A Functional Naturalism

Anthony Nguyen

We assert that Nature operates for the sake of an end,
and that this end is a good. (Aristotle, *PN* 455b17)

1. Introduction

Teleological explanations appeal to a thing's function or purpose. Such explanations are pervasive in ordinary life. Artifacts provide a clear-cut example. Why does a watch tell time? Well, of course, that is what watches *are for*![1] Watchmakers build watches with the intention that they will tell time. Telling time is the function of a watch. A watch that tells time performs its function. A watch that fails to tell time is deficient, failing to perform its function.

So far, so good. There seems to be nothing wrong with providing teleological explanations when explaining some behavior of (well-made) artifacts. But teleological explanations concerning natural phenomena abound within biology as well. And there, the use of teleological explanations is much more controversial.

Unless I explicitly specify otherwise, I will henceforth use 'function' to mean *biological function*.[2] Biological functions are unlike *artefactual functions*—like the watch's function of telling time—in that they, biological functions, are "intention-free."[3] A human heart, for instance, would have the biological function of pumping blood even if no one intended it to pump blood.[4]

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[1] Of course, this teleological explanation is not the *only* sort of explanation that could be offered in reply to the question at hand. One may also offer a mechanistic explanation that describes the causal processes that allows a watch to tell time. My point is merely that, in ordinary life, we would—at least sometimes—happily accept a teleological explanation.

[2] For helpful introductions to the literature on biological functions, see Bedau (1993), Garson (2016), and Wouters (2005).

[3] And as I will soon discuss, biological functions give rise to good effects for their possessors. Artefactual functions need not do this.

[4] McShea (2012) has argued that "goal-directedness [or teleology] is a function of the *perceived* complexity of the system" (p. 682, my emphasis). One

Many accept teleological explanations in biology as providing insight into the nature of the world.[5] But this does not settle what the content of a teleological explanation is. In particular, what is the content of the explanans (e.g. that the function of the heart is to pump blood)? One commonplace view nowadays is that biological teleology can be naturalized.

Naturalism, as I understand it, is the thesis that "everything real is…in principle within the scope of a purely scientific account of the world" (Bedau 1991, p. 647). Value-free naturalism is the conjunction of naturalism and a second thesis, which I will here call 'value-free realism':

> *Value-free Realism*: All scientific facts are purely non-evaluative.

According to value-free realism, all scientific facts are either irreducible and non-evaluative *or* reducible in terms of purely non-evaluative terms. Often, value-free naturalists are concerned with the appearance of normativity in biological teleology. After all, a thing's function is something that—in some sense—it *ought* to perform. Many value-free naturalists find this unpalatable. For them, naturalism requires "a relatively rigid fact/value distinction" (Bedau 1991, p. 647). On this view, science concerns facts, not values. The hope is that if biological teleology is naturalized, then we can appeal to teleological explanations without thereby appealing to evaluative notions.

But value-free naturalism is not the only game in town. In contrast to the value-free naturalist, the *teleological realist* believes in genuinely value-laden teleology. Thus the teleological realist will accuse the value-free naturalist of identifying something, teleology, with something that it is not. For the teleological realist, all biological teleology is value-laden teleology and not anything else. The value-free naturalist, on the other hand, will protest that she is telling us what teleology must be.

Some might wonder whether there is a genuine debate here. As Richard Cameron has aptly remarked, the orthodoxy seems to be

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advantage of this view is that it makes teleology naturalistically respectable whole avoiding the objection I raise in §2 against the etiological view. But, strikingly, this account makes it up to us whether something is teleological. For critical discussion of such "mentalism," see Bedau (1990). Here, I will assume the following: Whether or not something has a biological function is independent of our cognitive activity.

[5] This statement should perhaps be tempered so as to not offend the tastes of scientific antirealists. Scientific antirealists who are also "pro-teleology"— teleological realists—may accept that teleological explanations play some role in our best scientific theories. That is, such antirealists will say that our best theories appeal to some teleological explanations.

that "biological teleology is either reduced (or eliminated) or depends on…a supernatural entity" (2004, p. 73). What could naturalistically respectable and yet value-laden teleology be like? But, so I will argue, this rampant skepticism is a symptom of dogma. I side with the teleological realists. I reject value-free realism. I believe that a purely scientific account of the world may appeal to value-laden teleology.

Teleological realism requires substantial defense. I will provide two arguments, one negative and one positive. First, I argue that popular attempts to naturalize teleology fail because teleology may be present even without the presence of natural selection. This should trouble the value-free naturalist. Mainstream attempts to analyze teleological talk appeal to natural selection.[6] Second, I argue that value-free realism is false because (a) we frequently appeal to teleological explanations in biology and because (b) teleological explanations are inherently evaluative in nature. I will conclude with a short discussion on how to accept naturalism while denying value-free realism.

2. Teleology Without Natural Selection
Naturalists who wish to analyze teleological talk in terms of non-evaluative notions often appeal to natural selection. Such naturalists might say that any object has the function of having some property iff that property has been naturally selected. For example, the human heart has the function of pumping blood because the heart's pumping blood has been naturally selected for. The heart's pumping blood clearly improves a human's fitness.

Mark Bedau, has already, in my view, developed a powerful counterexample to this value-free analysis of teleology (1991, p. 654). He attacked the sufficiency of such accounts by developing a case in which a population of crystals undergoes natural selection in a lifeless world where nothing at all has a function.[7] In the envisioned world, nothing happens for anything else. Without life, there is no teleology.[8]

But the value-free naturalist has the option of revising her account so that more than natural selection is necessary for teleology. Perhaps, for instance, she will say that any object x has a function of exhibiting any feature F iff both (1) F has been naturally selected for and (2) x is part of a living thing. Bedau's lifeless crystal world fails

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[6] For just one influential naturalistic analysis in this vein, see Millikan (1984, p. 28).

[7] Perhaps ironically, Bedau (2010) defends a view of biological life on which crystals count as alive. This view, however, is extremely controversial. I will assume that crystals are not alive.

