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### ► To cite this version:

Cristian Saborido, Matteo Mossio, Kepa Ruiz-Mirazo. In search of conceptual bridges: a review of Krohs, U. & Kroes, P. "Functions in Biological and Artificial Worlds". *Artificial Life*, 2010, pp.337-340. halshs-00792438

**HAL Id: halshs-00792438**

**<https://shs.hal.science/halshs-00792438v1>**

Submitted on 18 Jul 2019

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# Book Review: In Search for Conceptual Bridges: A Review of “Functions in Biological and Artificial Worlds”

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*Functions in Biological and Artificial Worlds. Comparative Philosophical Perspectives.* U. Krohs and P. Kroes (Eds.). Vienna Series in Theoretical Biology. (2009, MIT Press.) 302 pages.

In recent times, several collections of classical or recent articles on the concept of function have appeared (see, e.g., [1–3]). The novelty of the book reviewed here deals with the concept of function from a perspective rarely adopted in philosophy of science, namely, focusing on the role of this concept as a common nexus between philosophy of biology and philosophy of technology. As a matter of fact, the various chapters of the book are revised versions of communications given by the authors during a workshop, held in 2006 at the Konrad Lorenz Institute in Vienna, on “Comparative Philosophy of Technical Artefacts and Biological Organisms.” Functions are intriguing for philosophical analysis in that they possess normative and teleological dimensions, which seem to be at odds with the accepted structure of scientific explanation. In particular, as the editors note in the introduction, functional explanations related to both biological organisms and human-made artefacts generate a number of theoretical difficulties. On the one hand, it is not easy, particularly in the biological case, to provide a naturalized grounding for the normative character of functional attributions, which is a necessary requirement to talk about dysfunctions. On the other hand, there are so many differences between biology and technology that no single theory has been able to characterize the concept of function as it is employed in each domain. For instance, the role of intentionality and the grounds for normativity appear to be very different in the two domains. In addition, whereas functional ascriptions concern artefacts as wholes, they usually refer to parts of organisms.

Still, parallelisms do exist between the two fields, as it is shown by the analogous use of a number of concepts or theoretical constructs (“hierarchically organized systemic structures,” “evolution,” “development,” “(re)production,” “integrity,” etc.), and, according to the editors, the purpose of this book is to offer an integrated framework for functionality as it pertains both to organisms and to artefacts. Actually, in their view, the lack of an adequate characterization leads to many of the difficulties in getting a satisfactory understanding of biological organisms, of technical artefacts, and of their mutual relations.

After the general introduction by the editors, the volume is divided in four main sections, each grouping several chapters that deal with different issues. In the lines below, we provide a brief summary of the contents of each section, followed by our own interpretation and critical remarks.

The first section (“Bridging Functions of Organisms and Artefacts”) presents several proposals advocating the theoretical integration of biological and artefactual functions. The chapter by Mark Perlman (Chap. 2) formulates recommendations for the future development of the theories of functions, defending a position that he calls “pragmatic teleo-pluralism”: It depends on the observer’s interests to choose the more relevant or interesting theoretical analysis of function for a given situation. In Chap. 3, Beth Preston makes the proposal to bring the etiological notion of biological proper function into the field of artefacts, by means of the notions of *use* and *reproduction*, which are analogous in biology and culture, and

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can offer us, according to her, a suitable etiological foundation for the idea of function in both domains (organisms and artefacts). Françoise Longy, in turn (Chap. 4), argues that the distinction between selection and intention is not valid for discerning between biological and technological functions and puts forward an integrating theory based on a wide interpretation of Wright's proto-etiological model [7], so that it includes a variety of selective mechanisms. Finally, Pieter Vermaas (Chap. 5) develops an account that interprets both biological and artefactual functions as objective properties possessed by specific kinds of entities, and not just as subjective ascriptions depending on the intentionality of an external observer.

Globally speaking, we can say that this section grasps the interest of the reader, providing good conceptual resources to tackle and understand the issue of natural versus artificial functions, as well as their mutual connections. All four contributors advocate a common approach that should deal in a coherent way with both biological and artefactual functions. The chapter by Perlman is adequate as a start, because it identifies many of the theoretical questions and problems later posed by the other three authors. Preston's chapter is well argued, but it is only suggestive if one accepts the etiological perspective as correct. Besides, there seems to be little novelty with regard to a previous proposal by Griffiths [5], which is embraced by Preston. Françoise Longy explains why it is so convenient to develop a unified theory of functions, though she is not that clear on the way to accomplish it. And the final contribution by Vermaas is possibly the one with the most solid line of argument, although it does not look (to us) ambitious enough, since it focuses on epistemic issues and does not really aim for an objective account of functionality.

The second section of the book, entitled "Functions and Normativity," deals with the philosophical foundations of the normative character usually attributed to functional ascriptions. Peter McLaughlin (Chap. 6) looks into the conceptual origin of normativity in functions, arguing that, actually, it appears at a deep level, inherent in any functional ascription, regardless of whether these stand for means-ends, part-whole, or type-token types of relations. Maarten Franssen (Chap. 7), in contrast, holds that normativity derives from human intentionality and it is directly related to justifying certain beliefs about the way in which various entities operate in the world. In a similar vein, Paul Sheldon Davies (Chap. 8) further argues that the act of considering functional ascriptions functional corresponds to a "conceptual conservatism," with psychological and cultural roots, which should be avoided to build proper, objective knowledge. The last contribution, written by Andrew Light (Chap. 9) discusses the issue of ecological restoration, by focusing on its descriptive and normative aspects. Light claims that restored ecosystems should be conceived as artefacts, and restorations as reproduction of damaged functions of ecosystems, by relying on the ICE account of technological functions described by Houkes and Vermaas [6].

