Despite eschewing the utility of ends or purposes in natural philosophy, Descartes frequently engages in functional explanation, which many have assumed is an essentially teleological form of explanation. This article considers the consistency of Descartes’s appeal to natural functions, advancing the idea that he is utilizing a non-normative, non-teleological form of functional explanation. It will be argued that Cartesian functional analysis resembles modern causal functional analysis, and yet, by emphasizing the interdependency of parts of biological systems, is able to avoid many of the problems attendant upon modern causal theories. It is for this reason, if no other, that the study of Descartes’s natural philosophy should be of interest to contemporary theorists of functional analysis.

1. Introduction

[Mechanists] make the world to be nothing else but a heap of dust, fortuitously agitated, or a dead cadaverous thing, that hath no signatures of mind and understanding, counsel and wisdom at all upon it . . .

[Ralph Cudworth, 1678: 147]

It is difficult to envisage a satisfactory form of biological explanation that does not make use of the notion of function. In the Aristotelian tradition the notion of function was tied to that of a final cause or that ‘for the sake of which’ a thing is or comes to be, and although there was a fairly healthy debate during the Middle Ages about how something final could also be a cause, there was widespread agreement that functional explanations made no sense without reference to purposes or ends. Although purporting to reject the idea of finality as a proper part of physics or natural philosophy, Descartes frequently employs functional explanations, particularly when accounting for the structure and behaviour of organic bodies. Indeed, the terms ‘function’ (fonction) and ‘use’ (l’usage; utilius) are ubiquitous in Descartes’s texts. The question to be considered here is whether Descartes’s

References to Descartes’s texts are from Oeuvres de Descartes, 11 volumes, edited by Charles Adam and Paul Tannery, 1897–1913, hereafter ‘AT’. Unless otherwise specified, translations are my own. In the Meditations the functions of sensations and passions are defined by their contribution to ‘the conservation of the healthy human’ [AT 7: 87–88]. The Passions of the Soul offers a finer-grained account of these functions, relating them to the body, the soul, and the whole human being [AT 11: 331–3; 342; 351; 359]. The organs of the human body are defined by their functions: ‘that which we call, for example, the arm or hand of a man is
use of such terms is consistent with his opposition to teleological explanations in natural philosophy.

I have framed this question with reference to a specific historical figure, Descartes, but the issues raised concern not just this distant moment in the history of philosophy. Descartes is the transitional figure between the Scholastic worldview, in which the divisions within nature were more or less congruent with common sense, and modern physics, in which the categories of ordinary experience have no obvious role to play. Descartes is also the transitional figure between a physics incorporating the ends of God into the very structure of material beings themselves, as things strive through their forms to be the very things they are in accordance with the intentions of God, and a more secular approach to physics, governed ultimately perhaps by God but through the medium of laws of motion and impact which are in themselves indifferent to the kinds of arrangements of matter they produce. On this modern picture, there is no apparent reason to suppose that nature is imbued with purpose, that the heart should form as it does so as to pump blood or that the bird should collect sticks so as to build a nest. The question of what entitles us to speak of these as functions is the driving force behind much of modern evolutionary theory, but such theoretical developments postdate Descartes and Descartes has, or so I shall argue here, his own way of settling such questions. This paper follows in the wake of several interesting discussions related to functions and finality in Descartes’s natural philosophy. Dennis Des Chene [2001] has deftly articulated the problems facing any attempt to reconcile Descartes’s functional language with the rejection of substantial forms and final causes. With the exception of the human being, which is matter ensouled by a rational being with purposes and an understanding of God [AT 7: 85–9; AT 4: 166–7], there is nothing else in nature which can, Des Chene argues, legitimately be said to have a function. Des Chene [2001: 11] suggests further that although of animals and plants,

Descartes can hardly avoid referring to the functions of their organs and operations . . . there is no locus for ascribing ends to them except in God: yet his ends are inscrutable. The functional language that, like his opponents, Descartes uses to describe living things can be explicated only as a projection of human intentions onto a nature devoid of them.

Des Chene’s reading echoes that of Richard Rorty, who argued that any divisions in Descartes’s res extensa between kinds or individuals consists in nothing more than projections of our conceptual distinctions onto an undifferentiated nature [Rorty 1956: 251–3]. Other scholars are more inclined to take these divisions in res extensa as real and read Descartes as modifying his mechanical philosophy to make sense of them. André Pichot [1993: 344–5] argues that Descartes’s use of
'fonction' signals a departure from a strictly mechanical philosophy, since, in resorting to functions, Descartes presupposes finalité. Others adopt a weaker position, arguing that Descartes recognises the necessity for theorizing about the processes of organic development in a ‘design context’ or of accepting some form of mitigated teleology. For some, this is teleology naturalized. Gary Hatfield [2008: 412–13] argues that Descartes’s rejection of final causes signals only a rejection of extrinsic finality, according to which God’s intentions fix the functions of things, leaving it open for him to embrace intrinsic or immanent finality, according to which the functions of things emerge blindly from the operations of the laws on the primordial soup and can be articulated without reference to the intentions of God. Descartes need not, on this reading, be committed to the view that future or possibly non-actual states or outcomes are the direct causes of the parts and processes of organic beings (‘end-state caused’ teleology). Rather, the functions of things are determined through a process of natural selection (‘end-state selected’ teleology). Where ‘a previous tendency to produce a certain end-state causes a type of thing or mechanism to exist now’ there we may ascribe a function [2008: 413]. Hatfield sees some evidence of selectionism in Descartes’s cosmogony in so far as it entails that through the operation of the laws matter assumes all the forms of which it is capable [AT 8A: 103]. Which forms survive and which die out is presumably, therefore, a matter of which forms are adaptive and which not. Hatfield appeals to selection to explain why it is that the parts of organic bodies have functions for Descartes: ‘Hearts exist because they pump blood. Their immanent end is pumping, because they have been blindly selected for doing that’ [Hatfield 2008: 413].