[8] It is a common thought that natural selection suffices for teleology. For instance, Basl and Sandler conclude that "selection etiologies are sufficient for genuine teleological organization" (2013, p. 699) after only a brief discussion of the claim.

to be a counterexample to this account. The crystals are not parts of any living system.

I do not plan to argue against merely this particular value-free analysis of teleology. I intend to argue against *all* naturalistic analyses according to which any object *x* has the function of exhibiting any feature *F* only if *F* has been naturally selected for. Henceforth, unless I explicitly specify otherwise, the only naturalistic analyses of teleology that I am concerned with in this section are analyses on which natural selection is necessary for teleology. I will argue that natural selection is unnecessary for teleology. There may be teleology even in the absence of natural selection.

I will proceed by developing a case in which, intuitively, there is a biological function that is not selected for. This case is unique in that it will actually occur. I do not invoke anything as fantastic as God or Swampman.[9] Instead, I invoke (wet) artificial life research. Before I present the case, allow me to review the relevant recent scientific findings.

Organisms are nothing but complex, organized collections of physical matter.[10] With time, then, there seems to be no reason why we could not learn to use non-living molecules in order to build minimal chemical lifeforms, which are sometimes called 'protocells'. This bottom-up approach to artificial life constitutes a significant project in synthetic biology (Rasmussen et al. 2004, p. 963). Concerning participants at two artificial life workshops that took place in 2003, Steen Rasmussen notes that "all workshop participants agreed that useful artificial cells [protocells] will be eventually created" (2004, p. 965).

And this enthusiasm among synthetic biologists has only intensified in recent years. Craig Venter's production of a synthetic genome for the bacterial species *Mycoplasma mycoides* was an important achievement in synthetic biology (Venter et al. 2010, p. 963). Venter effectively showed that we can create a genome, an essential component of all known life, in the laboratory. Even though Venter did not create life in the laboratory, his achievement is surely a sign of significant progress towards creating life from scratch—from just

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[9] One might imagine God creating a human out of nothing or a lightning strike hitting a tree and causing particles to be rearranged so that a man, Swampman, arises from the ashes. For the original Swampman case, see Davidson (1987, p. 443). It seems—at least to many—that these cases, while perhaps metaphysically possible, are too fantastic to bear much weight. Value-free naturalists generally "have little patience with purely science-fiction counterexamples" (Garson 2016, p. 10). On the other hand, the case I develop in the main text is likely to actually occur.

[10] At the very least, this is true of relatively simple lifeforms like amoebas. This is all that is needed for the case that I will develop. For all I will say, conscious organisms like humans may be more than merely complex, organized collections of physical matter.

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molecules—in the laboratory. Of course, there is *much* more to an organism than a genome. Venter did not create anything close to being alive.

But there certainly is reason to be optimistic. For example, Rasmussen's team of synthetic biologists is remarkably close to creating simple synthetic life (Rasmussen et al. 2016, p. 1).

Before describing Rasmussen's progress towards making protocells, however, we need to first understand the operational definition of life that he is working under. Rasmussen is working under a largely uncontroversial operational definition of minimal chemical life on which a chemical system is alive if it integrates three functional roles: program, metabolism, and container (2016, pp. 1-2). This operational definition says nothing about the nature of the matter through which these three functional roles are realized. It merely requires that they be realized, or performed.

The program role requires that information be somehow encoded and used to control growth, reproduction, metabolism, and the self-maintenance of the container. In a eukaryotic cell, the program role is played by the nucleus.[11] The metabolism role requires that resources be taken in from the environment in order to fuel growth, reproduction, and self-repair of the system. In a eukaryotic cell, the metabolism role is played by mitochondria. The container role requires that some barrier exist in order to protect the internal parts of the system, to ensure a reliable influx of resources used in metabolism, and to provide a means of releasing waste. In a eukaryotic cell, the container roll is played by the cell membrane.

Importantly, these three functional roles—program, metabolism, and container—support each other. They are three interdependent functional roles. The successful performance of one role makes the performance of the other two roles—if not possible *simpliciter*—much easier.

Rasmussen has achieved significant process towards developing a protocell that realizes the program, metabolism, and container roles. His team has been able to build chemical systems in the laboratory with the following properties:

> (i) self-assembly of a decanoic acid container; (ii) anchoring to the container a metabolic ruthenium complex as well as (iii) a conjugated nucleic acid information complex; (iv) container feeding and growth; (v) metabolically driven container replication; (vi) metabolically driven information ligation (part of replication); (vii) one-pot metabolic production of both amphiphilic molecules and ligated oligomers,

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[11] I am only considering *animal* eukaryotic cells here.

new information molecules. These are all key mile-
stones towards the construction of a minimal living
system (2016, p. 2).

Clearly, then, Rasmussen has made significant progress towards mak-
ing synthetic life in the laboratory. He can already build chemical sys-
tems in which the metabolism role, the container role, and most of the
program role are performed. The only missing piece is self-replication
of DNA. As he concedes,

One key milestone is not yet reached, however, be-
fore full protocell integration can occur: implementa-
tion of an effective DNA self-replication process
based on template-directed ligation of two smaller ol-
igomers (2016, p. 2).

So, while Rasmussen has not yet created synthetic life, he is getting
close.[12] There seems to be no reason why, in principle, his project of
developing life from the bottom-up *must* fail. After all, we know of
many lifeforms that are nothing but complex, organized collections of
physical matter. And there are plenty of synthetic biologists besides
Rasmussen who are working on creating life. We have all the reason
to believe that, *eventually*, synthetic biologists will be able to create
minimal chemical life in the laboratory.

What is crucial for my purposes here is this: There is no ques-
tion as to whether synthetic biologists will eventually create life. The
real question is when. It is highly likely that, at some point in the fu-
ture, synthetic biologists will create minimal chemical life. When that
happens, synthetic biologists will learn how to create at least one
form of life from scratch—from its constituent molecules.

Let us now return to our philosophical aims here. I will now
develop a case in which there is teleology without natural selection.
Moreover, this case is not only nomologically possible, but *will actu-
ally* happen.

