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Affordances and Organizational Functions

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Abstract
In this paper, we bring together the concepts of affordance from ecological psychology and function from the organizational approach to philosophy of biology into a single integrative framework. This integration allows us to account for the biological basis of the notion of affordance, offering theoretical tools to address the normative interrelations between the organisms and their environments.
Keywords:

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I. Introduction

Ecological psychology is a non-representational, embodied, and situated approach to perception and action that is based on four main claims: the basic unit of analysis for psychology is the organism-environment system, perception is continuous with action, perception is direct (does not need to rely on mental representations or inner processing), and perception is primarily of affordances (these are, the possibilities for action available in our environments) (Gibson 1979/2015, Gibson and Pick 2001, Richardson et al. 2008, Chemero 2009, Turvey 2018, Heras-Escribano & Lobo 2022). According to ecological psychology, the explanation of perception and action in terms of affordances is rooted on the knowledge that biological theory offers us (Gibson 1979/2015, Michaels & Carello 1981, Reed 1996, Chemero 2009).

Some authors assume that affordances have a functional character (Withagen and Chemero 2009). For example, Chemero claims that "since functions depend on evolutionary history and affordances are partly constituted by functions, affordances are tied to evolution. This makes ecological psychology a branch of biology, and a truly ecological science" (Chemero 2009: 146). As

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Chemero states, the functional character of affordances is usually characterized from an evolutionary perspective: our cognitive structures have historically been shaped by and to perceive affordances (Gibson 1966: Chapter 9, Gibson 179/2015, Michaels and Carello 1981: 15, Heras-Escribano 2020a, Saborido 2022). It is biological evolution that, through mechanisms such as natural selection and niche construction, has shaped the design of our cognitive structures for generations. The ability to perceive affordances and use them to guide our action is a selected effect of evolution because it is a positive contribution to biological fitness (Reed 1996: 47-51; 67).

Biological theory, understood in this case primarily as evolutionary theory, can be consequently understood as providing a biological basis for the notion of affordance. However, this approach per se does not seem to be capable of answering a fundamental question that refers to the biological basis of the notion of affordance; namely, how affordances make a functional contribution to the individual organisms themselves in their interaction with their environments, and not only with respect to their fitness. This aspect is essential because it is precisely this interaction with the environment that constitutes the main object of study of ecological psychology. It is also the phenomenon for which the notion of affordance is proposed and in which it makes sense. An evolutionary approach can explain how certain affordances are more present in the individuals of a population throughout its phylogenetic history, but not how these are implemented in the concrete organizations of the individual organisms. Also, if according to Chemero, "ecological psychology [is] a branch of biology" (2009:146), and if the organism-environment system is the main unit of analysis for ecological psychology, then an analysis of the functional contribution of affordances can explain how the organism-environment system is established in biological terms.

This paper attempts to address this issue by integrating the notion of affordance from ecological psychology and the idea of function from the theoretical framework of the organizational approach in philosophy of biology. We conclude that there are enough complementary aspects between both views so as to offer a tentative combination of both of them within a single framework that, if successful, we think it could contribute to shed some light on the relations between organism and environment at a behavioural level. In this sense, the main goal of this paper is very humble: simply to explore the combination of the organizational approach to functions and the notion of affordances. But, at the same time, it is quite promising, as it could be a starting point for enriching two views that have not typically been combined. As we will see, the notion of biological function of the organizational framework is a promising starting point to search for the biological foundations of the notion of affordance, serving also as a basis for

evolutionary considerations. Furthermore, we aim to show how the ecological approach could allow the organizational approach to address the normative interrelations between organism and environment. The notions of organization, environment, function, and normativity are reinterpreted from the ecological characterization of affordance. This fruitful and mutual interaction between ecological psychology and the organizational approach to functions could be enriched and in the future so as to start a research line that works in the crossroads between biology and psychology.

