

# No Function without Service: Selected Effects Functions, the Liberality Problem, and Whole Organisms

Antoine C. Dussault (orcid: 0000-0003-2164-1571)

## Abstract

Although an advantage commonly claimed for selected effects theories of function lies in their ability to eschew a problem of liberality that alternative theories allegedly face, they also face their own liberality problem. This problem is classically illustrated by Mark Bedau's case of clay crystals, which seem apt to undergo a kind of natural selection, and also, more recently, by Justine Kingsbury's example of rocks differentially persisting on a beach, discussed by Justin Garson in relation to his *generalized* selected effects theory. In this paper, I will be concerned with another type of case that illustrates this liberality problem: *whole organisms*. Although we may be reluctant to consider whole organisms as potential function bearers, they seem uncontestedly subject to a selection process (i.e. natural selection), such that selected effects theories seem *prima facie* committed to ascribing them functions. I will use the case of whole organisms to comparatively assess two influential responses to the liberality problem faced by selected effects theories: the *service response*, which introduces the requirement that selected effects functions result from selection for a contribution to a complexly organized system, and the *population response*, which restricts selected effects functions to effects that result from selection processes operating on populations of the appropriate type. I will argue that, although the latter response has been preferred in Garson and others' recent discussions of selected effects theories, the case of whole organisms shows the superiority of the former. Selected effects functions arise not from selection *simpliciter*, but from selection for service.

**Keywords:** function; selection; selected effects; etiological theory; Justin Garson; liberality problem

## 1 Introduction

The *selected effects* theory is among the most influential philosophical theories of function. In its classical formulation, it states that a function is an effect of a biological item that led to its being favoured by natural selection. It has been discussed and endorsed by many philosophers of

biology (e.g. Millikan [1989]; Brandon [1990], Chapter 5; Neander [1991]; Godfrey-Smith [1994]; see also Wright [1973]), and renewed interest in it has recently been sparked by Justin Garson's defence of a *generalized selected effects* theory, according to which functions may derive not just from natural selection, but from *any* selection process of differential reproduction or differential retention operating on a population of items (Garson [2016], Chapter 3, [2017], [2019], [2024]). An advantage commonly claimed for selected effects theories of function (both the classical theory and the generalized one) over their alternatives, such as the causal role, goal contribution, and organizational theories (e.g. Cummins [1975]; Boorse [1976]; Mossio *et al.* [2009]), pertains to their ability to eschew a problem of over-inclusiveness, or *liberality problem*, that these alternative theories are often thought to face. By restricting functions to effects of biological items that occur because they were favoured under past episodes of selection, selected effects theories avoid attributing functions to, for instance, components of purely physical systems (e.g. attributing to rocks in a river the function of widening the river delta), accidentally beneficial effects of biological items (e.g. attributing to the nose the function of holding glasses), or effects that seem dysfunctional (e.g. attributing to tumours the function of causing death) (see e.g. Wright [1973], p. 148; Neander [1991], p. 181; Kitcher [1993], p. 390).

Selected effects theories, however, also face their own liberality problem, classically illustrated by Mark Bedau's ([1991], pp. 651–4) case of clay crystals, which are able to replicate themselves and seem apt to undergo a kind of natural selection (see also Boorse [2002], p. 66). More recently, this problem has been illustrated by the example of rocks differentially persisting on a beach, introduced by Justine Kingsbury ([2008]) and discussed by Garson ([2016], p. 60, [2017], p. 535, [2019], pp. 102–3, [2024]) in relation to his *generalized* selected effects theory of function. Insofar as crystals and rocks undergo selection processes, selected effects theories seem (misguidedly) committed to ascribing them functions.

In this paper, I will be concerned with another type of case that illustrates the liberality problem faced by selected effects theories: *whole organisms*. Philosophers discussing function have usually been reluctant to consider whole organisms as potential function bearers (e.g. Godfrey-Smith [1994], p. 349; McLaughlin [2001], pp. 99–100; Nicholson [2013], p. 671; Huneman [2023], p. 98). Functions are paradigmatically ascribed to organisms' traits and parts, not to the organisms themselves. Garson himself, arguably the most influential current proponent

of selected effects theories, notes the seeming inapplicability of the concept of function to whole organisms (Garson [2019], p. 155, [2022], p. 3). Whole organisms, however, seem uncontestedly subject to selection processes and, in particular, not the least of them: natural selection. The case of whole organisms is thus important in that it constitutes a paradigmatic type of item subject to selection processes, and one that involves an outstandingly large array of instances (rather than involving some rare and peculiar cases that may seem easily dismissed). It is also interesting in that it constitutes a *biotic* illustration of the liberality problem, in contrast to clay crystals and rocks, which, as *abiotic* illustrations, may be thought to fall outside of the scope of theories of function from the outset simply on the grounds that functional concepts belong to the living realm (for discussions of this potential response to the liberality problem as illustrated by crystals and rocks, see Garson 2016, 53; 2022, 9–10).<sup>1</sup>

I will use the case of whole organisms to comparatively assess two solutions that have been proposed by proponents of selected effects and related theories in response to the liberality problem: the *service response*, which introduces the requirement that selected effects functions result from selection for a contribution to a complexly organized system (Price [2001], sec. 2.2; Wakefield [2005], pp. 884–5; see also Godfrey-Smith [1994], pp. 347–50; Huneman [2023], sec. 8.4), and the *population response*, which restricts selected effects functions to effects that result from selection processes operating on populations of the appropriate type (Garson [2016], pp. 54–5, 58–61, [2017], sec. 5, [2019], sec. 6.3–6.4, [2022], sec. 3, [2024]; Schulte [2021]). I will argue that, although the latter response has been preferred in Garson and others' recent

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<sup>1</sup> Another type of case commonly brought up as an illustration of the liberality problem and which, like organisms, pertains to the living realm, are selfish genetic elements like transposable DNA elements in an organism's genome and segregation distorter genes. These elements seem subject to natural selection, but achieve nothing that seems functional for the organism that carries them (and in some cases have deleterious effects). In fact, the service response to the liberality problem that I will support in this paper was initially introduced in order to deal with such cases (see Godfrey-Smith [1994], pp. 348–9). I will not discuss those cases in detail here, though I think the essential points I will bring up with respect to organisms also apply to them. In line with what is argued in Godfrey-Smith ([1994], pp. 347–50; see also Huneman [2023], sec. 8.3–8.4), I think that selfish genetic elements have no function with respect to their carrier organism because they (or their traits) are not selected for contributions to the fitness of that organism (for other discussions of selfish genetic elements, see e.g. Manning [1997], sec. 4; Lewens [2004], sec. 6.2; Elliott *et al.* [2014]; Garson [2016], pp. 44–5, [2022]).

discussions of selected effects theories (e.g. Schulte [2021]), the case of whole organisms shows the superiority of the former. Whole organisms, as well as abiotic items like clay crystals and rocks, do not bear selected effects functions (except in particular contexts about which I will say more below) because their selected features are not selected for contributions that they make to some complexly organized system.