Imagine the first time that synthetic biologists create a chemi-
cal system that uncontroversially and fully realizes the program, me-
tabolism, and container roles. Call this chemical system 'Eve'. Eve
satisfies one largely uncontroversial operational definition of life
among synthetic biologists. Moreover, Eve has parts with functions.[13]

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[12] If life is a matter of degree—so that, at least in principle, some things may
be more alive than others—rather than a binary matter, then we may be justi-
fied in claiming that synthetic biologists have already developed entities that
enjoy an intermediate status on the "liveliness" scale.

[13] Since the system integrates the program, metabolism, and container roles,
each of these functional roles is such that some part of the system performs
it.

Eve realizes the program, metabolism, and container roles. So, for each of these three functional roles, some part(s) of Eve must perform that role. So, some parts of Eve have the function of ensuring that at least one of these roles is played.

For example, consider the part(s) of Eve that realize(s) the metabolism role. Call this part (or collection of parts) 'the metabolizer'. The metabolizer ensures that resources are taken in from the environment and used in order to fuel growth, reproduction, and self-repair. Without the metabolizer, Eve would die. Without being able to manipulate resources from the environment, Eve would not be able to maintain itself. Analogously, I would die if my digestive system failed to process food.[14]

The metabolizer's function is to ensure that metabolism occurs in Eve.[15] But Eve is not the product of natural selection. Synthetic biologists built Eve from scratch in the laboratory. Eve had no parents that passed down heritable traits to Eve. So, the case of Eve is one in which there is teleology but no natural selection. Therefore, it is a counterexample to any naturalistic analysis on which natural selection is necessary for teleology.[16]

Moreover, the case of Eve will actually occur. As I outlined earlier, there are compelling reasons to believe that synthetic biologists will, eventually, create minimal chemical lifeforms like Eve. It is only a matter of time. Therefore, one cannot soberly object that the case is unrealistic. It is eminently realistic.

A better objection to this proposed counterexample is that Eve's metabolizer has a function *merely* in virtue of the intentions of Eve's creators. The problem is not that Eve's metabolism fails to have a function. It does have a function. However, this function is grounded in the intentions of the synthetic biologists who create Eve. This is not the sort of teleology that is relevant to biology. This sort of teleology present in artifacts. A watch, for instance, has the function of telling time only because its creators intended it to tell time. So, Eve's metabolizer does not have the right sort of function—the biological sort of function that the value-free naturalist was concerned with in the first place.

Let us assume, for the sake of argument, that Eve's metabolizer does have a function—an "artefactual" function—in virtue of the

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[14] Where *p* is a part of organism *o*, the inference from '*p* does something *F* to keep *o* alive' to '*p* has the function of *F*-ing' is admittedly defeasible. But I find it intuitive enough that, *by default*, we should accept the inference. This default, of course, can be overridden.

[15] As is common knowledge among those who have studied biology in high school, mitochondria are the powerhouse of a cell!

[16] Holm (2012) and Holm (2013) have also argued that bottom-up synthetic biology presents a problem for accounts of teleology that appeal to natural selection. But my modal argument involving Eve and Steve, which I develop below in the main text, is novel.

creative intentions of Eve's designers. I reply that while Eve's creators do intend its metabolizer to ensure metabolism occurs and thus gives Eve's metabolizer an *artefactual* function, Eve's metabolizer also has a *biological* function that is independent of the intentions of Eve's creators. Both the metabolizer's artefactual function and biological function "aim at" the metabolizer's ensuring that metabolism occurs.

They are distinct functions. They have differing modal profiles.[17] To see this, imagine the following case. Alice is an expert synthetic biologist who has made hundreds of living protocells from scratch—from mere molecules—in the laboratory. But then Alice hits her head one day and consequently forms the false belief that the realizers of metabolism and the realizers of program have swapped roles. So, Alice now falsely believes, of what in fact plays the metabolism role, that it now plays the program role (and vice-versa). For instance, if x uses energy so as to fuel growth in a protocell, then Alice might believe that x stores information. But Alice otherwise retains her knowledge of how to synthetically build life. She still knows how to arrange molecules in such a way so as to create minimal chemical life.[18] She then synthetically creates a physical duplicate—an exact, particle-for-particle clone—of Eve. Call this duplicate 'Steve'. Steve's metabolizer intuitively has the *biological* function of ensuring that metabolism occurs. If Steve did not have a metabolizer, Steve would die. But Steve's metabolizer does not have the *artefactual* function of ensuring that metabolism occurs. After all, Alice did not intend Steve's metabolizer to ensure that metabolism occurs. If anything, Alice intended, of Steve's metabolizer, that it perform the program role.[19] Therefore, Steve's metabolizer has the biological func-

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[17] My argument is inspired by the (in)famous metaphysical argument that a statue and its constituent clay are distinct objects, since the clay may exist even if the statue does not. For a few defenses of the attendant view of material constitution, see Fine (2003), Oderberg (1996), and Wiggins (1968).

[18] This seems clearly possible. I might know how to build a house even if I mistakenly believe that doors are for letting light in and windows are for allowing people to enter, and leave, a house. I might put together a perfectly normal house and intend the doors to function as windows and the windows to function as doors.

[19] It is important to note that Alice has a d*e re* intention, of what is in fact Steve's metabolizer, that it performs the program role. This means that, whatever the metabolizer actually is, Alice intends, *of it*, that it perform the program role. After all, after Alice hits her head, she begins to believe, of whatever actually plays the metabolism role, that *it* plays the program role. Alice may have the *de dicto* intention that whatever plays the metabolism role plays the metabolism role, but this is unproblematic. I only require Alice's *de re* intention.

To see the distinction between *de re* and *de dicto* intentions, consider another case. A philosophy student may have the *de dicto* intention that her conclusion not be a premise, but still have the *de re* intention, of what is in

tion, but not the artefactual function, of ensuring that metabolism occurs.[20]

But since Steve is a physical duplicate of Eve, it is eminently plausible that Eve *could* have had all the properties that Steve has.[21] Therefore, Eve's metabolizer could have had the biological function, but not the artefactual function, of ensuring that metabolism occurs. If Eve's biological function and artefactual function of ensuring that metabolism occurs were the same function, then there would not be any modal differences between these functions.[22] But there is a modal difference—the biological function could have existed without the artefactual function. Therefore, Eve's metabolizer's biological and artefactual functions of ensuring that metabolism occurs are distinct.

