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What’s at Stake in the Debate over Naturalizing Teleology? An Overlooked Metatheoretical Debate

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# 1. Introduction

There is perhaps no concept in the biological sciences more controversial than that of teleology. To rely on teleological language without clarification is perhaps the biologist’s prerogative, but philosophers, being never afraid to go where scientists fear to tread, have made the question of teleology a central project in philosophy of science. In the relatively early days of philosophy of biology as a modern discipline, this question was debated primarily in terms of biological functions. The aim was to make sense of such statements as ‘the heart is for pumping blood’ (Beckner 1969; Ayala 1970; Wright 1973; Garson 2016). More recently, however, developments in complex systems science and perceived shortcomings in the dominant Modern Evolutionary Synthesis paradigm in biology have inspired within philosophy of biology a renaissance of organism-centered accounts of teleology. On this organism-centered view, teleology is not restricted to biological functions but understood as the intrinsic goal-directedness of whole organisms insofar as they are agents that act on their own behalf. While this is a bold new vision for the organism, it is such a radical departure from scientific orthodoxy that it remains marginal in the scientific community.

Today there are a number of proposals for what an organism-centered account of teleology might look like (e.g., Thompson 2007; Di Paolo 2005; Deacon 2011; Walsh 2015; Mossio and Bich 2017). Though there are some important continuities between these approaches, there are sufficient differences that one might wonder if these accounts may be compatible or in conflict (Deacon and Cashman 2013; Fulda 2017; García-Valdecasas 2021; Gambarotto and Mossio 2022). This matter has been complicated by recent attempts to show how such accounts might be useful to biologists, which have underscored pragmatic considerations about the operationalization of teleology as a concept (Lee and McShea 2020; Cusimano and Sterner 2020; see also Sultan, Moczek, and Walsh 2021). There are, therefore, both methodological and substantive disagreements about naturalizing teleology.

In our view, such disagreements conceal a more fundamental problem, namely, an ambiguity about the aims of such a project. At a first pass, the idea of naturalized teleology is that we can talk about organismal goals, needs, and purposes without invoking specters of vital forces or anything problematically occult; and one might therefore assume that the naturalization of teleology is a singular problem with a single set of criteria for its successful advancement. On closer inspection, however, it becomes clear that the very idea of naturalized teleology is ambiguously situated between a wide variety of problems which range from the strictly scientific to the metaphysical. In our view, this ambiguity causes unnecessary confusion and hinders productive debate. We contend that this can only be remedied by a clarification of metatheoretical considerations concerning the nature and scope of the questions one takes oneself to be answering, and the criteria by which one might be deemed successful.

In this paper, we shall focus on two questions concerning teleology and clarify in what sense they should be considered relatively autonomous: 1) do we need an account of teleology as part and parcel of a theory of the organism for biology, which might bridge explanatory gaps in scientific research left by the dominance of the reductionist, gene-centric modern evolutionary synthesis paradigm? 2) What role might a teleological conception of organisms have in the philosophical debate about naturalism, particularly the possibility for finding a place for mind in nature? The relative autonomy of these questions suggests that one might need different accounts of teleology to answer each of them satisfactorily. Moreover, recognizing the multifacetedness of the teleology debate shows us why accounts that might otherwise seem to be in conflict are in fact compatible. We therefore argue that closer attention to such metatheoretical considerations is essential for advancing or even dissolving current debates.

Our argument proceeds as follows: we shall first give an overview of the contemporary landscape of organismic teleology (§2). While it is tempting to give such an overview by categorizing scholars and their accounts of teleology by the kinds of questions that they seem to be answering, we do not deem this to be an optimal strategy.[[3]](#footnote-3) Instead, we distinguish two questions which may call for a naturalistic account of teleology (3.1 and 3.2), in order to clarify how these impose different constraints on any account of teleology one might bring to bear on these problems (§3.3). Having established that the debate over naturalizing teleology ought to be governed by more than one set of criteria, we show how this insight may advance a recurring debate in the literature about how to demarcate the broad class of complex dynamical systems from genuinely teleological systems. As we see it, the outcome of these disputes ought to depend on the scientific (§4.1) and philosophical (§4.2) criteria introduced in the preceding section. We conclude that further work comparing different approaches to naturalizing organism-level teleology will benefit from making explicit differing metatheoretical orientations.

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# 2. The Contemporary Landscape of Organismic Teleology

A useful way to approach contemporary accounts of teleology is in terms of those that focus first and foremost on the *organizational* principles underlying the phenomenon in question, and those that focus on conceptualizing the specific kinds of *behavior* of such systems. Accounts which focus on organizational principles usually take inspiration from 20th century developments in cybernetics (Rosenblueth, Wiener, and Bigelow 1943; Ashby 1960; Maturana and Varela 1980), the sciences of complex systems (Pattee 1977; Prigogine and Stengers 1984; Kauffman 1993), theoretical biology (Rosen 1985), and other movements in biophilosophy (Jonas 2001). A key area of convergence has been on the idea that goal-directedness is expressed most fundamentally in the act of self-maintenance: the fact that some highly organized systems actively prevent their own dissolution and therefore can be said to have survival as their goal. Behavioral approaches, in contrast, conceptualize teleology from the outset as a specific kind of relationship between agents and their environments.

**2.1 Organizational Approaches**

As Erwin Schrödinger famously argued in his 1943 lectures entitled *What is Life?*, the fact organisms are capable of locally resisting the tendency toward increasing entropy cries out for explanation (Schrödinger 1992). This question had long been recognized as being closely tied to other questions about the existence of goal-directedness in nature. Immanuel Kant, for instance, presciently argued that organisms are fundamentally different than machines in virtue of the fact that they are “self-organized beings”; intrinsically teleological systems organized such that each part is cause and effect of another (Kant 2000; see also Gambarotto and Mossio 2022). Though several 20th century scholars have attempted to formalize the notion of self-production and self-maintenance in terms of circular causality (e.g., Rosen 1985), it has been partly thanks to the work of Stuart Kauffman, among others, that recent work has been able to clarify the precise organizational requirements for such a system in thermodynamic terms (Kauffman 2000).