There are lessons to be learned from these discussions. As will be developed below, the neo-teleological reading is right to think that Descartes’s use of function is intended to be genuinely explanatory—functional explanations are not simply ‘extrinsic denominations’—but capture why it is the case that independently of us some arrangements of matter exist and persist. Whether this phenomenon is best explained by the kind of etiological theory developed by Hatfield is less clear. Selection occurs when traits are adaptive to their environments, and through reproduction of heritable traits, whereas the kind of functional interrelationships Descartes describes are typically established prior to and independently of this, for example, in the embryological development of an individual. There may be a way to modify what we mean by ‘selection’ to cover such cases, but, in the absence of such a modification, the account will

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2Some scholars think that the ‘design context’ extends beyond biology to the whole of physics. Margaret Osler [1996: 389] notes that Boyle read into Descartes’s conservation laws suppositions about God’s design. She herself reads Descartes as rejecting the ‘immanent teleology’ of the Scholastics, according to which the final causes of things are in nature, while preserving ‘extrinsic teleology’ which identifies the finality of nature with God’s purposes. See also Machamer [1976], Karen Detlefsen [2001], Gary Hatfield [2008], and Alison Simmons [2001] are more interested in how design figures in the explanation of organic development or physiological explanation. Among the latter group there is a tendency towards a view opposite to Osler’s, namely, that Descartes rejected extrinsic teleology in favour of immanent teleology.

3There were precedents for this way of thinking. Hatfield [2008: 414–15] identifies Lucretius’s On the Nature of the Universe as one. A more direct source is Aristotle [Physics, I.8, 198b28–32] who attributes the idea to ancient materialists such as Empedocles.
persist in getting things backwards. The mechanisms Descartes describes do not have functions because they are selected for; they are selected for because they have functions.

Critics who, on the other hand, are more dubious of Descartes’s functional analyses are right to draw our attention to the obstacles facing any attempt to make sense of them. One particularly pressing problem is what Des Chene [2001: 132] refers to as the ‘boundary problem’, that of accounting for the individuation of an organic body (a problem traditionally solved through the notion of a substantial form). In general, the problem is that for a thing to have a function it must have a function for something, something that is differentiated from its surrounding matter. My heart does not pump blood for the entire universe; it pumps blood for me. The particular form this problem takes for Hatfield is that ends-selection assumes that ‘types of organisms, with heritable structures, form recognizable natural kinds that possess organic integrity’ [2008: 415]. Selectional forces operate on whole organisms in virtue of their adaptive traits, and although Hatfield [ibid.: 416] documents a variety of places in which Descartes helps himself to organic and other macroscopic kinds and individuals, there is no metaphysical justification for his supposing such divisions in res extensa. The problem is particularly acute for Descartes’s physiology because the one principle he uses to individuate bodies for the purposes of physics—that ‘one body’ is matter which moves with a common motion [Principles of Philosophy, II.25; AT 8A: 53–4]—is unsuitable for organic bodies which do not consist in the same matter (or the same motion) over time.

A further problem facing any attempt to make metaphysical sense of Descartes’s use of ‘function’ relates to the implicit normativity of functional attributions. To say that x has the function F seems to imply that x should or ought to do F, and when x fails to do F, there is some error on x’s part. In the Sixth Meditation, Descartes asserts that attributions of error to bodies result largely from comparisons we draw between natural bodies and artefacts, which have ends derived from our purposes [AT 7: 84–5]. Stephen Gaukroger [2000: 399] urges that with the exception of the human case, any presupposition of intrinsic goals is out of place in Descartes’s natural philosophy. By comparison, Hatfield [2008: 425–6] is inclined to discount Descartes’s remarks in the Sixth Meditation, lest it follow, he says, that death has no reality. It might be possible to occupy some middle ground

4 Godfrey-Smith [1994: 358] distinguishes ‘originating selection’ of traits through reproduction over generations from ‘maintaining selection’ of traits which contribute to the fitness of an individual during its lifetime.

5 A similar critique is levelled against modern etiological theories of function in Cummins [1975: 750]. Cummins [2002] argues further for the decoupling of function from selection and adaptiveness, noting, in particular, that selection requires variation in heritable traits, whereas function does not.

6 As one referee noted, this invites us to consider what, if anything, individuates Cartesian bodies. I read Descartes as holding that there are infinitely many individual bodies really distinct from each other (in line with a literal interpretation of Principles, I. 60 [AT 8A: 28–9]), but cannot defend this here. For a persuasive argument in favour of pluralism, see Normore [2008].

7 Detlefsen [2001: 83] also takes Descartes’s references to the well or ill-made artefact or body to ground a distinction between things that fulfil their functions ‘as designed machines’ and those that don’t, even though both equally obey the laws of nature. Des Chene [2001: 135] argues that bodily well-functioning can only be ascribed relative to God’s ends.
Lisa Shapiro [2003], for example, defends a non-teleological distinction between the normal and the pathological in Descartes’s natural philosophy. She notes correctly, however, that the success of accounting for the distinction in mechanistic terms depends first and foremost on the success of defining biological functions (and, more generally, ‘living things’) in mechanistic terms [ibid.: 423, n.3].

I shall proceed by outlining what Descartes’s rejection of finality amounts to and the ways in which he diverges from the Aristotelian tradition. I then draw on the causal theory of functions to develop an account of Cartesian functions. Although the causal theory is limited, particularly in relation to the boundary problem, I see a potential solution in Descartes’s recognition that things with functions stand in relations of reciprocal dependence. In the final section I reconsider Descartes’s rejection of normativity in nature, arguing that while it is possible to make sense of the distinction between the normal and pathological, it does not follow that there are purposes in (non-human) nature.