What is crucial for our purposes here is that Eve's metabolizer has a biological function—distinct from its artefactual function—that is independent of the intentions of Eve's creators. This is plausible because Steve's metabolizer has a biological function that is independent of the intentions of Steve's creator, Alice. Even though Alice has no intention—of Steve's metabolizer—that it will ensure that metabolism occurs, Steve's metabolizer still has the function of ensuring that metabolism occurs. And since Eve is a physical duplicate of Steve, Eve's parts would have any "intention-free" biological functions that Steve's parts do. So, Eve's metabolizer has a biological function.

It may here be objected that I still have failed to show that Eve's metabolizer has a biological function at all. I have only asserted that Eve's metabolizer has a biological function in addition to its artefactual function. Why not believe that Eve's metabolizer *only* has an

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fact her conclusion, that it be a premise. When this happens, we say that the student has (unwittingly) made a question-begging argument.

[20] Why not claim that Steve's metabolizer fails to have the function of ensuring metabolism occurs, but instead functions *as if* it ensures metabolism occur? A rock may not have the function of being a chair, but it may function *as if* it is a chair. A relevant difference between the rock and Steve's metabolizer and the rock, however, is that someone must intend, of the rock itself that it function as a chair. On the other hand, Alice—and we may suppose, everyone else—never intended, of Steve's metabolizer, that it ensures that metabolism occurs. The rock has something like an artefactual function to serve as a chair, whereas Steve's metabolizer does not have an artefactual intention to ensure that metabolism occurs. A second relevant difference is that the rock, being inanimate, has no interests in any sense. There is nothing that is literally good for it. However, Steve, being alive, does have interests in some sense. There are states of affairs—like being in a nutrient-rich environment—that are literally good for Steve. Ensuring metabolism is literally good for Steve, whereas serving as a chair is not literally good for a rock.

[21] Ignore haecceities like the property of being Steve. Eve could have had all the non-haecceitistic properties of Steve. This is all I require.

[22] This is an application of Leibniz's Law. If x and y have different (modal) properties, then $x \neq y$.

artefactual function—a function somehow grounded in the intentions of Eve's creators?

I reply that it is *ad hoc* to insist that this is so. Steve's metabolizer has a biological function. As Eve is a physical duplicate of Steve, Eve is, intuitively, a clone of Steve. So if any of Steve's parts has a biological function, the default assumption should be that the corresponding part of Eve has a corresponding biological function.[23] Intuitively, the property of being an organism (Steve) with a part (Steve's metabolizer) with a biological function (ensuring that metabolism occurs) is an intrinsic property. I will assume this is so. But physical duplicates share all their intrinsic properties. Eve and Steve are physical duplicates. If Steve's metabolizer has the function of ensuring that metabolism occurs (in Steve), then Eve's metabolizer has the function of ensuring that metabolism occurs (in Eve).

Moreover, just as Steve's metabolizer reliably generates good effects for Steve by ensuring that metabolism occurs, Eve's metabolizer reliably generates good effects for Eve by ensuring that metabolism occurs. Steve's metabolizer helps keep Steve alive, just as Eve's metabolizer helps keep Steve alive. The fact that Steve's metabolizer, a part of Steve, reliably promotes that which is good for Steve provides us reason to believe that Steve's metabolizer has a biological function.[24] Analogously, then, we ought to say that Eve's metabolizer has a biological function on the grounds that Eve's metabolizer, a part of Eve, promotes that which is good for Eve.[25]

We also now have the resources to answer a final objection: Does Eve's metabolizer's playing the metabolizer role really fail to be the product of any selection? After all, humans created Eve with the intention that its metabolizer play the metabolizer role. These creators may be Eve's parents. And the traits they intended to give Eve (and succeeded in giving) may be the traits "inherited" by Eve. As John Basl and Ronald Sandler put the idea, artifacts' "parts were selected for, intentionally, because of the roles they play in achieving certain ends" (2013, p. 700). But if there is selection in Eve's case, then Eve is no counterexample to the thesis that teleology requires selection.[26]

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[23] After all, if my heart has the function of pumping blood, then it is eminently plausible that my physical duplicate's heart has the function of pumping blood. Just as I would die if my heart failed to pump blood, my physical duplicate would die if his heart failed to pump blood.

[24] So as Sandler notes, a "synthesised organism still has a good, and it is still a good of its own" (2012, p. 52).

[25] Why, after all, do we say that my heart has the biological function of pumping blood? It seems that its being a part of me and its regularly generating good effects for me are jointly sufficient for its having a function.

[26] Basl (2012) advances this objection. He would be happy to accept that a synthetic organism like Eve is not the product of natural selection. Basl denies that "the only aetiologies capable of grounding teleology…are natural selection etiologies" (2012, p. 544). But Basl insists that the relevant artefac-

Even granting this for the sake of argument, Steve is still a counterexample. Steve's metabolizer has the function of playing the metabolizer role. But no one intended Steve's metabolizer to play that role. So even on an expansive notion of selection, Steve's metabolizer's playing the metabolizer role was not selected for. Therefore, we still have a case of teleology without selection.[27]

There is good reason to believe that Eve's or Steve's metabolizer has a biological function. The only reason I see to deny this is a prior theoretical commitment to some value-free analysis of teleology.[28] But it would be question-begging to appeal to a value-free analysis of teleology in this way.[29]

3. The Value Argument

So, natural selection is not necessary for teleology. Is there any hope for *any* value-free, naturalistic analysis of teleology? Can teleology be appropriately naturalized without appealing to natural selection? I develop an argument in this section suggesting that the answer to these questions is 'no'.

Before I present the argument, we should remind ourselves what value-free naturalism amounts to. Value-free naturalism is the conjunction of the following two theses:

> *Naturalism:* "[E]verything real is…in principle within the scope of a purely scientific account of the world" (Bedau 1991, p. 647).

> *Value-free Realism:* All scientific facts are purely non-evaluative.