Building on the work on Atkins (1984), Kauffman clearly laid out the relationship between organization and the capacity to do work via the concept of constraints. Constraints channel the spontaneous flow of energy to do useful work. In a cannon, for example, the energy released from the explosion of gunpowder is channeled by the walls of the cylinder to launch the cannonball (Kauffman 2000, 98–100). The same principles apply to the way the energy stored in gasoline is harnessed by a car engine. This illustrates that organization, in the form of constraints, is a precondition for doing work. But work is also required for the generation and maintenance of constraints which will otherwise spontaneously degrade. For machines, this work is provided externally by human labor.

Living beings, in contrast, have the capacity to channel energy back into their own organization so that it is self-regenerated over time. According to the so-called Organizational Approach (OA), self-maintenance is achieved via the channeling of energy by a constraint to produce and/or maintain another constraint, and so on in a circular fashion; what the authors call “closure of constraints” (Montévil and Mossio 2015). However, a system that realizes closure of constraints is also necessarily *open* to energy from its environment that it harnesses to maintain organizational closure. The system is therefore simultaneously *open* to the flow of matter and energy and *closed* in terms of its constraints. In so doing it achieves self-individuation and self-maintenance as a property of the whole system, and can be considered legitimately teleological insofar as its activity aims at its own continuation over time. Closure of constraints also provides the general framework for thinking about how such systems might include specific constraints that have the function of regulating exchanges with the environment. This provides the theoretical foundation for understanding several key biological concepts, including *function*. A function, in this view, is any part of the system that contributes to the maintenance of the whole.

A broadly similar account has been proposed by Terrence Deacon, who has put particular emphasis on the need to demarcate simple so called far-from-equilibrium dissipative systems, such as candle flames and whirlpools, from living systems.[[4]](#footnote-4) The need for this distinction emerges from the fact that far-from-equilibrium dissipative systems *appear* to be self-maintaining, or at least capable of withstanding disturbance from their environment. Deacon argues that such systems are not veritably teleological because the system does not have a coherent, unified structure that plays a causal role in maintaining itself. In other words, it is purely the product of environmental conditions, and does not maintain itself due to intrinsically generated work (see also: Bich 2012; Mossio and Bich 2017). For Deacon, the crucial emergent transition occurs only in the coupling of two (or more) dissipative systems that mutually support each other by preventing their mutual dissolution, a transition which Deacon dubs “morphodynamics” to “teleodynamics” (Deacon 2011). As a kind of proof of concept, Deacon proposes a model system he calls the “autogen” that instantiates the teleodynamic properties in their most basic form (Deacon, Srivastava, and Bacigalupi 2014).[[5]](#footnote-5) And like the Organizational Approach, Deacon seeks to elaborate more complex forms of goal-directedness and how those might successively emerge over the course of evolutionary time, while putting a stronger emphasis on there being a fundamental continuity (though not an identity) between life and mind.[[6]](#footnote-6)

Unlike Mossio and colleagues, however, Deacon argues that the autogen also instantiates the minimal conditions for the process of interpretation, namely, the process by which a physical pattern can have significance for an interpreting system, or self, which in this case is the autogen (Deacon 2015; 2021). This is because Deacon deems the question of the origin of teleology as being closely tied to the question concerning the origin of meaning: how it is that a pattern can come to be *about* something *for* an interpreting system. And because meaning is not an inherent property of a thing or pattern, the issue is really about the interpretive *process* by which a pattern in the world comes to be interpreted as carrying some meaning (ibid). This highlights the distinctively biosemiotic angle to Deacon’s approach which, as we shall show in the next section, makes his account particularly relevant for answering certain kinds of questions. And whether there is a veritable difference between Deacon’s conception of teleology and the Organizational Approach, or simply a semantic matter, is also a question which we will argue requires metatheoretical considerations (§4).

**2.2 Behavioral Approaches**

We now turn to a second broad category of approaches to naturalizing teleology, which focus primarily on the behavior of living systems and their relationship to the environment. As one example, Walsh explicitly motivates his account of the basis of perceived shortcomings in a gene-centric conception of evolution, which has given us an incorrect picture of the metaphysics of organisms and evolution. For Walsh, organisms are *agents*, which he defines using several concepts including “goal, means, affordance, repertoire, salience, reciprocal constitution, normative requirement, hypothetical necessity” (Walsh 2018, 274). Walsh singles three of these as being particularly relevant for understanding agency: goal-directedness, repertoire, and affordances. These concepts are inter-defined in the sense that a goal-directed system will encounter features in its environment that are conducive to its goals or not. These features of the environment therefore afford different actions depending on the system’s goals. Action is the product of the way the system can bias its behavioral repertoire in response to the affordances in its environment (see Walsh 2015, ch. 8-10, for further details). Agency, on this view, “is the gross behavioral capacity of an organism to bias its repertoire in response to what its conditions afford for attaining its goals.” (Fulda 2017, 84).

In contrast to the organizational schools, this ecological approach does not seek to ground the foregoing concepts in a formal account of a specific kind of organization. Rather, it provides a theory of the organism and evolution in terms of the coarse-grained behavior of a system in its environment (Walsh 2015, 210; Fulda 2017, 72).[[7]](#footnote-7) This approach puts emphasis on the concept of agency as an *explanans*, which can answer the “why” questions, rather than the organizational schools that treat teleology as an *explanandum* to “how” questions. As Walsh sees it, mechanistic explanations play a distinct, complementary role alongside teleological explanations: the former answer how questions, while the latter answer why questions (Walsh 2015, 199). These answers tell us different things, and neither requires the other to be a complete explanation.

