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Speakers:

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Title: *Organization and function in current biomedical sciences*

Abstract

The notion of organization was neglected by the mainstream philosophy of biology of the 20th century, mainly concerned with evolutionary and molecular issues. Recently, however, this notion is being recovered, along the new systemic concerns arising in Systems Biology and Evo-Devo, and the greater attention paid to biological organization has initiated a new philosophical analysis of its connection with biological function.

This symposium aims to examine the explanatory role of biological organization in current biomedical sciences. Topics focus on whether biological organization is (causally) open or close, on how constitutive parts are integrated, and on how organization can ground the teleological and normative dimensions. Specific attention will be paid to how organization-based approaches to biological function can face criticisms coming from accounts worried about the evolutionary and interactive aspects of living phenomena, and to how the notion of organization can ground a better understanding of organisms.

The first paper departs from the notion of “organizational closure” and defends that functions may be naturalized as contributions to the organization. The second sees problems in the very notion of organizational closure and considers that there are several fields (like EcoEvoDevo) and issues (as that concerning hierarchical levels) in Biology that suggest that the organization should be open rather than closed. The third paper examines form and function in Evo-Devo, where function may be seen as an internal adaptation. Finally, the last paper relates living organization with normativity, and how it can play a role in judgements on states of health and disease.

Keywords

organization, function, closure, normativity, Evo-Devo, open organization, internal adaptation, teleology

General description

The notion of organization has been central in the history of Biology, although it has been largely neglected by the mainstream theories and practices of the last 50 years. Before, this concept played a very important role in the understanding of life, and the

historical works of authors like Jacob (1970) or Foucault (1966) considered it to be highly relevant in the establishment of Biology as a science in the beginning of the 19th century. It can also be maintained that its relevance continued in relation to terms like organism or organicism, and to close synonyms such as holism or systemic thought (Gilbert & Sarkar 2000, Harold 2001, Brigandt & Love 2008). Nevertheless, the notion never disappeared completely from fields like Systems Theory, Cybernetics, Complexity Studies and Artificial Life (Van de Vijver et al 2003, Moreno et al 2008).

In the Philosophy of Biology, we can see the different views about organization supported by the Kantian and the Darwinian traditions: the former demands to judge living systems as being internally organized teleologically, but this requirement for integration, and the commitment of science to explain it, was lost in some “extreme” Darwinian works. Thus, the organizational tradition has pointed to the problem of how the relations among parts form an organization (Alberch 1989, Müller & Newman 2003), which also influences our views of the analogies or disanalogies between organisms and technological artefacts (Krohs & Kroes 2009).

Recently, the notion of organization is becoming salient again in the Life Sciences, in particular in fields like Systems Biology (Boogerd et al 2007; O'Malley & Dupré 2005) and Evo-Devo (Amundson 2005). There are several theoretical approaches (Etxeberria & Umerez, forthcoming). Some of them look for a logical abstract conception of organization that emphasizes the idea of organizational closure. This view has been prevalent in the work coming from Cybernetics and in some sections of Artificial Life, as well as in theories of autopoiesis (Maturana & Varela 1980). Some others, instead, consider that even abstract whole systems need to fulfil some material or structural properties, such as thermodynamic or homeostatic conditions, in order to reflect the empirical conditions of actual living systems (Luisi 2006). Finally, the new mechanistic view in the Philosophy of Science has also tried to approach many characteristic properties of biological organization as complex mechanisms composed of structural parts (Bechtel & Richardson 2010). One of the important features of this last approach is that the notion of organization can be reconciled with an evolutionary thinking, to the extent that both parts and wholes are conceived as evolved entities. All these issues have brought about a renewed interest in self-organization and materiality (Karsenti 2008), as well as in the subject of the organism as something different from the notion of individual as understood in evolutionary biology (Ruiz-Mirazo et al 2000).