In particular, I wish to emphasize value-free realism. It implies that teleological facts are non-evaluative. So, according to this thesis, an

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tual etiologies "involve intentions on the part of the designer/user" (2012, p. 544).

[27] Therefore, as an anonymous reviewer put the point, appealing to Darwin's (1859) distinction between artificial and natural selection would not help the value-free naturalist here.

[28] As an anonymous reviewer pointed out to me, it is hard to reason with someone who will bite any bullet. I cannot convince anyone who is so committed to an etiological view on which teleology is reducible to selection that she is eager to say that Eve and Steve's metabolizers do not have functions. But this is not a problem specific to my argument. In the face of any genuine counterexample to her view, a dogmatist can always accept an absurd claim.

[29] That is, it would be question-begging to deny that Steve's or Eve's metabolizer lacks a biological function *solely* on the grounds that some value-free analysis of teleology (that appeals to natural selection) is true. After all, I am currently arguing that no such analysis of teleology is true.

accurate account of teleology is not concerned with the notion of what is good for a thing.

But we speak of what is good for living things all the time. We regularly speak of what is good for our friends and family, our pets, our plants, and much more. A balanced diet is good for a growing child, long walks are good for a dog, and regular sun exposure is good for a plant. We even speak of what is good for microscopic organisms. Aerobic bacteria are bacteria that require oxygen in order to survive. An environment rich in oxygen, then, is good for an aerobic bacterium. We have a notion of what is good for many—if not all—living things.[30]

Any part of any living system *S* has the biological function of *F*-ing only if (φ) *F*-ing is, *in and of itself*, good for *S*.[31] Call this 'the Teleological Conditional'.[32] According to the Teleological Conditional, my heart has the function of pumping blood throughout my body only if (φ*) pumping blood throughout my body is, in and of itself, good for me. So far, so good. My heart has the function of pumping blood throughout my body, and pumping blood throughout my body is—in and of itself—good for me.

Further support for the Teleological Conditional derives from the observation that nothing has the function to do something that is not, on the whole, good for a living thing. Take a human with a compromised immune system. Her immune system regularly fails to fight off harmful pathogens. But, surely, her immune system does not have the function of failing to fight off harmful pathogens. Intuitively, in fact, her immune system has the function of fighting off harmful pathogens. Her immune system is just failing to perform its function.

Consider, once more, my heart. Besides pumping blood, another behavior my heart regularly exhibits is that of making lub-dub noises. Its making lub-dub noises is, in and of itself, neither good nor bad for me. If my heart could pump blood just as well without making lub-dub noises, I would be indifferent as to whether or not it makes lub-dub noises. As it so happens, my heart's making lub-dub noises is

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[30] Bedau similarly argues that "value plays a role in…teleological explanations" (1992b, p. 805). Bedau is the most prominent defender of this view.

[31] This Teleological Conditional bears some similarity to Bedau's "first grade of teleology" (1992b, p. 787). But there are some differences. Bedau, for instance, states his first grade of teleology with a *bi*conditional. Ayala states something very close to the Teleological Conditional when he tells us that a "feature of a system will be teleological…if the feature has utility for the system…and if such utility explains the presence of the feature in the systems" (1970, p. 13). However, Ayala's claim is stronger than the Teleological Conditional. The Teleological Conditional does not require that a teleological feature explain its own presence.

[32] The name 'Teleological Conditional' is a misnomer since the statement is, strictly speaking, a universal generalization, not a conditional. But alas, the name 'Teleological Generalization' does not roll off the tongue as well.

a byproduct of the causal processes that must occur in order for my heart to pump blood. But, intuitively, my heart still does not have the function of making lub-dub noises. The Teleological Conditional can explain why this is so. It is false that making lub-dub noises is, *in and of itself*, good for me. So, the relevant instance of (φ) is false. It is to accommodate such cases—in which a thing *x* has some property as a mere byproduct of *x*'s performing its function—that (φ) appeals to the notion of what is good, in and of itself, for a living system.

Functions, then, are evaluative in nature. They are value-laden. A thing has a function only if it does something that is *good* for the living system of which it is a part. This seems to be constitutive of our very concept of a function. But recall that value-free naturalism is committed to value-free realism, the thesis that all scientific facts are purely non-evaluative. So, according to value-free naturalism, a purely scientific account of the world need not appeal to teleology at all. But biology is a scientific discipline that often appeals to the concept of teleology.[33] I conclude that value-free naturalism is false.

This argument relies on the Teleological Conditional. But perhaps there is a counterexample to the Teleological Conditional? Suppose that a man is being horrendously tortured and has no chance of escaping. Let us grant, for the sake of argument, that his suffering is so extreme, that living is not, all-things-considered, good for him.[34] His heart's pumping blood is thus not good for him. This, after all, helps keep the man alive. But his heart intuitively still has the biological function of pumping blood. The man's terrible suffering cannot strip his heart of its function. But then we have a case in which something (the man's heart) has a function that is *not* good for the living system (the man).[35]

This case may initially seem to spell doom for the Teleological Conditional. But the case is no counterexample if the Teleological Conditional only appeals to the notion of a pro tanto good, and not an all-things-considered good.[36] On this understanding of the Teleological Conditional, it states the following: Any living system *S* has the

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[33] For instance, introductory biology textbooks tell us facts like this: "[B]lood delivers nutrients and removes wastes throughout an animal's body. These *functions* are made possible by the circulatory system" (Campbell and Reece 2005, p. 874, my emphasis).

[34] If it is impossible for death to constitute an all-things-considered good, then this case is no counterexample to the Teleological Conditional. Of course, I would welcome this result.

[35] Thanks to an anonymous referee for suggesting this seeming counterexample to me.

[36] Bedau, a teleological realist, also claims that the goodness present in teleology is pro tanto, not all-things-considered: "[T]he goodness of Cing implies merely that Cing confers *a* good, not that Cing is best overall…So the value analysis requires, not that Cing confers…the best good, but only that Cing confers *some* good" (Bedau 1992b, p. 791, his emphasis).

biological function of *F*-ing only if (φ) *F*-ing is, in and of itself, a (pro tanto) good for *S*. Importantly, pro tanto goods need not be all-things-considered goods. In the case of the tortured man, his heart's pumping blood is a pro tanto good, but not an all-things-considered good. Being alive is a substantial (pro tanto) good for an organism, but the tortured man is in an unusually gruesome circumstance in which death is his all-things-considered good.