I should emphasize that, in this discussion, I will be concerned with selected effects functions with no presumption that selected effects theories provide *the* correct account of functions capable of capturing *all* uses of the concept of function that occur in biology. Nowadays, most proponents of selected effects theories adopt a pluralistic approach to functions, which admits the possibility of function ascriptions that are more aptly captured by alternative theories like the causal role theory or the contribution to fitness theory (e.g. Millikan [1989]; Godfrey-Smith [1993]; Brandon [2013]; Garson [2018]). Hence, although my focus will be on the conditions for the existence of *selected effects functions*—that is, functions whose (purported) existence hinges on the occurrence of some selection process—my background assumption is that these functions most likely form just a subset of functions in general.

My discussion will be organized as follows. In section 2, I will provide more details about the liberality problem faced by selected effects theories (and the most prominent abiotic illustrations of this problem, clay crystals and rocks), and about the two above-mentioned attempted responses to it: the service and population responses. In section 3, I will discuss the case of whole organisms and argue that the service response fares much better than the population response with respect to this case. I will also say more about why and in what sense a satisfactory theory of function should be able to exclude whole organisms. In section 4, I will bring up additional considerations in favour of the service response and discuss a possible worry arising from potential cases of abiotic items selected for contributions to complexly organized systems (which this response seems unable to exclude). In section 5, I will summarize my claims and main arguments.

## 2 The Liberality Problem: Two Solutions

As mentioned above, the classical example used to illustrate the liberality problem posed by selected effects theories is Bedau's ([1991], pp. 651–4) case of clay crystals.<sup>2</sup> Clay crystals have the remarkable capacity to promote their own growth. Crystals immersed in a saturated solution of silicic acid seed new layers of crystals similar to themselves. Moreover, they seem to fulfil the standard conditions for natural selection (Lewontin [1970]; Godfrey-Smith [2009]). *Variation*: new layers of crystals are sometimes slightly different from those from which they are seeded. *Differential fitness*: these differences may positively or negatively affect the rate at which they seed new layers of crystal and/or cleave. *Heritability*: as they grow, the crystals eventually cleave and produce new crystals similar to themselves, which also grow and eventually cleave again. Crystals thus seem to undergo a process akin to natural selection, in which crystals with enhanced abilities to seed new crystals and cleave differentially proliferate. By virtue of this, selected effects theories seem committed to ascribing to crystals the function of seeding new crystals, an implication that makes these theories look too liberal.

More recently, Garson has discussed another abiotic case, taken up from Kingsbury ([2008], p. 496), which illustrates the liberality problem posed by selected effects theories: rocks on beaches (Garson [2016], p. 60, [2017], p. 535, [2019], pp. 102–3, [2022], p. 7, [2024], sec. 3). This case more strictly concerns his own *generalized* selected effects theory, since it involves a process of differential *retention* rather than one in which, like in the crystals' case, something like reproduction occurs. Rocks on a beach that differ from each other in their degrees of hardness undergo a kind of selection process: harder rocks are less subject to erosion than softer ones such that the former differentially persist.<sup>3</sup> By virtue of this, the generalized selected effects theory of function seems committed to ascribing rocks the function of withstanding erosion, an implication that makes it look too liberal.

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<sup>2</sup> Bedau takes this example from A. G. Cairns-Smith ([1982]).

<sup>3</sup> Along similar lines, Tim Lewens ([2004], pp. 92, 128) discusses the phenomenon of the 'longshore drift', in which small pebbles tend to accumulate at one end of a beach and larger pebbles tend to accumulate at the other. A similar example brought up by Leigh Van Valen ([1989], p. 2) involves selection among constituents of granite (mainly feldspars and quartz), which differ in their hardness.

A first influential solution to the liberality problem, *the service response*, consists in incorporating a service criterion to selected effects theories (Price [2001], sec. 2.2; Wakefield [2005], pp. 884–5; see also Godfrey-Smith [1994], pp. 347–50; Huneman [2023], sec. 8.4). The term ‘service’ comes from Carolyn Price ([2001], pp. 35–6), who first applied this response to the clay crystals case (see also Price [1995]).<sup>4</sup> Her core idea is that functions arise only through processes of ‘*preservation through service*’, and hence not through the kind of stand-alone processes of self-replication that crystals achieve (Price [2001], p. 36, italics in the original). While this is not exactly how Price formulated it, I submit that the service response is best understood as introducing the requirement that function-bearing items have been selected for a contribution they make to a complexly organized system to which they are related (see Dussault [2023], sec. 10.3).<sup>5</sup> For instance, hearts have the function of pumping blood because, by pumping

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<sup>4</sup> I should note that Price’s own theory of function more strictly aligns with what David Buller ([1998]) labelled the ‘weak etiological theory’ of function than with selected effects theories (see Price [2001], p. 40n8). Nevertheless, the liberality problem illustrated by clay crystals and rocks also applies to her view, and her ‘service’ solution to it also looks promising for selected effects theories (see Garson [2016], pp. 45, 54).