2. Descartes’s Rejection of Final Causes

A cornerstone of Aristotelian thought was the idea that it is necessary to conceive of natural processes as purposive in order to explain why regularities occur in nature. At Physics, II.5. Aristotle introduces the notion of final cause in addressing the question of whether or not chance is a cause. In things that happen ‘always or for the most part’ chance cannot be a cause, he argues, for if it were, we would see nothing but random variation. Generation, nourishment and reproduction are processes that have as their end the perfection and reproduction of the organism’s form [Physics II.199a9–18]. It is by reference to the final causes of things, moreover, that functions are defined. A hand or eye considered apart from its role in perfecting a living body is not a hand or eye except homonymously [Parts of Animals, I. 640b35–641a14]. Finality implies normativity. Pathological conditions, such as monstrous births and disease, constitute ‘failures in the purposive effort’, failures in the normal development or perfection of a form [Physics II.8, 199b4].

To say that Descartes rejects the doctrine of final causes outright is too quick. His commitment to God as the first cause of everything entails that every action in nature is subordinated to the actions and will of God [AT 7: 49–50]. Embracing the idea that God has purposes for nature does not, however, require us to factor them into the scientific explanation of nature. Descartes offers three arguments: (a) an argument against the knowability of God’s intentions [AT 7: 55; AT 8A: 81; AT 4: 292], (b) an argument denying that God’s intentions represent a kind of causality distinct from efficient causality [AT 8A: 15–16], and (c) an argument

8Other non-teleological readings include Stephen Gaukroger [2000], who holds that apparent teleological processes are subject to a strict mechanical reduction, and Annie Bitbol-Hespérès [2000] who holds that functions like the circulation of the blood are construed by Descartes without reference to vital, goal-directed forces such as those conceived by Harvey.
denying that anything incapable of cognition can move for the sake of an end. It is for this last reason that Descartes denies the Scholastic theory of *gravitas*, according to which bodies have a property (heaviness) that propels them to the centre of the earth. For Descartes, such inclinations presuppose cognition, which bodies essentially lack [AT 7: 442; AT 3: 667–8]. The laws of mechanics provide a sufficient explanation for the behaviour of bodies, living and non-living, and can be explicated without reference to ends [AT 8A: 62–3; 314–15]. In the letter to Mersenne of October 28, 1640, in response to criticisms from Father Lacombe, Descartes [AT 3: 213] writes:

I am able to conceive of these natural inclinations only in a thing which has understanding, and I do not attribute them even to animals without reason; rather, I explain everything in them that we call natural appetites or inclinations, solely by the rules of mechanics.

The rejection of finality does not, however, mean that we should embrace chance or fortune as a cause. The motions of bodies are law-governed and we can be assured that there is a providential order. ‘Providence’, he writes, is ‘like a fate or an immutable necessity which it is necessary to oppose to Fortune in order to destroy it like a chimera . . . for this opinion is founded only on our not knowing all the causes which contribute to each effect’ [AT 11: 438]. Thinking that what happens in nature happens by chance is simply ignorance [AT 4: 415]. The idea of Providence combines the idea of natural necessity and the idea that everything happens for the best. We can rest assured that whatever happens has been willed by God and is, therefore, good, but the normativity implied by this has no place in an explanatory physics.

What entitles Descartes to hold that there is order and goodness in all things while (a) upholding natural necessity and (b) denying the legitimacy of assumptions about God’s purposes in physics? Gassendi presses Descartes on exactly this point: if it is hubris to investigate God’s intentions, then we cannot assume a providential order, but if we can be assured of a providential order *through observation*, then, by the same means, we can know God’s purposes [AT 7: 310]. Gassendi argues further that Descartes will be hard pressed without final causes to understand ‘organic structures’ or their functions since ‘no mortal is able to understand nor explain what agent forms and organizes those valves which are constituted in the openings of the vessels in the chambers of the heart in that which we now observe’ [AT 7: 309]. This is an instance of a kind of objection commonly aimed at the mechanists, that without being able to attribute *reasons* to nature it will be impossible to understand why living things develop as they do.

Descartes’s reply to Gassendi is predictably dismissive. Conjectures about purposes belong to ethics, not an exact science like physics, and in any case natural efficient causes, such as those which explain the arrangement of the valves of the heart, are easier to know than God’s purposes. ‘Nor is it possible to suppose that some ends of God more than others are in public
display for they are all hidden in the same way in the abyss of his inscrutable wisdom’ [AT 7: 375].

We are now at the heart of the matter. The pull Descartes’s opponents felt towards the doctrine of final causation lay in its promise of explaining the regularity and order of organic forms, a conduit to the divine plan. We explain the formation of the valves of the heart—why there is that formation rather than some other or none at all—by reference to the contribution each makes to the proper functioning of the heart and to the organism as a whole. Why else would the corpuscles of the animal body form themselves in exactly this way, and repeatedly so throughout the species, and preserve that form in their offspring? To say ‘for no reason’ might seem no different from regarding such regularities as the product of chance or fortune, but, having dismissed the latter, what other choice does Descartes have but to embrace the role of ends or intentions in the natural order?

3. Towards a Causal Theory of Cartesian Functions

I desire, say I, that you would consider that these functions all follow naturally in this machine solely from the disposition of its organs, neither more nor less than the movements of a clock or other automaton [follow] from those of its counterweights and wheels, with the result that it is not at all necessary to conceive for their operation any other vegetative or sensitive soul in it or any other principle of movement and life than its blood and spirits, agitated by the heat of the fire which burns continuously in its heart and is in no way of another nature than all the fires that are in inanimate bodies.  