At this point, a different objection may be raised: The notion of what is good for an organism is mysterious or arbitrary. Basl and Sandler suggest something like this objection:[37]

> Still, in order to make the case that non-sentient organisms have a good of their own, an account of what grounds their good needs to be provided…If there is no explanation, then any assertions about what is good or bad for them are arbitrary (Basl and Sandler 2013, p. 698).

This objection, however, attacks a strawman. The teleological realist's position is *not* that facts about what is good for an organism are ungrounded. Some teleological realists may make this further leap, but it is not a necessary doctrine of teleological realism. What is central to teleological realism is only that the notion of biological function is to be understood in terms of what is good for an organism. Teleological realism, then, constitutes a value-first approach to teleology. Teleological realists can disagree about what grounds facts about what is good, or even whether such facts are grounded at all. A lengthy investigation into what the best version of teleological realism, however, is simply outside the scope of this paper. Thankfully, the burden of proof is on the value-free naturalist to show that *any* possible version of teleological realism is committed to the claim that facts about what is good for an organism are arbitrary.

But perhaps the value-free naturalist is instead asking for *some* guidance as to what the good of an organism is.[38] This is not a demand for an analysis, but a demand for some grasp of the notion. This is a fair demand. We can talk about something even if we do not have an analysis of it just yet.[39] But we are in luck in the case of teleology. The following remarks by Bedau give us some grasp of the notion of goodness relevant here:

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[37] Just to be clear, Basl and Sandler (2013) do not explicitly raise this objection against teleological realism in particular.

[38] Thanks to an anonymous reviewer for pressing me to clarify the notion of an organism's good.

[39] For a discussion of why it is unproblematic for the teleological realist if the notion of goodness is vague, see Bedau (1992b, pp. 792-793).

> [T]he theory of teleology appeals not to specifically ethical values but to goodness—the idea that certain entities have interests (independently of any interests of third-parties) that are prompted by certain kinds of states of affairs. For the plant, water is not right or just or fair but simply good; it makes it better off. Biological teleology might presuppose that circumstances can make plants more or less healthy and can affect the degree to which they flourish, but it is not so controversial that these matters are matters of fact discoverable by empirically investigating the natural world (Bedau 1992a, p. 47).

What is good for an organism furthers its interests.[40] It is in a plant's interests that it receive enough sunlight to survive; it is not in a plant's interests to die from dehydration. Any substantially deeper explanation of what is good for an organism will no longer be neutral between differing views (available to teleological realists) of what is good for an organism.[41]

We should acknowledge that the interests of organisms may conflict. For example, reproduction and survival may conflict. Sometimes, reproduction wins out. In semelparous species (species where reproduction occurs once and is followed by death), the cause of death is extremely high levels of glucocorticoids (Romero and Butler 2007, p. 93). Such species produce high levels of glucocorticoids during mating in order to catabolize—or break down—proteins. Presumably, this helps semelparous species to sustain the mating effort (Oakwood et al. 2001, p. 407). Glucocorticoids are produced in the organism's adrenal cortexes (Romero and Butler 2007, p. 91). Then it seems that one of the functions of adrenal cortexes in semelparous species is to produce lethally high levels of glucocorticoids during mating. This is still in the interests of the organism. If it helps, recall that our teleological account merely appeals to pro tanto good. Producing extremely high levels of glucocorticoids can constitute a pro tanto good, as this helps the organism reproduce. Enhanced ability to reproduce constitutes a pro tanto good. But perhaps this is not an all-

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[40] Regan (1976, p. 487) carefully distinguished between having an interest in something and taking an interest in something. The latter requires a mind, whereas the former—so I claim—does not. A plant can have an interest in sunlight even if it does not *take* an interest in sunlight. It is in a plant's interests that it receive enough sunlight, but plants plausibly do not have minds.

[41] Some value-free naturalists, like Basl and Sandler (2013), may be tempted to analyze facts about what is good for an organism in terms of facts about selection. But given my arguments in §2, this strategy is incompatible with teleological realism. Biological functions are not to be understood in terms of selection. But given teleological realism, biological functions are to be understood in terms of an organism's good.

things-considered good for the organism, as such high levels of glucocorticoids are lethal. No matter: This is compatible with the teleological realist's position.

Let us return to my argument, which I call 'the Value Argument', against value-free naturalism. Just to be explicit, it is as follows:[42]

1. There is at least one biological fact stating, of some $part_1$ of some organism, that it_1 has a biological function.
2. If value-free naturalism is true, then no biological fact states, of $something_2$, that it_2 has an evaluative property.[43]
3. All biological functions are evaluative properties.[44]
4. Therefore, value-free naturalism is false.

The Value Argument is deductively valid.[45] If the three premises are true, then the conclusion must also be true.

Premise (1) is plausible because we speak of the biological functions of organisms' parts all the time. It is commonplace to say, for instance, that the function of the heart is to pump blood. A philosophical view on which all such talk is erroneous would be prohibitively revisionary in its ambition. Premise (2) is plausible because of value-free naturalism's commitment to value-free realism. Value-free realism straightforwardly implies that any biological facts would not appeal to any evaluative notions. Premise (3) is true because the Teleological Conditional is true. Recall that the Teleological Conditional states that any part of any living system S has the biological function of F-ing only if F-ing is, in and of itself, good for S. And I have already raised reasons to accept the Teleological Conditional.

The three premises, then, each seem true. So it seems that we are forced to accept the Value Argument's conclusion, (4). But (4) simply states that value-free naturalism is false.

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[42] Here, I use subscripts in order to make it unambiguous what I use pronouns to refer to. For example, in 'John and $James_3$ ate cake, but he_3 would have preferred pie', the pronoun 'he' refers to James, not John.

[43] I intend the *de re* reading of premise (2), which states that if value-free naturalism is true, then there is no biological fact stating that something has a property that, as a matter of fact, happens to be an evaluative property.