Finally, another interesting behavioral approach to teleology that has some similarities to Walsh’s has been proposed by Dan McShea (McShea 2012; Lee and McShea 2020).[[8]](#footnote-8) According to his ‘field theory’, goal-directed behavior is typified by two features: persistence and plasticity. Persistence is a measure of “how much more likely, on average, an entity is to move toward the goal, rather than away from it, compared to chance alone, following a perturbation” (Lee and McShea 2020, 5) whereas plasticity is a measure of “the degree to which, on average, an increase in starting distance from the goal increases trajectory length” (ibid). Goal-directed behavior is a combination of persistence and plasticity and comes in degrees. Goals, in this view, are defined in terms of features of an environmental field encompassing the goal-directed system. Specifically, a field “is the set of external conditions that allows the entity to behave in a goal-directed manner, persistently and plastically.” (ibid, 3). In the case of a bacterium swimming toward sugar, for instance, the field is the chemical concentration of the sugar in its environment. On this view, it is the field, rather than the organizational structure of the bacterium, that explains the teleological behavior of the bacterium.

# 3. Two Perspectives on the Relevance of Biological Teleology Today

We have shown that one could naturalize teleology in more than one way. But it is also the case that one might seek to naturalize teleology for different reasons. And if the very project of naturalizing teleology can be motivated by more than one kind of metatheoretical orientation, then it is likely that different issues require different things from a naturalistic account of teleology. It is by no means obvious that a single account will be able to fulfill all these roles.

The different kinds of motivations for naturalizing teleology can be illustrated by the difference between contemporary debates about evolutionary theory and debates about the scope and content of philosophical naturalism. In both contexts, there are compelling reasons why one might support (or reject) an organism-centered conception of naturalized teleology. Thus, contemporary debates in theoretical biology about the limits of the Modern Evolutionary Synthesis (MES) have opened the door to rethinking the place of teleology as a fundamental feature of organisms insofar as it might advance biology (§3.1). Concurrently, we shall show that the philosophical debate about the limits of “scientific naturalism” and the prospects for “liberal naturalism” takes on a distinct orientation in light of naturalized teleology (§3.2). By showing that naturalized teleology can belong to one more than one kind of debate, we aim in section 4 to establish that closer attention to the metatheoretical stakes in the debate can resolve and dissolve recurring debates in the literature.

## 3.1 The Limits of the Modern Evolutionary Synthesis

By grounding the claims of evolutionary theory on the mathematical rigor of population genetics, the Modern Synthesis reconciled the then-competing explanations of Darwinian evolution and Mendelian genetics as to the origin of novel phenotypic features in the history of life. Though some branches of biology were marginalized as a result (such as paleontology and embryology), the Modern Synthesis was sufficiently compelling that Theodosius Dobzhansky was able to famously proclaim, “nothing in biology makes sense except in light of evolution” (1973). Not even the rise of punctuated equilibrium as an alternative to gradualism seemed to upset the theoretical orthodoxy (Eldredge and Gould 1989).

However, the gradual accumulation of evolutionary processes not accommodated by the Modern Synthesis (or what we might now call ‘standard evolutionary theory’)— developmental plasticity, inclusive inheritance, and niche construction, to name but three— have led to calls for revising the Modern Synthesis in what has been called “the Extended Evolutionary Synthesis” (Laland et al. 2015). The EES would broaden the scope of what can be considered a source of inheritance, phenotypic variation and what can be considered as selection. Subsequently there have been various calls ranging from reform to revolution about the place of the Modern Synthesis in biological theory, along with ensuing controversy over the exact meaning of these proposals (Fábregas-Tejeda and Vergara-Silva 2018; Lewens 2019; Baedke, Fábregas-Tejeda, and Vergara-Silva 2020).

According to several philosophers and biologists, our standard evolutionary theory hasn’t merely led us to get the ontology of organisms and evolution wrong (Walsh 2015), but has created significant explanatory gaps which may be bridged if one could incorporate the notion of biological agency and purposiveness into contemporary biology (Sultan, Moczek, and Walsh 2021; Jaeger 2022). On this view, an agency perspective is one of many complementary perspectives which biology can and should take on their object of study. An agency perspective is useful for making sense of findings that highlight the active role that organisms play in their evolution through the generation of environmentally responsive phenotypes (ibid). The agency of life may also be important for better understanding the nature of cancer and multicellularity (Soto et al. 2016; Sonnenschein and Soto 2016; Levin 2019), and for opening up new avenues for the study of the evolution of cognition (Lyon 2015; Ginsburg and Jablonka 2019; Bechtel and Bich 2021). Teleology may prove crucial to distinguishing different ways in which organisms construct their niches: through goal-directed behavior that aims at such construction, or merely as contributors (Aaby and Desmond 2021). The foregoing are tentative suggestions that standard theories of biology *may* be reaching their limits because they fundamentally remain “object theories”, when biology may now need to incorporate “subject theories” (Levins and Lewontin 2009; Walsh 2018).

At the heart of these proposals is a critique of reductionism as both an ontology and a method. The Modern Synthesis was a synthesis of sub-organismal biology (Mendelian and molecular genetics) and supra-organismal biology (populations) that neglected the organism itself, and by extension phenomena for which they are necessary parts of the explanation. But there are good, practical reasons why reductionism has been a dominant methodological principle in the life sciences, and why organicist biology —which favored an organism-centered account of teleology and flourished in the interwar period— was ultimately sidelined by the MES (Esposito 2013; Baedke 2019; Baedke, Fábregas-Tejeda, and Prieto 2021). Advancing biology requires developing tools, models, methods, and theoretical principles that are *useful* to practicing biologists. And if teleology does prove to be useful, it is difficult if impossible to know ahead of time exactly how biologists at large will make use of it. Doing so will require useful operationalizations and models of purportedly teleological processes; models that may very well be distorted and idealized to fit the needs of the biologist (Potochnik 2017; Godfrey-Smith 2001, 289). In fact, models that successfully predict and explain goal-directed phenomena in biology may not only be agnostic about the ontological status of the entities in question but also be useful precisely for this reason (Pezzulo and Levin 2016, 3–4).

Furthermore, it should be remembered that the failure of reductionism does *not* imply that teleological explanations will be a necessary (or useful) part of the future of biology. Nor should we assume that contemporary biological theories need to be revised simply because they get the metaphysics of life wrong (Walsh 2015, xii). This is in fact unsurprising given that, again, truthfulness is regularly discarded as an epistemic ideal in scientific theories and models in favor of empirical adequacy and usefulness.