II. Biological function, organization, and normative standards

II. 1. New directions in the philosophy of biology

In the philosophy of biology of recent decades there has been a renewed interest in the study of the distinctive aspects of biological organizations. After a period of 50 years (the second half of the twentieth century) in which approaches based on genetic or population-evolutionary aspects predominated, the philosophy of biology has put the notions of organism and organization at the center of its research. As Nicholson (2014) has pointed out, there are three main reasons why this has happened: first, the recognition that the so-called Modern Synthesis has not been able to give a completely satisfactory explanation of all the factors that influence evolution (Gilbert and Sarkar 2000, Odling-Smee et al. 2003); secondly, the growing scepticism among biologists about the possibilities of the reductionist program of molecular biology (Lewontin 1993; Rose 1997; Shostak 1998); finally, it seems that philosophers and scientists have regained interest in the problem of the definition of life (Bedau and Cleland 2010).

Thus, many authors have adopted an organicist approach to try to overcome the classical frameworks of the Modern Synthesis and molecular biology, and to account for what differentiates living beings from other physical systems. It is in this context that new perspectives have emerged, as influential as, for example, the Developmental Systems Theory (Oyama 2000; Oyama et al. 2001), Evolutionary Developmental Biology -also called evo-devo- (West-Eberhard 2003, Bateson and Gluckman 2011) or the Ecological-Evolutionary Developmental Biology -eco-evo-devo- (Gilbert & Epel 2008). These perspectives are often grouped together within the framework of a new way of understanding biological evolution which has been called the Extended Synthesis, as opposed to the Modern Synthesis (Pigliucci and Muller 2010).

Another perspective in the philosophy of biology has also been developed, one that focuses on seeking the minimum defining characteristics of biological organizations. While the Extended Synthesis theorists have expanded the focus of interest in evolutionary biology to account for a large number of

factors, processes, and mechanisms that were often ignored from the classical perspective (and that, according to these authors, offer an essential contribution in evolution) , organizational theorists depart from a different perspective. In particular, the Organizational Approach to life (Bich et al. 2016, Christensen & Bickhard 2002, Collier 2000, Mossio eta al. 2009, Moreno & Mossio 2015) is based on the theoretical advances that have been made in disciplines such as Far-from-equilibrium Systems Thermodynamics, Complex Systems Theory, and Theoretical Biology. These disciplines, halfway between Physics, Chemistry and Biology, have shaped an interpretation of living beings as self-maintained systems (Glansdorf and Prigogine 1971, Ganti 2003, Rosen 1991, Kauffman 2000). From this approach, the most distinctive aspect of living beings is that they are systems capable of exerting a coordinated action of their component parts which implies an intervention on their environment. This intervention results in the persistence of the conditions that allow living beings to continue existing.

The way in which they carry out their self-maintenance is precisely what characterizes living beings and what differentiates them from non-biological systems. The organizational approach claims the dynamic organization of living beings as its main object of study. In fact, the very idea of organization acts as an explanatory principle that allows the development of a new theoretical framework with which to address classical issues in the theory and philosophy of biology. An example of this would be the organizational characterization of the notion of function.

II. 2. The organizational approach to biological functions

The organizational approach defines the concept of function in the following terms: a trait is functional insofar as it contributes to the self-maintenance of the system to which it belongs (Schlosser 1998, Collier 2000, Christensen and Bickhard 2002). Thus, the metabolic pathways of a cell are functional because they serve the self-maintenance of the cell and the heart is functional because it contributes to the self-maintenance of the vertebrate organisms.

According to (probably) the most developed organizational proposal (Mossio et al. 2009, Saborido et al. 2011, Moreno and Mossio 2015), functional attributions require considering that biological self-maintenance is carried out thanks to a complex mode of interdependence called organizational closure. This organizational closure consists of the realization of a network of interrelations between material structures (constraints) that influence their environmental conditions in such a way that the whole network becomes self-maintaining (Mossio et al. 2013, Montévil and Mossio 2015).