[AT 11: 202]

Contrary to teleological readings, such passages suggest that Descartes attributes functions to things solely on the basis of their causal role in the machine to which they belong. Is it possible to build an account of Cartesian functions that remains faithful to this basic principle?

When contemporary philosophers refer to ‘causal functions’ they typically have in mind the notion defined by Robert Cummins in his 1975 article, ‘Functional Analysis’. Cummins defines a causal function by the contribution a component makes to a system’s exhibiting some complex capacity. The complex capacity of the whole system is subject to an ‘analysis’ which identifies a series of hierarchically organized subsystems, each with their own distinctive kind of activity, which interact in a way that accounts for the capacities of the whole. It is only against the background of such an analysis that it is possible to determine what the function of a thing is. Against the background of the circulatory system’s capacity to transport food, oxygen, waste, etc., we determine that the function of the heart is to pump blood. It

9Gassendi assumes that the idea of Providence entails normative standards, but this doesn’t follow. If everything is the work of Providence, then everything is the standard or, as Descartes suggests, nothing is. A six-fingered hand is as much part of the Providential order as a five-fingered one.

10‘Disposition’ refers to the arrangement of matter.
does not make sense to say that the heart’s function is to make a thumping noise because this is no way contributes to the explanation of the capacities of the circulatory system [ibid.: 762].

A causal function differs from a mere disposition or propensity to behave in certain ways under certain conditions—dispositions being directly subsumable under general laws—by its place in the analysis of a complex system and by the fact that the exercise of any one function is fundamentally different from any other and from the capacities of the system as a whole [ibid.: 757–9]. In particular, analysing capacities must be less complex and different in kind from the capacities of the whole containing system. 11 Although more complex than dispositions, functions entail dispositions. There would be no sense in attributing to a thing, x, the function, F, if x lacked the disposition to F under enabling circumstances [ibid.: 758].

Importantly, for our purposes, no predefined goal is required to specify the causal functions of the parts of complex systems. We specify the function of gills by examining their contribution to the definitive behaviours and capacities of fish. The fish is able to swim, feed and reproduce in part because its gills extract oxygen from water and excrete carbon dioxide, an exchange of gases without which such activities would be impossible. There is no assumption made in offering a causal functional explanation that a thing’s having a function explains its existence or that in attributing a causal function one is specifying what the thing is for. That gills make possible the exchange of gases is causally but not normatively responsible for the more complex capacities of the fish as a whole.12

Interestingly, Cummins [1975: 764] cites automata theory as a paradigm example of causal functional analyses. The interest in automata theory among mechanists of the seventeenth century is suggestive of an analogous commitment to causal functions. Descartes’s liberal use of the ‘machine analogy’ indicates more of an interest in how things work rather than in why they came to be. Here is a typical example:

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\text{[T]he particles of seminal fluid of animals which are produced ordinarily by the conjunction of two sexes seem to be only a confused mixture of two fluids which, serving [servant] to leaven each other, heat up, with the result that some of their particles acquiring the same agitation as fire, dilate and press the others, and by this method dispose them little by little in the fashion required to form the members.} \\
\text{[AT 11: 253]}
\]

11Cummins uses this observation to block the objection that relative to the body’s capacity to make a thumping sound the heart should, on the causal theory, have noisemaking as its function. There is no explanatory purchase in the kind of trivial causal analyses presupposed by this objection [1975: 764].

12Godfrey-Smith [1993: §3.3] argues that the statistical normality of a causal function could be used as a standard by which to identify malfunctions. This will be problematic if, as defenders of teleological theories are apt to point out, what is statistically normal is the character or trait not performing its function (the favourite example being sperm). Millikan [1989: 296–7] argues that although we tend to classify functions by their successful effects, this simply obscures their normativity. I find it odd, though, to say that each and every sperm ought to impregnate an ovum, when the idea that they might all succeed doesn’t bear thinking about. The causal theory could, however, support a kind of weak normativity. See §6 below.
The sense of ‘serving’ here signifies what the semen does in contributing to the formation of an organism, not what it ought to do. Although Descartes does not define automata beyond referring to them as ‘self-moving machines’,13 his contemporary, Kenelm Digby, anticipating the analytic strategy and the distinction between functions and mere dispositions, argues for a distinction between natural automata—hierarchical arrangements of heterogeneous parts exhibiting heterogeneous motions (e.g., animals)—and bodies which exhibit a relatively homogeneous structure and homogeneous kind of motion throughout. The difference between automata and these other kinds of structures is that whereas the latter are ‘divisible’, the former, at least in one sense, are not. Divide a crystal (or, Digby suggests, a plant) and you’ll produce two things ‘of the same nature’; divide a cat and you certainly won’t.14 Given the comparisons Descartes makes between animals and complex machines, it is natural to place him among those who, like Digby, engage the analytic strategy in relation to animals, rather than among those who, like Gassendi, are inclined to import teleology.

Descartes’s *Traité de l’Homme* is a paradigm example of the analytic strategy in operation. Descartes begins by excluding the relationship between the human body and the soul through imagining a hypothetical scenario in which God creates a body possessing all the functions of the human body that do not presuppose rationality. Such a being would have within it ‘all the parts required to make it walk, eat, respire, and finally … all of our functions which can be imagined to proceed from matter and to depend only on the disposition of the organs’ [AT 11: 120]. We are then asked to conceive of this body as having the ‘bones, nerves, muscles, veins, arteries, stomach, liver, spleen, heart, brain and various other parts from which it must be composed’ and then to consider ‘the parts which are too small to be seen’ about which we can learn enough if we know ‘the movements which depend on them’ [AT 11: 120–1]. Employing this strategy Descartes concludes: ‘I need only explain these movements in order [and] tell you by the same method which of our functions they represent’ [AT 11: 121].