These are preliminary, non-exhaustive considerations of why biology may need teleological thinking, along with what it would mean to successfully “naturalize teleology” in scientific practice. To consider naturalized teleology in epistemological terms would be to ask what makes teleological explanations distinct from mechanistic explanations, in what sense teleological explanations are genuinely explanatory, what criteria should be used to assess the epistemic virtues of teleological explanations, and how teleological explanations should be operationalized and tested. To consider naturalized teleology in ontological terms would be to ask what makes a teleological functional structure distinct from a mechanistic functional structure, how teleological functional structures cohere with the functional structures explained by other sciences, and how teleological functional structures emerge from non-teleological functional structures.

## 3.2 The Naturalism Debates

In 20th century Anglophone philosophy, especially in the United States, naturalism has a privileged position as perhaps the most widely accepted, if only by default, ontological and epistemological position. Even so, there are multiple versions of naturalism in both metaphysics and methodology. The rise of what is now called “liberal naturalism” (De Caro and Macarthur 2010; Macarthur 2019) now poses some important challenges to what is called, by contrast, “scientific naturalism.”[[9]](#footnote-9) Whereas the scientific naturalist takes nature to be whatever is described and explained by our best scientific theories, the liberal naturalist objects that we need a conception of nature sufficiently broad to include values, norms, intentionality, subjectivity, and perhaps even God.[[10]](#footnote-10) In this context, we can get critical leverage on the debate by considering the relevance of naturalized teleology.

In the debate between liberal and scientific naturalism, a cardinal role can be assigned to the epistemic and ontological status of biology—or more precisely, to the neglect of biology. In what might be regarded as a founding text of contemporary liberal naturalism, John McDowell in *Mind and World* urges a distinction between “the realm of law” and “the space of reasons” (1996)[[11]](#footnote-11) as a distinction between two different versions of naturalism: a naturalism that was limited to natural-scientific intelligibility and an expanded naturalism that could exploit Aristotle’s concept of “second nature” in order to take on board the thought that the initiation into the space of reasons that accompanies human enculturation is fully natural, but not restricted to nature as “the realm of law”.

Liberal naturalism, then, urges that we can have a conception of nature as distinct from “the supernatural” that is also not that of the natural sciences. The contrast with “natural” in the liberal sense is nature in the sense of “the realm of law,” which is to say, the laws and law-like generalizations that distinguish mechanistic physics and chemistry from their premodern predecessors. This conception of natural-scientific intelligibility omits biology entirely, and McDowell has indeed been criticized for his neglect of animal life as distinct from both the realm of law and the space of reasons (Bernstein 2002, Lovibond 2006, Sachs 2012).

Nevertheless, the neglect of biology as distinct science continues to shape the contrast between liberal naturalism and scientific naturalism. To see this, we need only consider what the liberal naturalist critique of scientific naturalism would amount to if scientific naturalism were to accept the irreducibility of biology to physics. A scientific naturalist who accepted the reality of organisms as agents capable of acting on their own behalf would have considerably more resources at her disposal for accommodating intentionality, normativity, value, and subjectivity within an expanded scientific naturalism (Okrent 2018; Rouse 2015; 2022). Specifically, such an account may take the fact that organisms are intrinsically teleological to warrant the claim that there is a fundamental continuity between the agency of organisms and the intentionality of human cognition. On this view, there is a sense in which mind truly co-emerges with life (Thompson 2007; Deacon 2012); though the challenge here is to not conflate these concepts, and to show how continuity does not necessarily imply identity (Gambarotto and Nahas 2023). It is far from clear how a liberal naturalist would respond to such an expanded scientific naturalism because liberal naturalism positions itself as the contrast with a highly restrictive scientific naturalism. Put otherwise, if a suitably expanded scientific naturalism were to show that agency and intentionality are grounded in the reality of organismal teleology, then what becomes of the liberal naturalist complaint that scientific naturalism fails to accommodate agency and intentionality? We do not wish to say that the liberal naturalist is therefore obliged to concede—only that an expanded or radicalized scientific naturalism that accepted the reality of organismal teleology would invite a revision to liberal naturalism.

More problematic for our purposes, however, is that it is far from clear what criteria are relevant for adjudicating the dispute between these various forms of naturalism. Unlike in the sciences, philosophical disputes are almost never resolved; some further questions can always be raised, foundational assumptions examined, bizarre counterfactuals entertained. The question about whether we ought to accept any version of naturalism, and if so, what version of naturalism that should be, turns on what we need and want from a comprehensive account of nature as such, and how we are to conceptualize the so-called “4Ms” (Morality, Modality, Meaning, and the Mental) within a worldview shaped not only by science but also by modernity generally.[[12]](#footnote-12)

## 3.3 Contrasting Metatheoretical Motivations

Whether one wishes to leverage an organism-centered account of teleology to advance biology (3.1) or debates and naturalism (3.2) has important consequences for the very way in which one conceptualizes it. Though an account of naturalized teleology may be pertinent to both or even utterly crucial for advancing them, these debates involve different sets of considerations. A philosophical debate even when informed by science (as naturalism must be) does not need to conceptualize teleology in a way that is sensitive to the practical needs of biologists (see Meyer and Brancazio 2022 for a parallel in cognitive science). Hence it incurs no obligation to operationalize its terms and make them immediately serviceable in the construction of testable hypotheses in the lab or field, even if they seem true.

Alternatively, if a philosophical account of teleology were drawn from a pre-existing, explanatorily successful account in biology, it would require careful interpretation of what this and other accounts are telling us, exactly, about the underlying causal pattern in nature that one would deem teleological. This is especially important since, as discussed in 3.1, scientific models must routinely sacrifice truth in favor of operationalizability and empirical adequacy, and the fact that false models can in some cases be a means to truer theories (Wimsatt 2007, chap. 6). There is a potentially large gap between claims that are broadly true and potentially ‘relevant’ to biology —like holistic approaches to causation (Godfrey-Smith 2001; Gallagher 2018)— and ideas that are concretely useful to its advance. As we see it, what the naturalism debate needs are the former, not the latter; naturalizing teleology in the context of metaphysics would need to be assessed by additional criteria that go beyond its mere explanatory success or theoretical indispensability in biology.