<sup>5</sup> Price’s ([2001], pp. 35–6) own proposal was that an item may bear a function only if its replication is achieved via a contribution it makes to another system. As she recognizes, however, this looks insufficiently restrictive since a crystal layer seems, in a sense, to meet this requirement: it contributes to the formation of a second-next layer of crystal via its contribution to the formation of a next layer (which may seem to count as ‘another system’) (see Price [2001], pp. 38–9; on this point, see also Garson [2016], p. 54). A similar proposal is made by Peter Godfrey-Smith ([1994], pp. 347–50) in relation to selfish genetic elements (e.g. selfish DNA), a case also often brought out to illustrate the liberality problem faced by selected effects theories (see footnote 1, above). Godfrey-Smith ([1994], p. 349) proposes to consider an item to possibly bear a function only if it is part of a ‘larger biologically real system’ and is selected for a contribution it makes to that larger system. Price’s and Godfrey-Smith’s proposals differ in that according to the former, function-bearing items may contribute to *any* other system, whereas according to the latter, such items must contribute to a biologically real system of which they are a part (see Garson [2016], p. 45). Although Godfrey-Smith’s formulation more aptly excludes clay crystals and rocks since neither are part of ‘biologically real systems’, this formulation seems too restrictive with respect to structures like nests and burrows that organisms build in their environment and which may be considered as their *extended phenotypes* (Dawkins [2004]). Godfrey-Smith’s restriction of selected effects functions to *parts* of containing systems entails that such structures have no functions, while it seems natural to ascribe them functions (see Griffiths [1993], p. 416). Moreover, Godfrey-Smith’s reference to a biologically real system remains vague. Thus, Antoine Dussault ([2023], p. 145) proposes the above formulation of the service criterion, according to which an item may have a selected

blood, they contribute to the differential survival and reproduction of organisms that have hearts, and this is how they promote the production of new instances of them. In contrast, clay crystals promote their own recurrence directly, by seeding new crystals, rather than by contributing to a complexly organized system, and this is why seeding new crystals cannot be seen as their function. The service response can also be used with respect to rocks. Rocks differentially persist on a beach in a stand-alone manner, by being more or less erodible than each other, rather than by contributing to a complexly organized system, and this is why resistance to erosion cannot be seen as their function.

As Godfrey-Smith ([1994], p. 349) notes, the incorporation of a service requirement into selected effects theories simply brings to the fore an aspect that was already present in classical formulations of these theories (see also Wakefield [2005], p. 885). It lines up with Robert Brandon's ([1990], p. 188) requirement that a function-bearing item increases the 'relative adaptedness of [its] possessor', with Karen Neander's ([1991], p. 174) characterization of an item's proper function as 'that which items of [its] type did to contribute to the inclusive fitness' of ancestors of the organism that carries it, and with Paul Griffiths's ([1993], p. 412) statement that '[t]he proper functions of a trait are those effects of the trait which were components of the fitness of ancestors'. Although in these and the above examples, the reference systems for functions are organisms, it seems prudent to leave open the possibility of functions related to other types of systems (e.g. colonies, social systems, ecosystems), whence the above broad linkage of functions to *complexly organized systems*. For the purpose of the present discussion, what such systems exactly consist of need not be fully and definitely specified. As I am inclined to see it, these would be systems composed of functionally differentiated parts whose combined activities are what enables them to persist. But the matter does not have to be settled here. What the service response entails is that a fully articulated theory of function would need to come with a principled account of what a complexly organized system is.

Although the service criterion provides an elegant explanation of why clay crystals and rocks do not bear function, Garson and some other recent proponents of selected effects theories

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effects function if it is selected for a contribution it makes to a complexly organized system, irrespective of whether it is a *part* of that system.

(e.g. Schulte [2021]) have seemed to prefer another line of response: *the population response*, which consists in incorporating a population criterion into selected effects theories. The population criterion states that differential reproduction or retention confer functions on items only when (or to the extent that) they occur among entities that belong to *populations* of the appropriate type. Garson fleshes out requirements for appropriate populations by drawing on philosophical discussions of the concept of population (Godfrey-Smith [2009], sec. 3.3; Millstein [2009]; Matthewson [2015]).<sup>6</sup> He has progressively refined these requirements in the course of developing his generalized selected effects theory of function and of responding to criticism (Garson [2016], pp. 54–5, [2017], sec. 5, [2019], sec. 6.3, [2022], pp. 11–3, [2024]), his most recent take being that a population is a ‘collection of individuals, of the same type, that impact one another’s persistence, survival, or reproduction prospects by virtue of the fact that, by using some common resources, they impact each other’s ability to use those same resources’ (Garson [2024], p. 964, see also [2022], p. 13).<sup>7</sup> Hence, abiotic items like clay crystals that differentially proliferate and rocks that differentially erode do not bear selected effects functions because they fail to meet at least one of the conditions contained in this characterization of populations. Clay crystals, one may argue, fail to sufficiently impact one another’s differential proliferation, and this is why they do not bear selected effects functions (Garson [2016], p. 54, [2022], p. 11).<sup>8</sup> Rocks differentially eroding do not affect one another’s access to resources, and this is why they do not bear selected effects functions (Garson [2022], pp. 12–3, [2024], pp. 963–4).

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<sup>6</sup> Garson initially considered the population criterion to be applicable either in a *categorical* or in a *graduated* manner (the latter being in line with Godfrey-Smith, Millstein and Matthewson’s notion that sets of items can meet their requirements for populations to a lesser or greater degree) (Garson [2017], p. 538). On the categorical interpretation, sets of items would either *have or not have* functions and would do so according to *whether* they form populations of appropriate type. On the graduated interpretation, they would *more or less have functions* and would do so according to *the degree to which* they form populations of appropriate type. In his more recent publications, Garson embraces the graduated interpretation (Garson [2019], pp. 107–8, [2024], p. 957; see also Matthewson [2020]). To simplify formulations, I speak below in categorical terms, since, in a large enough number of instances (if not most ones), organisms will meet the population criterion to a high degree.

<sup>7</sup> For some of the criticism and Garson’s discussion of it, see Brandon Conley ([2020]), Peter Schulte ([2021]), Pierrick Bourrat ([2021]), and Garson ([2024], sec. 4). For some further criticism, see Dussault ([2023], sec. 10.2).

<sup>8</sup> Garson ([2016], p. 55), however, considers a version of the crystal case where crystals that *do* affect one another’s proliferation, and is willing to accept that in such circumstances, the crystals would bear functions.



Both responses seem *prima facie* able to exclude abiotic items like clay crystals and rocks from the class of function bearers (though I will say more on this in sect. 4).<sup>9</sup> According to Garson, an attractive feature of the population response is that it adds nothing substantial to selected effects theories. The reference to populations is inherent to them, insofar as the notion of selection (on the standard understanding) carries with it that of populations (Garson [2019], p. 104, [2024], p. 957). Although this might be an advantage of the population response, the next section will show that this response fares less well with respect to an important type of case: whole organisms.