An observable phenomenon—our pulling our foot suddenly away from the fire—is then explained primarily in terms of the functional relationships between the nerves and the muscles, a function of the nerves being to cause the contracting or lengthening of the muscles. This, in turn, is explained by the sudden release of animal spirits through the pores in the brain, caused by

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13Animals are ‘natural automata’ that have ‘natural impulses of anger, fear, hunger’, passions and sensations ‘in so far as these depend on a bodily organ’ [AT 5: 278]. The capacity for self-motion is definitive: they are ‘moving machines’ [AT 6: 55] or ‘self-moving machines’ [AT 11: 331; AT 3: 566; see also Digby 1644: 255, 265]. Machines made by art, such as clocks, artificial fountains, mills and so on, ‘have the power to move by themselves in many different ways’ [AT 11: 120]. Their self-motion depends on the disposition of their counter-weights and wheels [AT 11: 202; AT 8A: 18–19]. As Descartes explains to Regius, the difference between a living and lifeless thing is like that between ‘a clock or other automaton, and a key, sword or other instrument, which does not move of its own accord’ [AT 3: 566]. The choice of examples here is illuminating. In contrast with automata, the key or sword—mere tools—move only when moved by something else.

14Digby [1644: 255] writes: ‘But there are other bodies in which this manifest and notable difference of parts, carrieth with it such a subordination of one of them unto another, as we cannot doubt that nature made such engines [if so I may call them] by design; and intended that this variety should be in one thing; whose unity and being what it is, should depend on the harmony of the several differing parts, and should be destroyed by their separation. As we see in living creatures, whose particular parts and members being once severed, there is no longer a living creature to be found among them.’
the tiny particles of fire touching the foot. The rapid motion of the animal spirits pulls the nerves to make the muscles in the feet and legs contract. The process that makes the ‘whole body turn in order to defend itself’ is ultimately explained in terms of the motions of particles obeying the laws of mechanics [AT 11: 142]. In theory, functional analyses give way to explanations in terms of the dispositions of microscopic particles, subsuming them directly under general laws.

A causal or Cummins’s functional analysis appears, therefore, to fit better with the analytical method Descartes actually employs. It is, moreover, entirely consistent with (a) his denial of finality, (b) his general indifference to the history of the systems under analysis, and (c) his apparent denial of normativity in nature. The running and the broken watch, the living body and the corpse, unfaillingly obey exactly the same laws of mechanics, and whatever purposes the one may serve that the other does not is irrelevant to their scientific explanation.

Cummins’s functional analysis suffers, however, from a number of limitations, which, arguably, Descartes’s does not. One limitation is that if a thing is not currently capable of performing its function, F, and so does not have the disposition to F, then, according to Cummins, it should be no part of the explanation for the thing that it once performed F or that things structurally analogous to it on account of a common ancestry perform or performed F. And one might well think, as Paul Griffiths [1993: 415–16] does, that functions ought to play a part in the explanation of a discarded feather or shell, the appendix, the vestigial eyes of cave-dwelling animals, or a broken machine or tool.

A second limitation is that causal functional explanations do not support the intuitively plausible distinction between a thing’s having a function F and a thing’s functioning as an F, a distinction which lies at the core of the idea of proper functions. Generally, causal functional explanations seem too weak to discriminate between genuine functions and fortuitous effects. The nose, we know, is useful for supporting eyeglasses (Voltaire), and without the elbow, the drinking of wine and obtaining of truth would be impossible (Franklin), but neither of these describes a function. Parodies aside, it seems plausible to suppose that although a phone book may function as a doorstop, or a tree hollow as a roost for birds and animals, it is not their function to do so.

A third limitation relates directly to the boundary problem. Cummins’s functional analyses presuppose the identity and integrity of the containing
system. The problem is that we have no principled way of excluding from any given system things which contribute to its complex capacities, but which we are not inclined to think of as genuine ‘components’. Biological systems are always open to the environments on which they depend, but this should not in itself make the boundary problem intractable or its solution ad hoc.\(^\text{17}\) (In recent discussions in the philosophy of biology, this problem relates to the status of extended phenotypic traits.\(^\text{18}\) ) Des Chene [2001: 132] argues that the boundary problem is particularly acute for Descartes since he ‘never asks himself why the sun whose light acts on the eye is not part of the visual system’.\(^\text{19}\) If sunlight contributes to the visual process as a *sine qua non* cause, why isn’t the sun a proper part of the visual system? Why isn’t producing light for organisms a function of the sun?

Interestingly, Descartes’s texts offer answers to these problems. Causal relations are ubiquitous and so it may initially seem impossible to single out some to account for the unity and integrity of an organic system. But this is not so. Some relations among arrangements of matter are relations of mutual dependence, and it is here that Descartes is inclined to treat a part of *res extensa* as a distinct organizational unit and to attribute to its parts functions.

### 4. Cartesian Functional Analysis

There is a principle at work in Descartes’s functional analyses which is not articulated in the causal theory outlined above. Let us call this the *principle of reciprocal dependence*. Functional interrelationships hold between material structures that stand in relations of reciprocal dependence (both for their operation and persistence) in a complex hierarchical structure.\(^\text{20}\) We can see this principle at work particularly in Descartes’s embryology.

In embryogenesis the movement of the heart and arteries is ‘the first and most general movement that we observe in animals’ [AT 6: 46; also AT 11:

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\(^{17}\) Attributing functions to traits which enhance ‘inclusive fitness’—the organism’s reproductive success or those of its offspring through kinship effects—is arguably an attempt to define the problem away rather than address it. See Griffiths [1993: 415].