To further illustrate this divide, consider that while a future biology that takes seriously an organism-centered account of teleology may use a plurality of different, perhaps even conflicting theories and models of the goal-directed phenomena in question, a metaphysician may rightly want to claim that underlying this variety is a single fact about the nature of teleology, even if the “right” way of conceiving it philosophically is completely useless from a scientific perspective. It does not follow from the fact that an entity is a natural kind that it will be explanatorily useful or even indispensable, and vice versa. And while such philosophical disputes about the nature of teleology may remain open-ended, one ought not to expect that their resolution will be necessary for successfully carrying out empirical research into goal-directed phenomena (see Kovaka, 2015, and Love, 2018, for a parallel case in the literature on biological individuality).[[13]](#footnote-13) Not only that, but advancing the debate in the broader context of naturalism will require an attentiveness to broader questions that have to do not just with biology and a teleological conception of life itself, but what must be true *of nature* such that teleology can emerge from it. This therefore requires the careful interpretation and integration of findings from multiple areas of scientific research, and possibly other forms of inquiry (Godfrey-Smith 2001).[[14]](#footnote-14)

As we see it, these foregoing considerations complicate claims regarding the need for mutual accountability between scientific research and scientifically informed metaphysics. It could well be that different metatheoretic motivations would justify relative autonomy in the ways that they respectively conceptualize teleology. An evolutionary theorist or philosopher of biology may very well use theories of naturalized teleology to motivate an argument for how we ought to study evolutionary processes, or for that matter, other biological processes such as homeostasis and allostasis. In doing so, the theorist *does* incur the obligation to show how naturalized teleology is operationalizable and can be put to work in scientific research. By contrast, a philosopher concerned with the metaphysics and epistemology of naturalism —scientific, liberal, etc.— need accept only the general epistemic norms of naturalism, which include rigorous argumentation and productive insight, and may even submit to norms of clarity and analytical precision in its terminological usage that a biologist would not find productive or useful.[[15]](#footnote-15) For present purposes we do not take a stand on whether or not a single account of naturalized teleology could satisfy both scientific and philosophical desiderata (though we are admittedly skeptical); we are only indicating the need to distinguish between these desiderata, which has heretofore been absent from discussions about how and why to naturalize teleology at all.

# 4. A Path to Resolving and Dissolving Disagreements

The previous section has aimed to clarify the differences between two kinds of disputes toward which an organism-centric account of teleology might contribute: a scientific dispute and a philosophical dispute. We have outlined how these issues impose different constraints on an adequate account of teleology. We will now show how this metatheoretical insight creates a path for advancing or even dissolving a recurrent debate in the literature: whether and how we should demarcate genuinely teleological systems from other complex systems, such as dissipative structures. While any account of naturalized teleology will need to answer this question, how the question gets raised and addressed is quite different in scientific and in metaphysical contexts, further illustrating the partial autonomy of these different projects. In 4.1, we will argue that in the context of scientific research, models of teleology cannot and need not do the kind of demarcating work that some think they can or ought to do. In 4.2, we will show how demarcation problems in a more philosophical context are governed by extra-scientific considerations that need to be made more explicit.

## 4.1 The Science of Naturalized Teleology

For the organizational accounts discussed in section 2.1, the demarcation problem has arisen due to the potential over-permissiveness of a definition of teleology in terms of self-maintenance, which would render all far-from-equilibrium systems from candle flames to tornadoes teleological. For the behavioral accounts (2.2), such as Walsh’s ecological approach, it also proves extremely difficult to clearly demarcate behavior that *appears* goal-directed from behavior that truly is.

As we have seen, Deacon’s model for the simplest teleological system, the “autogen”, is intended demarcate far-from-equilibrium self-organization or “morphodynamics” from properly teleological or “teleodynamic” systems (2011). In a follow up paper with Tyrone Cashman (2013), Deacon has then argued that another model with certain similarities to his own, called autopoiesis (see Thompson 2007), fails precisely on the grounds that it does not have the tools for making this distinction. More recently, this issue of demarcation has been addressed by the Organizational Approach, given that their account of ‘closure of constraints’ may be applicable to candle flames or even to weather systems such as the water cycle (Mossio and Moreno 2015; Mossio and Bich 2017). Cusimano and Sterner (2020) worry that according to the OA’s operational definition of constraints, what counts as a constraint in a given system will vary depending on the researcher’s interest. Furthermore, it is difficulty of operationalizing the notion of dependence *between* such constraints. This leaves ambiguous what kinds of systems realize closure, and by extension, are teleological; there seems to be an arbitrariness or lack of objectivity due to the description-dependence of closure. As a result, a candle flame could be thought to realize closure, and therefore be teleological. Even if the authors are incorrect about the specifics in the candle flame case, it remains true that getting a grip with any sufficiently complex system in practice will necessarily require making pragmatic choices about which aspects of the system to include in our description, and that there may not be a “complete description” to which we can appeal (2020, 265; see also Mitchell 2009).