### 3 Whole Organisms as Selected Effects Function Bearers?

Philosophers discussing function have usually been reluctant to consider whole organisms as candidate function bearers (e.g. Godfrey-Smith [1994], p. 349; McLaughlin [2001], pp. 99–100; Nicholson [2013], p. 671; Huneman [2023], p. 98). Functions are paradigmatically ascribed to organisms' traits and parts, not to organisms themselves. The conventional view is thus that organisms themselves, as opposed to their traits and parts, are functionless. Garson himself notes the seeming inapplicability of the concept of function to whole organisms:

People and other organisms have goals, but they do not have functions (Garson [2016], p. 18).

Organisms are not mechanisms for eating, or reproducing, or defecating because organisms, as wholes, don't have functions. Their parts or features have functions. My heart has the function of pumping blood, so it's a mechanism for pumping blood, but since I don't have a function, I'm not a mechanism for anything (Garson [2019], p. 155).

[W]e can ask about the function of the zebra's stripes, the function of the goblin shark's snout, the function of the silverfish's wiggling movement. But we don't talk about the functions of *zebras*, the functions of *silverfish*, the functions of *goblin sharks* (Garson [2022], p. 3, italics in the original).

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<sup>9</sup> At least two other responses have been attempted. First, Ruth Millikan ([1993], p. 39n7) simply bites the bullet and accepts that crystals might bear a function after all. Below, I will give reasons why crystals (and rocks) should not be thought to bear functions (except in some particular circumstances). Second, Bedau ([1991]) argues that they indicate a necessary linkage between functions and values: organisms' traits and parts can bear functions because organisms have a good of their own, which crystals lack. Few philosophers have been willing to accept this response. For criticisms, see e.g. Price ([2001], p. 35), Christopher Boorse ([2002], sec. 1.4), Garson ([2016], pp. 53–4), and Dussault ([2023], p. 132n4).

Their eventual failure to exclude whole organisms from the class of function bearers would therefore seem to be an Achilles heel of selected effects theories.

Whole organisms, however, seem uncontestedly subject to selection processes, and in particular, not the least of them: natural selection. The standard conditions for natural selection spelt out above—variation, differential fitness, heritability (Lewontin [1970]; Godfrey-Smith [2009])—paradigmatically apply to organisms. Indeed, it is by observing that they fulfil such conditions that Darwin was led to recognize the existence in nature of a process suitably dubbed ‘selection’. The natural selection of organismal traits and parts (to which functions are paradigmatically ascribed) occurs through the selection of the organisms that evince them. Whole organisms, moreover, seem recalcitrant to the population response in that they seem to meet Garson’s requirements for populations (see sect. 2). They in fact seem bound to do so to the extent that they are subject to natural selection. Populations of organisms that are subject to natural selection are indeed collections of individuals of the same type: they belong to the same species, Garson’s paradigm of being of the same type (see Garson [2022], pp. 11–2). And to the extent that this is required by the concept of natural selection (though see comments on this assumption below in sect. 4), they impact one another’s prospects for persistence, survival, or reproduction through using common resources and mutually impacting one other’s ability to use these resources. In any case, it would seem ill-advised for a selected effects theory to disqualify natural selection as a process from which items may acquire function, and this seems to be precisely what a version of the population response capable of excluding whole organisms from the class of function bearers would have to do. The population response thus seems bound to be helpless with respect to whole organisms.<sup>10</sup>

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<sup>10</sup> A proponent of Dawkins’s ([1976]) ‘gene’s-eye view’ of evolution would likely want to qualify to some of the points just made about organisms being subject to natural selection. On that view, selection operates on genes, not on organisms. The population criterion could therefore eschew having to assign selected effects functions to organisms simply by virtue of the (alleged) fact that they are not subject to selection. The gene’s-eye view of evolution, however, has been extensively criticized, and a widespread stance among philosophers of biology is that the opposition between selection at the level of genes and selection at the level of organisms is at best a false dilemma, in that the two types of entity play distinct and complementary roles in the evolutionary process (see e.g. Hull [1980]; Brandon [1988]; Lloyd [2001]). Moreover, even if organisms turned out not to be subject to *natural*

In contrast, the service response straightforwardly excludes whole organisms from the class of selected effects function bearers. Just like clay crystals and rocks (to the extent that they undergo selection processes), whole organisms are ordinarily subject to natural selection in a stand-alone manner. They face natural selection directly, by being *themselves* the items that differentially survive and/or reproduce in response to selection pressures, rather than indirectly, via contributions to complexly organized systems. This is so in all instances of the usual case where natural selection operates at the level of the organisms themselves rather than at supra-organismic levels—e.g. when it operates on whole social insect colonies or on multi-species communities or ecosystems (I will return to these cases below). In other words, in ordinary circumstances, whole organisms are not selected through what Price ([2001]) calls a process of ‘preservation through service’ (see sect. 2), such that the service response straightforwardly excludes them. Hence, the service response fares better than the population response with respect to whole organisms.

Although this upshot at first glance provides strong support to the service response, possible complications arise from the fact that not all discussants of function have in fact been convinced that whole organisms are functionless, and that there seem to be contexts in which ascribing functions to whole organisms makes sense. Tim Lewens, for instance, is willing to consider cheetahs as having the function to hunt large mammals provided that natural selection has favoured this ability among them (Lewens [2004], p. 126). Likewise, Roberta Millstein ([2020], pp. 1113–4) argues that coevolution can lead organisms of two interacting species (e.g. prey and predators) to acquire selected effects functions with respect to each other. Along similar lines, Ruth Millikan ([1984], p. 39) speaks of an amoeba as having the ‘relational proper function to flow in a direction determined by [...] the chemical variations in the water around it’. Should we really assume whole organisms to be functionless?

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selection, Garson’s generalized selected effects theory leaves open possibility that they bear functions by virtue of being subject to another relevant selection process. The population response would hence still face the challenge of providing an account of population that excludes organisms while including their traits and parts among selected effects function bearers. I thank Brandon Conley for drawing my attention to the nuances a ‘gene’s-eye view’ would call for.