We can identify certain traits as conditioning factors that exert mutually dependent differentiated causal effects and that, through the maintenance of the whole, contribute to their own maintenance. Accordingly, functions can be attributed to these traits and this has explanatory relevance when it comes to biological structures and processes. Thus, according to the definition of these authors, a trait has a function if and only if it meets these three conditions:

> C1. This trait contributes to the maintenance of the organization of a system.
> C2. This trait is produced and maintained under certain constraints exercised by this organization.
> C3. This trait is part of a system with organizational closure (Saborido et al. 2011).

In other words, organizational functions are teleological because they are based on the achievement of a biological end, self-maintenance, and they are normative because this satisfaction of the goal (the specific contribution to maintenance through the closure of constraints) includes a prescriptive character: all structures and processes subject to causal closure must fulfil their function so the organizational regime could be sustained. Thus, we can say that, for example, the heart has the function of pumping blood because (C1) pumping blood contributes to the maintenance of the organism by allowing the blood to circulate, which enables, among other things, the transport of nutrients into the cells and the stabilization of temperature and Ph, etc. At the same time, (C2) the heart is produced and maintained under certain constraints exerted by the body, and the integrity of the body is also a requirement for the existence of the heart itself. Finally, (C3) the organism is an organizationally closed system, since it is constituted by a set of interdependent structures that contribute through their constraining action to the biological self-maintenance of the whole system.

III. Organizational functions and ecological affordances

III.1. Situating organizational functions

By interpreting functions as contributions to organizational closure, this theoretical framework can answer classic questions of the debate, such as which is the rationale for distinguishing between functional and useful entities, and between functional and dysfunctional effects. However, the organizational framework also seems to have significant explanatory limitations. In particular, it seems necessary to complement this approach in order to "contextualize" the organizational processes of the actual living entities. From an organizational point of view, a biological trait is functional

because it contributes to organizational closure, i.e., to its self-maintenance. However, as biologists and philosophers have often insisted (e.g., Lewontin 1982), biological self-maintenance is not a process that occurs in isolation, in a vacuum, but is only possible under certain environmental conditions.

It is true that the very definition of organizational closure implicitly assumes a constitutive relationship between organism and environment, but it is not explained how this constitutive relationship between the conditions offered by the environment and the requirements for the self-maintenance of the biological organization are possible. In the best of cases, the organism-environment interaction is presented in terms of constraints: the organism acts in a cohesive and closed way on its environment to constrain it, that is, to exert an effect on the environmental conditions that serves to make possible the conditions of existence of the organization. However, the organizational formulations do not specify how this constraining interaction takes place (which allows the organism to face and transform its environment). By focusing mainly on the notion of organization as an explanatory principle, the environment is presented simply as an enabling element of organization to which one must "channel" and which remains outside the explanatory focus.

Of course, the closure of constraints is an essential biological property and implicitly entails the assumption of an active relationship between the organism and the environment, but the theoretical characterization of this relationship requires more conceptual tools. Some authors, such as Di Paolo (2005) present the organism/environment relationship in terms of "sense-making", a constitutive capacity that organisms demonstrate to evaluate their environment in terms of its potential implication for their self-maintenance. In this line, other authors have pointed out that organisms are capable of an adaptive plasticity and of regulating themselves by compensating the regulations of their environmental conditions (Barandiaran and Egbert 2014, Bich et al. 2016)2. However, while the standard organizational formulations assume a definitional distinction between "boundary conditions" and "internal constraints", we argue that the notion of affordance and the situated approach presented in this paper is a promising starting point to understand why some elements of the environment become part of the closure of constraints, moving from being "external elements" to part of the "organizational closure".

III. 2. Organizational affordances

The hypothesis that we defend here and that we think it is worth exploring is that it is possible to complement the theoretical perspective of the

[2] These views have a lot of aspects in common with West-Eberhard's developmental plasticity approach (2003).

organizational approach with the theoretical and methodological framework of ecological psychology. In particular, the notion of affordance can serve as a central theoretical tool for understanding the interactive nature of the organizational processes of biological beings. This alliance is mutually beneficial. On the one hand, ecological psychology can benefit from the organizational approach to functions as this approach shows what the functional role of affordances is. Indeed, it provides a new biological basis for nesting psychological processes in biological ones, making justice to Chemero's (2009) claim that ecological psychology is a branch of biology. On the other hand, the organizational approach can use all the methodological resources of ecological psychology (in particular, the ideas of affordance and ecological information) to make sense of how the organism couples with the environment. This expands the organizational approach to the notion of biological function.