\(^{18}\) Griffiths [ibid.: 415–16; 418] defines the causal functions of a character relative to its contribution to fitness over a proximal period of selection, either of the organism itself or the gene itself, in the case of genes which subvert the normal mechanisms of cell division at the expense of the organism, or, in some cases, of another individual, where the character in question has no function for the organism itself but only for another. He attributes to Karen Neander the objection that any model that lets in ‘extended phenotypic traits’, traits of one phenotypic individual that have functions for another individual, will have odd results. For example, ‘the items of food which come into an animal’s possession are assigned the function of feeding the animal . . . because there is a selective explanation of why current animals have those items of food which cites feeding the animal as the effect by which the bits of food possessed by ancestors enhanced their fitness.’ Griffiths declines to reformulate his account so as not to exclude ‘highly plausible claims as the claim that the function of the discarded mollusc shells possessed by hermit crabs is to protect them from predators’ [ibid.: 416]. This is a modern version of the boundary problem.

\(^{19}\) See also Millikan [1989: 294].

\(^{20}\) This is one way of cashing out Gaukroger’s [2000: 393] enigmatic remark that Descartes ‘subordinates function to structure’, reversing the Aristotelian ordering.
The process begins with a mixing of male and female seminal fluid, which creates a process not unlike fermentation as it circulates in the ovum, constrained only by the ovum’s membrane. Its denser parts eventually compact into flesh and bones; its more rarefied parts become the blood and animal spirits [AT 11: 253–6]. The formation of the heart is the first stage in the developing foetus and that by means of which other subsystems and viscera develop. Particles entering the heart are heated, rarefied, agitated and, as they expand, move according to the first law of motion in a straight line along the path of least resistance [AT 11: 254, 318, 516, 599]. Meeting with the resistance of the heart, particles of blood are forced into new areas compacting into new organs, beginning with the brain stem [AT 11: 254]. The repeated influx of particles, their expansion and expulsion, accounts for the beating of the pulse. Upon meeting the resistance of the brain stem, the blood is forced back towards the heart, but, encountering new blood from the heart, is forced outwards and downwards, which leads to the formation of the spine and genital organs, on the one side, and the vena cava, the route back to the heart through the chest, on the other [AT 6: 134–6]. At some point in its development, the foetus must start to produce something that acts like the ovum membrane in resisting external matter. This requires the formation of skin, initially as membranes of the veins and arteries and then as enclosures for the organs [AT 11: 274–6]. Accretion continues not by a simple adjoining of parts, as a piece of wood might when its holes start to be filled with dirt, but by division and expansion of the ‘little rivers’ that carry matter into new areas, until no further divisions are possible. Once fully formed, the parts of an organism can be nourished only through replacement of matter until, finally, its parts become too hardened to receive new matter and the organism eventually dies [AT 11: 596–7].

What is interesting about Descartes’s embryogenetic fable is the supposition that there are relations of reciprocal dependence among the parts of an organic being. The seminal fluid mixes and heats, and larger parts compact, producing the heart. The heart heats and forces the blood out. The blood must go somewhere and cool, whereupon it compacts again and new blood seeking new paths is reflected again in other directions. The process does not intend to form the heart or brain—nothing intends anything in this process—but the formation of the brain is necessary for the persistence of the heart and the formation of the heart a necessary precondition for the formation of the brain. The process by which one organ is formed and operates is not independent of the processes by which others form and operate and this whole matrix of interdependent processes continues until a relatively closed system, one in which at least no further structures are required to sustain the whole, comes into being.

21Detlefson [2001: 41] notes that in a fragment from Prima cogitationes circa Generationem Animalium [AT 11: 506–9], Descartes posits a different ordering beginning with the brain, but restores the official ordering in a later fragment [AT 11: 516] and in the Excerpta Anatomica [AT 11: 599] in line with the passages in the Description of the Human Body.


It is in such contexts where the formation and persistence of an arrangement of matter mutually depends on the formation and effects of other arrangements of matter that Descartes is apt to use the term ‘function’. The reciprocal dependence among the internal structures of an organism are made possible because of the effects those structures have on one another, and it is this which bootstraps the production of an effect into a function. Physiological contexts are unique in the realm of res extensa in this regard. As a metaphysical point, since a vacuum is impossible, every part of matter is dependent on the existence of every other [AT 8A: 49–51], but this fact is indifferent to the way in which matter is arranged. There is no other context in Descartes’s universe where the arrangements of matter exhibit such relations of reciprocal dependence on one another or where the arrangements are not directly subsumable under the laws. In contexts of non-mutual dependence, we are not inclined to attribute functions. The gravitational pull of the moon determines the tides and so the tides depend upon the moon, but it is no part of the explanation for why the moon exists or why it exerts a gravitational force that it affects the tides in this way. If the earth had no water, the moon would still exist and exert its gravitational force. This is why we do not regard it a function of the moon to govern the tides, even though but for the moon, there would be no tides.

5. Assessing the Model

How well does the above-modified causal functional analysis stand up against neo-teleological readings of Descartes, and how well does it help overcome the limitations of Cummins’s causal theory?

It should be noted first that the account of functions is thoroughly mechanistic and makes no reference to ends, purposes or divine intentions. Second, the account satisfies one of the conditions for being an account of ‘proper functions’—viz., that the effect that constitutes an exercise of a function is part of the explanation for the thing’s existence or persistence. This enables us to distinguish having a function, F, from functioning as an

24 A proviso is in order. Descartes also attributes functions to modes of things, such as sensations and passions, which are modes of the sensitive faculty of the soul and things and which sometimes have multiple functions depending on whether we are considering them in relation to the soul, the body, the whole human being, or larger social and political units. Thus, love and hatred function equally well for the body but not for the soul or for preserving social bonds [AT 11: 429–33]. These modes may not seem to fit the model being developed here which is primarily concerned to understand the functional interrelationships between the parts and processes of organic bodies, but there is no reason to think that the theory cannot be extended to accommodate them. Animal bodies do, after all, depend for their bodily integrity on the proper functioning of the sense organs and the sense organs depend upon the proper functioning of the rest of the animal. See Gaukroger [2000: 398] on the importance of corporeal sensory representations in animals. Sensations and passions [as modes of mind] are, moreover, critical for mind–body unity.