Some remarks Garson ([2022], pp. 8–9) makes as to why a theory of function should avoid ascribing functions to abiotic items like clay crystals and rocks give us, I think, some useful initial insight into how to tackle this question. He notes that, although it is fine to some degree for a philosophical account of a concept to have revisionary consequences—i.e. to have implications that compel us to change our understanding of that concept—it should not be *too revisionary*. When a philosophical account becomes too revisionary, it starts to look like an account of a different concept. As Garson states, it looks like its proponents have ‘changed the topic of the conversation’ and have shifted to a different (though possibly also legitimate) concept from the one we were assuming them to be talking about (Garson [2022], p. 8). As a rough guideline, Garson suggests that such ‘changes in topic’ occur when a proposed account does not ‘respect paradigm cases’. Accordingly, he suggests that a theory of function should aim to ‘respect paradigm cases of things that do, and things that do not, have functions’ (Garson [2022], p. 8). According to this guideline, a theory that ascribes functions to abiotic items like crystals and rocks seems to involve a change in topic, and this is why, he contends, selected effects theories of function should seek to exclude them.

The same verdict seems at first glance to apply to whole organisms. Organisms (in contrast to their traits and parts) are not paradigmatic function bearers, any more than abiotic items like clay crystals and rocks. In usual parlance, whole organisms might have goals, they may be more or less adapted to their environment, or be in more or less healthy states, but they do not, strictly speaking, bear functions (see e.g. Garson [2016], p. 18, [2022], p. 3; Huneman [2023], p. 98). In many instances, when one uses the term ‘function’ in reference to whole organisms, it is thus likely that they have ‘changed the topic of the conversation’ and are using ‘function’ in a sense that differs from the usual sense, or at least the sense on which philosophical discussions on functions have been focused.

I suggest that the ‘change in topic’ is one from the concept that typically applies to organisms’ traits and parts (on which philosophical discussions of function have been focused) to the concept of ‘function’ typically involved in the structure/function or form/function distinction (on this concept and its contrast with the notion philosophers of biology have been focusing on, see Wouters [2003], sec. 2.1; Gayon [2023], sec. 7.1). This concept, which is common in biology but has scarcely been examined by philosophers of biology, draws a contrast between, on the one

hand, what an item does or is capable of doing and, on the other hand, what it is made of, how it is built, and what it looks like (Wouters [2003], p. 636). As Arno Wouters ([2003], p. 636) suggests, this concept may be labelled ‘function as activity’. On this reading, ‘selected effects functions’ of whole organisms would mean ‘selected effects activities’ of whole organisms—activities that natural selection has shaped them to perform—rather than ‘selected effects functions’ in the usual sense of ‘function’ that applies to organisms’ parts and traits. Hence, I suggest, a statement like Lewens’s ([2004], p. 126) that cheetahs have the selected effects function to hunt large mammals is better understood as being about function-as-activity, meaning something like ‘hunting mammals is an activity that cheetahs have been selected to perform’, than as attributing a function to the cheetah in the same sense that is involved when functions are attributed to organisms’ parts and traits.

The linkage of ‘function’ to ‘service’ established by the service response may help further clarify the nature of the change in topic that occurs when ‘functions’ are ascribed to whole organisms. I submit that ‘function’ in a statement like ‘cheetahs have the selected effects function to hunt large mammals’ (i.e. about function-as-activity) differs from the usual concept of function that applies to organisms’ parts and traits precisely in that it involves no service provided to a complexly organized system (e.g. that the cheetah’s hunting would provide to such a system in which cheetahs participate). Hunting large mammals is just stated to be something that cheetahs do for their own survival and reproduction, as a result of having been shaped by natural selection for doing so. It differs from ‘function’ as used in statements about organisms’ parts and traits, such as for instance ‘the black tear marks on a cheetah’s face serve to deflect the sun’s glare from its eyes’,<sup>11</sup> which refer to how an item is serviceable to the organism that carries it. Hence, a possible explanation for why it has seemed obvious to most philosophers of biology, but not to all of them (e.g. Lewens, Millstein, and possibly Millikan), that whole organisms are functionless, is that the two groups of philosophers have been using ‘function’ in different senses. The former group has been assuming a notion of ‘function’ that contains the idea of a

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<sup>11</sup> On the presumed function of those marks, see Meredith Hanel ([2020]).

service that a trait or part provides to the biological entity that carries it, while the latter group has been assuming the notion of function as activity.<sup>12</sup>

The linkage of ‘function’ to ‘service’ also helps single out contexts in which, at partial variance with what I called above the conventional view, it *does* make sense to ascribe functions to whole organisms *with no change in topic*. Strictly speaking, the service response does not entirely close off the possibility that whole organisms bear functions. Rather, it implies that whole organisms may bear functions only in relation to contributions they make to some complexly organized system. This singles out possible contexts in which whole organisms might legitimately be considered to bear functions. As I highlighted, the service response excludes whole organisms from the selected effects theory in all instances of the usual case where natural selection operates at the level of the organisms themselves rather than at supra-organismic levels. This leaves open the possibility of unusual cases where natural selection operates on higher-level systems to which some organisms belong and, in so doing, confers selected effects functions on these organisms. In particular, whole organisms may acquire selected effects functions by being selected for contributions they make to some colony or ecological system in which they are involved. This aligns with the fact that ascriptions of functions to whole organisms seem relevant for studies of insect colonies (see Mitchell [2003], Chapter 2; Gayon [2023], sec. 7.2.2), and for functional branches of ecology, as reflected in the growing philosophical literature on the concept of ecological function (see e.g. Odenbaugh [2010]; Nunes-Neto *et al.* [2014]; Dussault

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<sup>12</sup> It might be remarked that, when linked to selection, the *function-as-activity* concept may retain a central aspect that proponents of selected effects theories attach to functions. Selected effects theories are commonly claimed to capture functions’ (putative) teleological dimension. Insofar as effects that occur because they were selected are in a sense ones that occur because they have useful consequences, selected effects functions seem to allow for teleological explanations of their bearers. Selected effects *activities*, insofar as they share this aspect with selected effects functions in the usual sense (which I claim involve service), might be teleological in just the same way as the latter. Service would hence be necessary for an item to bear a function (in the usual sense), but not for its being teleological, and selection per se would be sufficient for an item to be teleological. A corollary of this would be that whole organisms, insofar as they are subject to selection processes, are teleological (or goal-directed) entities (in line with the above remark that whole organisms might have *goals* rather than *functions*). Hence, in the function-as-activity sense, cheetahs’ selected effect ‘function’ of hunting large mammals may still be conceived as teleological (i.e. as an activity they achieve purposefully) by virtue of its being a selected effect.