More specifically, the mutually beneficial combination of ecological psychology and the organizational account of functions can be summarized in three main points: (1) it develops the idea of organizational function towards an openness to the environment, which overcomes the traditional criticism to the excessive emphasis on organismal agency (see, for example, Swenson 1992); (2) it substantiates the idea that the main unit of analysis is the organism-environment system, because 'system' means the functional organization that emerges from the history of mutual interactions between organism and environment (see section III.3); (3) the very idea of organization includes an etiological component, as there is cross-generational inheritance, both genetic and non-genetic, which allows the offspring to be adapted to the environment thanks to this situated organizational account. The organizational contribution of the environment facilitates adaptation of the offspring thanks to non-genetic ecological inheritances: some authors claimed that non-genetic ecological inheritances extend to affordances, as they play a contribution in the adaptation of the organism because they show the offspring in which sense they have to be related to the environment.

There have been previous attempts within the ecological approach to establish a connection with organizational approaches to the life sciences, at least timidly. In particular, the so-called Connecticut School (Heft and Richardson 2013) had a strong inclination towards biophysics and organizational approaches. This relation with organizational approaches can be traced back to Gibson's writings, in particular, when he wrote that "[t]he rules that govern behavior are not like the laws enforced by an authority or decisions made by a commander; behavior is regular without being regulated. The question is how this can be (Gibson, 1979/1986, p. 225)." As we can read, Gibson himself in the late 1970s pointed to the issue that there are lawful relations between organism and environment that have to do with regulation and organization.

He understood this organization as systematic and self-organized ('regular without being regulated'). He also knew that this proposal could easily be understood in systemic and organizational terms: "What psychology needs is the kind of thinking that is beginning to be attempted in what is loosely called systems theory (Gibson, 1979/1986, p. 2)." As we all know, this systems theory relies on an organizational perspective of how different elements or items are organized according to different lawful relations. In this sense, the idea of behaviour as regular without being externally regulated means that behaviour is regular or self-regulated in relation to the environment, establishing a unit of analysis (what in ecological psychology is called the organism-environment system). In this sense, some authors within the Connecticut School followed this path and found the organizational approach to the living as the most sophisticated nexus between life and mind. For example, Michael Turvey wrote the following on the connection between organizational approaches and ecological psychology:

The appeal of examining self-organizing systems is the possibility of finding unifying principles common to psychology, biology and physics (…). The identification of such principles would encourage a synergy of the aforementioned sciences—a synergy, ideally, with the conceptual power needed to pick up the gauntlet thrown down by Gibson's ecological approach to perception and action (Turvey 2008: 243).

Given this, someone could ask what's new in our proposal. Well, whereas there have been attempts to reunite organizational approaches and ecological psychology, our particular way of doing so is to shape that articulation through the organizational account of functions and through affordances. Originally formulated in the field of ecological psychology, the notion of affordance refers to the possibilities for acting that the environment offers the organism, that is, the practical meaning that, in relation to a specific agent, an element of the environment has. Thus, in the encounter between a human and a chair, the chair can be used as a seat. As we can see, these possibilities of acting of the environment are so with respect to bodily dimensions, capacities, and abilities of organisms: organisms with opposable thumbs that can grasp things will perceive certain objects of the environment as graspable (and those who do not have opposable thumbs won't), whereas organisms with wings will perceive certain spaces or locations as flyable (and those without wings won't). As noted, biological organizations require a specific interrelationship with the environment to ensure their functions, and this relationship can be understood in terms of affordances. In fact, the very notion of interrelationship with the environment through affordances is functional from an organizational point of view: the capacity of organisms to perceive possibilities for action in their environment is a contribution to the closure of constraints in their organization. Thanks to the detection of

affordances, elements of the environment become intrinsic parts of biological organizations.