[44] I assume that biological functions are properties. It is not clear that this is strictly speaking correct, but the simplifying assumption that functions are properties makes it easy to state this argument. Nothing of substance rests on this simplifying assumption. If functions are not properties, premises (2) and (3) of the Value Argument need only be slightly reworded.

[45] Cameron (2004) argues for a similar conclusion, but he appeals to strong emergence. I wish to remain neutral as to whether strong emergence exists. And I can: Perhaps some complex microphysical facts count as evaluative. For a vision of a naturalism that can, in principle, accommodate this, see §4.

For the rest of this section, I will consider objections to the Value Argument. As premises (1) and (2) are uncontroversial, I will consider objections to premise (3), the claim that all biological functions are evaluative in nature. All of the objections I will consider propose a value-free analysis of biological teleology in terms of non-evaluative, naturalistic notions. If any such analysis were true, then teleology would, strictly speaking, be nothing above and beyond such non-evaluative, naturalistic notions. Hence, no biological functions would be evaluative in nature. Premise (3), as well as the Teleological Conditional, would be false.

The most prominent proposed analyses of teleology in terms of non-evaluative notions appeal to natural selection. But, as we have already seen in §2, natural selection is not necessary for teleology. There can be teleology without natural selection. Therefore, any analysis on which natural selection is necessary for teleology is false.[46]

Another proposed analysis is that the function of x is to F iff both (i) x regularly F's and (ii) x's F-ing causally contributes to x's continuing to F.[47] On this analysis, the function of the heart is to pump blood iff (i*) the heart regularly pumps blood and (ii*) the heart's pumping blood tends to cause the heart to continue pumping blood. Indeed, the function of the heart is to pump blood, (i*) the heart regularly pumps blood, and (ii*) the heart's pumping blood tends to cause the heart to continue pumping blood. By pumping blood, the heart causes some circumstances to arise that allow the heart to continue pumping blood. On this view, functions are self-sustaining. What is wrong with this analysis?

Let us give the naturalist the stick. Bedau has developed a case in which something (a stick) is in a state (staying pinned to a rock) in such a way that causally contributes to its remaining in that state:[48]

> [S]omething that is not teleological might neverthe-less have an etiology like the heart's. Consider a stick floating down a stream which brushes against a rock and comes to be pinned there by the backwash it creates. The stick is creating the backwash because of a number of factors, including the flow of the water, the shape and mass of the stick, etc., but part of the explanation of why it creates the backwash is that the stick is pinned in a certain way on the rock by the

[46] And it seems right to be skeptical of any "disjunctive" analysis on which natural selection plays a role in only one disjunct in the *analysans*. Why would natural selection only sometimes contribute to teleology?

[47] This is Wright's (1976, p. 39) analysis of biological teleology. I have re-worded it for simplicity's sake.

[48] Bedau (1991, p. 648 fn8).attributes the case to Robert Van Gulick.

water. Why is it pinned in that way? The stick origi-
nally became pinned there accidentally, and it re-
mained pinned there because that way of being
pinned is self-perpetuating. Therefore, once pinned,
part of the explanation for why the stick is creating
the backwash is that the backwash keeps it pinned
there and being pinned there causes the backwash. In
this case, the stick meets the etiological conditions:
creating the backwash tends to pin the stick on the
rock and the stick creates the backwash because do-
ing so contributes to pinning it. Clearly, however, the
stick does not create the backwash *in order to* keep
itself pinned on the rock. The stick's behavior has no
teleological explanation (Bedau 1991, p. 648).

Both (i**) the stick is regularly pinned to the rock and (ii**) the
stick's being pinned to the rock generates a backwash, which keeps
the stick pinned on the rocks. But, intuitively, the stick does not have
the function of staying pinned to the rock. This is a counterexample to
the sufficiency of (i) and (ii) for biological teleology.[49] But can the
value-free naturalist revise her analysis so as to get the result that the
heart has a function and the stick does not?

The value-free naturalist might reply that there is a relevant
difference between the case of the stick and the case of the heart. The
stick is not part of a living thing. A human heart is. Intuitively, only
parts of living things can have biological functions. The naturalist
may then insist that *x* has the function to *F* iff (i) *x* regularly *F*'s, (ii)
x's *F*-ing causally contributes to *x*'s continuing to *F*, and (iii) *x* is part
of a living thing.

But this analysis is false. A close variant of Bedau's stick ex-
ample serves nicely as a counterexample. Imagine that, instead of a
stick, a branch of a big tree is pinned to the rock and generates a
backwash that keeps it pinned there. We may suppose that branch
used to hang above the rock but that, over the course of a few years,
the branch became so heavy that it fell into the water and became

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[49] A slight variant of the case is a counterexample to organizational accounts
of teleology, whereby "self-maintenance is sufficient for teleology" (Holm
2012, p. 538). Here, "self-maintenance is characterised as a property of sys-
tems that are able to exert a causal influence on their surroundings in order to
maintain…the boundary conditions required for their own existence" (Holm
2012, p. 537). Suppose the stick would be destroyed if it were not pinned to
the rock. So, the stick is a self-maintaining system. But then it seems organi-
zational accounts are committed to the absurd claim that the stick is a teleo-
logical system. But neither the stick nor any of its parts has any biological
functions. Relatedly, Basl (2012, p. 546, fn 10) points out that Holm's organ-
izational account is committed to the—in my view, absurd—claim that hur-
ricanes and candle flames count as teleological systems.

pinned to the rock. The current is strong enough—and the branch long enough—so that, if the branch were not pinned to the rock, the branch would be much further down the stream. So, (i***) the branch is regularly pinned to the rock, (ii***) the branch is pinned to the rock in a way that generates a backwash that keeps the branch pinned to the rock, and (iii***) the branch is part of a living thing—the tree. But the branch, intuitively, does not have the function of staying pinned to the rock. Therefore, we have a counterexample to the sufficiency of (i), (ii), and (iii) for biological teleology.

So far, I have considered a few objections to premise (3) of the Value Argument, which states that all biological functions are evaluative in nature. All of the value-free analyses of teleology I have considered here fail. So, what is a value-free naturalist to do?