and Bouchard [2017]; Lean [2020]; Millstein [2020]; Morrow [2023]). In ecology, functions are commonly ascribed to organisms (or populations of organisms) based on their contributions to some life-sustaining ecological process, such as when plants are ascribed the functional role of primary production in ecosystems, or bees and other insects are ascribed the functional role of pollinating plants. Notably, these functional roles involve services provided by the function-bearing organisms to other organisms or their ecosystems.<sup>13</sup>

Hence, I contend that the service response lines up with the spirit of the conventional view of whole organisms as functionless, while at the same time bringing an important nuance to this view. It lines up with this view by implying that whole organisms cannot bear functions (except in the ‘function as activity’ sense) in a standalone manner, that is, independently of any service they may provide to other systems. But it brings nuance to the view by implying that whole organisms may bear selected effects functions in contexts where they are subject to selection processes operating on complexly organized systems to which they are related (and hence are affected by these processes in a way similar to how their traits and parts are affected by selection processes operating at the organism level). My suggestion is that, when endorsing the

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<sup>13</sup> I must, however, point out that the above remarks on the consistency of the service response with the use of the concept of function in ecology do not, in and of themselves, establish that selected effects theories of function can suitably account for the use of ‘function’ in ecology. To establish the latter, one would need to show that the ‘functions’ identified by ecologists can, on a general basis, be adequately related to some selection processes, and it is at best an open question whether they can. In philosophical discussions of functions in ecology, there is a near-consensus view that selected effects theories are ill-suited to account for the use of ‘function’ in ecology (see e.g. Nunes-Neto *et al.* [2014], p. 124; Dussault [2022], pp. 172–3), and that this use more closely aligns with alternatives theories, such as the causal role, the organizational, or the contribution to fitness theories (Cummins [1975]; Bigelow and Pargetter [1987]; Mossio *et al.* [2009]; see, respectively, e.g. Odenbaugh [2010]; Nunes-Neto *et al.* [2014]; Dussault and Bouchard [2017]). By broadening the class of selection processes from which items may acquire selected effects functions, Garson’s generalized selected effects theory may possibly break this consensus, but this possibility would have to be explored in detail before it could be countenanced. Hence, I emphasize that my above point regarding the service response’s consistency with the use of ‘function’ in ecology does not amount to a claim that ecological functions are, as a matter of fact, selected effects functions. I remain neutral with respect to that claim here. For a challenge to the near-consensus view, see Millstein ([2020]), and see Dussault ([2022]) for a response. On the applicability of Garson’s generalized selected effects theory to ecology, and whether it raises a challenge for the near-consensus view, see Dussault and Bouchard ([Forthcoming]).

conventional view, philosophers of biology have, implicitly or explicitly, been considering whole organisms in abstraction from their possible contributions to the functioning of some complexly organized system. They have been considering whether they can bear functions in a standalone manner. It is when considered as such that whole organisms most obviously appear to be functionless. But when they are considered in relation to complexly organized systems (e.g. colonies or ecosystems) to which their activities contribute, the idea that they might bear functions looks much more natural (see Gayon [2023], p. 90). Hence, I contend that the service response lines up with a well weighed-up interpretation of the conventional view.

Interestingly, Garson hints at a view along these lines when commenting on the possibility for whole organisms to bear functions:

The only exception to this rule [that organisms themselves do not have functions] is when we think about organisms as parts of ecosystems; in that case, it makes perfect sense to say that organisms have functions. ... For example, a mountain lion population can be thought of as a mechanism for reducing deer populations because that's its function in that ecosystem (Garson [2019], p. 155).

If we do give functions to whole organism, we usually are thinking of the whole organism as a part of a larger system ('what's the function of the goblin shark in the marine ecosystem?') (Garson [2022], p. 3).

And more broadly, he at times seems sympathetic to the idea that functions require service, noting for instance that we usually do not ascribe functions to 'a self-contained entity—an uncontained container' (Garson [2016], p. 18), or that '[f]unctions are, paradigmatically, functions of *parts*' (Garson [2022], p. 3). In the next section, I will argue that, once we adopt the service response, it is unclear what conceptual work is left to be achieved by a population criterion of the kind introduced by the population response.

#### **4 Is Service Sufficiently Restrictive?**

I argued in the previous section that the population response is unable to exclude whole organisms from the class of selected effects function bearers, while the service response is straightforwardly able to do so, except for cases where ascribing functions to whole organisms looks legitimate. We have also seen in section 2 that the service response deals successfully with abiotic cases like clay crystals and rocks. Overall, the service response thus seems to do a better job than the population response in dealing with the liberality problem faced by selected effects



theories, and there seems to be no conceptual work left to be achieved by Garson's population criterion.

This might be seen as a happy result. Recent discussions of the population response have shown that it is remarkably difficult to define 'population' in a way that reliably excludes abiotic cases like clay crystals and rocks. As critics have remarked, successive refinements of this response intended to deal with further modified versions of the clay crystals and rocks cases—which have led to the version of the population criterion I presented above (sect. 2)—have begun to look increasingly ad hoc (see Bourrat [2021], sec. 3). Originally, this criterion stated that a set of entities forms a population in the appropriate sense to the extent that the entities interact and affect one another's fitness. Garson then specified the criterion (drawing on Matthewson [2015]) by requiring that the members of a bona fide population achieve fitness-relevant interactions with a large number of the members of their putative population, not just with a few of them (Garson [2016], p. 61, [2017], pp. 537–8, [2019], sec. 6.4). At this point, Garson's requirements for populations were still based on independently-motivated accounts of populations (i.e. ones based on requirements for natural selection, e.g. Godfrey-Smith [2009], sec. 3.3; Millstein [2009]; Matthewson [2015]), and so could still arguably escape the charge of being ad hoc (though see discussion in Bourrat [2021], pp. 64–5).<sup>14</sup> More recently, however, Garson introduced (drawing on Schulte [2021]) the further restriction that the fitness-relevant interactions from which selected effects functions arise must be ones that pertain to access to resources and ones that occur among individuals of the same type (Garson [2022], pp. 9–13, [2024], p. 964). This resource-restricted version of the population criterion seems exclusively motivated by the aim of dealing with some modified versions of the rocks case. In this respect, it looks rather ad hoc (besides being unable to deal with still further modified versions of the crystals and rocks cases where something like competition for resources occurs, see Dussault [2023], pp. 141–2).<sup>15</sup>

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<sup>14</sup> Recently, in response to Bourrat, Garson introduced an additional justification for these requirements which pertains to selected effects theories' realist take on functions (see Garson [2024], p. 962, see also, p. 953-954, and [2022], p. 13).