Despite the interest and quality of the works included, the general structure of this section is not fully convincing. First, it does not seem to have a direct relationship with the overall theme of the book (functions in artefacts and organisms, and their interconnections); and, second, it lacks theoretical or thematic coherence among the different chapters. The chapter by McLaughlin investigates the sources of normativity in functional explanations, claiming that functional ascriptions have, indeed, an inherent normative nature. But this is precisely the idea that is criticized and rejected in Franssen's and Davies' chapters, which embrace systemic views very close to Cummins' [4]. Davies even states that the normativity of functions just stems from a noxious conceptual conservatism. Finally, Light's contribution, although it deals with the idea of function from a seldom treated, interesting perspective and has potential applications, does not really connect with the other chapters at all, and the reader wonders whether it could have been inserted somewhere else.

The third section, "Functions and Classification," is more obviously linked with the first, since it is devoted to analyzing various criteria that can be used to distinguish between different types of functions and functional domains (the artificial versus the natural). Giacomo Romano (Chap. 10), focusing on the cognitive mechanisms through which humans are able to recognize functionality, criticizes functional accounts based on meta-intentional capacities in various ways, and puts forward a view in which functionality is perceived as for-ness in terms of a tripartite relation between an antecedent state, a consequent state, and a process of transformation realized by the functional object. Marzia Soavi (Chap. 11)

defends a realist position concerning the functions of artefacts, arguing that artefacts, as functional kinds defined by the intentions of the designer, correspond to real kinds (if functional relations are characterized in an adequately narrow way). Thus, Soavi interprets artefacts as functional kinds, emphasizing that the designer's intentions include the relation between function and structure, which is at odds with the idea that artefactual functions would be generically multi-realizable. In the last chapter of this section (Chap. 12), Kitamura and Mizoguchi approach the idea of function from an engineering perspective, and propose a characterization based on the notion of *device*. A function would be the role played by the behavior of the device in a given context of use, defined by an external user (which generates what they call *external* functions), or by the system of which the device is a part (which generates *component* functions).

The three chapters included in this section deal with very heterogeneous issues, and they sometimes hold rather opposing positions. Romano speaks about psychology and how mental processes would tend to ascribe teleology to everything, whereas Soavi and Kitamura & Mizoguchi restrict themselves to artefacts, although discussing two different questions: Soavi elaborates on the idea of "kinds" from a very philosophical perspective, while Kitamura & Mizoguchi take an engineering standpoint, arriving at quite opposite conclusions. This can be somewhat confusing for the reader, and the general impression is, again, an apparent lack of coherence among chapters, reflected in the actual title of the section (which does not really cover, e.g., Kitamura & Mizoguchi's contribution, far away from the issue of "classification").

The last main section, "Evolutionary Perspectives," consists of four chapters that take into consideration evolutionary aspects both in biology and technology, and, although they do not address so directly the question of function, they turn out to be an interesting theoretical complement to it. Wybo Houkes (Chap. 13) argues that, despite the differences between the domain of natural organisms and that of technological artefacts, there are frequent concept exchanges between them according to their specific needs or explanatory goals, and he explores two case studies (evolutionary design in electronics, and evolutionary archeology) in which concepts coming from the selectionist theoretical framework of evolutionary biology are transferred, in a rather spontaneous way, to fields that deal with "artefacts." Tim Lewens, in turn (Chap. 14), explores the benefits of transferring the evolutionary models of explanation to understand technological change/innovation, in particular through the "population thinking" perspective that they present. Then, Ulrich Krohs (Chap. 15) takes into consideration the idea of "modularity" (or near-decomposability) and explores how we could make better sense of its evolutionary origins and importance in the natural world by learning from the use of it in the technological context. He focuses on the complex ways in which modularity may relate to functional/structural decomposition in living organisms, as opposed to the simpler relationship that holds in technological devices. Finally, Peter Kroes (Chap. 16) discusses whether the notion of emergence is applicable to relatively simple technical devices and in what sense this could mean a challenge for the "control paradigm" within the traditional engineering practice.

The contributions included in this last section deal with the implications of taking an evolutionary standpoint to understand the functional organization of a natural entity or a technological artefact. Except for Krohs, none of the other authors touch upon philosophically/conceptually deep questions regarding the notion of function, in either the engineering or the biological context. The interconnections among the different chapters are also quite indirect. For instance, the text by Houkes, though quite interesting, remains far away from the issue of functionality. In contrast, Krohs puts his finger on truly relevant aspects to gain a better understanding of what the idea of function is and what it involves. He focuses more on the biological domain, but the connections with the world of technologies and engineering are quite appropriate, even if he ends up giving no conclusive solution to the problems raised. Peter Kroes only speaks about function in an engineering context (no comparison whatsoever with natural/biological phenomena).

In conclusion, although the book suffers from some lack of cohesion, mainly due to the variety of themes discussed and theoretical perspectives adopted by the contributors, it offers an interesting and innovative survey of foundational and philosophical issues on the concept of function, in its interdisciplinary and plural character. It demonstrates to what extent the concept of function is a central theoretical tool in both philosophy of biology and philosophy of technology, and the various chapters

collectively make a significant contribution to showing the need for a new framework establishing conceptual bridges between these two philosophical domains, which tend to unfold separately. In this manner the book paves the way to numerous conceptual and scientific developments in the future, specifically relevant for all those scientific disciplines, like artificial life, that work at the edge between the natural and artificial worlds.

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