Walsh (2015) has proposed to situate the evolutionary perspective using the notion of affordance to incorporate ecological and interactive aspects in the explanation of evolution. Similarly, the organizational framework must also be situated, incorporating the notion of affordance to explain the interactive dynamics of biological organizations. It is necessary to develop a broader vision that does not interpret organizations in a way that is abstracted from their real, biological context. A situated organizational approach shows that, through their relationship with the environment and the possibilities it offers, organisms are active agents for their own constitution. The notion of organization as a closure of constraints is an explanatory principle to address the concrete ways in which this interaction takes place.

This proposal can be implemented taking the developments that have been recently presented in cognitive and computer sciences, especially regarding the connection between behaviour and metabolism. The organizational perspective to functions has been applied to understand the connection between metabolism and behaviour in what has been called 'behavioral metabolution' (Egbert et al. 2012). This proposal aims "to show how a coupling between metabolism and behavior can affect evolutionary dynamics" and it is supported with a model that "demonstrates how changes to metabolic pathways can lead to improvement of behavioral strategies, and conversely, how behavior can contribute to the exploration and fixation of new metabolic pathways" (Ibid.). The model provided by the authors reproduced Escherichia coli chemotaxis behaviour, including changes in metabolism that affected their behaviour, and vice versa. In this sense, they offered a model in which behaviour and metabolism affected each other, something that, according to the authors, has been reported in in vivo bacteria experimentation (Egbert et al. 2012: 3). Their model and these in vivo studies show that there is a metabolism-based chemotaxis in which the inhibition of metabolism directly affects the bacteria's capacity for chemotaxis, something that emphasized the bacteria's behaviour dependence on their metabolic processes (energetic needs, etc.), which means that behaviour and evolution cannot be understood separately if we want to have a rich picture of bacteria behaviour (Ibid.). In their model, they replicate these studies showing that flagellar rotation is dependent upon the concentration of a metabolite, precluding the bacterium to behave chemotactically when the concentration is very low, hence showing this metabolism-dependence. But there is also affection regarding how environmental conditions affect metabolic processes. The authors claim that "when metabolic dynamics are directly coupled to behavior, a number of adaptive phenomena become evident that otherwise pass unnoticed" (Egbert et al. 2012: 5), something that has several unexpected

consequences, like the following: organisms adapt to other environmental conditions that might influence metabolism (such as temperature) and, in turn, their metabolic changes due to behavioural alterations cause an integration of both endogenous and exogenous information that feed back to each other. Thus, the view that departs from the connection between metabolism and behaviour is more explanatorily rich for both metabolism and behaviour than studying both approaches separately. In fact, the authors claim that thanks to this coupling, behaviour can open new metabolic pathways and that changes in metabolism can lead to more efficient behavioural strategies (Egbert et al. 2012: 25). In this sense, the metabolism-behavior coupling is fruitful in both directions.

Our proposal connects with this view: since bacteria's behaviour in these examples is explained attending to the coupling between metabolism and movement, it would not be strange to expand the metabolism-behaviour coupling to other systems and elements that could also play a substantial role in the understanding of behaviour and development. It has been claimed recently that evolutionary and developmental processes are guided by different kinds of genetic or acquired information (Scott-Phillips et al., 2014: 1234), and some authors have proposed that ecological information (this is, information for affordances) are a more than plausible candidate to be part of those kinds of information (Heras-Escribano, 2020). As we can see in the example of chemotaxis, the coupling between metabolism and behaviour illuminates both the functioning of behaviour and metabolism. Why not, then, including affordances and ecological information in the picture so as to enrich the metabolism-behavior coupling? In such view, and following the rationale of the authors, affordances could affect metabolism dynamics and changes in metabolism could affect the perception and taking of affordances. But why restricting this coupling to metabolism? An environmental property like affordances could be coupled to different subpersonal systems, like the metabolic one, or maybe the immune system. Since affordances are so decisive for behaviour, it is expectable that their perception and taking could alter metabolic routes or immunological dynamics in the organism, but also the other way round. And what about the relation between the metabolic system, the immune system, and behaviour? Metabolism has also been described as a driver of immunity (Pearce, 2021). If so, we cannot find conceptual restrictions to explore the connections and mutual affections of affordances and our subpersonal systems, and also the interrelations among them (or even to explore the connections empirically, through computational dynamics or with in vivo experimental setups). This invites us to think of a situated organizational approach to functions in which the organization of the functional system extends to beyond-the-skin environmental conditions, just like it happened with the well-documented cases that inspired and established the behavioural metabolution framework. And this leads us to another aspect