She cannot simply assert that (3) is false *because* value-free naturalism is true. This is to blatantly beg the question, since the Value Argument's conclusion is that value-free naturalism is false. So, the value-free naturalist must provide some independently motivated reason to believe that (3) is false. The question is: How is she to do this?[50]

Admittedly, I have only considered a few analyses here. Isn't it possible that I have simply failed to consider the best analysis that a value-free naturalist could conjure up?[51]

Indeed, I leave it as an open strategy to the value-free naturalist to develop an account on which all biological teleology is understood in purely non-evaluative terms. This, I believe, is the project she should pursue. I invite the value-free naturalist to try to develop a value-free analysis of biological teleology that avoids the counterexamples I have developed so far. If such an account is developed, we will just have to continue this familiar philosophical game of counterexample, revision, counterexample. For what it is worth, I am skeptical that the value-free naturalist can ultimately succeed. I confidently believe in the Teleological Conditional: Any part of any living system *S* has the biological function of *F*-ing only if *F*-ing is, in and of itself, good for *S*. And if the Teleological Conditional is true, then any account of teleology must go through evaluative notions.

Perhaps, however, the value-free naturalist has a more revisionary project in mind. Perhaps she does not wish to analyze our

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[50] And we must weigh the advantages of accepting any such analysis against the intuitive appeal of the Teleological Conditional. The Teleological Conditional supports premise (3) of the Value Argument. The value-free analyses we are considering are posed as objections to (3). Accepting such an analysis requires rejecting the Teleological Conditional, and this is, in my view, a substantial cost to pay.

[51] For critical discussion of "mentalist" analyses of biological teleology by a teleological realist, see Bedau (1990). For critical discussion of "systems" analyses by a teleological realist, see Bedau (1992a).

pretheoretic notion of teleology, but instead wishes to replace it altogether with a notion that is wholly non-evaluative in nature. Such a revisionary project would replace our ordinary, everyday notion of teleology with a much different one. It would replace an evaluative notion with a non-evaluative one.

To a value-free naturalist advancing such a project, I have two things to say. First, she should make it explicit that she is engaged in a revisionary philosophical project. Such a revisionary project is much different than a more conservative project. Revisionary projects seek to replace our ordinary notions, whereas conservative projects seek to better understand our ordinary notions so that we may use them more wisely.

Second, I doubt that the non-evaluative notion that such a project comes up with should entirely and always replace our pretheoretic notion of biological teleology. This non-evaluative notion is very unlikely to be what laymen—or biologists, for that matter—have in mind when they attribute functions to parts of organisms. Therefore, if we insist that all talk about biological teleology is to *always* be understood as talk about this non-evaluative notion, then a significant proportion of our beliefs about teleology would turn out to be systematically false. After all, does it not seem commonsensical that (I) the fact that my heart has the function of pumping blood is, at least partly, grounded in (II) the fact that my heart's pumping blood is (pro tanto) good for me? The unwelcome result that large swathes of our ordinary beliefs turn out to be false is a significant cost of any thoroughgoing revisionary project. I do not find the cost worth it in this case, but I happen to place significant weight on our pretheoretic beliefs and intuitions.

I see no easy way to convince you to weigh the costs and benefits of a theory as I do. But if this is the source of our disagreement, then it is important to flag it. A lengthy discussion on philosophical methodology is outside the scope of this paper. I will just assume here that, as Saul Kripke puts it, a claim's "intuitive content…is very heavy evidence in favor of [it]" (1980, p. 42).

4.   Conclusion

Value-free naturalism is in trouble. Not only have I argued that the natural selection is unnecessary for biological teleology, I have also argued directly for the falsehood of value-free naturalism.

Where does this leave us? Must we forgo all of naturalism? Must we welcome back vitalism with open arms? Must we take the mystical to be just as real as the physical? Must we posit ghostly entities that are no longer within the purview of the sciences?

No. We can salvage naturalism's claim that everything real can be studied by the sciences. We need only to admit of value among that which exists in nature. The arguments of this paper pose no prob-

lem for a more inclusive naturalism that forgoes value-free realism. Value-free realism is the source of value-free naturalism's ills. It is a philosophical prejudice that unnecessarily constrains the sciences. It is a functionless dogma.

The biologist J.B.S. Haldane is said to have lamented that "[t]eleology is like a mistress to a biologist: he cannot live without her but he's unwilling to be seen with her in public" (Mayr 1988, p. 63). Let us rectify this situation by making the relationship public. Genuinely value-laden teleology is a subject of biology. Naturalists should learn to live with this.

Bedau paints a clear picture of the sort of naturalism which I wish to endorse here:[52]

> These difficulties with naturalistic accounts of biological teleology arise specifically for the narrow naturalism that banishes "transcendent standards of value" from nature. But naturalists need not be narrow. A broader view of nature, perhaps roughly Aristotelian in outlook, could reckon objective standards of value as part of the natural order. According to this broader form of naturalism, which would contrast with supernaturalism and would reject the miraculous in nature, values would be real…natural properties, subject to broadly scientific investigation. Making sense of this broadly construed naturalism might enable the many attractions of a naturalistic treatment of biological teleology to be realized (1991, p. 655).[53]

If we naturalists release ourselves from the yolk of value-free realism, then we may embrace a naturalism that presents a rich view of a world chockfull of both the value-free and the teleological.[54] This inclusive naturalism is the *only* kind of naturalism we ought to subscribe to. This is a functional naturalism for teleological realists.[55]

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[52] Bedau (1991) seems to defend a teleological realism on which value is irreducible. While I am sympathetic to this view, I do not wish to commit myself to it here.

[53] For one helpful discussion of Aristotle's views on teleology, see Cameron (2010).

[54] One interesting upshot of such a naturalism concerns Teleological Individualism, "the view that organisms…are…goal-oriented systems while biological collectives…are mere assemblages of organisms" (Basl 2017, p. 1058). Basl (2017) argues that Teleological Individualism is incompatible with etiological accounts of teleology. So, it may be good news for Teleological Individualism that etiological accounts are false. Proponents of Teleological Individualism are better off accepting teleological realism.

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