<sup>15</sup> See also Gunnar Babcock's ([2023], secs 5–6) discussion of the rocks case and of mineral evolution.

The resource-restricted criterion in fact seems arbitrary in light of the very line of reasoning Garson deploys in support of his generalized selected effects theory. He notes that what makes the classical selected effects theory (which restricts functions to products of natural selection) appealing is its ability to make sense of three core features that functions are often thought to have: functions differ from *accidents* (conditioning air, not holding glasses, is the nose's function), functions are *explanatory* (we have hearts in part because hearts pump blood), and functions are *normative* (digesting food is something stomachs are *supposed to* do). He then argues that, since putative functions based on selection processes other than natural selection may also have those core features, the restriction of functions to products of natural selection is arbitrary, such that the generalized selected effects theory should be preferred over the classical selected effects theory. By virtue of this reasoning, Garson's restriction of fitness-relevant interactions to those that pertain to access to resources seems illegitimate. This reasoning commits one to accept as bona fide selected effects functions any effect that has the three core features above, and selection processes that do *not* pertain to access to resources seem capable of generating functions that have them. Consider, for instance, a group of plants of the same species distributed across a landscape far enough from each other to have no impact on one another's access to resources. An individual plant's use of some nutrient (or its niche constructive effects that make some nutrients more easily available to it) does not make the nutrients more or less available to the other individual plants. The plants, however, are all consumed by the same species of herbivore and have varying abilities to deter these herbivores—say, they produce different concentrations of tannins, which serve as a chemical defence. In such a case, there will be selection occurring on the group of plants, although, by hypothesis, they do not affect one another's access to resources. And it seems that as a result, the tannins' ability to deter herbivores will have the three above core features attached to selected effects functions: it will be a non-accidental effect of the tannins, it will explain why the plants produce the tannins, and it will make it sound to say that deterring herbivores is what the tannins are *supposed to* do. Hence, a requirement for populations that excludes such cases arising from non-resource-related selection processes would seem arbitrary by Garson's own lights.<sup>16</sup>

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<sup>16</sup> It might be objected that, in my plant-herbivore example, the plants are *indirectly* impacting one another's access to resources, since an individual plant that successfully deters herbivores increases the chances that another

This tannin example also indicates that the resource-restricted version of the population criterion is at risk of excluding some (putative) functions resulting from natural selection. The selection process that the plants undergo in the above setup seems to be *natural* selection. Although they do not compete (or cooperate) for resources, the plants meet the above-mentioned conditions for natural selection: they differ from one another as to their tannin concentration, this confers different fitness values on them, and tannin concentrations are typically heritable traits in plants. Cases of non-resource-related selection seem likely to be common in nature. Hence, the resource-restricted version of the population criterion creates the strange result that some naturally selected traits will not bear functions.<sup>17</sup> It thus looks overly restrictive.

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individual plant will be consumed, and the consumed plant will be less able to consume resources as a result of having some of its tissues removed. If we adopt this interpretation, however, I submit that it will be difficult to imagine a case where some individuals undergo fitness-affecting interactions that do not pertain to access to resources. Since any organism sustains its existence by consuming resources, any interaction that leads an organism to fare more or less well will ultimately be one that affects its access to resources. Abiotic items like clay crystals and rocks will then, at last, turn out to be excluded from selected effects theories simply because they do not share this feature with organisms. The population response will then fall into an instance of the response that excludes clay crystals and rocks simply by virtue of the fact that they are not alive, a response Garson rejects (for discussions of this potential response to the liberality problem as illustrated by crystals and rocks, see Garson 2016, 53; 2022, 9–10).

<sup>17</sup> I might emphasize that my plant-herbivore example differs from Richard Lewontin's ([1970], p. 1) well-known example of two strains of bacteria differentially multiplying in a test tube with abundant resources, which he controversially regards as an instance of natural selection. Of course, if Lewontin's two strains of bacteria are assumed not to interact in any way with each other (i.e. neither with regards to resources nor in any other way), we may hesitate to consider their differential proliferation as exhibiting natural selection. Saying that there is natural selection in this case would seem equivalent to saying that there is natural selection between members of two herds of reindeer, one located in Sweden, the other in Canada, if the members of the former have a higher reproductive rate (Lewens [2010], p. 831). However, my above plant-herbivore example differs from such cases in being a case in which there *are* fitness-affecting interactions among the individuals involved, albeit ones that do not pertain to access to resources. Commenting on Lewontin's case, Garson ([2022], p. 13n11) maintains that it does not matter for his purposes whether his criteria for 'population' align with those of biologists. My plant-herbivore example illustrates, however, that it *does* matter, at least indirectly, to the extent that the notion of 'population' at issue is the one that determines what sets of entities can undergo natural selection, and unless one welcomes the possibility that a 'selected effects' function theory excludes some traits whose presence results (in part) from natural selection.

The sufficiency of the service response for dealing with the abiotic cases is hence good news inasmuch as it entails that, should abiotic items like clay crystals and rocks turn out, in some circumstances, to form populations in the sense required by selected effects theories (either the classical selected effects theory that applies only to differentially reproducing items or Garson's generalized theory, which applies also to differentially persisting items), they would still fall short of bearing selected effects functions. They would do so by virtue of the fact that they face selection (either natural selection or a generalized selection process) in a stand-alone manner rather than via contributions to complexly organized systems. In other words, the sufficiency of the service response for dealing with abiotic cases relieves proponents of selected effects theories from the necessity—generated by the population response—of devising increasingly refined (or convolutedly restrictive) requirements for populations capable of dealing with further variants of these cases.

This, I must emphasize, does not in itself make the concept of population wholly irrelevant to selected effects functions. To the extent that, as Garson ([2019], p. 104, [2024], p. 957) remarks, selected effects theories link functions to selection, and selection processes are processes that operate on populations (at least on standard understandings), the concept of population will remain central to any theory of function that fits the 'selected effects' label.<sup>18</sup> My point, then, is not to entirely dismiss the concept of population as a component of selected effects theories, but rather to argue that this concept is of little help when it comes to dealing with the liberality problem, and that, in any case, there is no real need for it to be able to fulfil this task.

