and top-down; that is, anti-ecological and anti-bottom-up. Anyhow, although this approach had alternative debatable derivatives, finally seemed to stagnate into a blind alley. In general, as Eysenck and Keane (1997) assert, in these semantic decomposition approach there has been more theoretical analysis of relations than empirical testing of the theories. In this concern, Coleman and Kay (1981) and also Vaughan (1985) have shown that these primitives should be treated as characteristic attributes, as well as prototype concepts, rather than as defining *concepts*; a conclusion implying that basic bottom-up ecologically constructed concepts, such as characteristic and prototype concepts, are better explainers of the complex semantic process than the general top-down theorist defining concepts.

However, Schank and Abelson (1977) second attempt -that defined as *script theory*- had a more productive and expansive result, as we will see.

All approaches concerning schemata, frames and scripts seem more plausible to assume that there are more complex forms of conceptual organization; that concepts are related one another in ways that reflect *the temporal and causal structure of the world*. These concept representations go beyond the stable and standard hierarchical structure of superordinate and subordinate terms, which in substance are the primary logical super-inclusion and sub-inclusion relationships between concepts. But the temporal and causal structure of the world, which these schemata, frames and script theories try to explain or describe, cannot rest on a previous or primary structure of logical and hierarchical relationships, but only in the mere contingency and improvidence of the external world. This external world contingency and improvidence is a natural source and commonplace ecological situation for obtaining real world information and direct inference concerning the complex processes

conforming mental representations. However, in order to represent the notion of a contingent event it is necessary to have a knowledge structure that relates the perception and the recognition of the immediate meanings concerning the environmental event and the subject's most consequent and appropriate actions and the corresponding abstract representations. The knowledge structures that this type of information can represent have been variously called *schemata*, *frames*, and *scripts*. Scripts are schemata containing organized sequences of stereotypical actions to account for people's knowledge of everyday commonplace situations. In the same sense, Rumelhart and Ortony (1977), and also Rumelhart (1980) proposed a general theory of schemata, a concept long previously used by Kant, Bartlett and Piaget in their respective times. On his own part, Minsky (1975) suggested similar structures called *frames* in artificial intelligence, which he mainly implicated in visual perception.

Scripts were proposed by Schank and Abelson (1977) with the intention of capturing the knowledge people use to comprehend extended texts, such as having a lunch at a restaurant in terms of all its commonplace implications. They argued that we must have predictive schemata to make inferences and to fill in aspects of the event that are left implicit. Whatever the case, these are structures derived and encoded from an ecological stepwise relation, given beforehand in a commonplace situation, between the subject and his or her environment. In this sense, this second approach of Schank and Abelson is ampler and most comprehensive of the real basis on which the given cognitive process took place and arose from. In this approach the *script situation* is somehow equivalent to the *prototype situation* of the concept formation process.

This only example and argument seems enough to justify the inclusion of a necessary ecological approach into the study of the most complex and abstract cognitive processes.

Other impacting topic to be included under the scope of ecological bottom-up approaches is the case of knowledge organization and its three required fundamentals already above referred to. As already told, according to Eysenck and Keane (1997) our memory and knowledge organization appears to be guided by the principles of cognitive economy, informativeness, and natural coherence. One of the marvels of human memory and knowledge is that they balance these three principles in the acquisition of conceptual systems and relationship representation systems in a way that allow us to get around and understand the world immediately and in a high mental plasticity power. It indirectly shows that the structure of our environment representation is highly dynamic and holographic.

Cognitive economy is defined as an achievement to divide the world into classes of things to compact and decrease the amount of information we perceive and must learn, remember and recognize (Collins, & Quillian, 1969). Once concepts have been formed they can, in turn, be organized as hierarchical categories; such as animal is a concept superordinate to dog, and dog is a class and generic concept involving all the pooches that we knew and we didn't know in our lives. However cognitive economy must be balanced by informativeness, since because of cognitive economy constraints we would end up with too many general concepts losing many important details. However, a very economic conceptual system does not allow us to achieve a very informative system.

So, *informativeness* is defined as the capacity required to retrieve the minimal details of things left behind after abstraction and generalization took place. Third and finally, *natural coherence* is defined as a sense by which concepts assemble or bring together things that are naturally more directly related between than others; it's naturally easier to conjoin into a same concept two dogs, whatever different they are, than to conjoin a dog with a rabbit, or a cat or a spider. As Eysenck and Keane state:

“In short, for reasons of storage and effective use it seems to be necessary to organize and categorize experience. In human memory, this organization appears to be guided by the principles of cognitive economy, informativeness, and natural coherence. One of the marvels of human memory is that it balances these principles in the acquisition of conceptual systems that allow us to get around and understand our world” (1997, p. 234).

We shall try now to show why we consider that those three principles are essentially ecological in themselves. Because they are the best way to summarize and synthesize the enormous amount of sensorial information emerging around us that we perceive as permanently moving and changing both in our physical and social environment. We must be aware and clearly understand that this changing and moving condition is the inherent characteristic of our natural environment. So, it is the environment what is determining our mind, thought and memory organization, since it is necessary to conceptually categorize all that enormous burden of sensorial data in order to synthesize and organize it along time and space. So our mind is environmentally adapted and determined by these basic conditions, and it is organized bottom-up from our natural, sensorial and perceptual basic processes; so showing it is ecological and continuously stepwise in what concerns our environmental adapta-

tion. This is the natural basis of cognitive processes, which must always be explained and understood from this bottom-up direction, instead of artificial theoretic constructivist top-down approaches.

Lorenz (1986) provides the concept of *teleonomy* which takes from Pittendrigh (1958) to explain stepway successful changes and adaptations in living organism structures out of a teleological or mystical approach. We adhere to this epistemological point of view inasmuch as it represents the basis of ecological successful adaptations as developed from biological life-preserver functions and processes, both in ethological as well as in human-social aspects. It really matters what possibilities the ecological environment permits or impedes to the species, and within our sense of *ecological* it means that it depends minute-to-minute, day-by-day, along millions of years of biological evolution on the conditions and resources that the environment provides to the adaptive living and mentally endowed organisms in order to solve their inner and external unbalances and processes accordingly their milieu-representations.

Conclusively, we propose that the ecological approach cannot be omitted in order to find and better understand the real origin of the basic cognitive processes.

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Received: March 1, 2007
Accepted: October 8, 2007