But crucially, whether and why the demarcation problem matters depends on the kind of work we need our account of teleology to do. As we see it, the issue is unavoidable and not particularly problematic in the context of developing and applying models of biological organization and teleology that would advance biology. Though Cusimano and Sterner seem to be aware of this, they do not state it explicitly. On one hand, they state that the issue at hand is purely practical: it is merely about making “the leap from biological theory to concrete implications for empirical research” (2020, 266-267). But if this kind of demarcation problem is everywhere in the study of complex systems and is usually resolved pragmatically in the context of research, it is unclear why this would be problematic —or even surprising— for the deployment of closure of constraints as a model. They therefore do not draw the natural conclusion from their own argument that closure of constraints, *qua* model, is unlikely to ever be able to meet the criteria of “objectivity” that they ask it to meet, nor do they say enough about *why* it should meet such criteria in the first place. There may indeed be pragmatic reasons why demarcation is a concern for a certain area of biological practice, or specific research agenda. Nonetheless, it is not clear why their stated criterion of objectivity needs to be met for closure of constraints to do a better job of describing certain living phenomena, such as “the processes and constraints at play in the metabolism and regulation of glycaemia, by making explicit the different hierarchical orders involved” (Bich, Mossio, and Soto 2020, 1). Quite the contrary, one might even think that the broad and perhaps indefinite scope of applicability of closure of constraints as a model is an *advantage* when it comes to advancing biological research, insofar as it will allow it to unexpectedly prove useful in new research contexts. So if we wish to treat closure of constraints merely as one of many possible models for living systems, albeit as one with certain distinct theoretical advantages, then we should ask that it meet the same criteria as any other model.[[16]](#footnote-16) Any ensuing demarcation problems of concern will be local to the specific explanatory project or practice, and there is little use in worrying about these problems outside of this local context.

The issue of demarcation has also been raised by Jong Gwan Lee and Dan McShea (2020), both of whom are biologists who have explicitly disregarded demarcation issues —which they regard as the realm of the “analytic philosopher”— in favor of a “pragmatic” approach to the application of teleology, measured in terms of plasticity and persistence. Goal-directedness, measured as such, comes in degrees, applies equally to organisms and artifacts, and is context specific (ibid, 6). Despite this, they make a strong case for the usefulness of their model, and the specific kinds of questions it can answer. They also readily admit that this is only one of many ways of conceiving goal-directedness (ibid).[[17]](#footnote-17)   
 For the reasons argued above, we think McShea and colleagues are right in thinking that demarcation problems are less worrisome in the context of proposing potentially useful models for goal-directedness. But it would be mistaken to take this as evidence that the distinctions these models fail to make are altogether unimportant. Just because closure of constraints may, in a certain context, unproblematically fail to demarcate the limits of teleological systems does not mean that this question isn’t important on a philosophical level (a point we elaborate in the next section). Similarly, just because the field theory does a good job of explaining certain phenomena in certain contexts without distinguishing the “intrinsic” goal-directedness of an agent and the “extrinsic” goal-directedness of an artifact,[[18]](#footnote-18) does not warrant claiming without further justification that this distinction is completely mistaken. This would be a case of pernicious reification; a conflation of map and territory potentially as erroneous as claiming that cows are round because modeling them as such is explanatorily useful, or that the Mercator projection of the globe tells us that Greenland is the same size as Africa (Winther 2020; Rupik 2023).[[19]](#footnote-19) Unfortunately, this is precisely what McShea and Babcock (2021) seem to want to do. Not only that, but they also claim —in a move that goes against a previous openness toward pluralism— that theirs is “the *only* legitimate explanation” for teleology (emphasis added), in effect assuming that the other accounts discussed in section 2 have no potential to do explanatory work.[[20]](#footnote-20) But if one were to agree with Lee and McShea’s initial claim that the field theory is only one of many possible models that one might want to get a grip on goal-directed behavior, then it is not clear why their model should dictate matters of fact about the distinction (say) between intrinsic and extrinsic purposiveness, when that distinction could be derived from the explanatory success of others (such as the those of organizational schools). Their move also begs the question: as discussed in section 2, the field theory *defines* goals in terms of environmental features external to a system and chooses not to include any internal facts about the system in this definition.

As we see it, much of this confusion derives from the lack of engagement with the kinds of metatheoretical considerations discussed in section 3. This has led to overly hasty assumptions regarding the meaning of “naturalization” and “explanation”, without considering that the aims and methods of the project of naturalizing teleology are not given, but very much in need of justification. In the context of a scientific research program, we believe that *both* closure of constraints and McShea’s field theory may prove to be useful models; but they should not be asked to do the kind of demarcating work that Cusimano & Sterner and McShea & Babcock think they can or should do (but see footnote 14 for an important caveat). This point has been overlooked because the problem of demarcation has all too often been raised in the abstract, without clearly situating the issue in the context of a specific question that the account of teleology in question is deemed to be advancing. This has led to unnecessary confusion on this issue.

## 4.2. The Metaphysics of Naturalized Teleology

In addition to questions about the usefulness of an organism-centered account of teleology for biology in practice, there are also questions about the broader implications this has for our understanding of nature and our place in it. This question is less strictly governed by —though never wholly independent from— scientific desiderata and touches on questions that are more properly regarded as philosophical or even metaphysical. With this consideration in mind will now look at a recent critique of the Organizational Approach. Garcia-Valdecasas (2021) contrasts the Organizational Approach with Deacon’s teleodynamics and argues that teleodynamics succeeds in naturalizing teleology in ways that the OA fails to do. We shall argue that his critique is prone to the same kind of metatheoretical confusion discussed in the previous section, insofar as he does not make clear the broader theoretical context of his critique, which contains philosophical assumptions that are not of obvious or immediate concern to the practicing scientist, and in our view more relevant to broader questions about nature and naturalism.

Garcia-Valdecasas frames his critique in terms of an Aristotelian conception of teleology. As he sees it, “teleology is a causal principle whose primary role is the realisation of some specific good for an organism” (2).[[21]](#footnote-21) The idea that teleology requires a “beneficiary”, or must be for the good of something, in turn requires that there be an identical self for whom good is served by the actions it takes. Yet this is what he thinks is missing from the OA. He acknowledges that the OA identifies collective closure of constraints as necessary for a system that is self-determining and is prepared to acknowledge the distinction between a genuinely self-determining system and a self-organizing system (such as a dissipative structure), on the grounds that the former incorporate into their structure some of their own boundary conditions. Nevertheless, he maintains that teleodynamics succeeds where the OA fails, because teleodynamics allows for a specific understanding of biological individuality as a beneficiary.