that is quite important for organizational approaches: their normative character.

III. 3. Affordances and biological normativity

There has been an intricate debate on the normativity of affordances (Chemero 2009, Heras-Escribano & Pinedo 2016, Heras-Escribano 2019, 2020b, 2020c; Raja and Chemero 2020). As we have seen, Chemero (2009) equates the functional character of affordances with their normative character. In contrast, Heras-Escribano (2019, 2020b, 2020c) proposes not to use the label "normativity" to refer to functionality. He argues that the socially-established, conventional nature of social practices should not be conflated with the law-based, functional aspect of scientifically-described nomological regularities. The prescriptive force of both approaches is not identical. Social normativity has prescriptive force for social reasons and nomological explanations acquire their prescriptive force for other-than-social reasons - as happens with natural selection, for example. Although we accept that there is a conceptual distinction between these two kinds of prescriptive force (the social and the non-social one), here we will use the term 'normativity' as related to the nomological prescriptive force of different processes and mechanisms found in the realm of the life sciences –and we will make use of Canguilhem's approach to justify this move.

Understanding how biological organizations are implemented in environments with certain properties is something that has important theoretical and practical implications. From an organizational point of view, functions are normative. An organizational function is a condition for the existence of an organizational regime. If a dysfunction occurs, organisms may in some cases survive and continue to be self-sustaining, but the organizational closure to which this function was a contribution ceases to exist. In the best case scenario (e.g., an animal unable to see) the organism instances a different self-maintaining organizational regime. In any case, these authors that organizational functions are normative in the sense that they establish a norm for the behavior of all traits with respect to a given organizational closure.

An animal whose organization needs food must be able to perceive certain aspects of its environment as edible. This idea is not particularly controversial. In fact, there is a traditional and widespread assumption that life requires the imposition of rules. In the words of Canguilhem:

Life is indeed a normative activity. The normative, in philosophy, includes any judgment that evaluates or qualifies a fact in relation to a norm, but this type of judgment is essentially subordinated to what the norms establish. The normative, in the broadest sense of the word, is what establishes the rules.

And it is in this sense that we speak of biological normativity (Canguilhem, 2015, our emphasis).

We claim that this is very relevant to understand the functionality of the capacity of organisms to perceive affordances in their environment and to interact with their environments as normative terms –understanding the word "in the broadest sense", to follow Canguilhem's suggestion. The way in which organisms perceive possibilities in the world is can be understood as normative because it is a necessary condition for an organizational closure that requires this interaction. In other words, to preserve their self-maintenance, organisms must be able to perceive affordances in the environment. This means being able to differentiate between "right" and "wrong" interactions with the world, taking them as 'functional' or 'disfunctional'. The action of organisms is thus structured with respect to affordances, as it was proposed by Reed's idea of action systems (1982, 1996). Living beings establish with their environment a functional relationship in which the contribution or threat to the self-maintenance of the biological organization is the criterion that ultimately serves to judge the possibilities offered by the world. An animal needs to distinguish whether another animal affords partnership or competitiveness. Affordances can therefore be seen as properties that are established in a relational way, just as, from a situated approach, self-maintenance must also be seen as a relational property:

The persistence or cessation of processes that are far from equilibrium makes a causal difference to the world. It is a normative property, in the sense that such a contribution can be positive or negative, adequate or inadequate, and it is also a relational property (Bickhard 1993).