25 Given that for every action there is an equal and opposite reaction, one might object that there is always reciprocity where there is causal interaction. Reciprocity does not, however, entail reciprocal dependence. The sun affects us, and, at least on some theories, we affect the sun, but it is implausible to suppose that the sun would not be the very thing it is if we did not affect it. The claim here is that for Descartes, natural automata are unique in so far as the causal interactions among their parts is what accounts for their existence/persistence in that arrangement. We do not need, moreover, to resort to a functional analysis in order to explain the behaviour of non-automata [e.g., the planets] since their behaviour and effects on one another should be directly subsumable under the laws.

26 Burman records Descartes as working on ‘the functions of the animal’ in the winter of 1647–8 and as deriving ‘the reason for the existence of the eye, nose, brain, and so on’ from his principles [AT 5: 170].
F. Since the fact that the hollows of a tree provide roosts for birds plays no role in explaining the generation or nourishment of the tree, this is not their function. Similarly, a heart’s erratic thumping sound may contribute to the fitness of an organism by alerting doctors to an underlying condition, but since this effect plays no role in explaining how any other organ (such as the brain or lungs) develop or how they perform their functions, this is not a proper function of the heart.27

Third, we can determine the functions operating within an individual organism without relying on any suppositions about the selectional history of the mechanism or trait. A newly emerged trait may thus be as functional as one which has been selected for over generations, provided it plays a distinctive role in explaining the capacities of the organism and stands in relations of reciprocal dependence with other parts of the system. A fourth advantage is that in relation to arrangements of matter which no longer perform their proper function (e.g., vestigial traits), it may nonetheless be appropriate to cite the functions they once had, since their having once participated in relations of reciprocal dependence with other structural components of an organism is what initially accounts for their existence.28

Since the account does not rely solely on the criterion that a component actually is contributing to the complex capacities of the original system, functional analyses may be put to work in explaining the history of the system or its parts.

Most importantly, however, the analysis advanced above offers some relief to the boundary problem. Organisms are not ‘mere aggregates’ of corpuscles, for Descartes, but ‘individuals’ unified through the reciprocal dependence of their parts [AT 11: 596].29 We may exclude food, sunlight, rain, etc., from having functions for organisms, even when they contribute to the fitness or capacities of organisms, since they do not reciprocally depend for their being upon the existence of those organisms or their parts.

Herein, however, lies a potential difficulty. Notice that by this criterion an organic system may well include things that intuitively seem external to it. The spider and its web, a bird and its nest, and all symbiotic relationships may turn out on this analysis to constitute ‘individuals’ in Descartes’s terms. This is not necessarily a bad outcome. From a biological perspective, it is arguably appropriate to think of the web as part of the spider system or an animal and its indigenous microbiota as constituting one biological unit rather than many distinct individuals. By parity of reasoning, non-symbiotic (non-mutually dependent) parasite–host relationships would not count as constituting one biological system, even when the parasite is internal to the host and carried along with it (and so constitutes with it ‘one body’ by the

27This example is from Bigelow and Pargetter [1987: 195]. See also Wright [1973: 152].

28We should not infer from Descartes’s use of the machine analogy that he would have endorsed exactly the same kind of explanation for artefactual automata as for organisms. The formation of the parts of an artefact typically do not need either to follow a specific ordering in the way those of organisms do or to be created in conjunction with one another. But it is true to say that typically the parts of an artefactual automaton are created to serve complementary functions. There is, therefore, at least a reciprocal dependency between the activities of the parts of an artefactual automaton. A full discussion of artefactual automata must, however, be reserved for another occasion.

29Des Chene’s [2000: 88] referring to organisms, on Descartes’s view, as simply ‘piles of tools’ seems, therefore, slightly unfair.
criterion of *Principles* II, 25). Intuitively, these seem like acceptable results and demonstrate one significant difference between Cartesian and Cummins functions. Even though a parasite might contribute to some complex capacity of its host, its capacity to wither and die (as in parasitoidism) or less fatal capacities, it is counterintuitive to suppose that such roles a parasite plays constitute its proper functions.

Even if we grant these conclusions, the Cartesian functional analysis carries the danger of making functions more ubiquitous than many may be prepared to accept. There are some who see nature as riddled with symbiosis at the ecological or global level. Are the hollows of trees, they ask, really functionless when tree species are dependent on birds and animals to carry away their seeds? Even if we grant these conclusions, the Cartesian functional analysis carries the danger of making functions more ubiquitous than many may be prepared to accept. There are some who see nature as riddled with symbiosis at the ecological or global level. Are the hollows of trees, they ask, really functionless when tree species are dependent on birds and animals to carry away their seeds? I do not want to downplay the importance of recognizing ecological integration or to deny that smaller biological systems might be embedded in larger ones, although my hope is to remain neutral on these empirical questions. My own inclination is to try to preserve the intuition that even if the web is a part of the spider system, the fly it eats is not, though both make important contributions to the fitness of the spider. The Cartesian model offers a principled solution to the boundary problem on the reasonable empirical assumption that not every fitness-enhancing relationship an organism enters into is reciprocated.