Teleodynamics contains a certain conception of individuality because teleodynamic processes require at least two self-organizing processes, each of which inhibits the other's tendency to maximize entropy production. Whereas each self-organizing process would eventually run out of energy and collapse back into thermodynamic equilibrium with its environment, two self-organizing processes that are, as it were, antagonistically arranged can enable a higher-order constraint that engenders a new level of biological hierarchy:

this process gives rise to a new second-order constraint that sits above the constraint system. This constraint was absent from the component processes and must be specifically distinguished from them. Its goal is to preserve system integrity by resisting disintegration of their codependent component processes (Deacon and Cashman 2016, 418). This is how a system of constraints come to be a biological individual. This introduces a crucial difference between systems of components that are merely circularly supportive of one another —as are the components of an autocatalytic set or of any other circularly organised production process— and teleodynamic systems. The second-order constraint is not a mere aggregate of interlocking constraints; it is also a full individual that belongs to a biological class. (13)

This raises the following question: given that Garcia-Valdecasas is prepared to accept Mossio and Bich’s (2017) distinction between self-organizing systems and self-determining systems, why does he now seem to collapse the Organizational Approach back into mere self-organizing systems? Put otherwise, what is the difference that makes a difference between interlocking constraints and a second-order constraint, that is, the difference between a constraint operating at a “higher” level and a networking of interlocking constraints? The key issue for us is not that there is no difference between these positions, but the lack of clarity about what kind of difference it is.[[22]](#footnote-22) As we see it, Garcia-Valdecasas is prepared to draw a distinction between interlocking first-order constraints and a genuine second-order constraint due to two distinct —and distinctly *philosophical*— considerations.

The first is that teleodynamics is, at least on the face of it, a more hierarchical model than the OA. The OA conceptualizes closure in, as it were, egalitarian terms: each constraint contributes to the collective closure of all constraints. Closure is realized precisely as an effect of how each constraint constrains all other constraints. By contrast teleodynamics invites the picture of a new level of an ontological hierarchy that constitutes biological individuality, which Deacon (2014) leverages to make claims about the continuity between life and mind.[[23]](#footnote-23)

The second consideration is his conception of teleology is based upon his understanding of Aristotle and requires that there be a good for the system at which the system as a whole aims. Only a system that has a final end for itself can ground claims about what is good for the system, what kind of system it ought to be, and what it ought to do in order to be that kind of system. Since Garcia-Valdecasas follows Aristotle in connecting teleology with a final end, he argues that the OA is philosophically deficient due to not grounding an account of individuality as the beneficiary of what the system does.

We have mentioned this critique of the OA because we think it illustrates the problems that arise when the distinction between different metatheoretical projects is not drawn with sufficient clarity. Whether or not we ought to endorse Garcia-Valdecasas’s critique of the OA and prefer teleodynamics over the OA *for the reasons that he adduces* depends on why we want an account of naturalized teleology at all. For someone who wants naturalized teleology to be put to use in resolving the debate between liberal naturalism and scientific naturalism (cf § 3.2), an account of naturalized teleology that is inherently tied to a thick conception of normativity and selfhood, and can use these concepts to cleanly demarcate teleological from non-teleological systems, may indeed be preferable to one that is neutral about such philosophical issues.[[24]](#footnote-24) Someone who wants to expand the resources of scientific naturalism to address the challenge of liberal naturalism — a challenge that can also be framed in terms of a critique of modernity — might very well find Garcia-Valdecasas’ argument in favor of teleodynamics attractive, perhaps compelling. Garcia-Valdecasas thinks that we ought to prefer teleodynamics to the OA because teleodynamics is closer to the Aristotelian conception of teleology. Since Garcia-Valdecasas does not object to Moreno and Bich (2017) concluding that the OA satisfies a Kantian conception of teleology, it would need to be *argued*, rather than assumed, that we ought to prefer an Aristotelian over a Kantian conception of teleology.[[25]](#footnote-25)

At the same time, however, the philosophical issues that are at stake in this comparison, as Garcia-Valdecasas frames it, are orthogonal to the questions that concern theoretical or experimental biologists. In those contexts, the questions that arise concern the usefulness of closure as a theoretical framework or model for advancing current issues in biology, for which it may or may not be better suited. This demonstrates that there is not only more than one approach to naturalizing teleology, but also that naturalized teleology can be relevant to multiple, even disparate, theoretical and philosophical projects. Whether one prefers teleodynamics, the OA, or the ecological approach depends on what kind of problems one is trying to solve, and the extent to which those problems are more strictly metaphysical or scientific.[[26]](#footnote-26)

# 5. Conclusion

What is at stake in the debate about naturalizing teleology depends on what we ask such an account to do. And as we have hoped to show, there are at least two (but likely many more) kinds of questions —ranging from the scientific to the metaphilosophical— which might be advanced by an organism-centered account of purposiveness, and we are concerned about how these debates lose sight of this when they become overly siloed and self-referential. We hope that by making explicit the metatheoretical issues raised in this paper we will encourage a broader discussion about them to ultimately foster a more productive debate about the very meaning of naturalizing teleology.

It is tempting to suggest that the plurality of problems that teleology impacts necessarily lead to the need for a plurality of accounts of teleology, each of which has strengths and weaknesses depending on the theoretical context within which it is deployed. Indeed, it is hard to see how a single account can resolve all the myriad problems that teleology could be asked to resolve in different contexts, and it seems *possible* that the different requirements that would impose on a single account would not just be orthogonal but in direct conflict (see Godfrey-Smith 2001, 289 for an interesting parallel). It seems clear that Deacon’s account is quite unique and compelling with respect to its potential in debates about naturalism, though we by no means think that this is the *only* arena in which his ideas have relevance (see, e.g., Deacon, Srivastava, and Bacigalupi 2014). Similarly, Walsh’s Ecological Approach and the Organizational Approach have certain advantages when it comes to advancing biology, even if they remain largely untested. If we are right, this way of seeing the relationship between these various accounts opens new avenues for thinking about the ways in which they are compatible, in conflict, or even mutually supporting.