This functional characterization of affordances in organizational terms can be aligned with Chemero's interpretation of affordances as normative (in the sense of functional) relationships. For Chemero, affordances are "relationships between skills and the properties of the environment" (Chemero 2009: 145). The concept of affordance is what allows us to connect our abilities, that is, the properties of our organic organization, with the properties of the external environment. This relationship can only be functional and normative, because it is a condition of possibility of the organism-environment system, which is, for ecological psychology and for ecological approach to the cognitive sciences that Chemero defends, the basic unit of analysis. We will explain in a little more detail what this organism-environment system consists of in the following section.

III. 4. The organism-environment system

One of the great contributions of ecological psychology is to understand that the object of analysis of cognitive science cannot be only the nervous system, or the organism, or its environment, but the integration of all of them, or what is called the organism-environment system. Through their self-determined activity and the conformation of their affordances, the organisms are active agents of change in their environment and the environment is, at the same time, an active "agent" of change in the organization of the organisms. The organism and the environment are co-constituted (Gibson 1979/2015, Richardson et al. 2008).

The organizational account of functions is highly suitable to be related to affordances because it illuminates what ecological psychologists refer to when they use the expression 'organism-environment system'. This concept is key in ecological psychology, and it has been often defined as the right unit of study of cognition. Nevertheless, there is no formal definition of how that unit is constituted as such. We propose that the organizational approach to functions can explain in which sense the organism and the environment form a unit or system. It is a system because there is a history of interactions between organism and environment that shape the relation between them. This history of interactions gives rise to functional relations. Random interactions become functional relations as those mutual interactions contribute to the stability of both the organism and the environment; and that contribution, when is beneficial is often repeated, and when is repeated it supports both the organism and the environment at the same time. Thus, when there are many functional relations between organisms and particular aspects of their environments, when can see how this gives rise to an upper-level system, the organism-environment system, which is the set of functional relations between an organism and its environment. In this sense, we can see how this produces a system of nested functionalities: an organism-environment system is a system of unit that is shaped by a set of mutually beneficial relational functions. They are beneficial functions because they contribute to the stability of the organism-environment system, it perpetuates the system as such. And this unit that is formed from these functions is, at the same time, contributing to the stability of the relata of the function: both the organism and the environment. For example, a rabbit that hides in a particular location when escapes from predators perceive certain holes in the ground as pass-through-able to be hidden from the threat of the predators. Rabbits, then, use those holes as shelter and those holes allow them to survive and reproduce while avoiding the threat of predators. The organism-environment system of the rabbit and its environment is sustained thanks to the affordance of pass-through-ability that is perceived by the rabbit given the dimensions of the rabbit and the dimensions of the holes in the environment. Also, rabbits can

dig out other holes that will allow them to hide in different places. At the same time, the soil of that location will benefit from the presence of the rabbits by acquiring nutrients derived from the rabbits' feces. It is a mutually beneficial relation that endures over time.

This has consequences for adaptation and evolution. There are some authors who argued in favour of combining niche construction and ecological psychology (Withagen and Chemero 2009, Withagen and van Wermeskerken 2010, Heras-Escribano and Pinedo 2018, Heras-Escribano 2020). The reason is that affordances could be taken as non-genetic, ecological inheritances that are inherited in the ecosystem with the objects that possess them. The above mentioned example of the rabbits in their burrow can illustrate this: the offspring of the rabbits will find the holes created by their ancestors available to be used and then maximize their chances for survival. In this sense, we have seen how the organism-environment system, shaped by the functional character of affordances and the rabbits, contribute to the stability of the rabbits' ecosystem. This already includes an evolutionary character, as niche construction processes contribute to the adaptation of subsequent generations of rabbits, maintaining the mutually beneficial relations between them. As we can see, understanding affordances as having a functional role in organizational terms mean that they contribute to the organism-environment system, and that functional character endures with time thanks of being inserted within niche construction processes. In sum, (i) the organizational account of functions can illuminate the idea of an organism-environment system in ecological psychology because it is defined as a set of functional relations between the relata that allow for its own stability and the endurance of its elements. It forms a set of nested functions: affordances are functional because they contribute to the organization of the organism-environment system and also to the stability and organization of its parts. Also, it has consequences for evolution and adaptation because when this idea is combined with niche construction we can show how affordances maximize the chances of survival and reproduction for the offspring of the population. At the same time, the introduction of affordances within the organizational approach to functions allows us to expand the idea of the organizational closure and extend it beyond the frontiers of the organism, including the environment. Then, we should talk about the situated organizational approach.

