



Review

The organism and its double: An approach to the individual



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ARTICLE INFO

Article history:

Available online 4 April 2013

Keywords:

Autopoiesis

Biomathics

Individual

Category theory

Qualia

ABSTRACT

The individual is certainly the most complex entity that we know until now. Current research converges on a triad-like understanding of the biological individual as an interface of a mechanism and an ecosystem. The present article wants to propose a more generic concept of individual by integrating the functional role of its qualitative characteristics. Modules-problems ensuing from this generic model will serve as a matrix in the elaboration of a future integral biomathics, while category theory will be its syntactic base.

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1. Introduction

In this article we use the term “individual” to describe what is usually known as a “biological organism” in order to present it in a more generic sense. An individual is an autonomous entity, characterizing itself by a form of intelligence, memory and volition. These terms are to be considered in their most basic format up to the degree of complexity found in the human being. Sherman and Deacon (2007) made reference to this saying: “We recognize in organisms, then, the most basic analogues of what, in our mental experience we describe as self, intention, significance, desire, and purpose. These attributes, even in attenuated minimal form are significantly unlike anything found spontaneously in the

nonliving world.” The individual is open in both senses as Roger Penrose said about mind (1989), that is, epistemologically and ontologically. It calls for new properties, not only unknown, but radically unknown with respect what we currently know about the world.

One of the ways of conceiving a new mathematical formalism in developing research programs in interweaved mathematics, computation and innovative theoretical biology systems (Simeonov, 2010), consists of having a rather satisfactory definition of the individual. This is far from being attained. An adequate description of the individual requires a new language. This must have sufficient complexity to formalize the complexity of the individual. Its apprehension must free itself as much as possible from the shackles of reductionism that paradoxically tends to impose a limit on its meaning. When following the reductionist logic, we

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generally end up with a metabolism, and what we are referring to be an individual is at best a stillborn entity.

In the perspective of an adequate approach of the living, two paradigms, among others, left their mark. The first is autopoiesis which is the third-generation system according to Kawamoto's (1995) classification of typical systems theories into three generations. The second-generation system is a self-organizing system; it is interested in the mechanism by which a system self organizes from an initial uncoordinated state. The first-generation is a system in dynamic equilibrium; it focuses on the mechanisms by which a system maintains itself despite fluctuations in the environment. The third generation focuses on the self-production, namely, the mechanism by which a system is achieved. According to Maturana and Valera (1980) an autopoietic system consists of a unit in which the organization is defined by a particular network of the production process of elements. Kawamoto points out the difficulty and insufficiency in their attempt to formulate the definition into one single phrase. "An autopoietic machine is a machine organized (defined as a unity) as a network of processes of production (transformation and destruction) of components that produces the components. At this time, the components have the following characteristics: (1) through their interactions and transformations continuously they regenerate and realize the network of processes (relations) that produced them; and (2) they constitute it [the machine] as a concrete unity in the space in which they (the components) exist by specifying the topological domain of its realization as such a network." The sociologist Niklas Luhmann (1990) remarks that autopoiesis, contrary to self-organization, targets the production of the system's unity itself.

At first glance, the first difficulty is the language itself. It is about expressing phenomena which are relevant to life and consequently have spatial movements, interactions with the environment, self regulations, etc. All this is expressed in a language which is linear by nature and well adapted to sequential events (Kawamoto, 2011). The difficulty also lies in explaining something that is invisible, meaning the qualitative transformation which occurs in the traditional idea of productive causality. On the other hand, concerning the living, the process is looped onto itself, which is its main characteristic, whereas usually the agents and effectors of the productive causality are distinct entities. These considerations allow Kawamoto to focus on an aspect overlooked by Maturana and Valera; notably that the self incorporates its perpetual becoming, whereas they remained with the idea of self conservation. Finally, autopoiesis must include the constitution of a space. He suggests the following modification:

"Autopoiesis is a system which consists of organic matter (determined as unity) as a network of production processes (transformation and destruction) that produces elements in a repetitive manner. 1° when elements are produced in a repetitive way and furthermore put on the network of process (relations) which produces these elements themselves, — through transformation and interaction — we call them constitutive elements of the system. These are as far as they make continue to work the system, and it is through the operation of the system that is determined the sphere of the constitutive elements (*Sich*) of the latter. 2° When a series of constitutive elements forms a closed field in which takes place the productive operation, the movement produces between them, and their material properties, it is there that a network (system) becomes a concrete unit to form a field which is appropriate for it and to make topological the latter. The space which overhangs this closed field which becomes constantly (*Selbst*) is the topological space of the system, in other words the space for the system"

At first lecture, if Kawamoto has overcome the incompleteness of Maturana & Valera's proposal, much work remains to do so that the definition be intelligible. 1st, Kawamoto's proposal suggests

that it is necessary to sequence the formula. It is not possible to say everything in one shot. 2nd, one has to read the sequences more than once in order to reestablish the logic of the object, what would tend to prove the inadequacy of a linear language to describe a phenomenon rolled up on itself. Nevertheless, the reformulation that he proposes on the one hand restores the notion of self-reflexibility, which opens up the possibility of an evolution of the system. On the other hand, he clarifies two definitions of the self that are presupposed in the initial formula: the self produced in a discontinuous manner (*Sich*) and the self conformed in the topological space (*Selbst*). Autopoiesis is, therefore, a process that focuses on individuation. This particularity is the differentiating factor as far as it is not determined by input or output. The other aspect is its relationship with the environment. For Kawamoto, none of the environmental conditions allows to predict the emergence of an individual. It is a system that, while continuing to self-create, produces an asymmetry in the world. Kawamoto emphasizes the relationship that the individual creates with the environment as well as its importance in establishing a unity of a self. Besides this, he advocates the creation of fundamental categories in both philosophy and experimental sciences to explain the relationship with the environment. This actually contributes to the creation of a system even before this system distinguishes itself by its asymmetry; in other words, it contributes in building borders, or it contributes to the establishment of an asymmetry within itself.

The first paradigm has the advantage of highlighting the double aspect of the individual constructed by *Sich/Selbst*. It's worth researching this trait as it might be one of the key factors in understanding it. This paradigm also points out that the language or formalism is fundamental in conveying what is at first glance invisible while taking into account the different dimensions of the entity and its interrelations. Within the same concept is found the relationship with the environment, not only through the input/output flow that is required for all metabolisms, but also its initial role that becomes internalized to the point of being forgotten.

The second paradigm is the proposal of Robert Rosen with his model of living as "Metabolism and Repair", or (M, R) system. In this paradigm, the system is "closed to efficient causation, that is, it generates its own components in an immanent cause of itself" (1991). In other words, "a material system is an organism if and only if, it is closed to efficient causation". Current research points out three notions that are lacking in Rosen's model, namely, the environment, the individual as a hierarchical multiscale system, and temporality (Gare, 2008). His strong dichotomy between "organism" and "mechanism" to singularize life prevents the structural and hierarchical dimensions of the individual to be clarified. Besides, in his figure 10C6 (*Life Itself*, p. 251) the environment is only represented by the starting point. On this subject, Cottam et al. (2003, 2004, 2006) suggest that "organisms and rationality constitute hyperscalar systems and that they always operate within bi-rational frameworks of entity and ecosystems". The environment has the same importance in their proposition as Kawamoto's. Furthermore, these authors show that the modification of Rosen's proposal enables us to rediscover the multiscale hierarchy and bi-rationality. The convergence of these arguments allows apprehending the individual with regard to the environment in terms of asymmetry and of inseparability. This tension finds a dialectic solution à la Charles Sanders Pierce who considered the individual as a "complex interface between mechanisms and ecosystems" (Cottam et al., 2007). Consequently, an individual does not exist *in vacuo*. Nevertheless, there is still frustration surrounding the individual as if intuitively it is missing a dimension that prevents it from becoming truly living.

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