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3. This is due to the fact that, while some scholars are more explicit about the kinds of problems they take themselves to be answering, many are not (and this is precisely what we deem problematic). This may be because it is not always possible to pin down a single set of motivating factors for a framework, especially when it is developed by multiple scholars. Furthermore, a certain account of teleology may prove to be well suited for answering questions which its originators did not intend to answer. [↑](#footnote-ref-3)
4. It is worth noting that Deacon puts a strong processual understanding of emergence at the center of his project, going so far as to reinterpret constraints and work from an emergence perspective (Deacon 2011, chap. 11). The overall picture one gets from Deacon’s project is therefore not merely an account of the emergence of life, but a metaphysics of nature as radically emergent and processual. [↑](#footnote-ref-4)
5. According to Deacon, his model resembles a kind of ‘non-parasitic virus’ (2021) rather than an autopoietic protocell. [↑](#footnote-ref-5)
6. Deacon sees the basic logic of teleodynamics as recurring nested levels of emergent dynamics, and key to eventually understanding the biological basis of the human mind (Deacon 2011). [↑](#footnote-ref-6)
7. Agency is therefore much like fluid viscosity, which is considered a real phenomenon even though “it is not specified in terms of the properties of its molecular realizer but in terms of other concepts at the same gross dynamical scale, such as density or surface tension.” (Fulda 2017, 82; see also Walsh 2018, 171-172). Fluid viscosity, on this view, is a natural phenomenon because it is an indispensable explanans in the prediction and explanation of fluid behavior (Fulda 2017, 83). [↑](#footnote-ref-7)
8. Though this approach is the least ‘organism-centered’ of those we are discussing here, we include it insofar as it is “an account of teleological systems, not an account of function” (Badcock and McShea 2021, 8766). [↑](#footnote-ref-8)
9. This distinction is similar to, but arguably distinct from, Price’s (2013) distinction between “object naturalism” and “subject naturalism”, since subject naturalism can include what the sciences say about human cognitive capacities and incapacities. [↑](#footnote-ref-9)
10. Ellis (2017), for instance, suggests that McDowell’s arguments for the reality of value in a suitably expanded naturalism can also be used to expand naturalism even further to include God. [↑](#footnote-ref-10)
11. We say “contemporary liberal naturalism” because liberal naturalism has mid 20th century antecedents that have today fallen into relative obscurity; see Krikorian (1944) [↑](#footnote-ref-11)
12. On the Four Ms, see Price and Jackson (1997); on the centrality of naturalism to the modern worldview, see Bilgrami (2010). [↑](#footnote-ref-12)
13. We also think that the case of teleology and biological individuality would mirror each other insofar as the relationship between theory and practice would be symmetrical, with both sides ought to have input on the debate, change it in the process (Love 2018, 170). [↑](#footnote-ref-13)
14. We are, in effect, suggesting that advancing these kinds of debates require something like what Godfrey-Smith (2001) and Brancazio and Meyer (2022) call “philosophy of nature” though they use the term to label schools of thought (such as enactivism) rather than questions, which is our preferred framing of the issue. [↑](#footnote-ref-14)
15. As Fox-Keller (2003) argues, terminological ambiguity has in the past been essential to the establishment of a global narrative relating different biological phenomena, and thereby advancing research. [↑](#footnote-ref-15)
16. It is also possible for closure of constraints might play different roles in different contexts, such as those described in 3.1 and 3.2. But where closure of constraints may have strengths in one context, we expect it to have weaknesses in another. One *may* want to leverage it to make meaningful statements about the ontology of living systems, and in this context Cusimano and Sterner’s worries would take on a different hue. Furthermore, it is not necessarily the case that closure would be able to play no other role than one of a model in practice. These are the kinds of questions that we believe are in urgent need of elaboration (see Bich and Mossio 2012). [↑](#footnote-ref-16)
17. We find it revealing that the authors suggest they are solving ‘the philosophical problem of teleology’ in the singular, and without specifying what, exactly, they take this problem to be. The authors seem to think —though it is never clear— that this apparently singular problem has to do solely with advancing biology, and should be evaluated on those terms. But as we argued in the previous section, this is far from self-evident and cannot be assumed. [↑](#footnote-ref-17)
18. The idea being that a heat-seeking missile would be goal-directed in the same way as a bacterium, insofar as they are both directed by environmental fields (heat and sucrose gradients respectively). [↑](#footnote-ref-18)
19. This is not to say that the explanatory success of a model of teleology should have no impact on broader philosophical questions. It is simply that the relation between these areas, in our view, is far more complex than McShea and Babcock assume it to be. [↑](#footnote-ref-19)
20. Besides, they make these claims despite never defining the standards by which they deem their explanation successful. [↑](#footnote-ref-20)
21. Garcia-Valdecasas refers to this as “an illuminating principle that was lost in modernity” (ibid). At stake in teleology is therefore far more than what biology needs, but also an implicit critique of modernity in the style of Jonas (2001). [↑](#footnote-ref-21)
22. On the face of it, a second-order constraint would have to be constituted by interlocking constraints—otherwise it would not be a *second* *order* constraint, a constraint that constrains constraints. In other words, we are inclined to think that the OA does account for second-order constraints, though it does not emphasize, as Deacon does, the importance of two different kinds of self-organizing systems that are mutually inhibiting. [↑](#footnote-ref-22)
23. For those familiar with Deacon’s project, the teleodynamic level constrains the morphodynamic and homodynamic levels below it; see the discussion of Deacon in §1. [↑](#footnote-ref-23)
24. While the Organizational Approach does appeal to a certain conception of normativity, we find it to be thinner than Garcia-Valdecasas’s for the reasons described above. [↑](#footnote-ref-24)
25. Notice that it would not suffice to simply point out, as Garcia-Valdecasas does, that Kant takes teleology to be a subjective heuristic that our finite minds cannot avoid; one can be a realist about teleology *in Kant’s sense* (Gambarotto and Nahas 2022), which means that one need not be an Aristotelian about teleology to be a teleological realist. [↑](#footnote-ref-25)
26. Just as the OA’s operational definition of constraints has some advantages in some contexts and poses problems in others, so too is Deacon’s more metaphysical definition of constraints, defined as “absential phenomena” may prove advantageous in some and not others (Deacon 2011; Deacon and Cashman 2016). [↑](#footnote-ref-26)