For a situated organizational approach this means that the environment is part of the organization that allows us to explain the relational functions of the organism. The properties of the environment necessary for establishing an organizational closure are also part of the closure, as are the internal functional organic properties of the organism. It could be argued that these properties of the environment are not produced or maintained by the system,

thus violating condition C2 of the definition of organizational function but, in reality, the property of the environment that is necessary for organizational (and, therefore, functional) self-maintenance only emerges within the framework of the organism-environment system and is not independent of it. For example, the feature of "edible" (the affordance of edibility) only emerges when there is an interaction between an organism and an element of the environment. It is within the framework of an organization that includes both aspects of the organism and the environment - that is, the organization of the organism-environment system - that this property is "produced". Outside this organization of the organism-environment system there are no affordances and therefore there is nothing that is anything like "edible things" because, just like all affordances, these features of the organism-environment system are environmental aspects that are related to the organisms that can perceive them. In this sense, the affordances are produced and maintained by the organization to whose self-maintenance they contribute and, therefore, are functional. This means that there are perceptual processes and systems (the perception of affordances through different perceptual systems) that have a functional role that is similar to the rest of processes and systems inasmuch as they contribute to the organization of the system. Also, the introduction of affordances in the picture allows us to understand that the organizational structure of the living extends beyond the borders of the organism and include aspects of the environment that play an essential role for the establishment of particular functions and a contribution to the stability of the system.

This proposal has some antecedents in the literature. Recently, there have been some proposals to apply the organizational definition of function to ecological systems (Nunes-Neto et al. 2014) and even to social-ecological systems (Nunes-Neto et al. 2016). According to these proposals, a function in these case would be a contribution to the organizational closure of an ecological or social-ecological system that can be exercised by both organisms and environmental elements and can even have its origin in human activity. This work shows that it is possible to expand the organizational framework beyond individual organisms. From an organizational point of view, organisms, ecosystems and societies have functions and these are normative because they contribute to a closure of constraints. The organism-environment system of ecological psychology can be used to integrate all these different domains into a legitimate framework for functional organizational analysis, and it is also a promising strategy for theoretically grounding the biological functionality of cognitive phenomena, such as perception, or ecological phenomena, such as niche construction (see Heras-Escribano 2020a).

A trait is functional if it contributes to the organizational closure of the organism-environment system, but this closure can be achieved in very different ways. This has practical implications. For example, assuming that affordances have a functional role with respect to the way biological organizations are integrated into the world and that this integration can occur in very different ways is something that is beginning to have repercussions on the way psychologists and architects approach the design and use of residential spaces (Menatti and Casado 2017). It is also a potentially fruitful theoretical framework for the applied research in ecological psychology, where great advances in sensorial substitution have been achieved from an interpretation of the biological functionality based on the notion of affordance (Lobo et al. 2018, Lobo et al. 2014).

IV. Conclusion

This paper explores the plausibility of an integration of the theoretical frameworks of ecological psychology and the organizational approach to functions through the notion of affordance. The motivation for this integration is twofold: on the one hand, it helps to understand what are the biological foundations of the notion of affordance, specifically, what is the notion of biological function relevant to understanding how these are normatively implemented in the biological structures of organisms. On the other hand, this integration serves to develop the organizational approach and to "situate" it, i.e. to provide theoretical tools to understand how biological self-maintenance takes place in a normative interaction with the environment and in what way organism and environment are co-constituted.

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