The renewal of scientific work on the notion of organization has also facilitated the development of a new philosophical account of the biological concept of function, aimed at integrating ‘etiological’ and ‘systemic’ (or ‘dispositional’) theories (Mossio et al., 2009). According to this view, the al closure of the system provides a naturalized grounding to the concept of biological function, interpreted as the specific contribution of each localizable component subject to closure to the maintenance of the whole organization. In particular, al closure grounds the two constitutive dimensions of functions, namely: their teleology and normativity. On the one hand, al closure allows explaining the existence of a part by appealing to the effects of its activity, in a scientifically acceptable way. On the other hand, since each part must act in a specific way (otherwise the system, and then the parts, would cease to exist), the activity of the parts becomes their own norm.

Thus, this symposium presumes that the notion of organization has a new philosophical relevance in current Biology that is worth considering and analysing to provide:

- 1) A better understanding of how to overcome the organization versus evolution dichotomy, by rethinking the role of the notion of organism in Biology;
- 2) An evaluation of the requirements that an ecological collection of dynamically interacting components has to meet to be called an organization;
- 3) A fine-grained consideration of the problem of the emergence of organization from an evolutionary and developmental perspective;
- 4) An analysis of the notion of function, related to the features required to understand organization;
- 5) An examination of the tension between the scientific and applied relevance of knowing how a given organization constitutively maintains itself and knowing how to intervene in the kind of performances it enables.

In sum, the session will deal with many issues discussed in the Philosophy of the biomedical sciences from an organizational perspective paying special attention to how these questions about living organization are debated in current science and philosophy.

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Paper [1] Matteo Mossio (Université Paris-Sorbonne): *Organization, closure and functions*.

One of the open questions in contemporary philosophy of biology is whether the constitutive organization of biological organisms realizes a distinctive causal regime, irreducible to physico-chemical causation.

In this paper, we advocate the view that biological systems differ in a fundamental way from other natural systems in the causal role of constraints, i.e. those local and contingent causes, which generate a reduction of the degrees of freedom of the behaviour and dynamics of a system. In describing physical systems, constraints are usually introduced as external boundary conditions, unaffected by the dynamics on which they act, but required to provide an adequate description of the system.

In accordance with a long-lasting tradition, the central claim of this paper is that, in biological systems, parts and processes acting as constraints realize closure, i.e. a mutual dependency in virtue of which they are reciprocally causes and effects of the others, and collectively contribute to determine the conditions at which the whole organization can exist. Because of the closure among constraints, biological systems realize an intimate association between complexity and integration, an organized complexity – in Herbert Simon’s terms – which can compensate the decay of its components and recursively ensure its own self-maintenance.

This view has relevant implications for the philosophical debate. In this paper, we will focus on those concerning the concept of function. On this issue, our argument will be twofold. On the one hand, we will argue that al closure provides a naturalized grounding of the two fundamental dimensions of the concept of function, namely its teleology and normativity. On the other hand, we will claim that functional ascriptions are specifically relevant in those cases in which a set of constraints realizes an organization that is not only closed, but also layered or levelled, so that a hierarchy among the constraints and their mutual relations can be described.

In the conclusion, we will discuss the prospects of the research program aimed at understanding the idea of “closure of constraints”, by focusing on its potential contribution to explain how biological systems are able to evolve towards an increase of internal complexity.

Paper [2] Ulrich Krohs (Dept. of Philosophy, University of Hamburg): *Open organization*

The notion of organizational closure is central to several attempts of defining life that were developed during the second half of the 20th century, and to some recent explications of the concept of function. It serves as an important corrective to those approaches to teleological and normative concepts within biology that mistake the project of naturalizing teleology for the one of historicizing it, i.e., to etiological accounts of function. Conceptually, reference to closed (and at the same time differentiated) organization meets – in contrast to etiological accounts – the demands one should pose on any project of naturalizing normative functions. However, biological systems also show aspects that point to an open rather than to closed organization: reproduction and communication are directed to the outside, as are those developmental processes that depend on external input. Those basic capacities seem to transgress the zone of organizational closure. Whether my claim holds might depend, of course, on the precise definition of closure. Closure is sometimes understood as self-

maintenance, sometimes as a mutual causal dependence of microscopic and macroscopic phenomena (which might bring in the problematic notion of downward causation). Both explications will be considered.