6. Norms and Natures

If the above analysis is correct, we have a way of accounting for Descartes’s use of ‘function’ consistent with his commitment to mechanism, his rejection of final causes and his denial that death and disease outside the human being constitute ‘true errors of nature’ [AT 7: 85]. Death is nothing more than a body’s ceasing to do that which previously sustained it in existence and carries no further ontological or moral implications:

And let us judge that the body of a living man differs as much from that of a dead man as [much as] a watch or other automaton [that is to say, a machine that moves by itself] when it is in good working order and has in itself the corporeal principle of the movements for which it is instituted with all that is required for its action, [differs from] the same watch or other machine when it is broken and the principle of its movement ceases to act.

[AT 11: 331]
As the opening quote from Cudworth reveals, Descartes’s levelling of the differences between the living and the dead body, the healthy and diseased, provoked the immediate reaction that this would leave nature without the mark of its maker upon it. On this subject, Descartes is uncompromising. The point is not just that the laws of mechanics are sufficient to explain all the forms of nature without reference to God’s intentions; it is that, once we start down the path of supposing that God imbibes material things with standards of perfection, then he is as much the cause of things failing to meet such standards as he is of their succeeding. In his Prima Cogitationes circa Generationem Animalium, Descartes thus responds to those ‘fully disdainful’ of his using such ‘light causes’ as the laws to explain so momentous an event as human procreation by asking:

But, in truth, who would want heavier ones than the eternal laws of nature? Perhaps that they come from some mind? But from which mind? Immediately from God? Why, therefore, do they sometimes make monsters? Or from a most wise Nature, which would not have originated except for the dispensation of human thought?

[AT 11: 524]

The sentiments expressed here echo those of the Sixth Meditation where we are advised not to judge nature by our own standards. A disease like dropsy is an error of nature only relative to the composite of mind and body because a mind is involved, but this too is consistent with Descartes’s theodicy. Because a mind is involved, the functions of thirst and causes of dropsy can be known, and remedies sought [AT 7: 85–9].

It is intriguing, therefore, that this aspect of Descartes’s natural philosophy, his rejection of natural norms, continues to cause discomfort in his readers. It is not the case, as Cudworth suggests, that Descartes renders everything in the universe ‘cadaverous’. Indeed, Descartes has a healthy respect for living things and a way to distinguish them from the non-living. His point is rather that, in order to account for life, we do not need to invoke any additional principles besides those of mechanics and efficient causality. The distinction between living things (natural automata) — the parts of which are bound together by relations of reciprocal dependence — and non-living bodies, whose parts are not, is real. Descartes’s mechanical philosophy does not imply the elimination of all distinctions and boundaries between macroscopic objects. Could something similar be said for the mind-independent reality of the distinction between health and disease?

There is some evidence that Descartes would be happy to accept a weak distinction between the normal and pathological, weak in so far as it does not incriminate God. Shapiro [2003: 431] draws our attention to those passages in which Descartes ‘adverts to a perfection proper to the body itself’, including the foetus in utero prior to its union with the soul [AT 11: 407, 430; 4: 309]. More generally, that there are better and worse states of being seems to be part of Descartes’s commitment to the ‘best system’ that could be conceived. Some degree of representational inaccuracy in sensations is tolerated for the sake of being more conducive to self-
A sensation of pain that did not incline us to think the immediate cause was in the foot (but was rather in the brain) would not set us about doing what we need to save the foot. Shapiro [2003: 433–5] suggests that we can define a norm of health relative to the idea of an ‘intrinsic stable structure’ or ‘mechanical integrity’, which she also defines in non-teleological, mechanistic terms, but the success of her argument depends, as she notes, on being able to distinguish natural kinds from the rest of res extensa. This seems correct. Provided we can supply some story for what makes something a rat, then, relative to that kind, there may be identifiable better and worse instances. As rats go or in terms of what rats do, Gismo may be a better or healthier rat than Franz, with his deformed legs and eczema, but the res extensa that constitutes Gismo is not better relative to any description. Goodness, for Descartes, is being, and Gismo has no greater being than Franz. Moreover, we need not think that Franz is a worse rat because he ‘fails in the purposive effort’ to be a rat rather than because he lacks the kind of structural integrity required to sustain him against the slings and arrows of outrageous collisions.

I have not here attempted to provide a story, on Descartes’s behalf, for the processes that distinguish things into natural kinds. My concern has been with trying to find a naturalistic, mechanistic account of functions of the kind that explains the structural integrity of automata. If Descartes’s commitment to functions commits him also to there being weakly normative standards of proper functioning, then so be it. But we should resist the temptation to think that he has thereby unwittingly reintroduced teleology. We may speak of a healthy heart as something which is good at doing what hearts do, pumping blood, but this no more implies that the heart does what it does for the sake of the good or that it ought to pump blood, any more than a good thief or a good cold virus acts for the good and ought to steal or cause infection. Whereas the existence of an entity with a function is, for Aristotle, purposeful, an entity which performs a function does so, on Descartes’s view, without any purpose, not even the purpose of sustaining the system to which it belongs. And if it ceases to do that, there is thus no intrinsic failure or error on its part, which is just what Descartes says.

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References


Digby, Sir K. 1644 (1658). Two treatises: in the one of which, the nature of bodies; in the other, the nature of man’s soul, is looked into: in way of discovery of the immortality of reasonable souls. London: for R. Lowndes.


Highmore, N. 1651. The history of generation. Examining the several opinions of divers authors, especially that of Sir Kenelm Digby, in his discourse of bodies: with a general relation of the manner of generation, as well in plants as animals: with some figures delineating the first originals of some creatures . . .: to which is joyned, A discourse of the cure of wounds by sympathy, or without any real application of medicines to the part affected, but especially by that powder, known chiefly by the name of Sir Gilbert Talbots powder, London: printed by R. N. for John Martin.


Rorty, R. 1956. The Concept of Potentiality in Aristotle and Descartes, Yale University, dissertation.