It might be queried, however, whether the service response is really able to deal with *all* reasonably possible versions of the abiotic cases illustrating the liberality problem. Let us revisit a version of the clay crystal case described by Richard Dawkins, in which the crystals promote their own replication by damming up streams (Dawkins [1986], pp. 154–6; see also Bedau [1991], p. 653). Let us imagine that the ponds that this creates harbour complex ecosystems, and

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<sup>18</sup> I should note that the standard linkage between natural selection and populations has been challenged (e.g. Bouchard [2011], [2014]), such that the possibility of selected effects functions without populations is not entirely closed. Bouchard, however, links his discussions of natural selection not to selected effects functions, but to evolutionary forward-looking functions of the type advocated by John Bigelow and Robert Pargetter ([1987]; see Bouchard [2013]; Dussault and Bouchard [2017]).

that crystals with different patterns give rise to ecosystems with different species compositions, which differentially persist and, in so doing, differentially affect the crystals' proliferation (say, because they harbour bacteria that convert silicon to silicic acid more or less efficiently, and/or algae that draw more or less silicic acid from the water).<sup>19</sup> In such a case, we seem to have selection of crystals for contributions to complexly organized systems: the ecosystems that form in the ponds. Does this imply that, in such a case, the crystals have the selected effects function of creating ponds that harbour particular types of ecosystems? Likewise, let us imagine rocks that harbour different microorganism communities that differentially persist and, in so doing, differentially affect the rocks' rates of erosion (say, because of how they modify the surrounding soils' pH).<sup>20</sup> In such a case, we seem to have selection of rocks for contributions to complexly organized systems: the microorganism communities that they harbour. Does this imply that, in such a case, the rocks have the selected effects function of giving rise to particular types of microorganism communities?

It looks like, in circumstances such as these, the service response will entail that abiotic items like clay crystals and rocks bear selected effects functions. However, I submit that this need not be regarded as a problem, for the same reason that, as I argued above (see sect. 3), organisms selected for contributions they make to colonies or ecosystems can non-problematically be considered to bear selected effects functions. Philosophers discussing ecological function have tended to consider abiotic items as legitimate function bearers (see Odenbaugh [2010], p. 251; Dussault and Bouchard [2017], pp. 1134–6; El-Hani *et al.* [2024], sec. 13.6).<sup>21</sup> They have even considered that an appropriate account of ecological functions should ascribe functions to abiotic components of ecosystems (at least in some circumstances), and that selected effects theories' seeming inability to do so is unfortunate since it limits their

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<sup>19</sup> This ecosystem variation on the clay crystal case is inspired from Michael Rea ([2002], pp. 123–4), who however focuses on Larry Wright's ([1973]) etiological theory of function rather than on its selected-effects variant specifically.

<sup>20</sup> This example is inspired by Bouchard ([2013], pp. 91–2). For interesting empirical background on variations in rocks' associated microbial communities and on the possible effects of microorganisms on rock erosion, see, respectively, Yong-Hoe Choe *et al.* ([2021]) and Bastien Wild *et al.* ([2022]).

<sup>21</sup> On the legitimacy of ascribing functions (and teleology) to abiotic items, see also Babcock ([2023]).

applicability to ecology. Hence, that the service criterion commits selected effects theories to ascribing functions to abiotic items (in some circumstances) may turn out to be an advantage conferred on them by the service response rather than a drawback.

The service response thus remains adequate even with respect to cases of abiotic items that meet the service criterion. It turns out that, for those items as for whole organisms, an adequate solution to the liberality problem is one that spells out a condition under which they may bear selected effects functions rather than one that denies them functions altogether.<sup>22</sup>

## 5 Conclusion

Above, I discussed the liberality problem faced by selected effects theories of function in relation to an important type of case that illustrates this problem: whole organisms. I argued that whole organisms indicate the superiority of the *service response* to this problem over the *population response* preferred in Garson and others' recent discussions of selected effects theories. While it may be considered an unsettled matter whether the latter response can succeed with respect to the abiotic cases, this response seems bound to be ineffective with respect to whole organisms. Insofar as whole organisms are subject to natural selection, they seem guaranteed to meet any plausible version of Garson's requirements for populations undergoing selection processes from which functions may arise, such that appeals to the concept of population seem helpless in their case. In contrast, the requirement that function-bearing items be selected for contributions they make to complexly organized systems straightforwardly excludes

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<sup>22</sup> As an anonymous reviewer pointed out, absent a complete specification of what a complexly organized system consists of, the service response leaves some indeterminacy as to which items should or should not be considered as function bearers, especially in the case of abiotic items. As the reviewer suggests, we can imagine a case where some crystals or rocks have differentiated parts that collectively contribute to their ability to persist and/or reproduce (e.g. some rocks contain some mineral elements that increase their robustness). If this leads the crystals and rocks to differentially persist or reproduce, the service response may imply that *their parts* have selected effects functions. Whether this is so will depend on how the notion of complexly organized system is spelt out. As I said, I will not settle this question here. But I might remark that, as Garson does for the population response, one could adopt a graduated view according to which the more complex a system is, the more function-bearing its parts would be. Hence, parts of crystals or rocks that are functionally differentiated to a low degree might bear functions to a low degree.

whole organisms from selected effects theories, except for circumstances where ascribing them functions makes sense (i.e. when they are considered as function bearers in relation to some complexly organized system such as social colonies or ecological systems). Moreover, the service response fares at least as well as does the population response with respect to abiotic cases like clay crystals and rocks (although, like for organisms, it admits the possibility for them to bear functions in relation to complexly organized systems).

I remarked above that the incorporation of a service requirement into selected effects theories simply brings to the fore an aspect that was already present in classical formulations of these theories (Godfrey-Smith [1994], p. 349; Wakefield [2005], p. 885). The points brought up in the above discussion indicate that this service requirement ought to remain central to these theories, be they restricted to natural selection as they have classically been, or generalized to a broader class of selection processes as Garson proposes. To the extent that functions are tied to selection, they should be tied not just to selection *simpliciter*, but to selection for service.

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*Collège Lionel-Groulx*

*100, rue Duquet,*

*Sainte-Thérèse, Québec, Canada, J7E 3G6*

*Centre interuniversitaire de recherche sur la science et la technologie (CIRST)*

*1205, rue Saint-Denis*

*Montréal, Québec, Canada, H2X 3R9*

*antoine.cdussault@clg.qc.ca*

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