My paper discusses open organization in two respects: (i) are biological systems indeed organizationally open as it may seem, or is openness restricted to inessential aspects which can – or should – be neglected in attempts to naturalize biological normativity and teleology; (ii) do all relevant biological theories describe organisms as organizationally closed or are there relevant theories that presuppose or demonstrate the openness of biological organization. The latter might be the case with, e.g., EcoEvoDevo, with which I will therefore confront different notions of organizational closure.

I will argue that open organization is relevant to biological organisms under both perspectives, the ontic and the epistemic one. While the notion of organizational closure captures an important aspect of biological systems, it does not cover all functionally organized capacities. Consequences for a normative concept of function will be discussed.

Paper [3] Laura Nuño de la Rosa (Université Paris-Sorbonne and Univ. Complutense, Madrid): *Organization as internal functional adaptation in Evo-Devo*

This presentation is concerned with our understanding of living organization as internal adaptation of parts within the organicist approach to Evo-Devo. In this approach, both form and function are crucial to understand organization, and the perspectives of morphology and physiology need to be integrated.

In the *Critique of Judgement*, Kant distinguished two meanings of adaptation: *relative adaptation*, referring to utility, i.e. the adaptation to an external goal, and *internal adaptation*, alluding to the whole/parts relationship occurring within organisms. The Darwinian identification of function with relative adaptation (understood as ecological fitness) led evolutionary morphology to focus on the phylogeny of form, and the problem of internal adaptation almost disappeared from evolutionary biology.

My presentation aims to, first, identify the factors that can explain the relative neglect of internal adaptation in contemporary philosophy of biology, namely (i) the historical divorce between physiology and developmental biology; (ii) the exclusion of morphology from the Modern Synthesis (MS), which caused Evo-Devo to turn largely to the neglected problems of form; and (iii) the widespread reduction of Evo-Devo to evolutionary developmental genetics. All these obstacles have not prevented some evolutionary biologists to actually face the problem of the development and evolution of living organization, from some of the main heterodox biologists in the time of the success of the MS (Schmalhausen, Waddington, Riedl), including the work of some of the founders of evo-devo (Alberch, Wake) until key recent suggestions (e.g. Gilbert 2000, Schwenk and Wagner 2001). In the second part of my paper, I will explore the main conceptual models forged within this tradition to explain how organization (modularity and organismal integration) evolves: (i) evolutionary systems as changing networks of developmental and functional correlations, and (ii) the process of internal stabilising selection.

Paper [4] Arantza Etxeberria (Dept. of Logic and Philosophy of Science, University of the Basque Country): *Biological organization, mechanisms of malfunction, and normativity*

Debates between naturalists (concept of disease is based on scientific theories and practices) and normativists (concept of disease is inherently evaluative) have shaped recent discussions in the philosophy of medicine. Since Boorse, naturalist accounts in the philosophy of medicine usually consider that diseases are malfunctions, that is to say deviations of the normal functioning of physiological parts and processes, which are value neutral. This paper aims to examine the role of biological organization and its knowledge in concepts of health and disease and in medical practice.

The analysis will focus, first, on the normativity implied by the different accounts of biological function offered by the recent philosophy of biology to ground concepts of malfunction or disease. The main concepts may imply different kinds of normativity that provide different explanations of the physiological organization of the body, of its parts, and/or of pathologies, and therefore different accounts of malfunction.

Related to this, another main issue in the philosophy of medicine has been the extent to which knowledge of physiology and of the organization of the healthy organism can help understand the nature of pathologies and their cure. Recently Nervi (2010) has argued that medicine needs to distinguish between physiological and pathological mechanisms: the malfunctioning of a physiological mechanism and the mechanism of a malfunction are not the same matter. As for Canguilhem (1966), for Nervi we cannot assume that a pathological fact is the negation of a physiological one, because pathologies seem to have an organizational logic of their own.

In sum, the paper tries to analyse if a mechanist analysis of disease as malfunction can rest only in the understanding of function as a contribution to the organization of the individual organism. If not, a) medicine needs to account for diverse mechanisms of malfunction and, this implies that b) different kinds of normativity operate in medicine to account for malfunction and disease.